



...Ford's tough 4-wheelers.

(It's our middle name!)

Ford Ranger

Ford introduces Ranger SuperCab. It gives you over 22 cu. ft. of space behind the front seat. Or, add optional center-facing jump seats for seating up to five.



Sporty Ranger STX.

The 4x4 with everything on it... to go! The exuberant Ranger STX has over a dozen extra features, from unique paint to bucket seats, at a special package price. STX won the West, now it's offered nationwide.

New 2.9L V-6 Power.

The STX boasts
Ranger's new bigger,
more powerful 2.9L V-6.
Electronically fuel
injected, it hands
you the reins to 140
horses.* (Ranger
standard trim models also offer 2.3L
EFI Four.)

New "Touch-Drive" System.

Presto! Just touch
a button in the overhead
console to shift from
2WD to 4WD high at any
speed. Shift back to
2WD the same way.
Ford's new "Touch-Drive"
is that simple!
(Manual locking
hubs are still standard for you traditional off-roaders.)

Ford Bronco II

This tough number shares most of Ranger's good news. Like slick "Touch-Drive." Ford's remarkable new option brings push-button ease to 4-wheeling. You never have to wrestle a reluc-

tant 2WD/4WD shift lever. You always have the assurance of 4-wheel drive high instantly.

New Powerhouse V-6.

Bronco II has the dash and drive of Ford's new fuel-injected 2.9L V-6. It's the one for power. For bashing through the brush with tighter turns than S-10 Blazer or Jeep CJ's. And for turning heads in town, too.

Eddie Bauer Broncos.

Both Bronco II and Bronco are offered in luxurious Eddie Bauer

editions. They
feature unique
paint and special trim. Highstyled interiors
with Captain's
Chairs. Plus Eddie
Bauer tote and
garment bags. And
Ford's Extended
Maintenance and Limited Warranty coverage.
Ask to see this warranty
when you visit your
dealer.

Ford Bronco

Bronco's a winner... the strapping 4-wheeler that outsells every other full-size sport utility.**

Bronco starts with Ford's husky 4.9L Six, standard. And you go up from there, with the 5.0L V-8 with multiport electronic fuel injection — and 185 surging horsepower.*

Or Ford's 5.8L High Output V-8 with 4-barrel carb.

Nothing in its class can match Bronco for power!

Unique Suspension.

Of all the big
4-wheelers, only Bronco
has independent front
suspension. To smooth
your on-road ride. And to
help keep wheels glued
to the ground for maximum traction off the road.
Your choice: manual front
hubs or optional automatic front locking hubs.

Tow almost 4 tons!

The strong, powerful Ford Bronco can be equipped to tow 7,900 lbs. That's nearly a ton more than competitors giving Bronco extra value and versatility nobody else offers!

Ford F-Series

They're too tough to top: America's best sellers 8 years straight.†

This year, Ford 4x4's pour on the power. With the biggest standard Six, plus the most powerful lineup of V-8's—big as 7.5L and 245 horsepower.*

They're the only big 4x4's with independent front suspension (Mono-Beam on F-350). The only ones with your pick of three cab sizes.

With Ford's rugged 4-wheelers, even the choice is tough!

Best-Built American Trucks.

At Ford, Quality is Job 1. A 1985 survey established that Ford makes the best-built American trucks. This is based on an average of problems reported by owners in the prior six months on 1981-1984 models designed and built in the U.S.

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

Buckle up-together we can save lives.

*Horsepower based on SAE Standard J1349 7.5L engine horsepower lower in California.

"Based on 1985 model year manufacturers' reported retail deliveries through July 1985 Based on 1978 through July 1985 model year manufacturers' reported retail deliveries.

BEST-BUILT 🧟

AMERICAN TRUCKS



DON'T HIT THE ROAD WHEN YOU HIT THE ROAD



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Normal loads on heavy duty springs had all the "enjoyment" of riding on a jack hammer. On the other

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Ask about Moog Cargo Coils at your mechanic or auto parts store. After that you won't have to worry about hitting the road when you load up to hit the road.

*Check manufacturer's load specifications.

Moog Automotive, Inc. P.O. Box 7224, St. Louis, MO 63177



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Managing Editor Bill Hartford

Graphics Director Bryan Canniff

Science/Technology Dennis Eskow, editor

Automotive Wade A. Hoyt, SAE, editor Norman S. Mayersohn, assistant editor Jim Dunne, Detroit editor Michael Lamm, Steve Potter, Mort Schultz, Rich Taylor, contributing editors

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Electronics/Photography

Stephen A. Booth, editor James B. Meigs, Ron Scibilia, Terry Shea, contributing editors

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West Coast Steve Parker, editor

Editorial Production

Peter Francesconi, chief John Bostonian Jr., art Rebecca Harth, Tobin C. Morrison, copy editors

Ira Herrick, design director John Johanek, art director Alan Andresen, Ann Bennett, associate art directors Diane DePasque, assistant art director

Editorial Administration

Josephine Caronia, administrative assistant Barbara A. Novak, executive assistant

Editorial Offices

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POPULAR MECHANICS • MAY 1986

MAY 1986

VOLUME 163 NO. 5



ON THE COVER

A new car represents a big investment of money and emotion, and most people want to take extra good care of it, to maintain its value and make it last. But a new car seems to be so complicated, many buyers give up on trying to care for it themselves. Our Car Care Guide, beginning on page 125, tells you what you can fix, what to leave alone and how to get the most out of your new wheels

PM photo of 1986 Corvette convertible by Studio 10



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100 Five Fast Fishermen

Here's the latest in center-console utility boats.

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PM's you-build-it machine travels over land and sea.

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These utility knives are the latest twist in new-tech.

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The DC-3 is celebrating its 50th year in the air.

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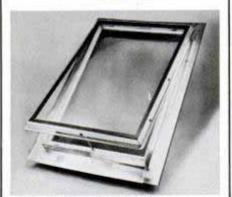
205 PM's Photo Contest Winner

TECHNOLOGY

PM Technology Update

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Editor's Notes



new name gets added to our masthead this month. Bob Vila, host of the popular public television series "This Old House," joins us as a Contributing Editor. Though the title of Bob's new monthly column is Old House Restoration (page 76), you can bet that he'll be covering topics of interest to all do-it-your-selfers, just as his TV show does. "This Old House" is seen on 260 public television stations all over the country and has proven to be one of the most popular shows on public



Shop talk: Bob Vila (left) and Steve Willson.



PM crew gives luxury cars proper setting.

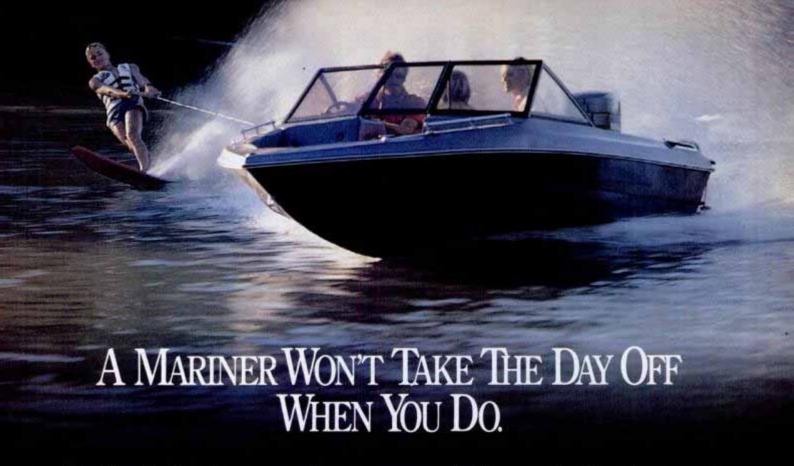
Sutton's huge tripod was set up in the truck bed to get the required camera height and Humphrey spent most of the day sitting on the top step of a ladder. . . . With Detroit and the import carmakers all coming off a record, or near-record, year, we thought it appropriate to theme this month's annual Car Care Guide around new cars. Our giant guide (beginning on page 125) takes you step-by-step through the maze of information you need to keep your new car running as new for years to come.

The information will also help you keep any car from growing old too fast. . . . In my whole life, I had been to Florida only twice. Now I've been there twice in the past month. My most recent trip was to attend the opening of the Miami Boat Show, this year combined with the Miami Sailboat Show. The Miami show is the largest in the U.S. and third largest in the whole world, according to the show's organizers. The big things this year seem to be radar arches, "Miami Vice" colors, and hot performance boats. "Miami Vice" is a hot show made hotter by hot cars, hot boats and hot guns. Can you stand the heat? If not, maybe you should take a trip to Seabase Alpha at the new Living Seas Pavilion in Disney World's Epcot Center. You can board a never-ending train of seacabs traveling through an ocean floor tunnel past crystal-clear acrylic windows for closeup views of more than 4000 sea creatures and a tropical reef in 6 million gallons of salt water. State-of-the-art computers control the environment in the huge "ocean" and keep all the living things happy. I was

there for opening day and I can tell you that the "world's sixth largest ocean," as Disney World is calling the tanks at The Living Seas, is a truly remarkable place to visit.

"Til next time.





There's nothing like a day on the water to help you forget your troubles. But an unreliable outboard can quickly give you new problems to worry about.

That's why you should be

running a Mariner.

Mariner Outboards from 4 to 200 horsepower have CD ignition for quick, reliable starting. All electric start models from 40 hp on up have oil injection, to assure a more accurate gas and oil mix, and a longer engine life. And to make

sure they keep running, we build them with rugged lower units and internal components that undergo the industry's toughest testing. So you can spend your free time on the water, not in the repair shop.

A Mariner will also squeeze the most out of every drop of fuel. And with optional Power Trim, you won't find a comparable outboard that can snap a skier out of the water more quickly.

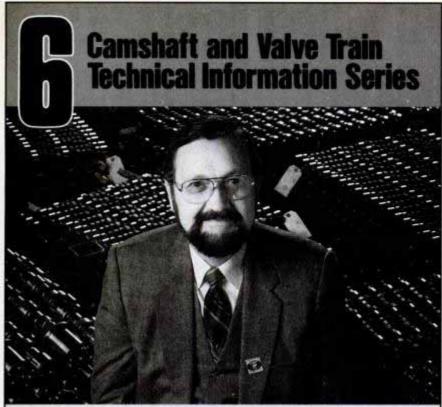
We even offer an extended product protection plan to make

sure they live up to our expectations, and yours. And with our exclusive MMAC financing option, we make it easier to own a Marinerpowered boat than ever before.

See your dealer for a catalog showing our complete line, or write Mariner, 1939 Pioneer Road, Fond du Lac, Wisconsin 54935. And find out more about the outboards that take pleasure seriously.







ant to ask Harvey Crane what Cam to use in your engine? Now's your chance.

Well, almost. Obviously, we can't have Mr. Harvey Crane himself take all your calls. He'd never get the chance to design the world's best cams if we did that. But we've got the next best thing—Harvey



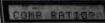
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Publisher

Daniel J. Coleman

Advertising Director Floyd Sembler

National Sales Manager **Bud Gilbert**

Advertising Offices

New York

224 West 57th St. New York, NY 10019 (212) 262-8824

1 South Wacker Dr. Chicago, IL 60606 (312) 984-5190

Detroit

377 Fisher Rd. Grosse Pointe, MI 48230 (313) 881-3520

Los Angeles 3000 Ocean Park Blvd. Santa Monica, CA 90405 (213) 450-8881

Business Manager Agnes P. Maillaro

Marketing Director Edward Vaquero

Production Manager Lori Ellwood

Advertising Production Patricia Woods

(212) 262-4800

Classified Sales Manager

Sophie Gronowicz (212) 262-4825

Reader Service Department

Gary Frederick, supervisor 224 West 57th St., New York, NY 10019 (212) 262-4292

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Letters



Lore and lure of the

Your article Titanic—Lost And Found (page 75, Jan. '86) was one of the most spellbinding stories ever in PM! Whatever the future holds, the Titanic will long cast her intriguing, haunting spell.

> ANDREW ANTHOS LANSING, MI

The initials "R.M.S." for Royal Mail Ship did not appear on the bow as in your illustrations-just the name Titanic. And her sister ship was the Olympic. White Star Line gave all its ships names ending in ic. Some "mysteries" of the Titanic's sinking aren't mysteries at all. For example, the reason she sailed with only 20 lifeboats (even though she could have carried two or three times as many) is because British Maritime laws of the period didn't require lifeboats for everyone aboard.

The *Titanic*'s passengers were at first reluctant to board the lifeboats simply because they could not believe that the brand-new, "unsinkable" ship was actually going down.

It is well known that another ship was within a few miles of the Titanic. The Californian had stopped upon encountering the same icefield. Her radio shut down for the night, her captain asleep, the Californian was waiting for daylight when her officers on watch sighted flares (that they would later find out were from the Titanic)

The Californian's captain was awakened and told of the flares, but he inexplicably took no action. His em-



ployers fired him for this. RAY WODEHOUSE TAMARAC, FL

Twenty Titanics would have to be raised from the deep just to pay for the two supertankers in Dick Frederick's approach (page 78). Tremendous water pressure would require a great deal of hull reinforcement, and getting slings under the Titanic's hull would be nigh impossible. The way to bring up the ship is with gas-filled lift bags-500 of them, each providing a lift of 67.5 tons for a controlled ascent of 50 to 60 feet per minute. Since the gases will double in volume for every 33 feet that the ship rises, gas will be released through relief valves. I've designed gas-generating systems to fill the bags at that depth. JOHN ROEHRIG

PLEASURE RIDGE COMMERCIAL DIVING SERVICE LOUISVILLE, KY

Recover the wine from the Titanic? When the ship sank, the water pressure pushed the corks into the air space. Maybe the mushroom-corked champagnes made it, but internal pressure would pop those corks as the bottles were brought to the surface.

ROGER W. MARSTERS, PH.D. CLEVELAND, OH

I'm 16 years old and read all I can about the *Titanic*. Leave the ship, full of its mysteries, where it is. It's a grave to many souls.

> TERRI LYNN AMSHEY GLENS FALLS, NY

Since we ran our Titanic story, Congress has passed a resolution to leave the ship in its resting place, but only a law will be legally binding. Incidentally, the 28½-foot model made for the movie Titanic is in the Maritime Museum in Fall River, MA.

Music first

I do all Bruce Springsteen's guitars, and make and modify all the string instruments in the band. There's a lot more that goes into the performances besides the sound system (The Heart Of Rock 'n' Roll, page 99, March '86). It took a few years of work to come up with that sound.

PHILLIP J. PETILLO MASTERPIECE GUITARS OCEAN, NJ

Your article missed the heart of the new and stunning special effects. Lasers and large-screen video are enhancing many stage shows—and were used by Rush on a recent tour.

DAVE PEWOWARUK BEMIDJI, MN

We couldn't get the whole rock scene into one article, so stay tuned for our encore.

Credit where due

We were pleased to see Polar Frontier Drilling's offshore rig, the Polar Pioneer, in "Oil rig melts exterior ice" (Technology Update, page 79, Feb. '86), but wish it had been fully identified as ours.

SONAT OFFSHORE DRILLING HOUSTON, TX

In your February cover story, Working Miracles In Space (page 103), you referred to "torque-set bits." Our company's bits are called Torq-Set. In space, ease of access is important and quick-action fasteners will be used extensively.

> PETER J. FERGUSON PHILLIPS SCREW CO. GLOUCESTER, MA

Your article on Northrop's Tigershark was interesting ("Why The F-20 Isn't Selling" in Foreign Air Raid, page 86, March '86), but contains one error: Rockwell is the prime contractor for the B-1 bomber. Northrop is a subcontractor, supplying electronic countermeasures.

WILLIAM BOLLIG ELK GROVE VILLAGE, IL

Eyes on the stars

PM's playhouse plans (Space Expanders, page 106, July '85) were perfect. However, we customized the playhouse in several ways: It's raised to 6 ft. for more room underneath for a sandbox, has a different railing, an extra, small window opposite the door and a skylight which was son Daniel's idea!

JULIE DAVIS YOUNGSTOWN, OH

That skylight is going to give ideas to a lot of homeowners. If they install an adult-size roof window (see New Windows, page 109, April '85), they'll have a room as nice as Daniel's.



Skylight in Daniel's playhouse was improvement on PM plans.





RUS WAGON. N DOESN'T HAVE TO O TO BE LOADED.

The best-built American cars.

At Ford, Quality is Job 1. A 1985 survey established that Ford makes the best-built American cars. This is based on an average of problems reported by owners in a six-month period on 1981-1984 models designed and built in the U.S.

*Based on 1986 EPA Cargo Volume Index.

The illuminated mirror on the passenger side of the LX slides out from inside one of the dual sun visors, so it can be adjusted close to the face.



Have you driven a Ford ... lately?





Buckle up-Together we can save lives.

Audio



BY TERRY SHEA

Audio meets video



Denon's AVC-500II control center has amp for Dolby Surround Sound.

If you follow the latest advertising for stereo receivers and amplifiers, you might have noticed something that distinguishes to-day's components from those of the past. Specifically, the ads hype the video capabilities of these formerly audio-only devices.

Hybrid audio/video components let you combine audio and video equipment to create an integrated home entertainment system. Why would you want to merge sight and sound? Because home video components now deliver better sound quality than in the past.

VCRs, for example, used to sound muddy. But today's hi-fi models deliver audio performance nearly as crisp as the digital Compact Disc. If you want to appreciate what a hi-fi VCR can do for your ears, route the sound through a stereo system and loudspeakers. The same goes for TV programs broadcast in stereo.

Once you've decided that you just can't keep your audio and video systems apart any longer, you need a way to integrate them. That's the role of an audio/video receiver or amp. The best of these serve as a control center through which you select what it is you'd like to listen to or watch. Trouble is, there's no agreement within the hi-fi industry about what constitutes an audio/video receiver or amp, so shopping for one can be a confusing experience.

Perhaps most misleading is the VIDEO or TV designation with which some manufacturers label one or more of the input selection buttons on a receiver or amp (others are for tuner, tape deck, turntable and CD player).

More often than not, this input handles only the sound portion of a video program. In some cases, extra inputs have been added to accommodate the growing number of sources—audio and vid-



SA-V1160 amp by Pioneer has video switching, stereo from mono.

eo—that you might want to connect to your receiver or amp. But in many cases the manufacturer has replaced the old AUX (auxiliary) designation with the fashionable VIDEO label.

Using an ordinary receiver or amp to handle the sound from your VCR or TV set is just fine, but you'll run into problems when you want to add more components. Not only is it likely that you'll run out of audio inputs, but even more important, should you want to connect more than one video source (a pair of VCRs, for example) you'll need some way to select which video signal goes to your TV set, while the soundtrack runs through the receiver or amp to your loudspeakers.

There are outboard switch boxes that could handle this problem, but a proper audio/ video receiver or amp solves the problem more conveniently, with audio and video switching at the touch of a single button.

What's more, most A/V receivers and amps also offer a variety of other features unique to this breed of component. These features include 1-button dubbing from VCR to VCR (or videodisc player to VCR), simulated stereo for enhancing the sound of mono broadcasts or video soundtracks, and even surround-sound circuitry to add a more realistic sense of depth to the sound.

Besides the basic A/V receiver, you'll find models that offer a TV audio tuner, in addition to AM and FM bands. Such models receive the sound portion of a TV broadcast and deliver it directly to your loudspeakers.

This means there's no need to connect your television to your receiver or amp. When you turn on the TV set, just lower its volume and let the hi-fi receiver handle the sound portion. Some models even include the necessary circuitry to receive stereo TV broadcasts. This type of receiver makes sense if your present TV isn't equipped to receive stereo, or if your set lacks audio outputs needed to send sound through an audio system.

Beyond this, you'll even find A/V components that receive both TV sound and video. The audio signal goes to your speakers while the picture appears on your TV. Such an arrangement makes sense if you want to buy a dedicated TV monitor (basically a TV set with no tuner for receiving stations)—or want to use a color computer monitor as a second TV.

Finally, there are components that go by the name of audio/video control centers. They differ from A/V receivers in that they lack an AM/FM tuner and sometimes a phonograph input. In general, A/V control centers offer modest amplification less than 25 watts per channel-compared to higherhorsepower audio/video receivers and amps. But they do provide audio and video switching, dubbing capabilities and features such as surround-sound and synthesized stereo, ideal if you're looking to enhance the sound of a video system but have no need for the audio-only features that an audio/video receiver or amp provides.

These are some other new things to look at this month:

(Please turn to page 13)



Sony's Access receiver: TV tuning, video switching, surround sound.

Screen Test these electronic marvels.

The Electronic Car has arrived. Microprocessors control your engine functions. Your heating and air conditioning. Your radio. In some cases, even your suspension system and brakes.

Mr. Goodwrench has the equipment to take care of

The latest test equipment. Because it takes a computer to know one. And the latest training. So he knows what to look for, before he starts looking.

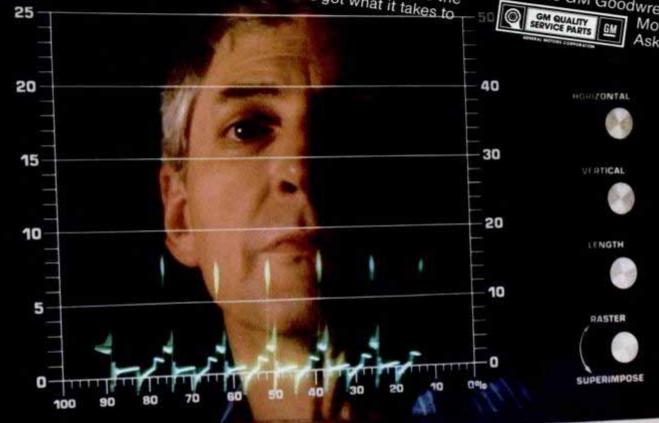
Put Mr. Goodwrench to the test. He's got what it takes to

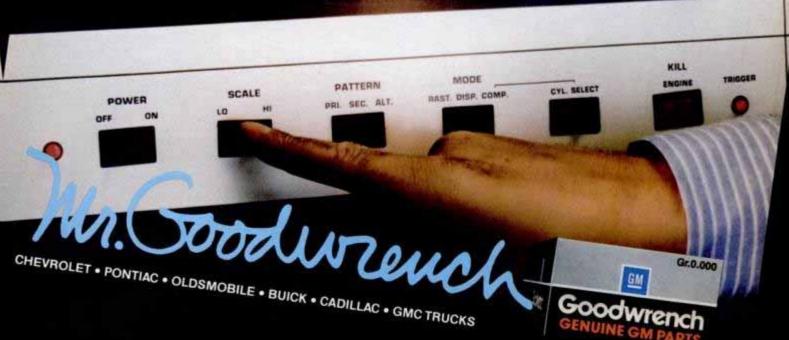
take care of you—and yo electronic car.

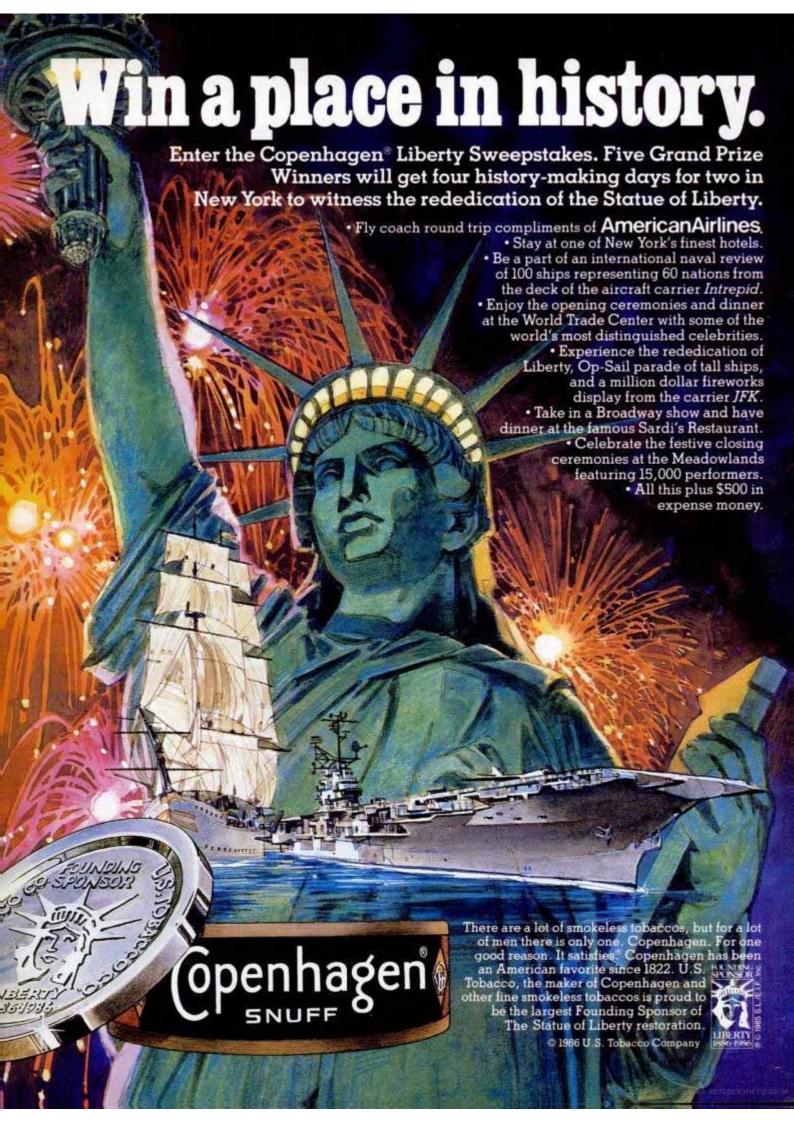
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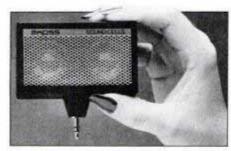




AUDIO

(Continued from page 10)

 For those times when you'd rather not be limited to using headphones with your personal portable tape player or radio, Koss offers the Sound Cells, a



Sound Cells plug into portable radio/cassette.

tiny \$10 speaker that plugs into your personal stereo's headphone jack. The speaker measures 2 inches tall, 3 inches across and an inch deep.

 Welcome relief from the raft of lookalike plastic clock and table radios comes from KLH. The company's Mod-



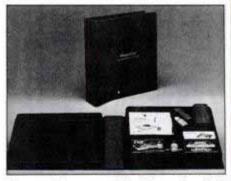
KLH stereo table radio has walnut veneer.

el 200 AM/FM table radio offers all the features of a conventional clock radio, but combines them with such home hi-fi features as balance and tone controls, inputs for tape or other components, and a separate speaker for better stereo separation. Price is \$200.

■ Trouble storing your Compact Discs? A company called Geneva has a unique solution—a clear plastic case the size of an LP record jacket that holds four CDs. This way, shelves or storage devices sized for LPs can easily accommodate the CD format. Priced at \$8 each, the case holds four CDs while still housed in their original plastic boxes. Each box opens without the need to remove it from the case.



Geneva case fits four CDs in LP-size space.



Greatest Hits come with Discwasher hi-fi care products. Box stacks alongside LPS.

■ Here's another neat storage idea that takes advantage of shelf space used for LP records. It's Discwasher's Greatest Hits Collection—a treasure trove of record, tape and CD care products stowed in a 3-in.-thick box the size of an LP jacket. Price is \$49.95.

■ There's at least half a dozen portable Compact Disc players you can buy for less than \$300. Now Yamaha offers a home unit for \$259. The company's model CD-300 lets you program up to nine selections on a disc, in any order of play. You can repeat individual songs or an entire CD. There's no remote control at this price, but the midi-sized (13½-in.-wide) unit gives you a head-phone jack for private listening.



Digital sound on a budget: Yamaha's CD-300 has high-tech features, low \$259 price tag.

■ The computer's come to hi-fi equipment in Sansui's new 12-band stereo graphic equalizer. Instead of conventional sliders, the SE-99 (\$700) uses a light pen to let you draw the frequency curve you'd like. If you've got writer's cramp, you can shape the curve from your armchair with the unit's remote control. A microphone in the remote helps the SE-99's pink-noise generator/ spectrum analyzer to create an absolutely flat frequency contour for your favorite listening position. The SE-99 will store this setting in one of its 11 memory banks-along with five factory preset curves and another five of your own making.



Sansui's magic box and wands: SE-99 computerizes equalization of acoustics and tapes.

How to win.



Complete the entry form below and include 1 proof of purchase (Copenhagen label). You may also enter by taking a 3½" x 5" card, and on the card write "Copenhagen was

established in 1822"

Enter as often as you like, but mail each entry separately to: "Copenhagen Liberty Sweepstakes," P.O. Box 9804, Bridgeport, CT 06699.

Entries must be received by midnight,

Entries must be received by midnight, May 25, 1986. Winners will be selected by random drawing, conducted by an independent judging organization, whose decision is final. Sweepstakes is open to adults 18 and over. Employees and their families of U.S. Tobacco Company, subsidiaries, their distributors, advertising and promotional agencies are not eligible. Void where prohibited by law or regulation. All federal, state and local regulations apply.

Winners will be notified by mail. No substitutions for prizes other than offered by the judging organization will be permitted. Taxes are the responsibility of the winner. Odds of winning are determined by total number of entries received. Winner may be required to sign statement of eligibility, and name and likeness may be used for promotion numbers.

for the list of winners, send a stamped, self-addressed envelope to: UST Marketing Communications, 100 W. Putnam Avenue, Greenwich, CT 06830.

Coach round-trip airfare provided by AmericanAirlines.



Yes, I'd like to win a place in history.

a place in mater y	
Send to: "Copenhagen I P.O. Box 9804, Bridge	
I certify that I am	years of age*
Name	7.51
Address	
City	
State 7in	

*Offer not available to minors.

© 1986 U.S. Tobacco Company

Imports

BY BILL HARTFORD

Classic shape of Porsche



Porsche 911 for 1987 will have a new integrated front bumper.

If you were at the Frankfurt Motor Show in September 1963, you would have seen the unveiling of an extraordinary new car—the Porsche 901, prototype of the 911. The 911 shape has needed no improvement in

Most prominent in front is the new integrated, snubnose bumper. In the rear is a now-you-see-it, now-youdon't spoiler that automatically deploys when you need its aerodynamic assist, but folds down when you slow down. When slowing down fast in an emergency with the 911, you'll have the help

> of ABS antilock brakes, and getting back up to speed will be quicker than ever with a 40-hp boost

from new 4-valve cylinder heads on the boxer Six rear engine.

Also on the way to United States streets, as a limitedproduction car, is the ultimate evolution of the 911 shape, the bulging 450-hp, Rambo of a Porsche, the 959.

the 911,

Rear spoiler automatically goes up at high speed, down at low.

23 years—and still counting. That's why you'll have to look hard to see what's different about the 911 for 1987, seen in color here.



The 959, alias Group B racer, will be Porsche's supercar for '87.

The all-wheel-drive, twinturbo sports car began life as a Group B racer in Europe and will lead a double life here—as a street musclecar and as the racer's edge for motorsports.

When grandfather Ferdinand rolled the first 356 out of his Gmund, Austria, shop in 1948, it was the Porsche. Today, there are 3 classic shapes to choose from: the 911, 944 and 928. The 944 "young" 928 are Porsches-only 10-year-old designs. The V8-powered 928 will get some refinements for its 10th year of production in 1987. The 944, which evolved from the meek 924, is now a 217-hp screamer with its new turbo. The 911 Turbo is the hottest of the bunch with a top speed of 157 mph, even though its horsepower rating is less than the 928's: 282 vs. 288.

For 1986 the complete model lineup, with prices, looks like this: The normally aspirated 944 with 5-speed is \$22,950, with automatic it's another \$500; the 944 turbo is \$29,500; the 911 Coupe is \$31,950; the 911 Targa, \$33,450; the 911 Cabriolet, \$36,450; the 911 Turbo, \$48,000 and the 288-hp 928 S is \$50,000. You have to pay for Porsche power.

New Sube

Subaru just covered all the bases. With the 1986½ introduction of the 3-Door, the model line is complete. On my team, the wagon and new



Slippery Subaru has a 0.32 Cd.

3-Door are the heavy hitters. But if you're straightarrow, there's the sedan; offbeat, the Brat and laid-back, the XT Coupe—all with fwd or choice of On-Demand 4wd. The new hatchback is an inch lower than the sedan with slightly more windshield rake—sportier, yet infinitely more practical for heavy toters. With split rear seat folded, cargo space is 39.8 cu. ft. There are DL, GL and GL Turbo models with different trim levels and powertrains. The 1.8liter, overhead-cam, horizontally opposed Four in the DLs is carbureted (82 hp) and single-point electronically injected (90 hp) in the GLs. Add multipoint electronic injection and turbo in a GL (110 hp) and go like a bat out a' hell.

Ritzy roustabout on the way



The Pinzgauer will ford 2-ft.-deep old mill streams in stride.

It looks like a Brink's truck, climbs like a military 4x4, is as roomy as a Greyhound, comfortable as a Rolls-Royce and costs as much as a Mercedes. And it's destined to become the most sought-after off-roader for the status conscious. The \$50,000 Pinzgauer is the pride and joy of Steyr-Daimler-Puch AG of Graz, Austria, maybe the world's foremost designers and builders of 4-wheel-drive vehicles. This stomping Refrigerator of 4x4s has a curb weight of 5070 pounds, a payload of 2205. It'll tow 5000 pounds on-road and 1500 off with its 110-hp turbodiesel. We'll check the 13.2-in. ground clearance when we drive one. East Coast sales start this November. Pinzgauer of North America Inc., Telford, PA 18969.



Your local independent sporting goods retailer has outstand-

ing offers on leading brand names for fishing, camping. boating and outdoor fun for the family. While you're shopping for great bargains on great gear on sale during the Spring National Great Outdoors Sale be sure to enter the big sweepstakes. You may win one of more than 500 prizes!

GRAND PRIZE—You may win a beautiful new Astro van, the new concept from Chevrolet in a people-carrying, cargohauling van, Outstanding towing capability, plus comfort

TWO GREAT FIRST PRIZES—You may win a luxurious Coleman® Folding Camping Trailer that sleeps up to seven people. All the comforts of home away from home! Or you may and convenience. people. All the comforts of nome away from figure space and win a Starcraft Bass Boss with plenty of storage space and rugged hull, equipped with a gutsy, high-performance

EASY TO ENTER. NOTHING TO BUY. To enter, fill out the coupon in this special section and deposit it at any participating independent store. Or, pick up an entry blank at the store, Note: Some participating stores may not stock all

Sporting Goods Wholesalers.
Chicago, IL. items advertised here.



OVER 500 GREAT PRIZES! 1986 Chevrolet Astro Van. ... \$11,000

2 First Prizes—16' Starcraft Bass Boss and Trailer with

50 hp Johnson® Outboard.

Plus outfitting.... \$ 6,495 -Coleman® Williamsburg™ Folding Camping Trailer

4 Second Prizes -1 Lowrance Z-15 Computer Graph Recorder, XD-2 Transducer and Graph Paper. Hecorder, XU-2 Transducer and Graph Paper, \$1,000 Kit -1 Humminbird* LCR 4000* Depth Finder, \$638-1 Shakespeare* "Kickern" Trolling Motor. \$500-1 Minn Kota Electric Trolling Motor and

Maximizer Electronic Power Control. \$460. 66 Third Prizes -5 ABU Garcia Ambassadeur Rod

86 Third Prizes -5 ABU Garcia Ampassageur Rod and Reels \$120 -6 Gotts 80 qt. Coolers \$75 each-40 Penns 10 or 210 Reels, \$55 each -15 Sets 40 Penn 10 or 210 Heels. \$55 each 15 Sets Berkley* Bionix Rod, Trilene* Filler Spool, Berkley* Strike and Outdoorsman combo pack. \$100 per kit. 90 Fourth Prizes -50 Daiwa Reels, \$39 each -20

Ryobi MGT-2 Reels. \$40 each 20 Plano Tackle 375 Fifth Prizes 75 Fiskars Tackle Box Snips. 100 Boxes \$30 each.

Prime Fishing Line Paks, 200 Eagle Claw Lazer Fish Hooks, \$6-8 each.

\$ 7,800

Save on Berkley

Berkley Trilene

Over 1000 World Records

Independent laboratory tests prove it and over 1000 World Records back it up . . . Berkley Trilene is stronger. Actually up to

20% stronger than other premium monofilaments. And if you set a new IGFA World Record on Trilene, Berkley will pay you \$1000.

\$200 and

. (2)

Rebates

Berkley Strike
Fish Attractant
Formula

At last there's a scientifically formulated fish attractant that's been proven in thousands of hours of laboratory and underwater use. Berkley Strike is so potent, so effective that if you don't get twice the strikes, Berkley will give your money back!

\$500 Rebate



Outdoorsman

The Outdoorsman selection features a unique lineup of products for the fisher-

man, hunter, camper and boatman. Look for the new Outdoorsman 4-Blade Knife and Knife/ Fish Scale combo packs (shown). They make great gifts!

Unique Gift Ideas

Rebate

Lightning Rod

The Berkley Lightning Rod is 100% radial graphite tip to butt. It contains no fiberglass. And the graphite blank extends thru to the base of the custom fitted handle for maximum strength and sensitivity. In fact, Lightning Rod is the lightest, fastest, strongest, most sensitive graphite rod you've ever fished or your money back!

100% Radial Graphite

> 3000 yds. of Free Trilene!

Berkley Rebates thru May 18th

1 600

PENN'S PERFECT PAIR. The 210 & Mag Tuned™ 10 Hi-Speed Level Winds

These reels bring it all together ..level wind convenience, fast 4-1 gear ratio, and ball bearing reliability. And the Mag Tuned™ 10 offers magnetic spool control for backlash-free casting. Both reels

are ideal when casting or trolling for salmon, trout, walleye, striped bass, weakfish and the like. See your retailer today or send \$1 for a full color 52-page catalog. Dealers inquire.



The Great American **Reel Company**

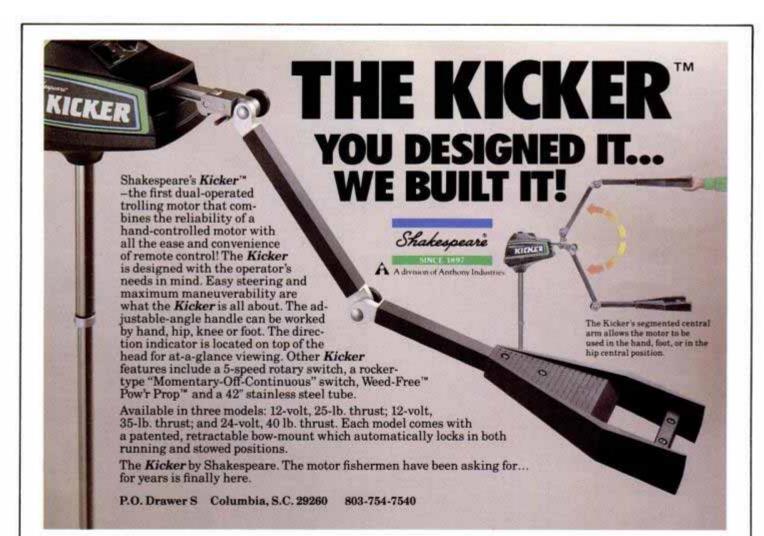
Penn Fishing Tackle Mfg. Co. 3028 W. Hunting Park Ave. Philadelphia, PA 19132

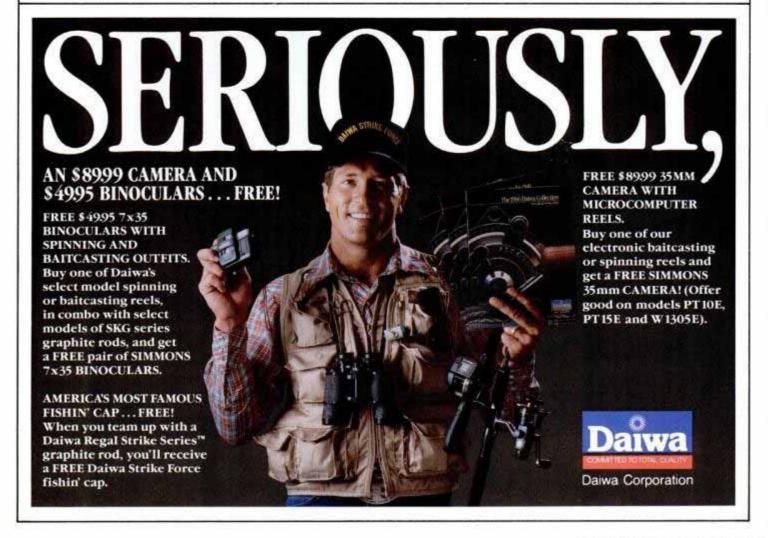


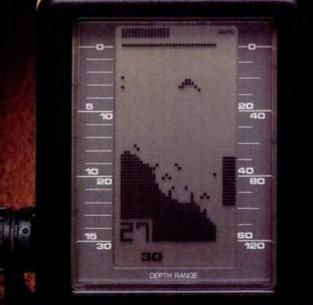
Wt. 21 oz.













CR. BETTER THAN EVER.

HUMMINBIRD

LCR. No other depth sounder in history sold more in its first year. And for its second year, the LCR 4000® has been updated with even more features! Like bottom-lock with Humminbird's unique contour indication, showing you both expanded, bottom up readings and bottom contour! An easy-to-read digital depth display right on the screen. An increased memory capacity for three full screens of reverse. And advanced shallow-water per-

formance. Along with these new features, the LCR 4000 includes zoom, Humminbird's exclusive Total Screen Update; the new high-speed transducer, and more, for the sharpest, most accurate readings in marine electronics!

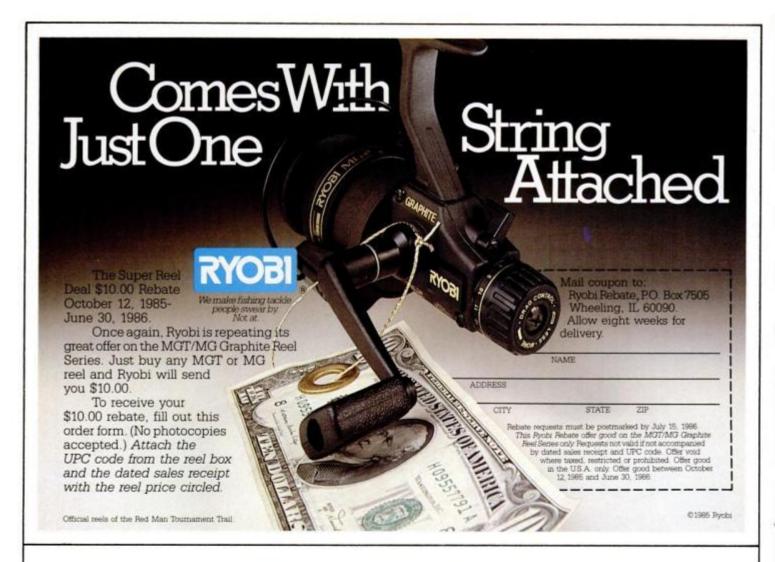
Advanced features and ease of operation are only the beginning — the new LCR 2000® Portable just might be the most versatile depth sounder you've ever owned! At the press of a button, you can stop, start, speed up or slow down the display. The adjustable audible alarm can be set for fish or for bottom. And the rugged, go-anywhere portable case holds the unit, transducer and batteries (not included). It's perfect

for rented boats, for boats without mounting space or batteries, or even for ice-fishing! Simple to set up, simple to use ... the choice of fishermen and pleasure boaters across the country . . . the LCR 2000 Portable!

Both models feature four depth ranges down to 120 feet, a high-contrast LCD screen, automatic/manual controls that are easy to understand and use, and much more. And both are backed by

Humminbird's famous Lifetime-Guaranteed Service Policy, with one-year full warranty and three-day turnaround on repairs. The best in the industry just got better, with new features and new versatility. LCR 4000 and LCR 2000 Portable.





Think of it as a fortress for your food.

Just fill these Refreeze bottles with water, freeze and then lock back into the lid. No melting cubes, no soggy food.

> Removable food trays protect soft items from being crushed down below.

Gott cooler chests have extra-thick insulation in the sides, top and bottom. Other coolers don't compare.



Gott cooler chests have a tough, doublewall body with built-in handles that can take all the banging, bouncing and dropping you can dish out.

Every Gott cooler chest is guaranteed for six years. And built to last a lifetime. So not only does this fortress protect your food, it also protects your investment.

NEW ULTRA-SENSITIVE PRIME. IT WILL CATCH FISH YOU DIDN'T KNOW WERE THERE.

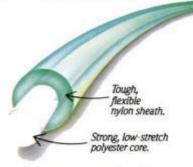
Fishing is a contact sport. Until you make contact, you can't catch fish.

That's why Du Pont has patented a whole new kind of fishing line. Ultra-sensitive Prime.

Prime makes contact so positive, so effective, it's almost eerie.

You'll feel more fish. Hook more fish. So you can catch more fish.

THE WORLD'S FIRST AND ONLY COFILAMENT.



To create Prime, Du Pont introduced the first cofilament fishing line. It combines the advantages of two very different materials—a core of strong, low-stretch polyester surrounded by a sheath of tough, yet flexible, nylon. It marks the leading edge of line technology.

YOU CAN FEEL THE DIFFERENCE YOU SEE.

Prime looks different. But you have to fish it to discover the real difference—Prime's sensitivity. In blind tests, fishermen using Prime reported an uncanny ability to feel what was happening down at the business end of their lines.

Put Prime to your own test on water you know really well. You'll feel details of underwater structure you may have overlooked. Lure action that was lost to you. Hits you missed.

Set the hook. Prime's speed and power will surprise you. And the fish. The reason? Prime has half

The reason? Prime has half the stretch of nylon monofilament in water. Action that gets lost in the stretch of regular line sends tremors of information back through Prime.



TWICE THE HOOKSETTING SPEED.

Low stretch also gives Prime extra-quick reflexes. With conventional nylon line, there's a lag between the sweep of the rod and the bite of the hook. With Prime, you set the hook. Right now. This split-second

response time can mean the difference between hooking fish and losing them.





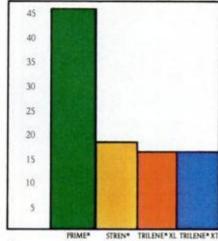


THREE TIMES THE HOOKSETTING POWER.

Prime is not only fast, it's powerful. With nearly three times more hooksetting power than the leading monofilaments. You can set the hook as well with 8-pound test Prime as you can with 20-pound mono.

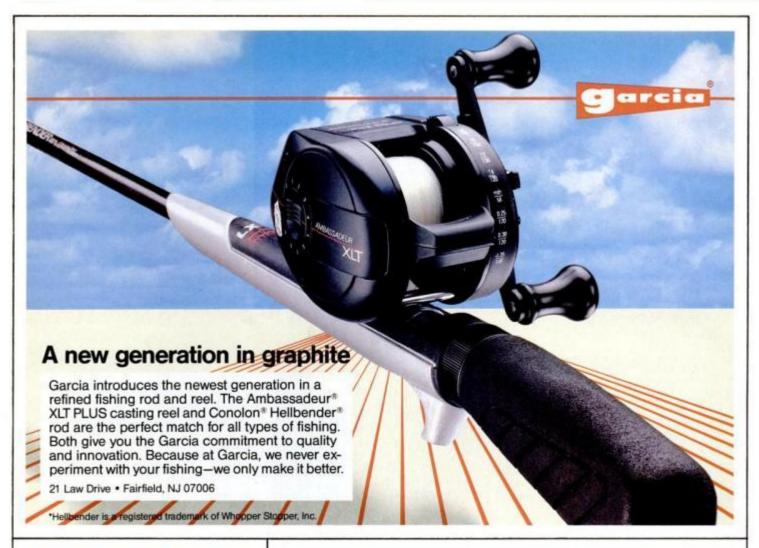
What are the trade-offs?
None. Prime handles and casts
beautifully. It's strong every way a line
should be strong. It's tough. And it's
visible, a soft fluorescent green.

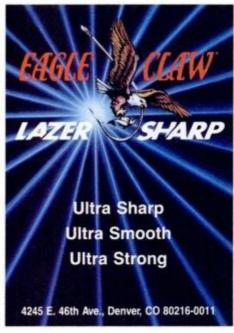
Now you can re-explore your favorite water. Make your next cast with new ultra-sensitive Prime. And start fishing with feeling.



Force transmitted by wet lines in kilograms per square inch (Kpsi)





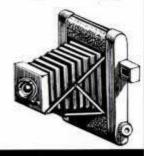




National Fishing Week June 2-8, 1986



Photography



Farsighted accessory





Photo (left) taken with 50-mm lens. Photo (right) from same distance, with Sigma 2X teleconverter.

A telephoto lens will bring distant subjects within closer view of your camera. But simple, inexpensive accessories called teleconverters can increase the magnification of the normal 50-mm lens that probably came with your camera.

The teleconverter contains its own optics, and is inserted between your camera's body and regular lens. It measures only an inch or two long and weighs about half a pound. This makes it easier to carry than a longer, heavier telephoto lens—and it will perform similar magic.

For example, a 2X teleconverter will turn a 50-mm
lens into a 100-mm telephoto. Or, slip the teleconverter
between your camera
and your 35-mm to
135-mm zoom and
you've got a 70mm to 270-mm super-telephoto
zoom, You'll even
find some 3X teleconverters on the

confined to double magnification. They're available from most camera manufacturers and from specialty lens suppliers such as Sigma, Tokina and Vivitar.

Besides size and weight savings, teleconverters are economical alternatives to longer focal-length lenses. Though suggested retail prices vary, you'll find they sell for \$30 to \$50.

Like telephotos or zooms, a teleconverter added to your normal lens is a boon in sports photography. They're helpful also for shooting

> Above, Sigma teleconverter used

Above, Sigma teleconverter used in photos at top right. Left, matched Nikon converter.

wildlife, where getting too close could jeopardize your photo or your well being.

Teleconverters can help you take better portraits by eliminating the bloated-face distortion that often occurs when you focus from close range with normal or wideangle lenses. By using the teleconverter with a normal 50-mm lens, you can focus from a greater distance and still get a tight closeup.

On the other hand, you can get macro-like super closeups with the addition of a teleconverter. Though the accessory doubles the focal ches. With a teleconverter, you'll still focus from 1½ feet, but the 2X magnification will make it seem as though you're 9 inches out.

A disadvantage of teleconverters is that they cut down the amount of light reaching the film. This means longer exposure times are required. Your camera's automatic metering system will guide you to the proper shutter speed and f/stop combination. Just make sure you buy a teleconverter that's compatible with your camera's metering system. Most manufacturers offer matched teleconverters for specific cameras or lenses.

You should also know that when used with 50-mm lenses, teleconverters can inflict sight distortion at the edge of your photo (there's no problem with longer lenses). To minimize this, select an f'stop (aperture) two or three higher than what your camera's meter suggests—and be sure to increase exposure time (shutter speed) accordingly.

As with any high-magnification lens, longer exposure times increase the chance your photo will show camera shake. Using fast (high ASA) films will cut exposure time.—Carl Caiati

PM PHOTO ALBUM

range of your lens, it does so

without changing your mini-

mum focusing distance from

the subject. For example,

most 50-mm lenses can't fo-

cus any closer than 18 in-

One of the most useful camera accessories is also one of the least expensive—the lens shade. Besides protecting

your lens from bumps and rain, it improves image contrast by blocking out extraneous light. Rays from bright sources such as the sun can enter an unprotected lens and bounce around within the lens elements, producing an unwanted, milky-looking flare.

Extreme internal reflections (see top photo at the right) might superimpose images of the lens aperture on your photograph.

When buying a lens shade, be sure to match the shade's angle of view to that of the lens you'll use. The bottom photograph shows why.

It was taken with a wide-angle lens, but one fitted with a normal lens shade.

-Armand Ensanian





market, but the

greater array is

Appliance Clinic

BY STEVE TOTH

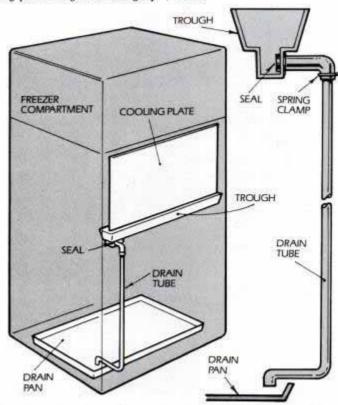
Watery refrigerator

have a Philco refrigerator model No. RD16A3, serial No. 2VZ101841. It's not a self-defrosting model—condensation is supposed to run to a drain pan in its base and evaporate. Instead, the water is running down the inside of the back and collecting on the bottom shelf inside the refrigerator. I would appreciate any help you can give me.

R.R. HEINHOLD BUFFALO, NY

Condensation dripping from the refrigerator's cooling plate may be backing up due to a plug somewhere in the drain system. Something may be plugging the trough below the cooling plate or the tube that leads from the trough to the drain pan.

Disconnect the refrigerator's power and pull it away from the wall. The drain tube runs down the refrigerator's back. A small faucetlike fitting connects the drain tube to the trough, which is on the inside wall of the refrigerator. A spring clamp holds the tube to the fitting. Loosen the clamp and gently pull the tube loose.



An obstruction in a refrigerator's drain system can be removed by flushing the drain tube and unplugging the trough fitting.

Flush out the tube with a solution of two cups of hot water and one teaspoon of baking soda. Insert the tip of a meat baster filled with the solution into the tube and force the solution through.

Next, with the baster empty, blow air from the fitting into the trough. If the fitting appears plugged, try gently cleaning it with a piece of wire.

Finally, reconnect the drain tube and pour a little warm water down the trough. Check for leaks and proper drainage before plugging the refrigerator back in.

Gear source

We own an Easy washing machine model No. 506SSAA, serial No. 89202. We need a gear for the spindry basket. We know the company is defunct, but surely someone, somewhere has the gear. The dirty laundry is piling up, please help.

CURTIS W. NUNN OGALLALA, NE

I found an appliance parts company that still has a small supply of Easy parts in stock. If you are trying to find a part, but don't know its name or number, send the appliance's model number with a sketch or photo of the item you want.

The part you need is called a fiber gear, Easy part No. 217, about \$34 postpaid. Write Koss Appliance Service Co., Rt. 309 Montgomeryville, PA 18936.

Testy toaster

I am having trouble with my Sunbeam Radiant Control toaster Model T35. Often, the bread will go down only if it is dropped in several times.

Sometimes the bread goes down and pops up again without being fully toasted. A second slice will go down fine if the toaster is hot from another slice. Should I throw the toaster away, or can I fix it?

GREGORY YOUNG
PALO ALTO, CA

Your toaster was made between 1958 and 1962. It may need a simple adjustment to increase the tension on the bread carriage, which lowers the bread into the toaster.

To adjust the tension, unplug the toaster and turn it upside down. Be sure that you use a towel to catch the breadcrumbs. Open crumb tray to expose the adjusting screw, located be-tween the two bread slots. Turn the adjustment screw one turn counterclockwise. Plug the toaster in and test it with a slice of bread. If it still doesn't work, repeat the procedure, with one more turn. If this doesn't work, you should take the toaster to your local Sunbeam repair center.

Service tip

With the hot months of summer quickly approaching, it may be a good idea to take precautions with your freezer in case of power outages. Remember that a full freezer will stay colder longer than a half full one. If your freezer will be only partially filled with food for a long period, make up the difference by partially filling plastic bottles with water and placing them in the freezer. The bottles will act as a coolant should the power go out, and the freezer won't have to work as hard to cool once the power is back on.

Another option is to stock up on dry ice before a severe storm, especially if you live in an area that is prone to frequent and long power outages. About 25 pounds of dry ice will keep a full 10-cubicft. freezer below 32° for three or four days.

Calculate the space in your freezer, with its contents, and buy an appropriate amount of dry ice. It's usually sold by ice dealers.

Remember to wear gloves when handling dry ice, and put cardboard on top of food packages and ice on top of the cardboard.

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.

Compare the new two-wheel drive Jeep Comanche to Ford Ranger and Chevy S-10, and you'll find Comanche has the lowest price tag. And in 4x4's, Comanche is the lowest-priced long-bed pickup you can buy!

Up front, a gutsy 117 horsepower 2.5 litre electronic fuelinjected engine is standard. It's more powerful than the base engine of any other pickup in its class. Comanche's 119.9 inch wheelbase is longer than any other long-bed pickup in its class.

Comanche is the only 4x4 pickup built with a choice of two "shift-on-the-fly" four-wheel drive systems.

You'll find big 15-inch wheels and all-weather radials standard on Comanche, optional on two-wheel drive Ford Ranger and Chevy S-10.

Four Wheeler of the Year.

Safety belts save lives.

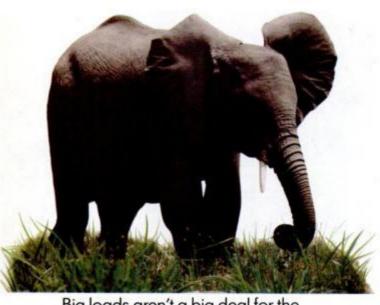
*Based on manufacturers' suggested retail prices for base long-bed vehicles. Excluding taxes, license, destination charges and optional equipment. Prices may change without notice.



Easy to be a truck. Hard to be a Jeep.



MICHELIN INTROD LETS YOUR PICKUP, LIKE A CAR AND W



Big loads aren't a big deal for the XCH4 radial. It gives you the carrying capacity of a light truck tire. And because a Michelin never forgets, the XCH4 also provides the comfort of a Michelin passenger tire.



Michelin believes a tire should be seen (the XCH4 is really sharp) but not heard. The XCH4's unique tread design is inherently quiet. So it reduces highway hum—the nerve-racking racket common to aggressive tires.

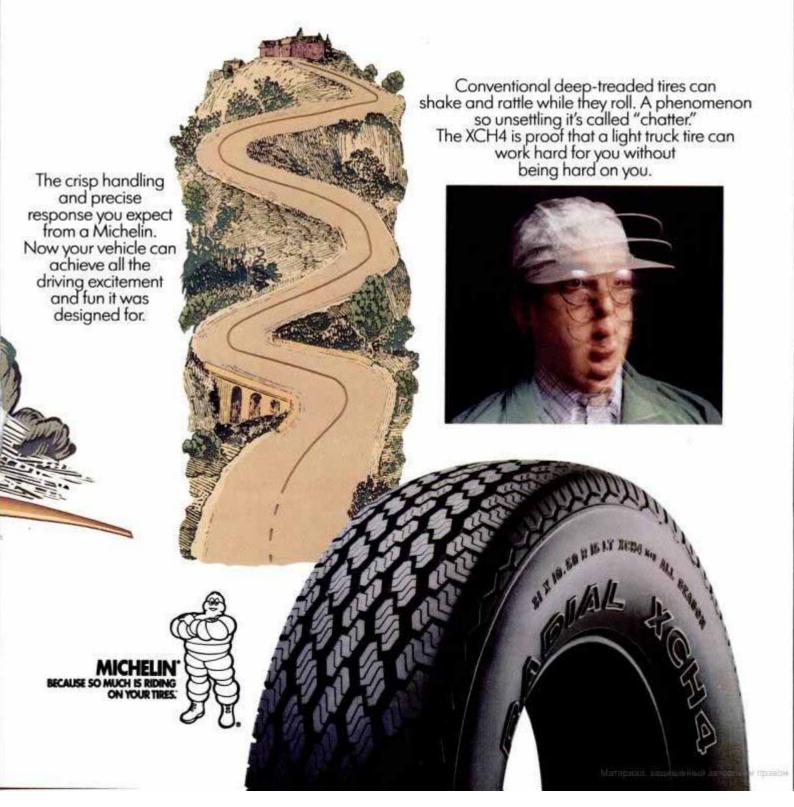


Anyone can make a tire that looks tough. The trick is to make it last. The XCH4 is designed to wear slowly, and just as important, evenly. Which prevents premature wearout. And gives you the kind of mileage Michelin is famous for.



Bad weather is good weather for a Michelin. The XCH4 all-season radial has all the right elements for the elements. Its special tread design and compounds provide excellent traction and performance in rain and snow.

UCES THE TIRE THAT VAN AND 4X4 RIDE ORK LIKE A TRUCK.



Homeowners' Clinic

BY NORMAN BECKER, P.E.

Home fire sprinklers

A ffordable and depend-able sprinkler systems with low-profile heads are available for 1- and 2-family homes. A sprinkler system combined with smoke detectors provide the most reliable form of residential fire protection for you and your family. Excluding deaths by explosion or flash fire, there are no known cases of multiple deaths in a fully sprinklered building due to fire or smoke, according to the U.S. Fire Administration. Though 80 percent of fire deaths occur in residential buildings, they rarely have sprinklers.

In 1976, less than 5 percent of U.S. homes had a smoke detector. Today, more than 65 percent have one or a vital contribution to fire protection by providing early warning, but sometimes even this is not enough. About 50 percent of the firedeath victims were very young or old, handicapped or intoxicated and were unable to escape.

Residential sprinklers are designed to protect people in the area of fire origin and reduce fire damage. They activate five to seven times faster than standard commercial sprinklers and have a different spray pattern and droplet size. Their quick response keeps toxic gases and smoke to a minimum.

Also, they prevent fire from growing to the flash-

SPRINKLER HEAD

CHECK VALVE

TEST VALVE

CONTROL VALVE

SPRINKLER

HEADS

CONTROL PANEL

DOMESTIC SUPPLY

LINE

PIPE FOR

PLUMBING FIXTURES

A residential sprinkler system's check valve prevents a back flow of water from being mixed with domestic drinking water. over stage. This occurs when gases from burning materials accumulate and explode. Generally, flashover takes place when temperature at ceiling level reaches 1000° to 2000° F. With many combustible materials being introduced into homes in construction or as furnishings, flashpoint can be reached in two to three minutes.

Designers paid special attention to the appearance of the sprinkler head. They project only about 14 in. from the finished ceiling. Many use escutcheon plates that can be painted or plated. The heads thread into

feed pipes.

Recognizing the benefits of sprinklers, four U.S. localities passed laws requiring them in new construction. Costs average about 90 cents to \$1.30 per sq. ft. of area sprinklered. To offset these costs, some localities let builders reduce other fire code measures. Sprinklers can be retrofitted into existing homes at a slightly higher cost. This may be offset by a reduction in the homeowner's policy premium. Some insurance companies offer discounts of up to 15 percent of the policy premium.

For information, contact the National Fire Sprinkler Assn., Rt. 22, Box 1000, Patterson, NY 12563. Two companies with UL-listed sprinklers are: Central Sprinkler Corp., 451 North Cannon Ave., Landsdale, PA 19446, and Grinnell Fire Protection Systems Co., 10 Dorrance St., Providence, RI 02903.

Cabinet face lift

I want to cover my painted wooden kitchen cabinets with plastic laminate. I won't have a problem making new doors, but how do I cover the existing front frame and sides of the cabinets? Will laminate stick to the painted wood?

NEIL J. CIRILLO HICKSVILLE, NY

See Resurface Your Kitchen Cabinets For A Brand New Look in our January '85 issue (page 100). It spells out the procedure, tools and supplies needed for this job. It's just what the doctor ordered for your cabinets.

Softener bypass

We have a water softener in our house. Unfortunately, it adds a lot of salt to our water. For health reasons, we don't want to drink this water because of the high salt content. As a result, we buy bottled water for drinking and cooking. However, we can't use our refrigerator's ice maker because it uses the softened water. Is there a way to bypass this and pipe in unsoftened water?

CLYDE ALLARD AMARILLO, TX

Cut into the water supply line before the softener and install a Tee or Y fitting. Run a 1/2-in.-dia. copper pipe from this fitting to the back of the refrigerator. You can then tap into this pipe and run a copper tube to your ice maker.

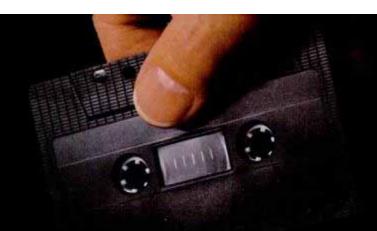
Compressor cover

I recently replaced my outside air-conditioning compressor, which was covered by a weatherproof metal housing, with a Carrier unit that's not protected from the weather. My old compressor lasted 25 years; is the new one at risk due to the effect of the elements?

E.M. NUNNELEE MAYFIELD, KY

The people at Carrier told me their air-conditioning compressors do not need covers. They said their equipment is coated with a weather-protective paint. However, if you intend to cover the compressor to keep out leaves and debris, they recommend you leave about 12 in. open at the bottom to allow air to circulate.

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.



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Car Clinic



BY MORT SCHULTZ

Taken for a sap

I parked my car under some pine trees last summer, and sap dripped on the paint. Bug and tar remover doesn't begin to make a dent on the stuff—neither does gasoline, kerosene or turpentine. Body shops here haven't any idea what to do. Can you help me?

DOUG FOWLER MASSENA, NY

Sure. But you're the guy who's going to have to be patient when doing the hard work if the repair procedure is to be successful.

Start with a small plastic squeegee like the kind used by body shops for spreading filler. Squeegees are sold in auto supply and accessory stores. Use it to scrape as much sap off the car as possible. Don't apply too much pressure.

Next, make a sudsy solution with Tide and hot water. Using a relatively coarse cloth—turkish towel is good—scrub the spot. Apply lots of pressure. As the water cools, mix a new solution.

You may have to scrub over and over and over maybe for more than an hour. Eventually, though, sap will disintegrate. When it does, wash, compound and wax the spot. A ring may be left, but it will hardly be noticeable.

A new Rocky

Before I brought my 1982 Honda Prelude into an AAMCO transmission shop for automatic transmission servicing, the unit shifted as gently as a cradle rocks-but not since. The manager at AAMCO swears that only the fluid and filter were changed-that his men touched nothing else. We're all stymied by the rough shifting. Could the vacuum modulator be causing it?

> RALPH LOWE MARYVILLE, TN

It could be—if the Hondamatic used a vacuum modulator. But since it doesn't, there has to be another cause.

It's logical that if the transmission was shifting smoothly before fluid was changed, the problem probably lies with the fluid that

was put into the transmission by AAMCO—especially in your case, since pre-1984 Hondamatics are sensitive to certain brands of DEX-RON II automatic transmission fluid. In 1984 the design of the Hondamatic

was changed, so newer models perform equally on any brand of DEXRON II.

In any event, before you consider other possibilities for harsh shifting, have the fluid changed again. This time see that one of three brands of DEXRON II is used: ARCO, Kendall or UNOCAL 76. These are closest in additive composition, especially friction modifiers, to the Honda transmission fluid put into the car before it left the factory.

If the new fluid doesn't clear up the condition, then check for a worn or misadjusted throttle valve or shift linkage.

Old is better

Before I request that Toyota convene an arbitration panel to hear my complaint, I'm hoping you can resolve the problem. It concerns a steering-wheel vibration and front-end noise in a 1985 Camry. The solution offered by the dealership was the same all five times I brought in the car—wheel balancing. It proved to be no solution at all. To make a long story short, an independent frontend specialist worked on the car for three days and found no fault with wheel balancing or tires, and further contact with Toyota's regional and national offices led to the conclusion, "Everything is normal." In fact, a representative from Toyota's regional office had the gall to tell me that vibration and front-end noise are normal, and that my car drove better than her Camry. Any help you can provide will be greatly appreciated. AL WEST

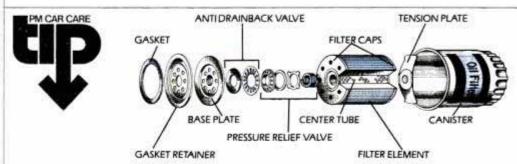
CORVALLIS, OR

There are going to be some embarrassed people when they learn that the solution to this problem is no big deal. What to do is not use one of those off-the-car hightech wheel balancing units most shops now rely on. Ask a technician to go into the storage room and pull out the old on-the-car strobe spin balancer. The procedure he should follow to eliminate vibration and noise in your Camry is:

- See that toe-in is set to specification, which should be 2 ±1 mm if the car has power steering and 1 ±1 mm if it doesn't.
- Torque wheel nuts to 75 ft.-lb.
- Using the on-the-car spin balancer, spin wheels between 50 and 60 mph, then balance.

Followup report: Right before this solution for Al
West's problem was to go to
press, I got the following
note from Al: "The problem
has been fixed after a visit to
a local shop where they balanced the wheels while on the
car." Clipped to Al's note
was a report from the shop,
D&B Bear Service of Corvallis, which stated that balancing wheels on the car results
in elimination of the dynamic steering-wheel shake.

(Please turn to page 34)



Slow-motion oil pressure

Instant-worry is starting up an engine in the morning and having that oil-pressure light glow for five or six seconds. A check of oil level finds it to be up there, so is a major repair on the horizon? Maybe. But then again, maybe not.

Inside most oil filters there's an antidrainback valve. Its job is to assure that oil is in the engine

ready for circulation when the engine is started. If something like a carbon particle gets lodged between the valve and the filter baseplate, the valve can't close and oil will drain back into the crankcase. When the engine is started, oil must be pumped from the crankcase to the engine, resulting in the delay. The solution may be as simple as installing a new oil filter.



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Turn it on, start to listen and discover love at first sound. You'll never want to leave your truck again.

That's the way we planned it. Right on the drawing board, while GM was designing your truck, Delco Electronics was designing the right music system to match that truck's acoustics.

Delco's tuned in to all the latest features, too. From

five-band equalizers* that let you adjust the sound to your own ear to locked-in electronic tuning engineered not to drift, even if you do

Stop by your GM Dealer and discover how

Music System can make the great outdoors sound better indoors.

Delco Electronics

You'll love it too much to leave it.

CAR CLINIC

(Continued from page 32)

Looks are deceiving

Your description of Cadillac's problem with the HT 4100 engine (Car Clinic, page 64, Feb. '86) did not include the fact that this engine uses oil.

I had the oil and filter changed in my 1985 Deville and checked it two or three weeks later after driving about 800 miles. The level was down almost a full quart. A complaint to the dealer resulted in the statement, "Cadillac says that using a quart in 750 to 1000 miles is normal." How can the company deny that this engine is a dog?

JOHN T. SULLIVAN BOSTON, MA

I've not had any other complaints about the HT 4100 using oil. I'm not saying that yours isn't valid—only that the engine may appear to be using oil when, in fact, it isn't.

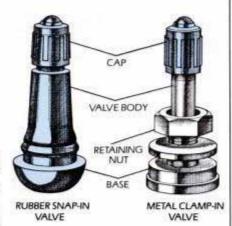
A number of 1985 Devilles and Fleetwoods have incorrectly calibrated oil dipsticks. They show the oil level to be as much as 44 of a quart low although the crankcase is actually full. If your model is affected, it will have a Vehicle Identification Number (VIN) below 372276. Is yours one of these?

If so, remove the dipstick and mea-



A tale of two valves

You should always install a new valve when replacing a worn tire. An old valve is a weak link that increases the chance of an air leak. But use the right valve. There are two kinds. Rubber snap-in valves are for passenger car tires, including temporary spare tires. Then there are metal clamp-in valves. According to tire manufacturers, tires requiring over 60-psi air pressure should be equipped with them. These tires are found



on light trucks, RVs and trailers. That high air pressure may cause air loss around the base of a rubber snap-in valve.

sure along the dipstick tube from the hole to the top of the bracket holding the tube to the engine. This measurement should be 61/4 to 64% in.

- If the dipstick tube measurement is 6½ to 6½ in. replace the dipstick with part No. 1634398.
- If the dipstick tube measures less than 6½ in., replace the dipstick tube with part No. 1631240 and the dipstick with part 1634398.

In either event, tell your dealer this

is to be done at Cadillac's expense. If he needs verification, refer him to technical service bulletin (TSB) 85-94.

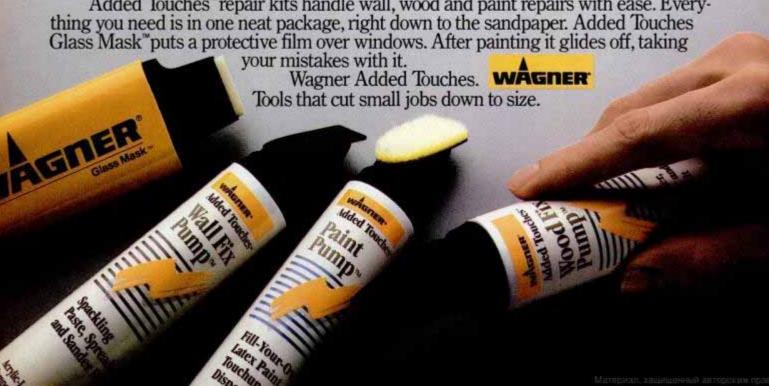
Stand up to dealer pressure

Right from the day of delivery, the oilpressure gauge in my 1985 Dodge Lancer (2.2-liter engine) has fallen to almost zero when the 5-speed transmission is in FIFTH gear. In all other gears, oil pressure is up there. The dealer says

TOOLS YOU'LL LIKE FOR JOBS YOU DON'T.

Fixing a gouge in the wall. Filling a nail hole. Painting ever so carefully around windows. The jobs nobody likes. Wagner has done something about them.

Added Touches repair kits handle wall, wood and paint repairs with ease. Everything you need is in one neat package, right down to the sandpaper. Added Touches



There is a dry place in this wet and windy world.

With a notable exception, most storms are short. But in just minutes, a tenter that leaks or blows down can spoil your fun for days. That's why it's wise to protect your camping fun.

Eureka! StormShield Tents keep you dry. Their double-coated rainproofing protects you everywhere water might enter—in roofs, awnings and floors. And their flow-through ventilation keeps you comfortable in the worst of weather.

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Choose from 40 Eureka! StormShield Tents. You'll find a size, style and price just right for you. Call 1-800-821-7700, ext. 808, for dealer locations. (In Alaska or Hawaii, call 1-800-821-3777.) And don't let a few minutes of weather spoil days of fun!



it's perfectly normal. Is he right? Please help put my mind at rest.

HAROLD B. SORENSON CITTENANGO, NY

No—he's not right. Traveling at 55 mph in FIFTH gear, your engine is turning at 2200 revolutions per minute and oil pressure should be between 25 and 28 psi. That should show a quarter of the way up on the gauge—not "almost zero." Only when the engine is idling should the oil-pressure gauge read near zero. (Actual idling speed oil pressure is 5 psi.)

Have the dealer test oil pressure by attaching a known accurate gauge to the engine. If oil pressure is 25 to 28 psi, replace the gauge now in the car. But if the dealer's gauge shows that oil pressure is below 25 psi with the engine running at 2200 rpm in FIFTH gear, repairs are needed. There's a malfunction, probably with the oil delivery system.

If your dealer stands on his "it's perfectly normal" policy, you should get in touch with the Chrysler zone office in Tarrytown. The guys there will help you with this problem.

Mexican standoff

Is it true there is something wrong with 2.3-liter HSC engines in 1985 Tempo and Topaz that's causing Ford Motor Co. to replace these engines? My dealer says it's not so. Don't get me wrong—my engine's working OK, but I don't need any grief later on.

BILL NELSON TULSA, OK

It's true. According to a letter sent to dealers by Ford, "A small number of 1984-85 Tempo and Topaz vehicles equipped with a Chihuahua-built 2.3L HSC engine have insufficient honed cylinder bore surfaces that may cause an oil-consumption concern early in the vehicle warranty period. The engines involved were built between April 2, 1984, and March 5, 1985, at the Chihuahua engine plant."

To qualify for this repair:

 One must have a Chihuahua-built engine, which is verified by the letters CH on the engine code label located on the front of the rocker cover.

 The engine must have started to consume oil during the warranty period, and this fact must be on record if the vehicle is now out of warranty.

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

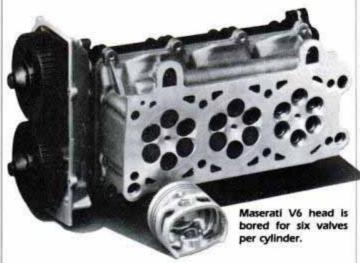
- A whine at 40-50 mph from 1984-85 Chrysler front-wheel-drive cars, except imports, can usually be eliminated by installing a damper weight (part No. 431107) on the end of the left-hand motor mount through-bolt. Ask your dealer to check TSB 21-20-85 for details.
- A drift to the left in some 1985-86 Ford and Mercury models may be resolved by rotating tires one way, and if that doesn't work, another way. First, though, tire pressure and front-wheel alignment angle have to be checked. Models affected are Escort, EXP, Tempo, Lynx and Topaz. Refer your dealer to TSB 85-23-6.
- A V6 engine of a 1986 Pontiac Fiero that has a severe hesitation or won't start may have a fuel pump relay wire harness shorting out against the exhaust manifold or exhaust pipe. Reposition the harness as explained in TSB 86-8-5.
- A loud noise coming from the V6 engine compartment of a 1986 Jeep at idling speed may be nothing more serious than an air pump that has to be muzzled. The muzzler is a silencer (part No. 8933001955) that goes between the pump and air-control valve. The reference for your dealer is M.R. 277, I.S. 5E.
- Rattling wheel covers on 1986 Honda Civics can be silenced by replacing washers on each lug nut with a special plastic washer (Honda Code No. 2310191). The thicker washers hold wheel covers more securely to the wheels.

Freewheeling

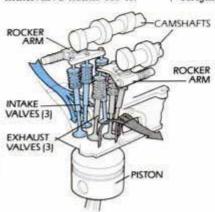


BY WADE HOYT

Maserati one-upmanship



nce everyone from Detroit to Tokyo had introduced four valves per cylinder—a popular racing design—on street cars, Yamaha went them all one better with five valves per cylinder. Now Maserati has a set of 6-valve cylinder heads for its 2-liter V6 engine. The V6 already has double-overhead camshafts, so it was relatively easy to design multivalve heads for it.



Wide rocker arms let each cam lobe work three valves in the 2-liter V6.

A careful look at the drawing shows that the valves are canted at different angles—porcupine style—not all in a row, which is the common practice in automotive 4-valvers. Splaying the valves and intake runners gives better swirl patterns for increased combustion efficiency, which is the way most motorcycle designers do it. This is not surprising, since Alejandro deTomaso, Ma-

serati's owner, also owns the Benelli and Moto Guzzi motorcycle companies.

The 6-valve heads will go into a 1987 rear-drive 2-seater called the Maserati 228. Its twin turbo-chargers will give it over 260 hp, enough to launch it nicely into Corvette, Ferrari and Porsche territory—assuming all 32 valves are kept in adjustment!

Marriage made in Akron

B.F. Goodrich and Uniroyal Inc. have announced plans to merge their tire operations, forming the second-largest tire firm in North America. The new company will be called The Uniroyal-Goodrich Tire Co.

Don't look for any "Goodroyal" or "Unirich" tires for a while. Both the Uniroyal and Goodrich brand names will be retained, as will the private brands that the two companies make. One thing that made a smooth merger possible is that Uniroyal deals almost exclusively in original equipment sales to automakers, while BFG specializes in the replacement market.

The joint venture may give Goodrich a chance to supply its high-performance T/A Radials to Detroit, which now relies on the Goodyear Eagle GT as its



Rare high-performance Uniroyal may be overshadowed by BFG.

standard-issue performance tire. Research and development efforts will be pooled.

Fast photo service

Let's say you're Mercedes-Benz, maker of some of the best performing luxury cars in the world (see Lap Of Luxury on page 94). When you take action photos of your cars, or hold press previews for auto journalists, you need a chase vehicle for car-to-car photography. A pickup truck just won't do. It's not just a matter of image; most pickups aren't fast or agile enough to keep up with the hotter Mercs on a twisting test track. The solution? Convert a big old 450 SEL sedan into a high-speed camera platform. It's as easy as 1,2,3.



 M-B camera car looks like a standard 450 SEL with a roof rack. But wait . . .



2 Mechanic puts trunk lid on roof rack and slides out photographer's "drawer."



3 Wind-deflecting "tent" in place, camera car is ready to roll.



WE JAPANESE HAVE FINALLY DEVELOPED AN ECONOMICAL ALTERNATIVE TO THE AUTOMOBILE.

At a time when Japan's car engineers are acknowledged as being among the best in the world, we'd like to acknowledge some who may be even better.

Isuzu's truck engineers.

For starters, consider price. At \$5969," the P'UP you see here is not only the lowest priced truck sold in America, it's also \$3000 lower than the average price of a Japanese import car. Or consider economy. The EPA rates it at \$\overline{25}\$ MPG City and 31 Highway." Two

numbers that a number of Japanese economy cars have trouble matching. Or finally, consider practicality. This Isuzu P'UP not only carries three in comfort, it gives you a cargo bed that'll carry practically anything.

So before you rush out and buy a Japanese car, perhaps you should stop for a moment and

consider your alternatives.

Starting, of course, with ours.

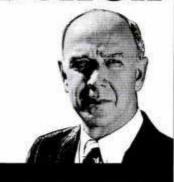
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THE FIRST CAR BUILDERS OF JAPAN.

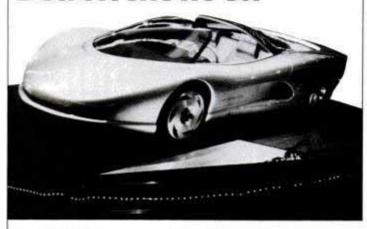
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Inside Detroit



BY JIM DUNNE

Detroit shows off



Corvette Indy show car, named after the 32-valve V8 engine mounted in the middle, will be a test bed for new technology.

merican carmakers are stealing the limelight on this year's auto show circuit with a number of radical concept cars. This time there's a difference, though. More than just design studies, the 1986 crop is more of a sneak preview of production cars to come. At the Detroit show. Chevrolet displayed the Corvette Indy. A running prototype of this model is being built by Chevy to test out such features as 4wheel steering, traction control (wheels won't spin on slippery roadways during acceleration) and a suspension that can be set by the driver for sporty or cushy ride.

The engine is set amidships, just behind the driver. It's a 32-valve V8 design based on Chevrolet's special Indianapolis 500 racing engine (see From Driveway To Speedway, page 226, May '85). Though displacement is

a relatively small 2.65 liters (162 cu. in.), output is expected to top that of the current 350-cu.-in. V8. Don't look for this car in Chevy showrooms soon, but the active suspension and 4-wheel steering, could be used when they are proven.

without elaborate supports.

Insiders say that Pontiac will have a high-production version of the TranSport by 1989. It will have a plastic body and be powered by a 2.9-liter aluminum V6 and use front drive, lifted from GM's A-car lines.



Futuristic Pontiac Transport van could be on the road in '89.

Plastic van

Dodge pace car for the CART circuit is race ready with 440 hp and 194-mph top

end.

That futuristic TranSport that Pontiac has shown at auto shows around the country is only a hint of what will eventually be seen on the road three years from now. Problems with the huge windshield will have to be worked out before the final design is frozen. For one, the windshield lets in too much sun and will make the interior of the van feel like an oven on sunny days. Then there is the problem of rollover protection-the glass is not strong enough on its own to meet government safety standards. And that gullwing side door is difficult to open and keep propped open

More than just good looks

This PPG/Dodge pace car will go as fast as its styling indicates. Dodge claims the car, with twin-turbo 4-cylinder engine, was clocked at just over 194 mph. The engine is set amidships, and was specially modified with 16-valve breathing and intercooling for the turbos. Chrysler claims an amazing 440 hp when the turbo is set at its maximum 23 pounds of boost.

Designed by Chrysler and made with plastic body panels, the sleek body has an ultraspecial paint job. Base coat is PPG black. That's topped by 16 coats of pearl and five coats of clear. The finish is either golden brown

or mauve, depending on the light. Created to pace CART races as part of PPG's pace car series, the Dodge is fully raceequipped, including roll

Heavy trucking

Pickups are hot, because they're consistently fastselling models. That's why Ford, GMC, Chevy and Mitsubishi are all planning new models for 1987, introductions that fall hard on the heels of the new Nissan and Dodge Dakota pickups. Ford and GM are both going aerodynamic cab shapes.

But GM, in its GMC and Chevy full-size models, will be the first with antiskid brakes for rear wheels, a feature sorely needed for the nose-heavy chassis. The noskid brakes prevent rearwheel lockup when the brakes are applied on slippery surfaces.

Mitsubishi will have an allnew pickup to sell both un-

(Please turn to page 40)



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for electricity that's just a cord's length away.

Why let your do-it-yourself spirit be confined to the length of an extension cord? With Powermate's* portable 1500 watt generator, you can take your own power to places electricity's never reached before.

Our popular sized generator is easy to carry and easy to use; capable of running your favorite power tool or small appliance – around the house or on a camping or fishing trip. It comes in handy during power outages, too; delivering enough electricity to keep a deep freeze or sump pump operating for hours.

For information on all six Powermate* generators (ranging from 500 to 4600 watts) contact the Powermate* dealer nearest you.

For the Powermate* dealer nearest you, call 1-800-344-1010 (In Canada, call 1-800-526-8000.)

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INSIDE DETROIT

(Continued from page 38)

der its own brand and as a replacement for the Dodge Ram next fall. Prototypes spotted during cold weather testing last January in upper Michigan are bigger, huskier looking than the current Ram, and sport a completely new cab and chassis. Big 15-in. tires and 4-wheel drive will make it a match for the other Japanese imports, especially import leader Toyota. First production of this truck will use an inline 4-cylinder engine, but Mitsubishi plans to offer its upcoming 3-liter V6 a year later.

DeVille convertible

Cadillac dropped convertibles from its lineup this year when the Eldorado changed to the new, smaller body style. But the prestige nameplate will be able to take its place in parades once again next year when a deVille convertible comes on the market. The new fabric top is so well done that it looks like simple vinyl covering the standard 2-door roof. But the bumps from four support bows can be clearly seen.

Look out, Detroit iron

Nissan's sensational Cue-X show car is set to show up in American showrooms as early as 1989 to challenge the untouchable American big luxury cars. Japanese cars have been edging into the high-priced markets here at a slow pace, but the competition will quicken when the Cue-X hits the market. Some details include a V6 engine with two variable-inlet, ceramic-turbine turbo-chargers; 4-wheel antilock brakes and adjustable suspension for ride and handling. If it sells in the \$18,000 to \$25,000 range, the 4-wheel-drive Cue-X, one step bigger than Maxima, will compete against the traditional American full-size cars that up to now have been mostly untouched by the imports.

Me-too Blazer

Seldom does a small company like American Motors show a big company like General Motors how to market a vehicle. But look for just that to happen when the Chevy S10 Blazer and the GMC S10 Jimmy come out with 4-door models later this year. The stunning sales success of the AMC Cherokee has not gone unnoticed, and part of that success is due to the popularity of the 4-door. The overall length and wheelbase will stay unchanged, but the front doors will be narrower, and rear door added.

ItaliOlds

Oldsmobile's search for a European connection to compete against Cadillac's Allante may be over at last. Latest word is that Olds will team up with Alfa-Romeo for a sporty 4-seater that will sell in the sub-\$20,000 class. What Olds is looking for is a little more expensive version of its Cutlass Supreme, one of its all-time moneymakers. Bets are that Olds will put its 16-valve 4-cylinder engine and GM transmission in an Italian-made body that is shipped to Lansing for final assembly.

Getting Justy ready

Even though the Justy, Subaru's 1987 minicar, has been built in Japan for almost two years, the American version must undergo extensive testing in this country before it is ready for American roads (see Invasion Of The Microcars, page 95, Feb. '86). Spotted in upper Michigan last winter, a Justy model was undergoing cold-weather tests. The tiny 3-door hatchback will sell for under \$5000 in its base version. and offer front-wheel drive, a 3-cylinder 1.2-liter inline engine set crossways and fuel economy in the 50-mpg range. Besides the small engine, the sub-2000pound chassis weight is the key to its outstanding fuel economy. Look for a 4wheel-drive version of this model to appear by the end of 1987, with the price pushing \$8000.

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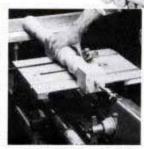




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Cycles

BY NORMAN MAYERSOHN



Learning to ride faster



"Ready to go?" instructor Code asks before sending out each pupil.

ver watched the Grand Prix motorcycle racers in action and thought those maniaes show more guts in one lap than you'll display in a lifetime? Feeling their way through the 100-mph turns with knees skimming the pavement, heroes like Kenny Roberts and Freddie Spencer rightfully take on superhuman attributes. You and I may never come up to their level of natural talent, but there is a way to vastly improve the racetrack riding skills of us mere mortals-California Superbike School.

Actually, that's a misnomer, as the roadrace school takes to the road for a crosscountry tour stretching from



Classroom session concentrates on cerebral demands of racing.

Monterey on the West Coast to Pocono International Raceway in Pennsylvania. My class was held at Laguna Seca Raceway in the Golden State, a picturesque but demanding course that offers both fast sweepers and the notorious Corkscrew series of downhill turns. Having only watched races there before, I fretted endlessly about my ability to ride respectably fast through the tricky curves and still keep my body intact enough to edit stories at a desk in New York

I shouldn't have worried—school founder Keith Code quickly dispelled all apprehensions with a classroom session that emphasizes thinking rather than stylish technique. As a former proracer, Code realizes that beyond the rider's natural skills, what promotes or prevents improvement is his ability to divvy up the proportions of attention he allocates to all the factors involved in going fast.

Code teaches by the budget method. Each of the five major points requiring a rider's attention-speed, traction, ground clearance, location and timing-eats up a bit of the allotment. If the budget is set at \$10 and you expend \$7.50 of your attention concentrating on speed, there's only so much left over to divide among the other important matters. Improving, then, means learning that you don't have to spend any attention on ground clearance along the straightaway, so more can be given over to an issue like location. With that under control, your approach to the next turn is bound to be more accurate and lap times will drop.

By the California Superbike School method, each lap should be a learning experience for the next, and those who learn how best to balance their attention budget

will be forever working on the critical points and be constantly aware of the No. 1 issue: Where am I on the track? Speed around a race course is inseparably tied to taking The Right Line through the turns, and if you don't know where you are, there's no hope



Fleet of Kawasaki GPz550s make perfect training mounts.

of finding out where you ought to be.

Specifics of technique are addressed mainly in question-and-answer sessions. Code feels strongly that the up-and-coming rider should use as little braking as possible, and ignore the rear binder since weight transfer under deceleration renders it nearly powerless anyway. Better to budget more attention to location and ground clearance and not waste it needlessly on controlling skids. He also discourages the use of the engine for braking, and when downshifts are necessary, rev the engine a bit between gear lever clicks to prevent rearwheel lockup.

After the classroom session wraps up and students review the flag signal system, everyone suits up in full leathers and approved helmets. Two follow-the-leader slow laps point out the best lines for each turn, and then students are sent out a safe distance from each other.

(Please turn to page 49)



Riders find the line that lowers lap times.

The insulator that really is a window.

or presenting Transparent Insulation from Ford Glass.







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on a tough box-ladder steel chassis that handles a 1400 lb. payload. With the biggest cargo volume of the leading compact trucks.

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Power Package: power windows and door locks, cruise control, dual power outside windows, 4-speaker stereo radio/cassette deck, and variable-speed intermittent wipers.

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Now you have a real choice for boats in the 15-18' range. Now, instead of crawling on all four, you can be hitting on all six with the new Black Max* 135. The only 135 V-6, and the

135. The only 135 V-6, and the flat-out fastest, most fuel-efficient engine in the class.

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pain, no strain.

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you want to blow the cowling off the next guy's 140. We do it with more cylinders. And more trim for a surge in performance that's like getting another inch of throttle.

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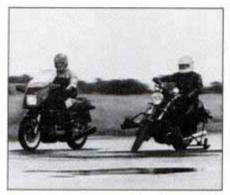
With all the advantages, we think everyone's going to want a V-6 in this power range. Espe-cially our competitors. Now that they know what one is.



(Continued from page 44)

More than anything, what I learned was that I can learn! After 18 laps, my times on the school's specially prepped Kawasaki GPz550 motorcycles dropped from just under two minutes to 1:34. For comparison, the 2-wheeled lap record is better than 1:10. Without the worry of oncoming trucks, lurking radar traps or gravel in the apex, the sensation of fear gives way to unabated exhilaration! Guardrails blur in your peripheral vision, turns that seem unfathomable at first try soon find a predictable rhythm, and all those fast exits where I seemed to be running out of racetrack fell fully under my control.

The school is offered in both half-day and full-day advanced sessions. For scheduling, contact California Superbike School, P.O. Box 3743, Manhattan Beach, CA 90266.



Outrigger device allows safe development of motorcycle antilock brake system.

Antilock for bikes

A few months ago, a pal of mine asked about antiskid brake systems for motorcycles of the future. "No way," I said. "Too heavy and too complex."

Today I'm sitting down with salt and pepper to have a nice meal of my words. The folks at BMW are hard at work testing a setup by the FAG Kugel-fischer company that will allow riders completely controllable panic stops on future K-series machines. The car division of BMW has already put the anti-lock system into production (it's on all '86 models), but the motorcycle application, called ASBS, is a first.

The work may have been inspired by other photos making the rounds showing BMW police bikes with Lucas Girling antilock brake devices. This hydromechanical Stop Control System (SCS) is already in use in Britain in the hope of cutting casualties on the often-slick roads of rainy England.

For a production option on their topof-the-line 2-wheelers, BMW is employing a system similar to automotive antiskid installations: Speed sensors detect when a front or rear wheel is turning at a speed inconsistent with road speed or the other wheel. Hydraulic pressure from the master cylinder is then released and quickly reapplied until line pressure from the rider's control matches the ability of the front tire to grip the road.

Since the motorcycle system uses the bike's own master cylinder as a pressure source and does not carry a separate pumping device, it really acts as a sampling device, constantly matching the rider's input to actual braking requirements. A solenoid is used to cut back pressure at the brake caliper and seal off the master cylinder from repressurizing it. If electronics fail, the system gives a visible and audible warning to signal the rider that manual control is back in effect. Projected costs are in the \$400 range.

Flexy framework

Take a close look at the dirt-digging bike in action below. There's a missing link in the frame, namely the front down tube, which normally runs from the steering head to the pedal crank area. It's replaced by a pair of stainless-steel cables which anchor solidly at the top of their run and end in twin coil springs down by the chainring.

The Slingshot frame originated as a BMX design and is now being applied to mountain and all-terrain bikes by the Greendale Bicycle Co. (41 Commerce Southwest, Grand Rapids, MI 49503). The idea is to store up some of the energy that normally is directed into the frame tubes and release it for an extra kick when the pedals are on the upstroke part of their travel. The top portion of the frame incorporates a Kevlar spring plate member at its rear section. When pedaling torque tries to spread the frame, the springs mounted at the cable ends are compressed. At the end of the pedal stroke, the spring relaxes and drives the crank upward.

Frame flex is bound to be high in this sort of flexible link design, so the Slingshot folks have taken to the racetrack to prove the design. Wins at the BMX Superbowls tend to support their claims of improved performance, but we'll have to ride the \$169 frame before pronouncing it a miracle.



Stainless-steel cables replace frame tube in the Slingshot mountain bike chassis.

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Motorsports



BY STEVE POTTER

Indy escalation



Mario Andretti in new Lola that will be used by six to eight teams.

every year the speeds get faster during practice for the Indianapolis 500, and this May should be no exception, despite revisions in the technical specifications that reduce the Indy cars' cornering and top-speed potential.

New chassis from March, Lola, Penske and Dan Gurney's All American Racing have been built for this month's Indy speed-fest, while the dominance of the Cosworth DFX is threatened by new engines.

Actually, the changes in the rules the past few years have focused more on making the cars safer than on slowing them down.

Rule changes at the end of the 1984 season cut the number of potentially crippling leg injuries from six to just one in 1985. The '86 rules require new, stronger and reprofiled ground-effect side pods. The new pods have creased drag and generate 30 percent less downforce, while stronger construction protects the

driver in cases where a glancing blow tears a front wheel off the car and flips it back toward the cockpit.

During the past two seasons, Indy car racing has been dominated by cars built in England by March and Lola. Last year, Danny Sullivan won the Indy 500 in a March. while Sullivan's teammate, Al Unser Sr., narrowly defeated Loladriving Al Unser Jr. for the PPG season title.

Although only 33 cars will start the Indy 500, between them March and Lola will build nearly 70 new chassis, at about \$160,000 each-less engine! Some of these cars will be assigned by major teams to backup duty.



Indy car racing has become so competitive that teams lengthy development programs, extensively modifying the cars they get from March and Lola. The factories themselves engage in ongoing development work, so Mario Andretti's car, which is owned by Lola importer Carl Haas, often sports new modifications a race or two before they appear on customers' cars.

Lolas will be run at Indy by half a dozen other teams, including Galles Racing, which last year fielded the pole-winning March-Buick. With the exception of Dan Gurney, who will once again field the only American-built car at Indy, everyone else will be running a March.

In qualifying trim at Indy, the Buick V6 probably has a 75-hp advantage over the 700 ponies generated by the Cosworth. Unfortunately for stock-block fans, the V6 turned out to be a nickel rocket in '85. Buick has spent the past winter improving the reliability of its V6, so things may be different this time around.

For the first time the March factory is entering a car of its own at Indy. It will be driven by veteran Danny Ongais, and it will be powered by a Buick V6.

Galles Racing is turning away from the March chassis, in favor of the Lola, and away from the Buick engine in favor of a Honda! It isn't



lenge Cosworth-Fords in '86.

an official project of the Japanese factory, but it promises to be a threat to the Cosworth anyway. Developed from Honda's all-conquering Formula Two V6, the turbo V8 Indy version was developed in secrecy by Englishman John Judd.

Geoff Brabham track-tested the Honda V8 Turbo last year at Laguna Seca. He reported that the Honda, even at its early stage of development, matched the Cosworth's power.

For 1986, the Penske team hopes to have its new PC-14 ready, designed and built with the aid of Computervision's CAD/CAM (computeraided design and manufacturing) system. In the engine bay Penske plans to have the new Ilmor-Chevy V8 Turbo. Developed by two former Cosworth engineers, Mario Illien and Paul Morgan, it's very similar to the Cosworth.

Development of both the chassis and engine have been slower than anticipated, and as a backup Penske has purchased some new March chassis. He still has a full inventory of Cosworth engines.

Porsche and Ferrari engines won't appear before 1987, when there may be yet another fascinating powerplant at Indy. Amoco Chemicals is sponsoring the development of a V6 turbo constructed largely of Torlon plastic by Polimotor, the New Jersey firm that ran a plastic-engined GTP car in the Camel GT sports car series the past two seasons. PM

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BY TIM COLE

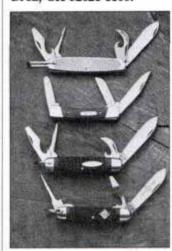
Suzuki's on-demand



Suzuki lets you fine-tune power and handling to the conditions.

et's call it the thinking man's all-terrain vehicle. While the Honda Fourtrax 4x4 offers continuous 4wheel drive, the Suzuki LT-4WD Quadrunner offers 4wheeling only when you want it. Push a lever and you can send power to the frontwheel differential via the centerline shaft drive-2wheel for top-end running on flat terrain; 4-wheel for extremely rough ground. Push another lever and you have three gear ranges at your disposal-super-low, low and high-so you can finetune power delivery to the conditions. By preloading the double-A-arm front suspension and diagonal swingaxle rear suspension, you can make additional adjustments to speed and handling for all types of country.

Beyond this kind of versatility under way, the Suzuki LT-4WD offers a torquey, long-stroke 246-cc engine with a large-capacity generator to power twin built-in halogen lamps. A snorkel-type air intake and a high location up front for electrical components makes the LT-4WD Quadrunner unusually water resistant. Contact U.S. Suzuki Motor Corp., 3251 East Imperial Highway, P.O. Box 1100, Brea, CA 92621-1100.



These pocket talismans work hard in a pinch and stow easily.

Rowing it right

Small Craft Inc. is considered a major player in the

growing rowing shell business, and their latest shell ushers in a new generation in this popular recreational activity. It's called the Lightening and, as its name implies, its primary feature is its light weight. At a bare 45 pounds, exclud-

ing oars, the average rower can heft this boat from car top to the water's edge alone. Small Craft builds the Lightening with foam-core construction inside two fiberglass skins. Aircraftgrade aluminum forms the



Long run and fine entry mark Lightening.

rowing rigging on this \$1400 unit. For more information, contact Small Craft., P.O. Box 766, Baltic, CT 06330, (203) 822-8269.

Old standbys

In The Cutting Edge (page 104) in this issue, we take a close look at what's new in utility knives. But there's more to this story. Some very fine pocket knivesthose old friends you'd feel naked without-are still being made by such old-line firms as W.R. Case & Sons, Camillus Cutlery and Buck. Camillus makes the stainless-steel military issue pocket knife at the top of the photo, lower left. It's made to government specs, priced at \$14.25, and has four implements—spear leather punch, screwdriver and cap lift/can opener. At \$30, the Buck Colt pocket knife, second from the top, performs the same kind of jobs with similar implements. Case and Camillus make the two Scout knives at the bottom of the photo. The Case knife-priced at \$18-has blank-cut standard implements. The Camillus Cub Scout knife-price \$10.85-has similar features, but has two locking mechanisms to protect eager but unpracticed hands. For more information, contact W.R. Case & Sons Cutlery Co., Owens Way, Bradford, PA 16701, (814) 368-4123; Camillus Cutlery Co., 52-54 West Genesee St., Camillus, NY 13031, (315) 672-8111; Buck Knives, P.O. Box 1267, El Cajon, CA 92022, (619) 449-1100.

Room with a view

Well, the family's growing and the van is too small. You can either peddle the old girl, or add additional living space with one of Billy Hood's Sundowner International conversion kits. Simply implant your van's folding bedroom directly into the side panel using Hood's stepby-step instructions. The 200-pound unit measures 75 × 41 × 33 in., just clearing the port-side wheel well. Two people can install the foldout double bed in about

(Please turn to page 56)





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"Before enrolling I checked other courses and also asked for advice from several of the professional locksmiths in my area. They all said Foley-Belsaw was tops and by the most versatile Key Machine. "I always wanted to have

my own business and now I do, thanks to Foley-Belsaw." David Fairbrother—Dave's Locksmith Service Milwaukee, Wisconsin 53209

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OUTDOORS

(Continued from page 55)

four hours using simple tools. For more information about this \$995 unit-one that can actually save you money-you should contact Sundowner International, 9978 Lemon, Fontana, CA 92335, (714) 822-5229.

Cadillac of baitcasters

It's called the Shakespeare President, and behind its flashy lines and multi-



function level-wind performance, it has the unique ability to convert to left- or right-handed retrieve. Remove a simple cap screw and the handle, driveshaft and star wheel slide right out and can be switched with ease.

Add to this left/right flexibility a centered thumb bar for quick release, machine-cut gears (instead of die cast), magnetic brake system and a 4.3:1 gear ratio. To go with the President, Shakespeare has virtually rewritten the book on baitcasting rods. Their new doubleblank Gutts Butt extends the first blank through the handle. The second blank wraps around the first and reaches all the way to the first guide. For more information, contact Shakespeare Fish and Tackle Division, P.O. Drawer S, Columbia, SC 29260.

Rescue strobe

The search-and-rescue industry is working overtime to devise new ways to save people in man-overboard (MOB) situations. One manufacturer has even devised a self-inflating balloon, which, when deployed, dramatically increases the visibility of a man in the water.

Perhaps the tiniest yet most useful MOB device is made by ACR Electron-

ics, 3901 North 29th Ave., Hollywood, FL 33020. Its Firefly Rescue Light emits a powerful beam that's visible for miles, and best of all, the \$69.95 unit is small enough to put in the pocket of your foulweather jacket or clip to your life That's jacket. plenty of security in a very small package. PM



Firefly Rescue Light has a beam that's visible for miles. It's security that fits in a pocket.

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 Guiness 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."

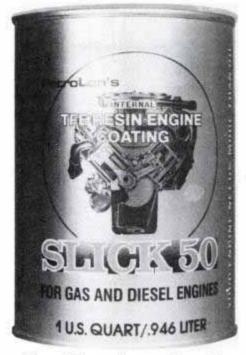
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money 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 senior engineering researcher at a leading southern California university stated, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university."

The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a torture test overseen by the Automotive Services Council for Pennsylvania and shown on WTVE television. Three cars with 75,000 to 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars driven without the oil plugs for about a half hour. The water temperature never rose and the engines sustained no apparent damage.



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

It's Easy to Treat Your Engine

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

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 petroleumbased 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
- Increase horsepower (small economy cars and large RV's really need this)

- Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine
- 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.

There's No Risk with Our Money Back Guarantee

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.

Profit from Selling Slick 50 Yourself

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.

Free engine flush sent with each order. Free shipping with orders of 2 or more.

For purchase or further information call toll-free 1-800-525-8624, ext. 5 (in Colorado call 1-303-762-1385) or send to: Progressive Energy Corp., 3148 South York Street, Dept. PM586, Englewood, Colorado 80110.

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Aviation



Air sailing



Sweden's new Windex sailplane features improved flight controls.

Sweden's new sailplane, the Windex 1100/12000, has passed initial flight tests with a maximum speed of 143 mph. That's fast for a sailplane, but enthusiasts of these sports planes aren't really looking for speed. Test pilots have, however, waxed eloquent about the



The cockpit of the Windex has the latest in electronics.

Windex flight controls. Average time to change roll angle by 45° was around two seconds. The only criticism in testing was too much response on the pitch stick. That, the manufacturer says, will be fixed with the addition of a mechanical control to slow the response. The cockpit of this epoxy/ Nomex craft has all the latest in electronics. It should be flying in America by the end of the summer.

The Hawk is coming

The Navy will begin training its pilots in the British-made Hawk T-45 by 1988. But the training curriculum is already sketched out. It will include the usual classroom work, followed by simulator time. Perhaps a bit unusual is the Hawk's Training Integration System (TIS).

TIS computers will compile data on how the student does in classroom, simulator and in-flight training. All the information will be stored in the same computer system. In that way, the Navy feels, subtle problems that might escape the hawk eyes of Navy flight instructors may show up in a review of the computer file on a regular basis.

The Navy doesn't say how closely it will be able to watch a student pilot. But we've tried on some experimental helmets that incorporate headup displays in the visor. These helmets can be wired to the aircraft's computer, and it is conceivable that by 1988, Navy flight instructors will be able to have a record of every blink of their students' eyes, as recorded through the wired helmet.

Will pilots wash out of training more readily? Probably not, says an insider at the Flight Training School in Pensacola, Florida. But if TIS is as sophisticated as predicted, selection of a student's first assignment may hinge on minute details of his performance as analyzed by computer.

Mustang trots

Loehle Aviation has been tantalizing the sports aviation world with its underwraps 5151 Mustang replica. But we've had some preview looks and can report that the sport plane of the year is almost ready to prove in the air what everyone knew it could do on paper.

Initial engine runup to check the engine mounts and other factors have been complete. All the skin is on and the plane has been painted, we're told, with camouflage paint. Low-level flight test following wing mounting reportedly went without a hitch.

What's all the excitement about? The kit plane is expected to draw a lot of attention at air shows, where replicas are always popular. This particular kit is expected to come with a high-performance powerhouse at a low \$5000. Watch this space for updates on the Mustang.

S is for safety

One bright spot looms on the horizon for air traffic safety. It's called Mode-S beacon (the S stands for secondary surveillance), and it will be operating from air traffic control centers across the nation by the 1990s.

Mode-S is a key element in the Federal Aviation Administration's effort to completely revamp air traffic control. With the new radar system, a local ATC center will be able to follow a craft at 12,500 ft. without interference from crossing signals. At present, planes flying at that altitude on approach can be lost momentarily due to signal interference. A computer hooked to Mode-S radar will be able to separate signals when they cross and no plane should be lost even for a fraction of a second

Under a contract with Westinghouse, the FAA already has ordered 78 of the systems for major airports and large general aviation areas. There is also an option to purchase an additional 59 Mode-S units.

The Mode-S system is in design phase. But the first unit is expected to be tested at an as-yet undisclosed location by the end of next year.

Nose in the ground

Officials at Charles De Gaulle International Airport in France are experimenting with a new in-the-nose guidance system that will help avoid those almost-comic mishaps you hear about at major airports. Jumbo jets docking for off-loading once in a while move slightly out of position, causing broken glass, damaged planes, and frightened patrons. No injuries have ever been recorded in such accidents. But the economics are such that De Gaulle has purchased one docking unit for tests. Planes carry a low-power nose beacon. As they dock, an overhead arm extending from the terminal follows the nose. If the plane goes out of position it can be stopped before impact.

T'S HERE!... A Helicopter You can Afford!





IT'S AFFORDABLE!

The RotorWay Exec is a two man helicopter that actually costs less than a luxury sports car! It doesn't cost too much more to operate either. It burns only 8 gallons of unleaded auto fuel per hour. It's sophisticated yet simple design makes it user friendly for the backyard mechanic, therefore you can do your own maintenance!

IT'S FAST!

It's powered by the RW152 piston-powered engine. It's a four cycle, 4 cylinder water-cooled powerplant that produces 150 horsepower for a maximum airspeed of 115 miles per hour! It's one of the fastest piston-powered helicopters around!

IT'S JUST PLAIN FUN!

Instead of a boring 2-hour drive, you're just a hop away. If you'd rather spend your time being there instead of getting there, this is your machinel But, then again with the Exec, getting there is half the fun!

IT'S ON VIDEO!

Experience this machine for yourself! Take an action packed hour long flight in the Exec through the "Exec Experience" video tape. See the history of helicopters in general and the Exec in particular. You'll see how a helicopter works, how RotorWay made the helicopter affordable and then fly with our pilots throughout the scenic Southwest. For you video buffs this production features the latest in Ampex Digital Optics combined with a dynamic soundtrack!

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Computers



BY RON SCIBILIA

Electronic palette



programs can be combinedif you wish-with a fourth program called Deluxe Video. This \$100 program is a computerized film-and-animation studio. It lets you create videos (up to 20 minutes long) that combine animation, graphics, sound effects, music and live action. You can play the videos on Amiga's color monitor, or transfer them to videotape. Additionally, this micro magic-lantern lets you create titles and graphics that you can splice into movies you've made with your videocamera.





New programs for Electronic Arts exploit Amiga computer's sophisticated color graphics.

Commodore's Amiga com-puter gets widespread praise for its stunning color graphics and synthesized stereo sound. Now, Electronic Arts of San Mateo, California, offers four programs that exploit Amiga's talents.

Leading off the line is Deluxe Paint, a \$100 program that offers an arsenal of artistic effects for computerage Picassos. These effects include different types of freehand drawing, airbrush patterns, magnify and zoom controls, and grid overlays for precise spacing.

There's a symmetry mode for producing complex geometric designs. Another mode lets you mix images with text and has 11 built-in type fonts—great for logos, letterheads, or title pages. A custom brush feature lets you use anything as a brush.

Finally, Deluxe Paint's

color-cycling feature even permits a kind of animation effect that lets you suggest, for example, falling snow, water, moving running clouds or flickering lights. Each painting can have up to 32 different colors out of the Amiga's maximum of 4096 possible hues.

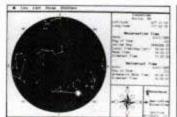
Even more impressive than Deluxe Paint's own powers is its teamwork with other Amiga programs from Electronics Arts. One program, Deluxe Print, lets you fashion virtually anything on paper, including banners, and calendars greeting cards. Another program, the Deluxe Music Construction Set, is a composition tool that avails itself of Amiga's synthesizer-like powers to create a sound studio. It lets a solitary musician perform like a band.

All the imagery, music and text from these three

Apple in orbit

Spectrum Holobyte, a Boulder, Colorado, software house, wants to turn your attention skyward with a couple of astronomy programs for Apple's Macintosh computer.

The company has enhanced and updated its Tellstar program (previously available for the IBM PC and the Apple IIe and IIc) to take advantage of the Macintosh's high-resolution graphics and mouse. The program, priced at \$50 for a basic version and \$80 for an advanced



version with three detailed star tables, turns the Mac's monitor into an electronic observatory.

Ever wonder what the sky looks like tonight in Rio de Janeiro, or what it looked like when Columbus set sail in 1492? Mac users can scan the night sky from anywhere on earth, on any date from 1 A.D. all the way through the year 3000. You can also now track the position of Halley's Comet from any location, for any date and time, from 1980 through 1991. Mac's pulldown menus let you locate and identify a large selection of celestial objects, change your viewing perspective if you so desire. With the new Mac version of Tellstar, you can even view stellar objects and read astronomical data simultaneously.

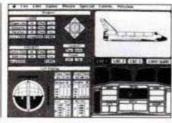
Orbiter—part game, part learning simulation—takes your Macintosh on a space mission from launch to orbit to re-entry. The \$50 program taps Mac's visual and sonic gifts with simulated 3-D perspective graphics and voice synthesis that mimics NASA Control.

Cheap software

Personal computers might join the ranks of avid readers if a new software delivery system becomes popular. Cauzin Systems, headquartered in Waterbury, Connecticut, has developed a technology that imprints computer data on ordinary paper, allowing programs to be published inexpensively in magazines, books, manuals, or business correspondence.

The Softstrip system makes use of data strips that hold up to 5500 bytes (about 21/2 typed pages) of encoded

(Please turn to page 63)



Tellstar (left) and Orbiter: Astronomy programs from Macintosh.

COMPUTERS

(Continued from page 60)

data. The strips are % in. wide and from 1 to 9½ in. long. The strips can be printed either to allow or to prevent reproduction by photocopiers. Low-density data strips can be printed on a dot-matrix printer with a Cauzin-supplied program. High-density strips require photographic reproduction or laser printing.

To get the data into a personal computer (through its RS-232 serial port or cassette input) you'll need a Softstrip Reader. This hand-held \$200 scanner turns the black-and-white image into computer-acceptable information. According to Cauzin, the Reader's proprietary lens system uses near-infrared light to read the strip. It's sufficiently sensitive to read data even if the strip has been scratched, stained or wrinkled. It takes about 30 seconds to read a 5.5KB data strip, which uses the almost universally accepted ASCII code. Cauzin envisions Stripware programs retailing in the \$3 to \$13 range.

Readers will be available soon for the Apple II family, the IBM PCs, and Apple's Macintosh. The Apple II reader will be the first delivered, and Apple-oriented magazines plan to carry free data strips. Bantamweight PC

There's a new portable computer available from Toshiba, which joins the ranks of suppliers trying to find the right formula for a successful power-on-the-road lap-top.

Toshiba's entry, the \$2000 T1100, is an IBM-compatible unit that uses the MS-DOS operating system and packs 512kb of random access memory as standard equipment. Also included is a 720,000-byte 3½-in. microfloppy disk drive that will let you store the equivalent of 400 double-spaced pages of text. The unit's built-in, rechargeable NiCad battery will operate for eight hours.

One bugaboo of some lap-tops that aspire to PC punch is bulk. Toshiba's unit weighs 9 pounds—as much as 6 pounds less than some competitors in the battery-driven field. The unit measures 1 foot square by 2½ in. high.

Toshiba touts extra crispness for the computer's 25-line by 80-character liquid-crystal display (LCD). It's adjustable to reduce glare, at any convenient angle within 90°. Recognizing that even the best current LCD is a compromise, the company stresses that the T1100 includes RGB and composite video ports. These let you connect the T1100 to a full-size color display for extended in-office or at-home work sessions. To facilitate using a regular CRT, the por-



Toshiba's 9-pound IBM-compatible lap-top packs 512K-RAM and 31/2-in. disk drive.

table's LCD screen folds back flat. Display resolution is 640 by 200 pixels for graphics or text.

Also included as standard equipment are interfaces for a parallel printer and a second floppy-disk drive. For optional external drives, Toshiba offers either a battery-operated 720KB 3½-in. microfloppy unit (for maximum portability), or a 360KB 5¼-in. minifloppy unit. The latter lets you use IBM PC programs and transfer data to the portable's built-in 3½-in. format.

Toshiba also has an optional PC Floppy Link that lets the T1100 connect directly with the floppy drive in an IBM PC or IBM-compatible.

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At last! A wood filler for the big jobs.

Now there's a wood filler that can rescue damaged and even rotted wood—High Performance Wood Filler by Minwax.

It won't shrink, crack, or fall out. It hardens in only 15 minutes and can be sanded, planed, drilled, carved, painted, or stained in less than half an hour. And it's weather, water, and rot resistant.

It repairs almost anything made of wood, indoors or out. From windowsills and decks to woodwork and furniture... it's the wood filler for the big jobs. Look for it at your favorite store. For more information, send in the coupon.

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Electronics



BY STEPHEN A. BOOTH

Long-distance calling



wer run out of change midway through a conversation on a public telephone? Imagine how frustrated you'd become if the battery ran down on a transportable cellular phone that costs three grand plus monthly fees.

Until recently, the auxiliary power pack for most transportables gave you less than half an hour of talk-time or four hours of standby juice. Though it let you use the phone away from your car, it added about 5 pounds of weight.

Now, talk's becoming lighter, if not cheaper. Mitsubishi's Mesa 55 Diamondtel can be had with a power-pack that gives you an hour of talk-time and eight hours of standby power. This option adds 7 pounds and \$400 to the basic 4-pound, \$2200 Mesa 55. For big talkers, Mitsubishi also offers a 2-hour/20-hour battery that weighs 11 pounds and brings the price of the Mesa 55 to \$2900.

Besides Mitsubishi, NEC

America is extending on-thego gab for its T-7000 series of transportable cellular telephones. The company's new powerpack weighs the same 4½ pounds as its predecessor, but doubles talk-time to 45 minutes and standby time to eight hours. Thus equipped, a T-7000 phone lists for \$2995.

For both the Mitsubishi and NEC powerpacks, talk-time is rated at the full 3 watts of transmitting power. This means talk-time could be longer. One beauty of cellular telephone technology is that the local operating system regulates the wattage

tem regulates the wattage music teachers.

Electronic keyboards from Texas Instruments teach kids music.

your phone puts out, according to your distance from the nearest cell antenna. When shopping for a transportable phone, be sure to ask whether talk-time is rated at full power, or less.

Who said talk is cheap?

So long as we're on the subject of wireless telephones, I'd like to share my experience with the Airfone. In case you haven't heard, that's a new radiotelephone service in experimental use on American Airlines and some other carriers. Slide your credit card in the machine, remove the handset from the bulkhead and start dialing from your seat—it's that simple. When I called New York recently from

37,000 feet above the Great Plains, my voice came through loud and clear. Reception aboard the plane was noisy but discernable enough. The cost? Nearly \$9 for a 4-min-

ute conversation. 'Nuff sed.
Meanwhile, Japan's Ministry of Posts and Telecommunications is employing voice recognition and synthesis to develop a phone system that will translate Japanese into English. It's expected to take 15 years and cost half a billion bucks.



Infrared sensors in Cue-Tel faucet turn water on and off.

Let your fingers do the washing

We're usually quite thorough, but we let this one slip through our hands in the March issue's story about infrared remotes (*Let Your Fingers Do The Walking*, on page 109).

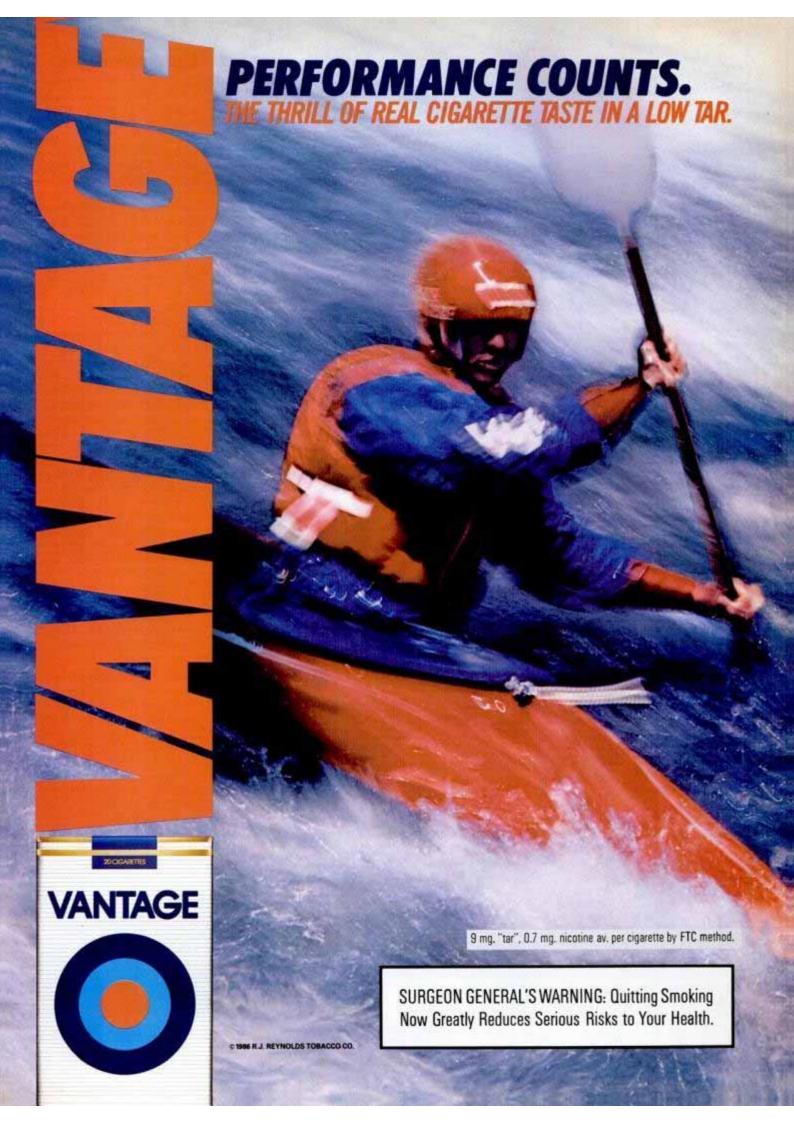
Now, infrared technology's being used to keep bathroom spigots clean. The Cue-Tel Automatic Faucet (\$300) turns the water off and on as your hands approach or withdraw from the infrared sensors in its base. According to Columbia Electronic Research Group, the manufacturer, the Cue-Tel's made from chromed solid brass. No word on whether you use a washer or photodiode to plug leaks.

Hello, Mr. Chips

Remember Mr. Chips, the fictional teacher of English boarding-school fame? Now Texas Instruments has put the microprocessor chip at the service of youth in two keyboard products that were designed with the help of music teachers.

Little Maestro (\$40) can help kids 3 to 6 years old develop an ear for pitch by guiding them through a series of games. Besides this, it offers 10 permanently programmed songs and produces eight sound effects. Young Mozarts can even record the tunes they compose on Little Maestro's scale.

More sophisticated is TI's Speak & Music (\$55). It also teaches music through games, but uses a humansounding voice to coach 7- to 11-year-olds through its 20-note keyboard. The synthesizer plays 12 permanently programmed tunes. Like Little Maestro, it offers sound effects and has the ability to record. It also changes tempos.

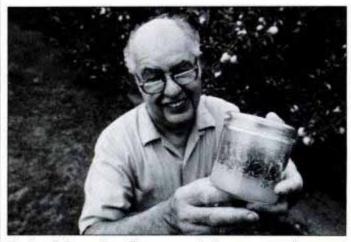


Science



BY DENNIS ESKOW

Miracle crop yields bounty



Single cells in one jar will soon grow to become an apple grove.

It's happening in Beltsville, Maryland, where federal Agriculture Department researchers are growing apple trees from single cells. The new technique, called tissue culture, is an offshoot of genetic engineering. In a jar containing gelatin, mineral salts, sugar, vitamins and growth hormones, scientists place tiny shoots of genetically selected plants. The first jar of plant tissue was started five years ago. From that single jar, the scientists grew a grove that this year produced 125 pounds of fruit.

Cards and letters

I wish I had enough space to share all the comments from readers supporting my application to be the first journalist in space.

William Morgan of Florida
City, Florida, offers his
backing with a wish that I
"come back okay." Psychology
Prof. Albert M. Crall of
Frostburg State College in
Maryland says POPULAR
MECHANICS' reporting is
"timely, concise, to the point
and well-informed."

Joe Pavlovich of Agawam, Massachusetts, notes that "in spite of the tragedy of the Space Shuttle explosion, the space program must continue." Obviously NASA agrees. I just received a postcard stating that the selection process for the journalist in space has resumed following a brief delay.

L.J. Sutch of Brantford, Ontario, is "excited to see POPULAR MECHANICS taking an active approach." So are we.

J. Brand of Oxnard, California, wanted to know if only one journalist will be picked. NASA will choose 40 for flight training. But only one journalist will take the trip.

More trees grow

Advances in genetic engineering may bring the revival of the elm. Dutch elm disease has all but wiped out the tree in many parts of the country. But the Elm Research Institute has developed a reliable fungicide to prevent the disease. It received federal approval in 1975, but only in the past two years has it come into wide use. Data on 8000 test trees over the last nine years have shown a 98-percent reduction in the disease.

In 1983, the Elm Research Institute announced an even bigger breakthrough-the creation of a disease-resistant elm, called Ulmus americana libertas. American Liberty Elm. On July 4, as the nation observes the rededication of the Statue of Liberty, the Boy Scouts of America will be launching a Johnny Elmseed program to plant the new genetically engineered elm across America.

The elm can grow as tall as 100 ft. and provides excellent shade and lumber. But once Dutch elm disease gets into a population, thousands of trees can be wiped out in one season. For more information, write to the Elm Research Institute, Harrisville, NH 03450.

Lake turns killer

On Aug. 15, 1984, two Italian tourists vacationing near a lake in Cameroon, Africa, reported feeling a very slight, very brief earthquake. The next day, a group of Europeans traveling by Lake Monoun stopped to talk to a man sitting on a motorcycle. According to an account in Science News, the cyclist turned out to be dead. Before noon that day, 37 people were found lying dead near the lake.

A medical examiner concluded that all the victims had been asphyxiated and had experienced seizures.

Investigators arriving at the scene saw the last vestiges of a cloud that was breaking up near the lake. The lake's color had changed to a reddish brown, indicating that something might have stirred up to the surface from its bottom.

Subsequent investigations ruled out any human involvement in the discoloration of the lake. Instead, they tentatively concluded that bicarbonate deposits that settled into the lake over centuries were released into the air by a sudden stirring of the otherwise placid body of water. Researchers are going back this summer for a deeper probe.

Tiny eye tool

Jean Marie Parel and his associates at the University of Miami School of Medicine are refining a new tool for eye surgery. The Vitreous Infusion Suction Cutter

(Visc) is a tiny lighted probe, equipped with electric blades and a suction tip. It can

be used to cut into the eyeball and remove growths that cause blindness. The basic suction device is already in the hands of most ophthalmologists, but Parel's refinements are adding power to the cutting blades. Parel and his colleagues declined to patent the device when they made the prototype in 1970. As a result, 13 companies are making the basic model. But high-power version won't be on the market until next year.

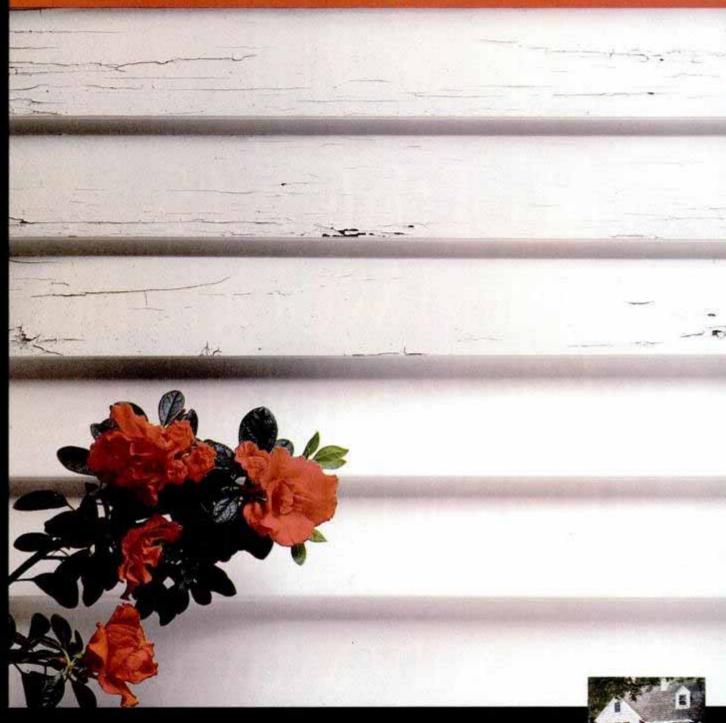
The Visc is a tiny cutting instrument used by eye surgeons to remove growths from the eyeball.



Half of this ad is painted wood and half is Restoration Vinyl Siding.

The only way to tell the difference...

...is to wait five years.



Introducing Restoration Vinyl Siding from Wolverine.



As seen on "This Old House." Our apologies to Mother Nature, but, as you can see, our new Restoration solid vinyl siding not only looks like real wood, it's actually better. It lasts longer. It never needs painting. And it costs substantially less.

Restoration solid vinyl siding comes in seven beautiful colors. The color is actually part of the vinyl, so Restoration will never peel or blister. Never. That's one of the reasons we guarantee





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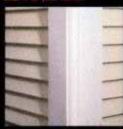
The siding is just one member of the Restoration Collection, a family of solid vinyl accessories designed to accent and beautify your home.

For more information on the entire Restoration Collection, call Wolverine Technologies at 1-800-356-8722 (in Michigan, call 313-386-0800) for a free color brochure.

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RESTORATION COLLECTION

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But low price isn't the only thing these 8- and 11-hp riders have going for them. They also have a new 30-inch high-performance mower deck for a clean, even cut and superior bagging results. And a full-length steel frame for added durability. for added durability.

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For the name of your nearest dealer, or a free folder on the John Deere Riding Mower line, call 800-447-9126 toll free (800-322-6796 in Illinois) or write John Deere, Dept. 59, Moline, IL 61265.



Nothing Runs Like a Deere

TECHNOLOGY UPDATE 5/86

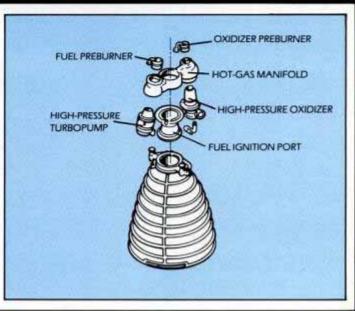


Shuttle's new engines

Throughout the investigations into this year's deadly Space Shuttle explosion, attention has been on the booster engines. Meanwhile, NASA is moving ahead with long-standing plans to replace the main engines. A series of onground tests completed last year has led to the redesign of several main engine components.

NASA is in the midst of deciding how to build its next Shuttle, and it is likely to include the new engines designed by Aerojet. Improvements include new preburners, oxidizers, gas manifolds, turbopumps and fuel ignition ports, where the most volatile reactions take place. The redesign will extend main Shuttle engine life by about 20 percent. But more important, it's expected to reduce the number of places where things can go wrong during launch. Spinoffs may be a larger, more powerful engine.

Editor: Dennis Eskow Contributors: John Domberg, Jack Hammond, Steve Eskow, Irena Scott, Steve Parker, Mort Schultz, Richard Schvaeder



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TECHNOLOGY

UPDATE 5/86

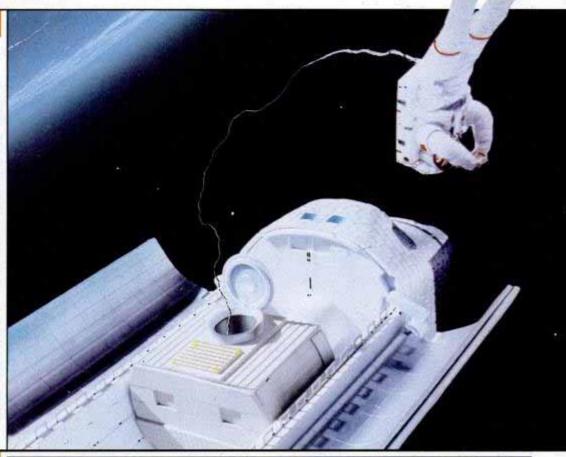
SPACE

Space expands

A private aerospace company has entered into an agreement with NASA to build a module that would double the habitable space on the Shuttle. Spacehao's "shuttle mid-deck extension" could be ready by the end of 1987.

"We expect to have it available for three flights a year by 1990," says Spacehab engineering director Thomas C. Taylor. He noted that the current Space Shuttle configuration allows for a maximum crew of 12.

The Spacehab would fit into the rear quarter of the cargo bay right behind the Shuttle cabin. Astronauts could get in through an airlock and exit Spacehab through an overhead hatch. The European Space Agency has already indicated that it will use Spacehab.



ELECTRONICS

Looking up

Phased-array radar works somewhat like a machine gun, sending out bursts of waves in different directions to give it a wider field of view. Stick it on an aircraft and you have instant AWACS and more.

The Air Force and Army are working on a joint project to develop a Joint Surveillance Target Attack Radar System (JSTARS). A remodeled 707 jet carrying phased-array radar in its underbelly or nose (or both), would work with AWACS and ground-based radar to help attack jets pick up targets.

The AWACS would watch for enemy aircraft and missiles, while the JSTARS would round up data from several radar sources and add in its own spotting of slow-moving or stationary targets. JSTARS will be part of the American defense program by 1988.

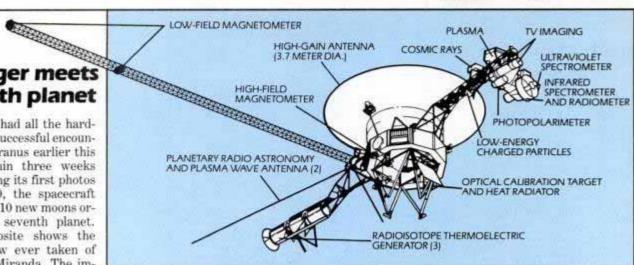




Voyager meets seventh planet

Voyager 2 had all the hardware for a successful encounter with Uranus earlier this year. Within three weeks from sending its first photos on Dec. 30, the spacecraft discovered 10 new moons orbiting the seventh planet. The composite shows the closest view ever taken of the moon Miranda. The image suggests the possibility that Miranda once had water flowing on its surface. And the closeup of Ariel shows ridges suggesting periodic lunar quakes.

Voyager carries a full range of optical and radio sensors and transmitters that will be used in the early 1990s to bring us the first closeups of Neptune.

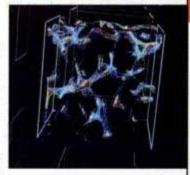






Inner space

What does the inside of a water molecule look like? The image at the right, generated by a Cray supercomputer, is the first attempt to reconstruct such a molecule based on all the data available. Ohio State University researchers are planning a supercomputing national center for molecular and other research in the 1990s. The



National Science Foundation is funding the program.

HOUSING

Foam homes

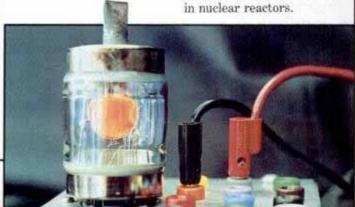
ARCO Building Products Co. has become the first major manufacturer to get into the growing foam home industry.

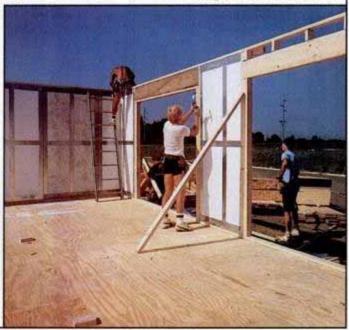
ARCO now makes polystyrene structural panels called Wallframe, The material is stiffened with strips of 22-gauge galvanized steel. Wallframe allows builders to do away with wall-sheathing, in-wall insulation and other products. In addition, the new Wallframe meets with most building codes, according to the manufacturer.

Future shock

The glowing object below is a vacuum tube. Los Alamos National Laboratory is reviving the old technology.

The new vacuum tube contains thousands of electrical devices on computer chips. The vacuum and the hard structure of the tube protects the microcircuits from intense heat so it can be used





TECHNOLOGY UPDATE 5/86

AVIATION

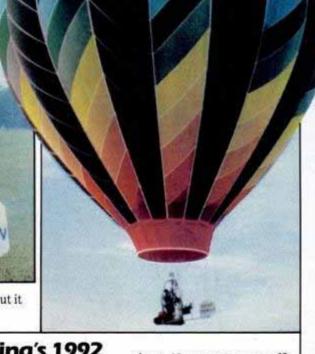
Is it the Wright stuff?

The Wright brothers put an engine on a glider and revolutionized heavier-than-air flight. Igor Bensen may have done something similar with the balloon.

The Bensen Gyrostat is a ruddered balloon with a 64-hp engine mounted on it. Combine the balloon's lift and bouyancy with the engine's power and the rudder's direction and you have a whole new class of flying machine. Cruising at about 6 mph, the Bensen Gyrostat



certainly won't replace the helicopter. But it may develop into a new sport.





Boeing's 1992 airliner taxis

Boeing is taxiing into position for the next decade's commercial airline competition with what the company calls the 1992 airliner. In the design phase, the twin-engine plane is expected to use a new type of engine called UBE, or extreme bypass engine. These engines are about 40 percent more efficient than the best jet powerhouses of today. The 150-seat jet will use advanced materials that will allow ultralong wings without adding weight. The slightly swept wings would provide greater lift and extra stability than current models. It also will have grooved surfaces along its fuselage to improve aerodynamics.

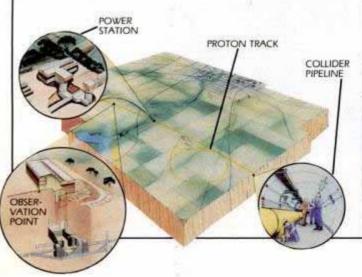
ENGINEERING

America on Collider course

Federally funded plans have been announced to build the world's largest scientific instrument in America. The Superconducting Super Collider will include a 60-mile circular track along which proton beams can be fired in nuclear acceleration experiments. The rig will have its own power supply and supercomputer observation points. A site has not been chosen, but Ohio State University leads the field.

Any port

Tanker ports are located far from oil rigs at sea. But now the port can come right up alongside any rig. ITM Flexiport, borrowing from naval technology, has designed a modular docking port. For ports that are too shallow to accommodate supertankers, a Flexiport can be built out from a dock or the shore to a point that is deep enough for off-loading the ship. Flexiport is seeing use this summer along the English North Sea coast.





PM



MARINE

Foiled in Germany

Airfoil technology has gained popularity in the military and in Scandinavian countries where you need a vehicle that can move swiftly over sea and land. But the airfoils currently in operation are on a small scale compared to those being created by two West German inventors, Gunther Jorg and Hanno Fischer have each built prototypes in competition for a West German government contract. The ultimate prize is the building of a 400passenger craft with a 1000mile range that can travel at speeds over 120 mph. A Jorg prototype is shown in the inset photo above. West Germany is expected to have in operation the world's largest airfoil by 1990.



New Army truck

Both the Army and Marines have begun replacing their 6x6 truck fleets with new 8x8s from Oshkosh. The Marine version, dubbed dragon wagon, can be lifted by helicopter. The Army's "straight eight" is not helicopter ready, however the truck is lower-priced and easier to maintain.



MILITARY

Brazil's tank

Brazil has cut itself loose from one old tie with Washington with the introduction of its Main Battle Tank. The Brazilian Osorio is a 40-ton tank designed to work with a range of guns. With the Osorio, the U.S. now has a competitor in the Third World. The Osorio, by the way, can carry Soviet-made cannons and rocket-launching devices.

Tight shot

The Army's Aberdeen Proving Ground is testing an artillery projectile made of lightweight but very hard metal. It reportedly packs a small nuclear charge for launch be-

yond the range of the nuclear blast. That could make localized nuclear combat more possible.



Old House Restoration

BY BOB VILA

Making a house a home

After years of working in all phases of the homebuilding industry, I've learned one great and simple truth—there is no such thing as a perfect house.

The house may be too small, or too large. Or the rooms were designed for the wrong purpose. Or you need another bathroom, or no longer get much use out of the family room after the kids go off to college. Or the house is so old that it's costly to heat, and perhaps even dangerous to inhabit.

So what produces the perfect house—the house you would have designed and built for yourself the first time around? The answer is a process defined as renovation, remodeling or improvement.

Is it difficult? No. Anyone can do it, and thousands do. And if you are a regular reader of this magazine, you probably have a talent and an appetite for getting things done. So you're already halfway there.

Is it expensive? It can be, but with the right advice, some self-discipline and a lot of common sense, you can do the job under almost any budget. And it could be the only way you'll ever own that dream house.

As a POPULAR MECHAN-ICS columnist, I'll be devoting future articles to the spe-

Contributing Editor Bob Vila is host of public television's "This Old House," funded by Owens-Corning Fiberglas. cifics of home improvement: adding rooms, changing layouts, installing windows, dealing with moisture problems and even home security. But in this maiden voyage, I want to begin by outlining the most important considerations you should keep in mind—whether you plan to improve the home you have, or buy another and renovate it. First, the three basic rules:

1. Think it through. Always go slowly at the start. Before you make any big decisions or commitments, think through what you are doing, and why. Make this

an iron-clad rule whether the house you plan to work on is your current home, or one you intend to buy.

Before undertaking serious renovation, get accustomed to the place. Plug yourself into its patterns and flow. Understand how—and why—it was originally designed to function. Decide whether that plan works for you, or if it won't, what will.

This will require some creative thought. Stand quietly in each room. Try to envision how your belongings will fit in, how the room will be used, how it will improve, or impede, the flow of family traffic, how well it integrates with the rest of the house.

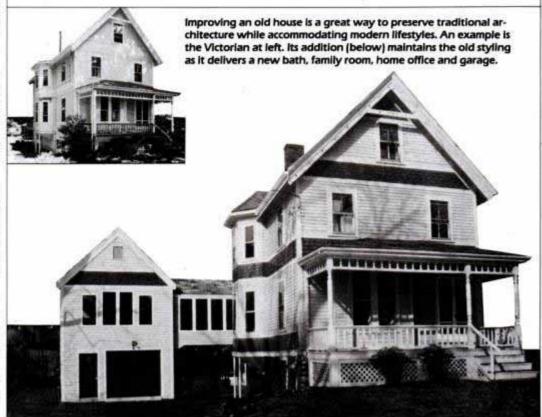
2. Get help. You can't do major projects alone. Even trying will put a severe strain on your sanity and your pocketbook. You need an architect to direct the enterprise and supervise the specialized contractors who will be needed. This sets up your first crucial decision: finding the right architect. The real-estate lending officer at your bank can probably recommend one who is reliable and has given good service to others. Local chambers of commerce and Better Business Bureaus can also help. Before making a choice, get to know the architect personally. Meet with him or her and talk over your plans. Inspect work he or she has done and talk to clients about their experiences and the extent to which their expectations were met. Look for weak as well as strong points. Compatibility is important here.

The architect is the instrument by which your visions and dreams will—or will not—be translated into reality. Both of you have to be on the same wavelength.

3. Don't overdo it. In other words, don't bite off more than you can chew, emotionally or financially. Renovation ceases being fun when the job begins to eat your lunch. Keep in mind that many projects may greatly exceed their original budget. So take a piecemeal approach. Get the basic job done first.

If you are already living in the house under renovation, set up a family center free of noise, dirt and stacks of construction materials. At the end of a long day, you'll need a refuge.

If you are planning to buy (Please turn to page 78)



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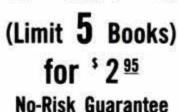


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OLD HOUSE RESTORATION

(Continued from page 76)

a house for future renovation, there are several additional factors to consider. These are:

Location-When it comes to houses. the importance of location can't be overemphasized. Even the most magnificently renovated house can't overcome a lousy location. So when you've identified the neighborhood you like, learn it thoroughly: zoning regulations, tax base, incentives for or restrictions on restorations, quality of the school system and public transportation.

Ambiance-Get to know your prospective neighbors. Better yet, watch them in action, particularly on a typical Saturday morning. If they are outdoors with paint, hammer and nails, it's a good sign the neighborhood is on the way up and that you'll fit right in.

Structural soundness-Look for a home that's structurally sound. You want to renovate a house, not re-invent the wheel. The job can be challenging enough without attempting the impossible. If the house has sagging or rotting floors, large cracks or water stains on walls and ceilings, crumbling cornices, a sagging roof and extensive exterior decay, keep looking.

If you're not experienced in these inspections, hire architects, engineers or home inspectors to check out the house basic systems. They'll soon determine whether there are more problems than meet the eye.

Budget-Select a home that can be restored without crippling you financially. Remember that if the basic design and layout cannot be preserved, you are looking at major work, and major costs. The better choice would be to pass by such a house and find another better suited to meet your needs.

It's often a good idea to consider buying a smaller and less expensive house than you had planned; you can always add a wing to the house later on. But if your heart is set on a large old house, consider putting in a rental unit to offset costs with income. However, be realistic about what it means to be a landlord, and always check zoning ordinances.

In any case, before deciding to buy, draw up your own renovation plan. Room by room, system by system, assess what has to be done to get things the way you want them. Determine what you can do yourself, and what will require a contractor. Estimate the cost of each step, and by all means, add a cushion for overspending and inflation. This process will help you to understand the expenses which are actually involved, and to decide whether you want to make the necessary invest-

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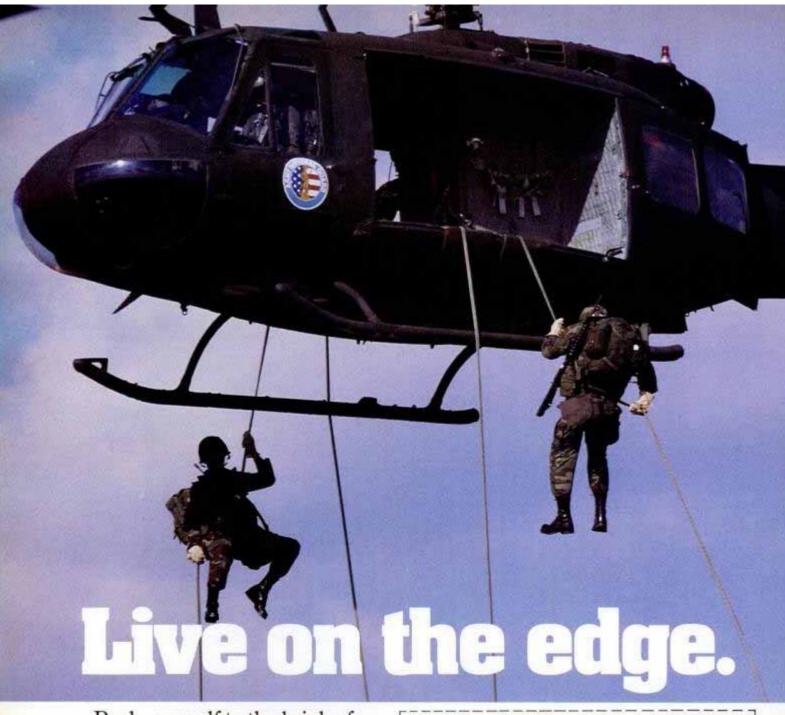
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Home Video



BY JAMES B. MEIGS

Breakthrough in flat-screen TV



For 40 years experts have been predicting we'll have a flat TV screen thin enough to hang on the wall "within 10 years." Well, we're finally getting close. Progress in LCD (liquid-crystal display) technology has finally made small size, flat-screen sets more than an expensive novelty. Larger sets using the same technology already exist in prototype form.

The progress has come in two areas: performance and price. The drop in prices can be seen in Citizen's \$100 Model 06TA with 2½-inch black and white screen. The picture isn't going to win any Emmy awards, but for a TV that literally fits in your shirt pocket, it's more than adequate. The company pre-

dicts prices for the cheapest models will drop below \$50 within five years.

Improvements in performance are visible in the new crop of color LCD models, such as Panasonic's \$300 Pocket Watch. The combination of price and performance gains means LCD might replace CRTs (cathode-ray tubes) in smaller screen sizes over the next few years. Even Sony,

which champions the unique flattened CRT used in its Watchman portable sets, says it will bring out an LCD model soon.

Further price and performance gains will be necessary before larger LCD sets become practical, but the goal is in sight. Several companies have demonstrated reasonably good 12-inch LCD screens. Citizen executives believe 12-inch models could be available within two years. Hang-on-the-wall LCD screens 25 inches or larger might become a reality within five years.

In the meantime, LCD could well take over other functions performed by CRTs today. LCD panels already are popular for computer displays, and they might soon replace CRT displays in medical equipment and airplane cockpits.

NASA engineers recently unveiled an intriguing use of LCD screens in a 3-D helmet display they call VIVED (Virtual Visual Environment Display). The display system uses two LCD screens and wide-angle optics to create a stereoscopic simulation of a scene.

The helmet is wired to a position sensor that monitors its movements: Whenever the wearer moves his head, the scene moves as

well, realistically mimicking what the wearer would see if he were actually in the environment depicted.

Ultimately, NASA hopes to develop a VIVED system that includes sensors for arm and hand motion. This would allow a human operator to vicariously inhabit a robot performing tasks in hostile

environments such as outer space or underwater. It could also make a great videogame.

Look, Mom, one hand!

Until now, anyone who wanted a tiny 1-hand camcorder had only one choice: Sony's 8-mm Handycam. But now JVC has launched a counterattack with a new VideoMovie camcorder. At 3½ pounds with battery, the model GR-C7 is lighter than Handycam, and can do far more. Moreover, it's compatible with any VHS VCR.

Like the previous Video-Movie camcorders (available from JVC and Zenith), the new model uses the tiny VHS-C cassette. A bit smaller than a pack of unfiltered cigarets, the VHS-C cassette holds only enough tape to record 20 minutes in the standard play (SP) VHS speed. To play back in a home VHS VCR, you place the VHS-C tape in an adapter the size and shape of a conventional VHS cassette. Inserted in a VHS VCR, the combination will play back normally.

In the past, many buyers resisted the VideoMovie because they felt (wrongly, I think) that 20 minutes wasn't enough recording time on one cassette.

JVC wants to change all that. The new VideoMovie (Please turn to page 84)



HOME VIDEO

(Continued from page 83)



Controls for VideoMovie's many features are logically placed for operation with left hand.

lets you record for one hour on one VHS-C cassette. JVC managed to boost the recording time by incorporating the company's latest brainchild: the HQ (high-quality) picture boosting circuitry included in many VHS VCRs.

By including HQ, JVC found the camcorder could record at the slowest VHS speed and still get acceptable picture quality. I recently had a chance to put the new VideoMovie through its paces. I was skeptical that any camcorder could get decent results recording in the slow, extended-play mode. After all, using EP with most tabletop VCRs means putting up with pretty mediocre pictures.

But JVC's claims are true: The new VideoMovie's pictures at EP are more than adequate. In fact, they look as good as the best 8-mm pictures. At its standard play speed, VideoMovie's pictures with HQ are remarkable.

Good picture quality is only part of the story. Unlike Sony's tiny 8-mm Handycam, VideoMovie is a full-feature camcorder. It can play back directly through its own electronic viewfinder or on any TV set. To do this with Handycam, you need a separate playback deck. Whereas Handycam uses fixed-zone focusing, VideoMovie employs a 6:1 power zoom with autofocus.

This lens and autofocus system are noteworthy in themselves. The image-sensing autofocus system has its own pickup, independent of the f/1.6 lens. This means no incoming light is siphoned off the lens, enabling it to focus more brightness on the VideoMovie's CCD (charge-coupled device, used instead of a tube). The net result is that VideoMovie's able to grab images in

low light—down to 15 lux. That's a bit more than Handycam's 25-lux rating.

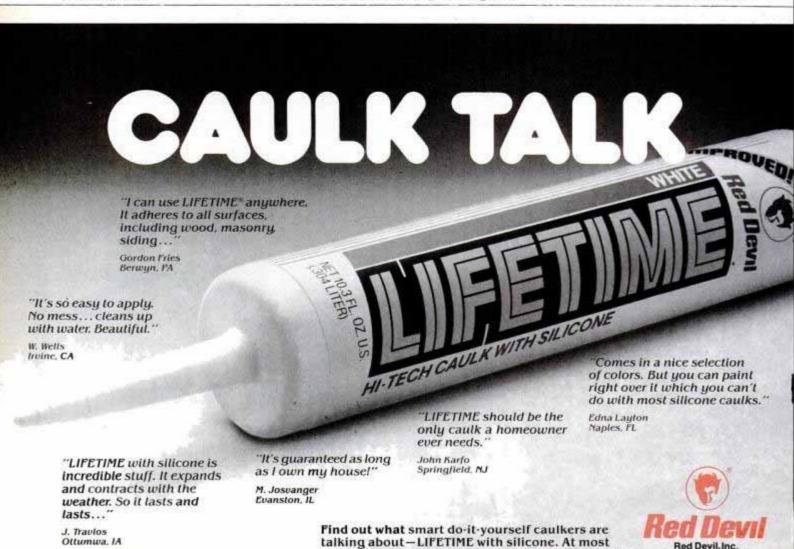
Another worthwhile feature is VideoMovie's fully automatic white balance. This means the camcorder continually adjusts itself to changes in lighting, as when as you go from bright to shaded areas. There's also a switch you can set manually for indoor or outdoor lighting.

During my workout with the system, I found all the functions worked impeccably and, while VideoMovie isn't as simple to operate as the idiot-proof Handycam, it is virtually self-explanatory. The new VideoMovie makes its debut this month, at \$1500 (the Handycam system lists for \$1800). If you are in the market for a small camcorder, you owe it to yourself to look at this new kid on the block.



Choice of VideoMovie accessories includes batteries, rechargers, cables, carrying cases.

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The subconscious or "inner mind" is a mysterious thing. Scientists are finding out more about it every year. It's not like your conscious mind. Instead it soaks up impressions. You'll be amazed how fast the "successmechanism" already within you will put you ahead of the game in life.

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Until recently, scientists were stopped dead in their tracks in figuring out how to harness the powers of the inner mind. For years we've known it could be tapped. But the big question was: "How can the average man put its huge power to work?"

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Be a part of the cutting edge of today's world of science.

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Minicourse



BY ROSARIO CAPOTOSTO

Most masonry anchors require a prebored hole. You can bore these holes with a carbide-tipped bit in an electric drill or manually with a star drill and hammer. Wear goggles for both.

Anchoring to masonry: 1

ritems to masonry is easier than many people think. There are a host of devices made for the job and most fall into four basic types: screw anchors, bolt anchors, anchor/fastener combinations and wedge-type fasteners. The first three grip when the device expands in a prebored hole. The last grips by friction; some require holes, most don't.

Screw anchors are designed for wood, sheetmetal or lagscrews. Bolt anchors look similar, but they have internal threads, like a nut, to receive the bolt threads.

Anchor/fastener combinations are 1-part devices that permit installation in a single operation. Toggle bolts are the most common example. The wedge-type fasteners include drive pins, cut nails and self-tapping screws.

You can bore the required holes in block, brick, concrete and mortar with a carbide-tipped drill bit and a variable-speed drill. The drill should be operated between 300 and 750 rpm with the larger diameter bits needing the slower speed. Back out the drill occasionally to cool the bit and clear the cuttings.

Holes can also be bored using a star drill and hammer. This chisel-like tool has a cutting end in the shape of a star. Hold the drill against the surface and strike the back end repeatedly with the hammer, rotating the bit 15° after each blow. More on wedge fasteners and toggle bolts next month.



Operate masonry bits at low rpm, about 300 rpm for the ½-in.-dia. bit shown. Apply steady pressure and back out occasionally to clear hole.



Star drills come in sizes up to 1 in. dia. Strike drill repeatedly with heavy hammer (2- or 2½-pound). Rotate bit 15° after each blow.



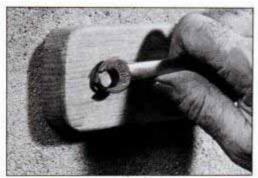
Screw-anchor types, from top: lead anchor with lagscrew, lead with wood screw, lead-lined jute with wood screw, plastic with sheetmetal screw.



Anchor/fastener combinations and bolt anchors, from top: nylon and nall pin, zinc and nall pin, threaded lead with bolt, lead cone with bolt.



Most anchors have ribs or fins on outside to prevent turning in hole. Light hammer taps are required to bring anchor flush to surface.



Once anchor is installed, bore clearance hole through wood and insert fastener. As screw or bolt is tightened, anchor expands against hole.

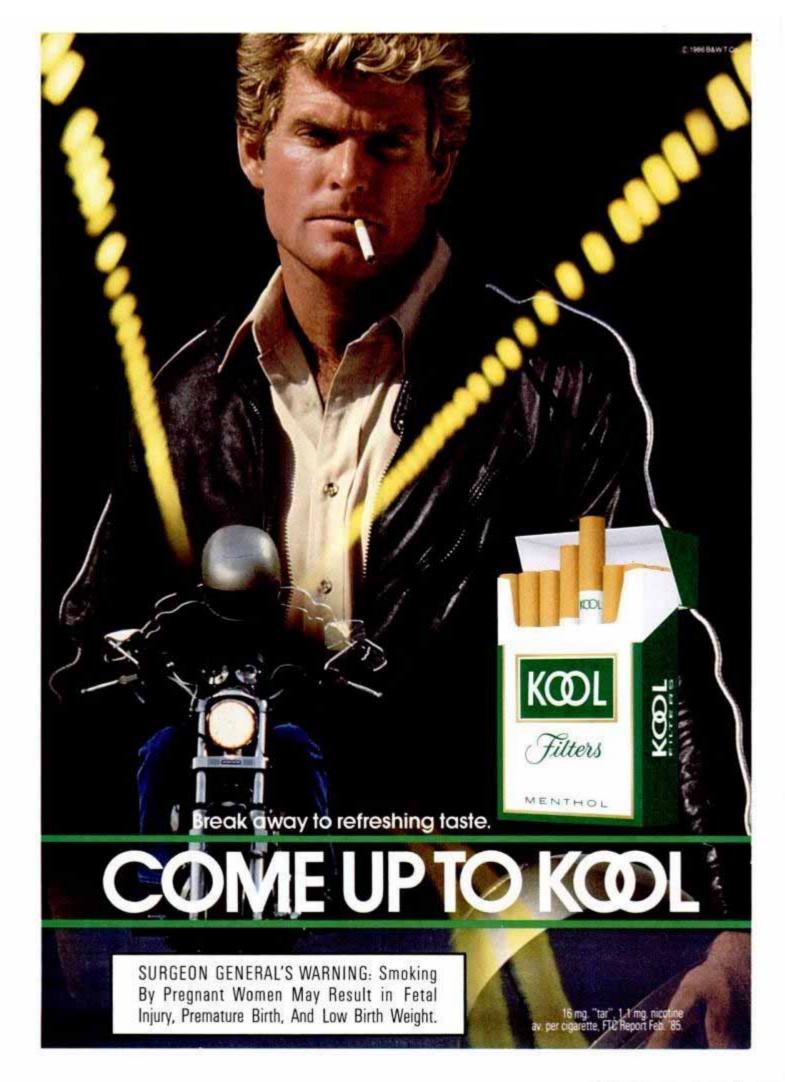


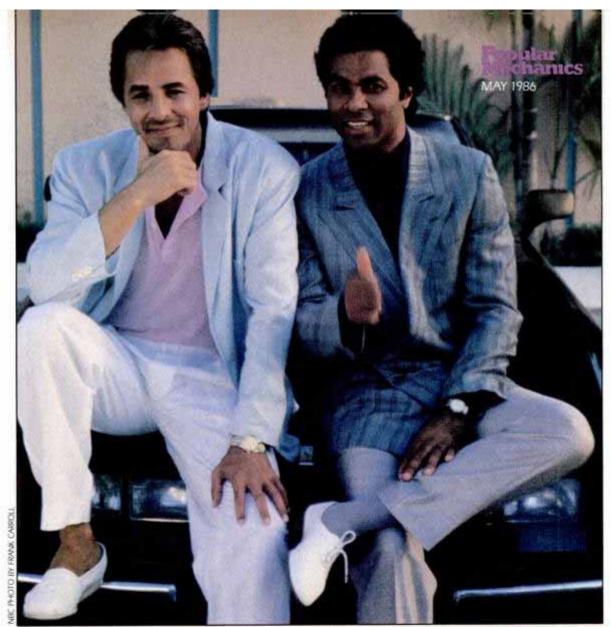
Few cars today can offer you the size, the luxury and the confidence of Parisienne.

The Pontiac Parisienne is expressly for those who prefer a full-sized formal sedan. It's luxury the way Pontiac defines it—distinctively styled, richly detailed and gracefully confident on the open road.

PONTIAC PARISIENNE WE BUILD EXCITEMENT







THE MACHINES OF MIAMINES OF

The car, the boats, the guns that make it TV's hottest show.

achines—particularly large, fast, expensive ones that make a lot of noise—have always shared top billing with Hollywood's brightest stars. Choppers. Planes. Bikes. Yachts. And always cars. They become a show's stylistic standard, often shaping the characters' personalities with greater effectiveness than the director or the scriptwriters.

So forget the fact that "Miami Vice's"



BY TIM COLE Boating/Outdoors Editor

Sonny Crockett could never afford on a cop's salary the automobile, the boats, even the assault weapons, he's seen playing with each week. This is Hollywood, baby, and these are the gadgets that give "Miami Vice" that oh-so-right

THE PLAYERS

Sonny Crockett and Tubbs (a.k.a. Don Johnson and Philip Michael Thomas) lounge against another star of Miami Vice—Tom McBurnie's California Daytona Spyder, also shown below left. Right, their Wellcraft Scarab '38 KV.



fantasy touch. These machines—like the linen duds, the hard rock music and the hot-pink imagery—are the quintessence of cool at the very core of "Miami Vice's" blockbuster success.

Start with the car. We can't have





CALIFORNIA DAYTONA SPYDER This Ferrari Daytona Spyder look-alike uses any '69 to '82 'Vette frame and engine, with some original Ferrari gear.

equipment as the front park light lenses, taillights, rear side marker lights, door handles and license plate lights. The bumpers are described as Ferrari duplicates and grillework is the same basic design, but slightly wider.

"The overall appearance of the car is a Daytona, McBurnie says, "although it's not an exact replica because the Corvette's dimensions differ in the windshield, wheelbase and track.

You see the marine equivalent of the California Daytona Spyder in the Well-craft 38 Scarab KV that Sonny and Tubbs pilot on Miami's waterways. Twin 440s turning specially cupped and balanced stainless-steel props will launch this boat on a 60-plus sleigh ride. The long snout, flush deck, venturi windshield and radar arch are all typical sport-boat characteristics. But this

screamer, base price \$105,000, also comes with a special \$3500 "Miami Vice" paint option—"variations on the turquoise, aqua and orchid families," according to Wellcraft.

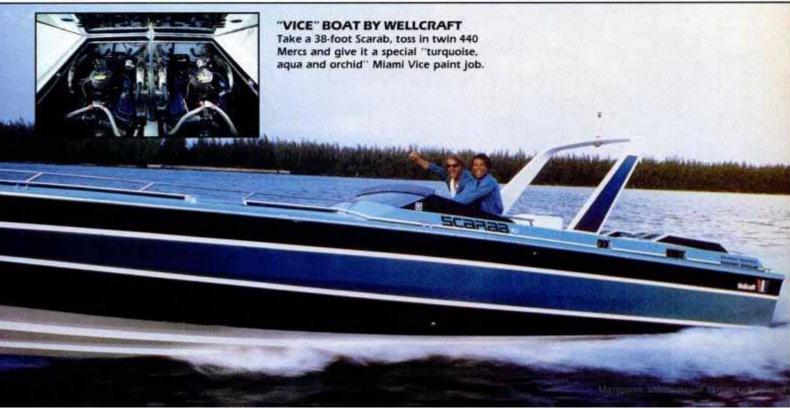
The nautical connection is a strong one on "Vice," extending to Sonny Crockett's principal living quarters aboard an Endeavour 42 sailboat, which he shares with his pet alligator. The center-cockpit sloop—base price, \$134,950—features a spacious aft sleeping cabin and vee-berth forward, with galley and living space in the area of maximum beam. There are two private heads aboard the 42, each with separate

shower stalls, stainless-steel sinks and vanities. Auxiliary power comes from a 62-hp Perkins diesel engine.

So what about firepower?
Crockett's handgun of choice is a \$600 Bren Ten made by Dornaus & Dickson Enterprises Inc. The 10-mm automatic has an 11-shot capacity and weighs 39 ounces. It features textured black nylon grips and a hard-chrome slide on a stainless-steel frame. Crockett's full-size version of the Bren Ten comes in selective double or single action and has a reversible thumb-action safety and firing-pin block.

You'll also see Sonny and Tubbs relying on a Steyr AUG-SA for heavy-duty work from time to time. This futuristic semi- or fully-automatic weapon-base price \$889—is made of high-impact Zytel synthetic. It accepts NATO 5.56mm ammunition in an optional 42-round magazine, which fits into the AUG's stock. The pistol grip, trigger and vertical fore-end grip are all forward of the shell ejector aperture, which can be converted for left-hand use. The AUG-SA is also offered with four interchangeable barrels, one attached to a nonremovable bipod. An optical sight is built into the handle.

So what does it take for a guy to be cool these days? Obviously, it takes a bit more than sockless European loafers, baggy linen pants, tight T-shirts and mirror shades. To be really cool, you have to have the right stuff.





Travel on land and sea with PM's you-build-it air machine.

rab the fully articulated, aircraft-style joystick, twist the throttle grip and blast off. Suddenly, you're flying at more than 75 mph over land or water, soaring over 8-in. obstacles, even climbing hills. You're riding POPULAR MECHANICS' Tri-Flyer, the high-tech hovercraft you can build.

It consists of 1/s-in. plywood laid over wood stringers. Lift comes from a 10-hp vertical-shaft mower engine driving a 26-in. 4-bladed fan that forces air underneath the hull. The Tri-Flyer will lift you and two companions—a total payload of 800 pounds. A separate 65-hp snowmobile engine powers a ducted prop aft, which delivers 350 pounds of static thrust.

The secret of Tri-Flyer's highly efficient power system comes from carefully optimizing the relationship between weight, thrust and drag. To keep all this power under control, Tri-Flyer relies on three rudders and a horizontal pitch-control assembly mounted on the duct. The three rudders offer directional control. The horizontal pitch wing supplies



FOVERGRAFI

BY BOB RILEY: Photos by Dave Benson

correct fore-and-aft trim. All controls, including throttles, are led to the 3-axis control stick.

You can build Tri-Flyer in under 300 hours for about \$500, less engines and fans (they'll run you around \$1200). PM plans—including six 17-in. by 22-in. plan sheets and a 60-page booklet with drawings, photos and building tips—cost \$19.95. Make your check or money order payable to POPULAR MECHANICS and mail to: PM's Tri-Flyer, Box 1014, Radio City Station, New York, NY 10101.







PM's unique hovercraft design accommodates three passengers, or a total of 800 pounds. The three rudders and horizontal pitch control are led to throttle-grip joystick in the cockpit. Far left, you can exit water or ice and climb a 45° grade, even float over 8-in.-high obstacles. Left, a 65-hp snowmobile engine turns a belt-driven ducted fan at 2700 rpm. Lift is provided by a 10-hp vertical-shaft mower engine mounted ahead of the cockpit.





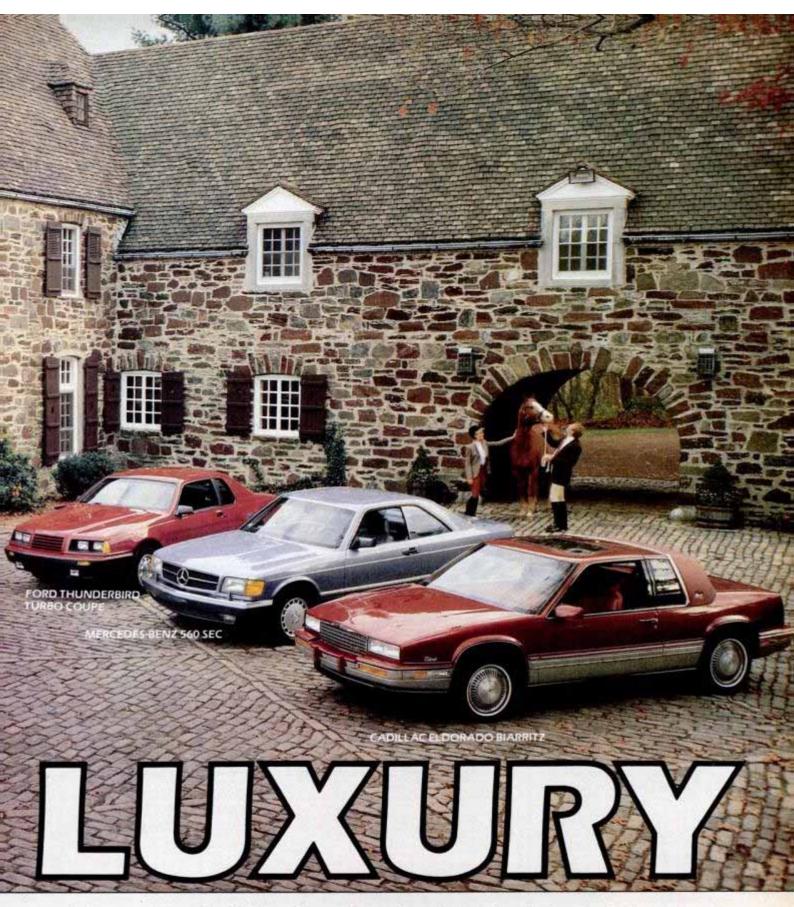
PM tests six personal luxury coupes.

Oldsmobile Interior

the comfort and convenience of an expensive sedan with the performance of a sports car. Most important, perhaps, it makes an unqualified statement about the driver. There's nothing frivolous about a person who drives one of these coupes, but nothing hidebound either.

For 1986, there are six luxury coupes

POPULAR MECHANICS • MAY 1986



on the American market. General Motors has significantly downsized the Oldsmobile Toronado, Buick Riviera and Cadillac Eldorado. The best-selling Thunderbird and trend-setting Lincoln Mark VII LSC are the first of the new aerodynamic Fords. Last but not least, Mercedes-Benz has added yet more power to its awe-inspiring coupe, now called the 560 SEC.

Since performance is a major part of the luxury coupe formula, we brought all six to Raceway Park in Englishtown, New Jersey, and ran them through our battery of track tests. Then we took them out on back-to-back circuits of our standard driving loop so eight drivers could compare the cars.

Finally, we spent some time in and around Princeton, New Jersey, evaluating the "drop-dead quotient" in that bastion of Eastern Establishment snobbishness. Status is as important as handling when you're discussing ornaments for a Rockefeller's driveway.

Mercedes-Benz 560 SEC

Mercedes-Benz wins the status competition hands down. The \$60,000 560 SEC not only turns heads with its bold

styling, but even automotive Neanderthals get the message that here is something special-and pricey. Happily, the Mercedes is a lot more than just an expensive bauble with a 3-pointed star in the grille. The 560 SEC is one of the best 4-passenger automobiles ever built anywhere by anybody.

Essentially, the 560 SEC is a shortwheelbase version of the big 560 SEL sedan. The coupe has two doors instead of four, a lower hood line with Mercedes' sports car grille instead of the standup formal grille and a sleek notchback roofline with steeply raked windshield and backlight.

All the American coupes except the Cadillac came equipped with Goodyear Eagle GT gatorbacks-probably the best OE tires you can buy. The Mercedes arrived wearing Continental Contacts that are one step up from snow tires. Hampered by such oldfashioned tires, it was no better than

mediocre in the slalom and skidpad. Even slippery tires can't sabotage 342 cu. in. of single-overhead-cam V8. Our 560 SEC screamed through the quarter-mile in 15.382 seconds at 92.59 mph and went on to a top speed of 140 mph. This blend of acceleration and top end puts the 560 SEC in the same league with the Corvette, Ferrari 328 and Porsche 928S-among the hottest new cars you can buy in America.

Mercedes has been a leader in ABS development-we first drove an ABSequipped Mercedes way back in 1971. For 1986, every Mercedes model is available with ABS. If NHTSA was really concerned about safety, they'd mandate these antilock brakes.

ABS works by preventing wheel lock-up under braking. Even a skilled test driver can't modulate the brakes as precisely as a Bosch computer. The 560 SEC stopped shorter and more controllably than any of its competitors. ABS also allows you to brake in a corner without losing steering control or to

brake on slippery surfaces without sliding. It's magic-magic that saves lives.

Inside, the 560 SEC is typically Mercedes. The dash carries time-honored white-on-black round dials, the steering wheel is big and thick-rimmed, the controls are traditional Mercedes: functional, logical and surrounded by burled walnut. The driving position is terrific, though Mercedes engineers still refuse



Touch-sensitive cathode ray tube (CRT) operates Buick radio and climate control.



Robot arms hand you the safety belts when you start up the \$60,000 Mercedes 560.

to install a tilt steering wheel.

In our experience, men like Mercedes bucket seats, calling them firm and supportive, but in need of more side and lumbar support. Women don't like them, saying they're too hard, the leather is too cold and slippery, and

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

they're uncomfortable for long periods.

For once, our nitpicking testers had no complaints when it came time to sum up. There are a few things we'd improve-tires, seats and steering wheel-but taken as a whole, we have to admit that the 560 SEC is not only the best 4-seater coupe you can buy, but perhaps the best all-around automobile on the American market.

Said our testers, "Wonderful, terrific, superb, flawless, excellent and as good as can be." Mercedes-Benz has the highest customer satisfaction in the automobile industry, as well as the highest number of repeat buyers. There's good reason for that. Once you own a Mercedes 560 SEC, anything else would be a step backward.

Lincoln Mark VII LSC

This is the most impressive Ford product we've ever driven, a \$25,000 American car that can legitimately be compared with the top-line \$60,000 Mercedes. Even if your name is Rockefeller, a Mercedes 560 SEC must seem like an expensive car. But a lot of regular folks could make the stretch from a run-of-themill \$17,000 Chevy, Ford or Chrysler to the \$25,000 Lincoln.

The Mark VII is a textbook lesson in successfully stitching a silk purse from a sow's ear. This chassis started out as the Fox pan engineered for the Ford Fairmont a decade ago. It was the first Ford chassis with MacPherson strut front suspension, and over the years was used under the Mustang, LTD, Thunderbird and equivalent Lincoln/ Mercury models.

There's not much left of the Fairmont origins. The Mark VII has an air-spring suspension, computer-controlled for ride height and weight distribution. The Luxury Sport Coupe model uses stiffer settings than the base Mark VII. and comes with Eagle GT gatorbacks on alloy wheels. The 4-wheel disc brakes are fitted with ABS similar to

TEST RESULTS

CAR	GAS MILEAGE (EPA city/ PM test)	1/4-MILE (sec @ mph)	SLALOM ¹ (mph)	SKIDPAD ² (cw/ccw)	BRAKING (ft.) (60-0 mph)	TRUNK CAP. INDEX ³	INTERIOR SPACE INDEX	TEST TRACK RANKING ⁵	ROAD TEST RANKING ⁶	OVERALL RATING ⁷	
Buick Riviera T Type	19/16.5	17.058 @ 78.60	61.85	.82/.81	149	- 10	108.17	4	4	5	
Cadillac Eldorado Biarritz	17/16,2	18.146 @ 75.25	51.62	.71/.69	140	13	113.72	6	6	6	
Ford Thunderbird Turbo Coupe	16.15.3	16.637 @ 82.26	59.99	.80/.80	134	7	107.58	5	3	4	
Lincoln Continental Mark VII LSC	16/16.3	16.059 @ 86.28	60.59	.77/.80	137	7	113.58	3	2	2	
Mercedes-Benz 560 SEC	14/14.9	15.382 @ 92.59	57.60	.79/.74	126	14	117.49	2	1	1	
Oldsmobile Toronado	19/17.0	17.138 @ 78.91	62.09	.83/.82	132	12	108.53	1	5	3	

Best speed achieved while weaving through seven cones placed 100 feet apart; the higher the speed, the better the transient handling.
 G-forces generated during steady-state cornering around a 200-foot-diameter circle; cw = clockwise, ccw=counterclockwise.
 The number of standard-size grocery bags that will stand upright (1-inch crush space permitted) in the trunk.
 Front-seat width × headroom × legroom + rear-seat width × headroom × legroom ÷ 1000.

the Mercedes, while the engine is the same High Output 200-hp, 302-cu.-in. V8 that's in the Mustang GT, here matched to a 4-speed automatic.

The result is a hot-rod Lincoln. It's a tick slower than the big Mercedes, but capable of out-dragging any number of high-performance sports cars. When was the last time you drove a Lincoln that would spin the tires?

Even more impressive is the LSC's handling and braking. "Really amazing," wrote our track test driver. The big Lincoln will go around a corner as neatly as the far smaller GM cars, and the ABS brakes pull it up just as securely as the Mercedes.

Inside, the Mark VII scored equally high marks. Our group loved the driving position and seats. "Mercedes should buy their seats from Lincoln," said one of our crew. "They fit like a glove." The interior was praised for its excellent ergonomics and upscale, functional and plush appearance. The white-on-black analog gauges are a great improvement over digital instruments.

Some testers called the Mark VII fabulous. "It retains the traditional Continental styling theme, combined with a Mercedes-like flair. It'd be tough to improve." But others in our group disagreed. "Looks like a T-Bird with a Pep Boys grille and Continental kit," grumbled the chief dissenter.

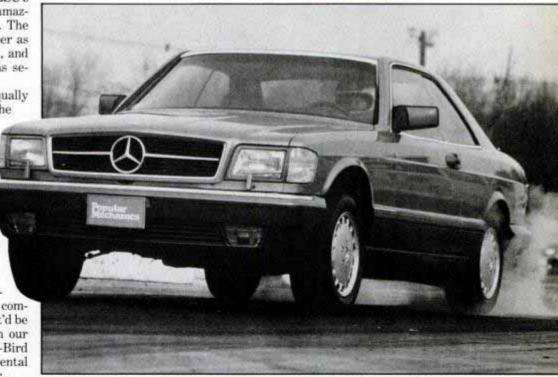
Overall, we like the Mark VII a lot. It's a car definitely worth stretching for. It's in the same league with the 560 SEC-better in some respects-for half the price.

Oldsmobile Toronado

We originally decided to test this group of luxury coupes because GM had downsized the best-selling Eldorado/Riviera/ Toronado. It's the first major change for this car since '79. The previous cars shared a chassis with the fastback Seville sedan, while the new cars share a chassis with a more conventional-looking new notchback Seville.

The 1986 chassis is a variation on GM's generic front-wheel-drive floorpan, similar but not identical to that under the Celebrity/6000/Cutlass/Century sedans and the Grand Am/Calais/ Somerset coupes. Both the Toronado and skidpad tests by significant margins. (Interestingly, every Oldsmobile model we've tested in the past year has outhandled its competitors.)

The Toro was also second behind the 560 SEC in braking, impressively outstopping the ABS-equipped Lincoln. It fell behind in acceleration, with a dismal 17.138 seconds at 78.91 mph quarter-mile. The low-pressure V6 just isn't



A bigger, 5.6-liter version of the all-aluminum overhead-cam Mercedes V8 gives the posh 560 SEC the kind of dragstrip performance that hot-rodders envy-15-sec. 1/4-mile times.

and Riviera use the Buick 3.8-liter V6; the Eldorado uses Cadillac's own 4.1liter V8. All three models are roughly a foot shorter and 400 pounds lighter than the Mercedes and Lincoln, though still 200 pounds heavier than the larger Thunderbird.

Oldsmobile's Toronado weaved to first on the test track. It won the slalom up to towing more than a ton and a half of Toro. Unfortunately, there's no corresponding fuel economy advantage from this low-performance engine. The Riviera and Toronado are only marginally more efficient than the zestier Continental and Mercedes.

All three GM luxury coupes share the (Please turn to page 203)

SPECIFICATIONS AND DIMENSIONS

	Control of the Contro						
VEHICLE TYPE	BASE PRICE	PRICE AS TESTED	ENGINE	TRANS- MISSION	WHEEL- BASE (in.)	LENGTH (in.)	WEIGHT (lb.)
5-passenger 2-door	\$21,577	\$23,814	142-hp OHV 3.8-liter V6	4-speed automatic	108.0	187.2	3300
5-passenger 2-door	\$24,251	\$24,781	130-hp OHV 4.1-liter V8	4-speed automatic	108.0	188.2	3365
5-passenger 2-door	\$14,575	\$15,769	175-hp SOHC 2.3-liter turbo-4	5-speed manual	104.0	197.6	3100
5-passenger 2-door	\$24,381	\$24,905	200-hp OHV 4.9-liter V8	4-speed automatic	108.6	202,8	3650
5-passenger 2-door	\$58,700	\$60,200	238-hp SOHC 5.6-liter V8	4-speed automatic	112.0	199.2	3700
5-passenger 2-door	\$19,418	\$21,134	142-hp OHV 3.8-liter V6	4-speed automatic	108.0	187.5	3300

Points are awarded from best (1) to worst (6) in each category. The car with the fewest total points ranks first, next lowest second, and so on. Subjective ranking on the road by a team of testers; cars are graded by "feel," independent of test track results.

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

Bold numbers indicate best performance.





Here's our choice of the most innovative, trendsetting products from the Consumer Electronics Show.

BY STEPHEN A. BOOTH, Electronics Editor

Want to give your TV digital effects such as picture-in-apicture? The MultiVision 3.1 will do the job for \$400—and it doesn't matter how old your set is. Hook up the 3.1 and you can watch a second program inset into any corner of

swap the two pictures, even scan other channels or freeze

action on the smaller image. The 3.1 adds stereo sound reception to your TV, too.



Switch-hitting car stereo from Sanyo.

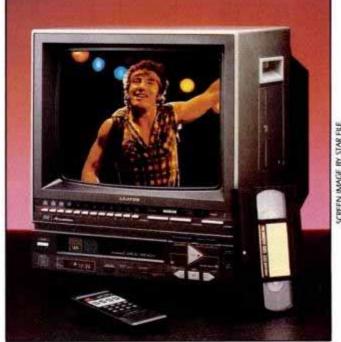
Most in-dash car stereos give you the choice of radio and Compact Disc, or radio and cassette. It's simply impossible to cram CD, cassette and AM/FM tuner into a hole in the dash. Sanyo's come up with an elegant solution in its FTEC-1. The \$600 unit lets you play the latest digital discs or tune into a radio station. But for those times when you want to hear a cassette, the FTEC-1 sports a frontpanel input jack that lets you hook up a battery-powered portable tape player. The FTEC-1 requires a separate amplifier to drive your speakers.

Sony entry leads the pack with 10-to-1 playoff.

You're set for the long-haul with Sony's DiscJockey—the first Compact Disc changer for cars. Load 10 discs into the CDX-A10's magazine and program them for any order of play via the unit's remote control. Magazine and player stow safely in your car's trunk, connected to the controller in the passenger cabin by coaxial cable. You can pass the controller around and conceal it under a seat, or mount it. The \$1000 DiscJockey has a suspension system and casing suitable for steeplechases-on land, sea or air.



ew Year's Day has hardly passed when the electronics industry convenes for a different kind of celebration. The winter powwow brings some 200,000 eyes and ears to Las Vegas to preview the hi-fi, video and other electronics marvels that will appear on store shelves come spring. Our entire Electronics Department took on the task of picking the most innovative products at the show-no easy assignment, considering the thousands of new items. Our criteria? The product is either the first of its kind, advances the state of the art, or offers a meaningful function to the owner. Here they are-PM's Nifty Nine.



Matter of policy: Lloyd's assures this offspring of TV and VCR is born for fun.

This electronic clone is the first TVCR born since 1976, when Sony introduced a console TV with something called a Betamax built-in. Lloyd's Electronics has resurrected the concept with its L950. The hybrid combines a monitorquality 13-inch color TV with a VHS videorecorder, both operated by wireless remote control. The L950 should sell for about \$600.

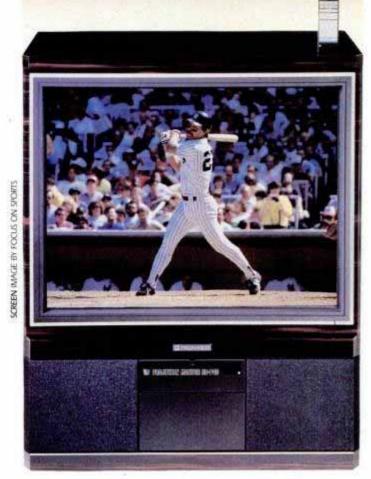
NINE



remembers your favorites.

Just about every Compact Disc player lets you program the order of play for each song on the disc. Now, the

\$410 Magnavox CDB650 goes a step further. Punch in your preferences just once on the unit's retractable keypad, and the CDB650 plays 'em that way first time every time. How? By memorizing the identity code embedded in each CD. The player remembers nearly 800 selections, but lets you change the order any time.



Join the big leagues with Pioneer's projection TV.

You'll see a major improvement in projection TV when you get a gander at Pioneer's SD-P40. With brightness and resolution equal to the best cathode ray tube screens, the 40-inch unit simply blows its rear-projection competition away. Images are sharp and punchy-even in the corners and when viewed from an angle. The \$3500 price

tag includes broadcast stereo reception.

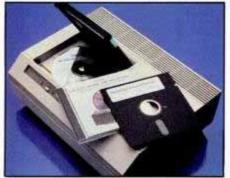




Computer conducts in Kenwood's dashboard maestro.

You could buy a home hi-fi system for the \$1300 price of Kenwood's KRC-999 car stereo cassette/tuner/equalizer. But what Kenwood's done is build home audio performance into a mobile system—and computerize all the functions with a 16-bit microprocessor that mounts outboard. That microprocessor lets you program every aspect of the KRC-999. You can program the equalizer to shape different sound contours for different kinds of music-rock, classical, jazz. Ditto for balance and fader controls. Program the cassette to play songs in any order you like, program the radio to seek out your favorite stations. Performance-wise, the KRC-999's auto-reverse Bi-Azimuth tape head aligns itself electronically for clearest playback. The tuner eliminates multipath distortion, and scans for strong signals.

A world of knowledge in your palm with Grolier's CD Encyclopedia.



There's more than music to the digital Compact Disc. Each shiny platter can store about 200,000 pages of printed text-or Grolier's entire Academic American Encyclopedia. For \$1500, you get the smart disc and a special CD-ROM player to unlock its knowledge (music CD players won't do the trick). You'll also need an IBM-compatible personal computer to access and display the information.

Wedge your way into digital bliss with Toshiba's XR-P9.

This \$300 battery-powered portable CD player is just slightly larger than six CD cases stacked. For home use, it snaps onto a wedge-shaped AC power supply and connects to your hi-fi system. More impressive still, an infrared receiver snaps atop the unit to take remote commands.

PM COMPARISON TEST

FIVE FAST

Going to the limit with the latest in center-console utility boats.

when it applies to center-console powerboats. You won't find rakish Med styling on these fiberglass runabouts, no sculpted compound recurves or fancy-pants fabric interiors. They're designed for work—primarily on salt water—sprinting to the offshore fishing canyons, poking around the reefs on a snorkeling trip, or hauling all the gear and equipment that normally accompanies a waterside lifestyle. And yet, as workboats, they also offer enough unbridled enjoyment to rival the sassiest sportster.

The logic at the heart of the center-console design is as simple as it is profound. First, position passengers directly over the boat's center of pitching moment. That way, occupants remain relatively stable while the ends of the boat rock and roll with the

waves. You get a fair degree of spray protection crouched behind the console's wind screen, and the

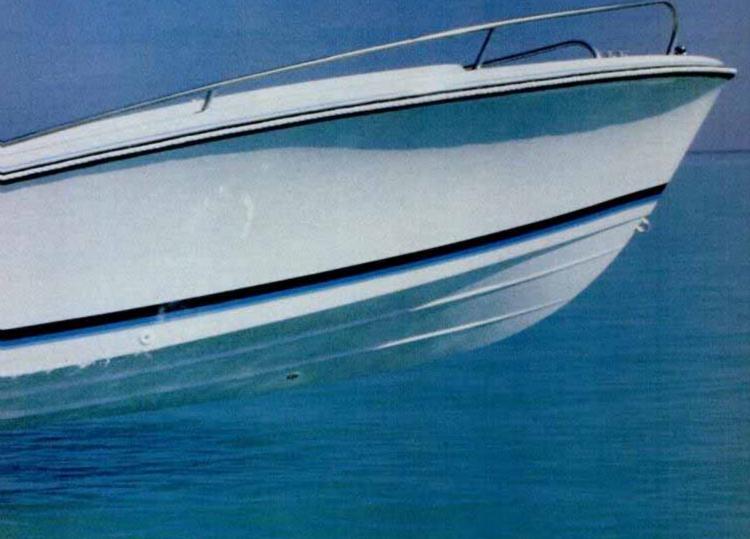




FISHERMEN

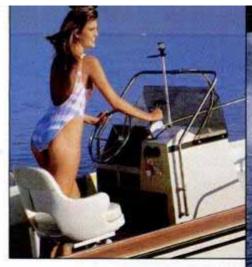
BY TIM COLE, Boating/Outdoors Editor; Photos by Skip Gandy

WELLCRAFT 180 FISHERMAN









Molded seats on Outrage, well aft for standup operation, characterized all designs.

console itself serves as a suitable dry stowage area for radios and other finicky electronics. At the same time, invest this sturdy performer with enough side pockets, rod holders, ice chests, bait wells and extraneous compartments to turn it—if called upon—into a floating tackle box, dive platform or utility boat.

That's the theme anyway, but within the spirit of the center-console design exists numerous sets, subsets, innovations, tangents and, well, anomalies, to make for a rather compelling head-tohead comparison. That's why PM invited five of the top-selling center-consoles to a little showdown at Joe Roth's



Tavernier Creek Marina north of Islamorada, Florida. Aquasport, Robalo, Boston Whaler, Sea Ox and Wellcraft answered the call. Johnson Outboards supplied five identical, superbly crafted 150-hp powerplants that happily absorbed all manner of abuse over a 3-day test period.

The result was perhaps the toughest PM boat performance test ever—tough on the boats, sure, but also tough on the testers. At first glance, it was easy to summon forth the ultimate cop-out: "They're all pretty good." But, after a battery of on-the-water speed and handling evaluations, and a round of static measurements to compare deck and

stowage space, clear winners and losers rapidly emerged.

Wellcraft 180 Fisherman

We ranked the Wellcraft 180 best overall for several reasons. Dockside, this modified-vee hull reflects a thoughtful balance between deck space, stowage area and the relative position of the console fore and aft. It had the shortest LOA—17 ft., 10 in. on the centerline—with a 93-in. beam, one of the widest. That meant Wellcraft didn't have to skimp on the actual size of the console—which you can only appreciate on plane hunkered down out of the rain. It also

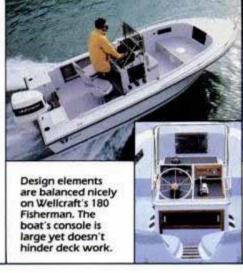
Overall Ranking/Make/Model	1. Wellcraft 180 Fisherman	2. Sea Ox 180
Length Overall/Beam (in.)/Weight (lb.)/Fuel Cap.	17'10"/ 93/ 1750/ 43 gal.	18'3"/87.5/1900/50 gal.
Stowage: Gnwle. 1/In Cnsle.2/Under Fwd. Platform2	9/ 13.66/ 4.75	13/17/4.94
Stowage Ranking/Comments	1/ Nice balance; molded boxes aft inspirational.	3/ Rod and console stowage merely adequate.
Deck Area3: Fwd. Platform/Aft Deck/Fwd. Deck	8.85/ 14.47/ 9.32	18.11/15.33/5.64
Deck Space Ranking/Comments	3/ Intelligent use of somewhat condensed space.	5/ Cramped standing room around console, aft.
Hull Construction (see key below)4	4LY CM, 3LY WR, 1LY FM, WdSS, Spr. PU	3LY WR, 4LY CM, 2LY M, 1LY FM, WdSS, Spr. PU
Time (sec.) From 0-40 (trim out)/Top End ⁵	Fastest-7.91, Slowest-10.22/ 47/ Speed king.	Fastest-13.78, Slowest-14.42/44/ Reasonably swift.
Time (sec.) Through 180° Course (trim in)5	Fastest-1:05.69, Slowest-1:07.57/ Tight handling.	Fastest-1:08.30, Slowest-1:10.80/ Safe, responsive.
Time (sec.) Maneuverability Course (trim varied)5	Fastest-1:02.74, Slowest-1:06.22/ A bit skittish.	Fastest-1:08.23, Slowest-1:12.34/ Drives superbly.
Rough-Water Handling Ranking/Comments	2/ Extremely fast; lands square on her bottom.	1/ High speed and extreme comfort in big water.
Fit-And-Finish Ranking/Comments ⁶	1/ Superb glass work and detailing.	4/ On the rough side in glass work and detailing.
Price As Tested, Less Engines	\$8645	\$9295

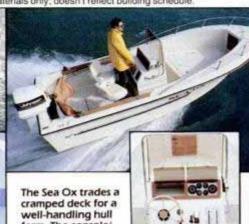
1. Total length of rod stowage, unless indicated by as pocket stowage. 2. Cubic feet. 3. Square feet. 4. Materials only; doesn't reflect building schedule.

Test Parameters

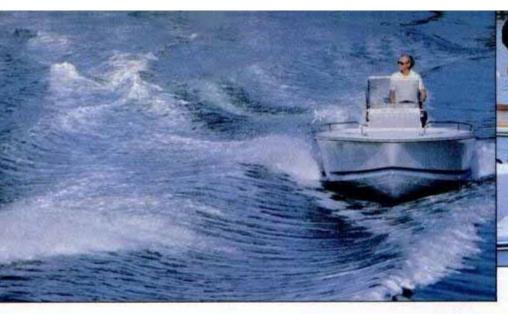
Each center-console design was equipped with an identical VRO Johnson 150, double-oiled for break-in and fully fueled for each performance test. Speed through PM's 0-40 trap was measured with an MPH radar unit and timed with a Heuer digital stopwatch. The same driver (author) and passenger were aboard for each test, which also included time through a quick-turn 180° trap and a fixed maneuverability course. Fastest and slowest times after tour runs are shown to indicate consistency of handling. All compartments were measured to their maximum depth, regardless of turns in the hull.

Hull Construction Key: HLU=Hand Layup; LY=Layer; M=Mat; C=Chopped; WR=Woven Roving; FM=Fabmat, combination mat and roving; SS=Stringer System; WdR=Wood; FG=Fiberglass Reinforcement; In;=Injected; Spr. = Sprayed; PU=Polyurethane Foam Flotation





cramped deck for a well-handling hull form. The console/ seating arrangement works well during a rough ride.



Time out for fishing—an activity where center-console designs truly shine.

offered plenty of room between the console and the side of the cockpit to facilitate movement fore and aft.

Freeboard height is moderate—no impediment to boating large fish, in other words—and while the forward platform area is small, stowage underneath is adequate. Wellcraft has borrowed a bass-boat concept in providing for an auxiliary seat mount forward during trolling or low-speed operations. Pluck the buddy seat out from behind the console, reinsert it forward and you have a splendid seating alternative. Aft, Wellcraft has built in two stowage boxes—one to accept batteries and tankage, the other to serve as an

aerator-equipped live well. There's even a cutting board on the lid for cleaning fish at sea.

The boat also comes equipped with vertical rod holders and voluminous rod stowage in the area under each gunwale port and starboard.

Add to these well-conceived deck and stowage features such important details as extensive around-console grab bars, footwell and a moderate, though appealing, use of teak trim, which accents superb glass work. Wash down is also simpler because Wellcraft has figured out how to drain the cockpit properly, unlike some of the other models we reviewed.

While the Wellcraft was the fastest boat we ran—topping out at 47 according to our MPH radar unit—it didn't handle quite as nicely as we would have liked. We detected inferior tracking through our fixed maneuverability course—along the convoluted length of Tavernier Creek, But it certainly didn't deter us from bestowing high marks. We also ran each boat out of sight of land to the periphery of the Gulf Stream and back. The Wellcraft handled fast and well in these somewhat extreme conditions, staying on her centerline through the confused swells and cross chop. When she did leave the (Please turn to page 206)

3. Boston Whaler Outrage 18	4. Robalo 1800	5. Aquasport Osprey		
18'6"/ 86/ 1250/ 63 gal.	18'/ 93/ 1900/ 55 gal.	19'6"/ 92"/ 1550/ 45 gal.		
6/12.05/6	1.98 2/15.4/7.8	9'4"/ 12/ 6.86		
5/ Rod and platform stowage poor.	4/ Side pockets superfluous; console adequate.	2/ Has a slight edge in stowage accessibility.		
15.43/ 21.57/ 11.63	18.24/ 12.58/ 6.77	18.52/ 19.39/ 11.06		
1/ Lots of room to maneuver.	4/ Needs more attention to driver comfort.	2/ The advantages of a longer LOA are clear.		
Combination CM, WR, Inj. PU ⁷	HLU, 5LY M, 4LY WR, Inj. PU	8LY M, 6LY WR, WdR ⁶ , FG SS, Spr. PU		
Fastest-8.41, Slowest-9.79/46/ Up to expectation.	Fastest-21.02, Slowest-27.48/41/ Could be better.	Fastest-8.93, Slowest-10.53/46/ Fast but rough		
Fastest-1:06.59, Slowest-1:07.46/ Consistent.	Fastest-1:11.98, Slowest-1:13.23/ A little rough.	Fastest-1:05.40, Slowest-1:07.21/ Slams water.		
Fastest-1:01.98, Slowest-1:06.39/ A bit erratic.	Fastest-1:10.53, Slowest-1:15.05/ Ditto.	Fastest-1:03.95, Slowest-1:08.42/ Erratic.		
3/ Low freeboard, narrow console exposes driver.	4/ Safe, stable, but tough on the driver.	5/ Pounds, rattles, lands on its edges a bit.		
3/ Plain Jane; cockpit drains poorly.	2/ Glass, teak and canopy make attractive combo.	5/ Latches ineffective; cheap detailing.		
\$12,390	\$12,205	\$10,290		
5. Tests run on flat water, 6. Considers glass work,	detailing, 7, Boston Whaler declines to divulge construct	tion details. 8. Wood reinforcement in transom only.		





Robalo's excellent glass work and teak trim rated high. Handling could be improved by moving seats closer to console.



Aquasport takes full advantage of its longer hull to offer improved deck space and stowage. Downside? Rough handling.



The smallest Swiss Army Knife in the Victorinox line is still long on performance. It offers a penknife blade and emery board, plus plastic toothpick and metal tweezers. ou could say that a utility knife is any bladed instrument that gets the job done, whatever the job may be. But you can't chop down a Sequoia with a penknife. Nor can you perform brain surgery with a drop-point hunting blade. These days, there's a utility knife to suit every eclectic purpose, from multifeatured Swiss Army Knives, to hyper-sophisticated (and expensive) interchangeable blade knives that let one handle perform a variety of selective functions. Top-of-the line Swiss Army Knife Take knifemaker Billy Mace Imel's by Wenger offers files, saws, beautifully crafted lock-back nonblades, openers, scissors, even folder as an example. This \$925 a glass/stainless-steel magnifier. instrument can be fitted with a dagger, drop-point and skinner-each blade ground and shaped to perform a specific task. The Pocket Tool Chest includes a knife and a pair of needle-nose pliers in a folding, 4-inlong package. The Switchblade II from Star Sales Co. is billed primarily as a collectible and comes with drop-point, clip and spey blades, each etched with animal scenes. These interchangeable blade knives have varying degrees of usefulness and The latest twist in new-tech utility knives.

BY BUTCH WINTER; Photos by Bill Dolce

Материал задишенный автороким прирог

enger makes this beefy knife with stainless steel sideplates for Issue to the Swiss Army. It has fewer implements but is stronger and welghs less. The Switchblade II from Star Sales Co., Knoxville, Tennessee, is a folding interchangeable blade knife with animal scenes etched on each blade. Billy Mace Imel's custom-made nonfolding lock-back knife comes with three blades — dagger, drop-point and skinner — and two leather sheaths. Price: \$925.

THE CUTTING EDGE

artistic appeal. But no discussion of the complex utility knife field would be complete without examining the Swiss Army Knife. Victorinox and Wenger, the two principal Swiss Army Knife makers, make a long line of pocket utility knives that offer substantial performance at reasonable prices. Victorinox (imported by Swiss Army Knives Inc.) makes its Swiss Army Knife in 98 different variations, using 36 different implements. Wenger (imported by Precise International) has over 50 different knives built to various combinations.



The Gerber folding interchangeable blade knife features a bolt-action design that safety-locks drop-point, skinner and saw.

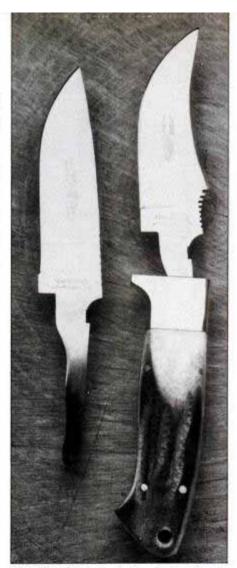
The Swiss Army Knife story begins with Karl Elsner, a Swiss cutler born in 1860 in Zug, Switzerland. In 1890, Elsner helped establish the Association of Swiss Cutlers. It was formed to design and sell a knife to the Swiss Army, which had been buying its knives from the German cutlery center at Solingen.

The Association of Swiss Cutlers was successful and the first knives were delivered to the Swiss Army in October 1891. The original Swiss Army Knife contained a cutting blade, punch, can opener and screwdriver. A lighter and better-looking version of the soldier's knife was designed in 1897 and called The Officer's Knife. In addition to the standard blades of the army knife, The Officer's Knife had a smaller knife, called an erasing blade, and a corkscrew. A tougher, more resistant red fiber material replaced the standard wood handles, which had a tendency to split. Elsner later added a wood saw and scissors to counter the rising number of imitations that were beginning to flood the market.

In 1909, Elsner also began to inlay the Swiss cross on the handles of his knife, identifying the knife as a Swiss product.

Today, Elsner's original firm is called Victorinox—a combination of Karl's mother's name and *inox*, the international symbol for stainless steel, which was developed in 1921.

Wenger is the other "official Swiss Army Knife." Wenger and Victorinox are the only firms authorized to make



Straight shaft blades are inserted in a female slot in the handle of Parker Sales Co. knife.

Swiss Army Knives for the Swiss Army. The knives are made to identical specifications, with each firm supplying half the army's needs.

Wenger officials dispute the Victorinox claim that Elsner supplied the Swiss Army with knives as early as 1891. Wenger says it was not until 1908 that the knives were purchased, and then half from each company.

Wenger began using Elsner's patent of three blades working off one spring when it passed into the public domain after 10 years. Victorinox was later repaid for this idea when Wenger allowed it to use its patent for rivetless plastic side scales.

In fact, Wenger likes to stress that it has been its contributions that have improved the Swiss Army Knife. The rivetless handles, introduced in 1953, are made with a substance called Tenite Butyrite. Wenger feels that this substance is harder and more durable than any other plastic, including Delrin.

Other Wenger improvements include: scissors with integral spring (1972), ski wax scraper (1975), wrench with flat Phillips screwdriver (1980), "Packlock" locking main blade (1982) and locking screwdriver (1984). An "orienteering tool" is scheduled for re-



Two interchangeable blade concepts: Top, Berkley Outdoorsman uses two setscrews to lock saw, dagger, filet or combo blades. Kershaw Blade Trader Jr. fits knives to a handle lug via rotating metal clip.

lease by Wenger in 1986, which consists of a straightedge with inch and centimeter scales plus a compass at the tip.

The basic metallurgy in a Wenger knife is also interesting. The dividers between the blades in a Wenger knife are electroplated aluminum for lightness. The blades are made of 4034 Hi-Chrome, surgical-quality hardened stainless. The steel contains 14-percent chromium and .5- to .55-percent carbon. Wenger considers the process of forging its blades obsolete and instead uses a process called laminated steel hardened to a 54-56 Rockwell hardness. It's not considered hard enough for superior edge holding, but Wenger feels it is more important that its blades be easily sharpened to razor keenness rather than strive for edge holding and difficulty in sharpening.

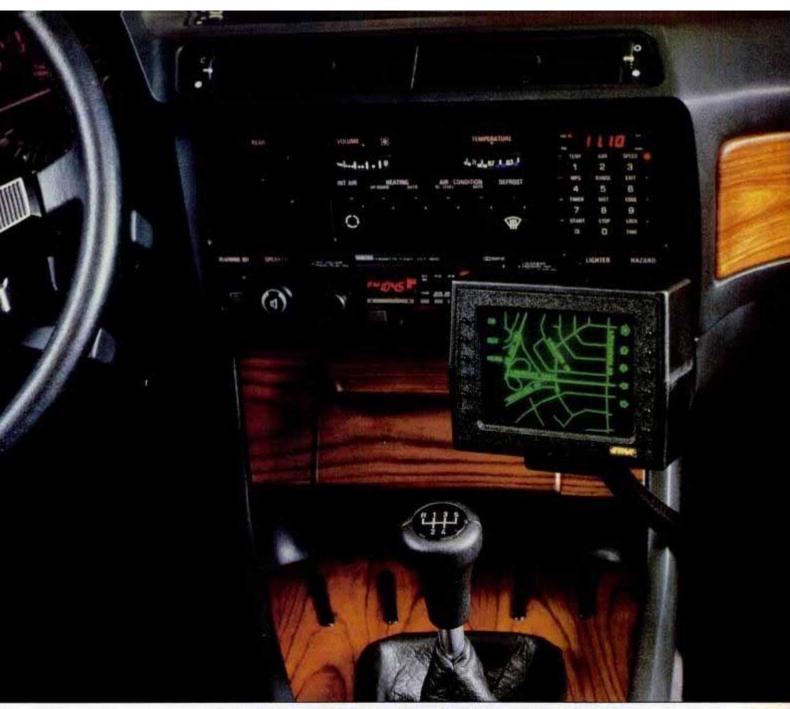
Wenger importers, Precise International, are very forthcoming about releasing data on Wenger products, including new tools to be fitted to the top-of-the-line models. Victorinox is more circumspect, however, giving a polite but firm "no" to inquiries about building techniques and improvement plans.

Swiss Army Knives represent only one facet of the three sides to utility knife design philosophy. The cleverly designed Pocket Tool Chest represents the second.

The Pocket Tool Chest condenses 12 commonly used tools in a high-carbon stainless-steel package. The handles fold open to make an 8-in. ruler and then lock back, forming a full-size needle-nose pliers. The jaws of the pliers are curved for holding or tightening bolts, and the rear of the jaws are wire cutters. Other tools include four separate screwdrivers, a wood/metal file, an awl/punch, can/bottle opener and a 2.5-in. cutting blade.

Another type of utility knife is designed with interchangeable blades. Used primarily for cutting, most lack the all-purpose quality that distinguishes the Swiss Army Knife or gadgets like The Pocket Tool Chest. But

(Please turn to page 209)



DEAD RECKONING

ons before the automobile, seafaring Polynesians devised a navigation system to pilot their canoes across their ocean world. Now, researchers on three continents are adapting the islanders' technique and automating it for use on the asphalt lanes that link our modern world. Before long, electronics and orbiting satellites will finally force the Polynesian pathfinders into early retirement.

The modern-day quest for an automotive navigation aid dates back at Forget the map pocket.
Electronic navigation
systems are here today
and there's more to come.
Soon, Rand McNally might
be pressing digital discs.

BY FRANK VIZARD

Etak Navigator (above) uses stalk-mounted TV to show car's position and destination.

least as far as the computer. Nearly every automaker has included an electronic navigation device in its concept car of the future. Until recently, though, the computer power needed for an effective system made it too costly for use in individual vehicles.

Now that computers have large and relatively cheap memory capability, car navigation systems at last seem feasible. There's work in progress by major automakers in the U.S. and Asia. Japanese electronics manufacturers such as

DEAD RECKONING

Matsushita, Mitsubishi, Hitachi and Clarion pursue the project. And in Europe, Volkswagen, Mercedes, Blaupunkt, Philips, VDO and Siemens are all developing navigation systems.

What constitutes a car navigation system? The type available today uses dead reckoning, but the system of the future will rely on orbiting satellites to guide your car.

Right now, \$1400 will buy you a system developed by a California company called Etak Inc. Etak is a Polynesian word that means "dead reckoning," an ancient technique of deducing a present position by plotting the course and distance travelled from a previously known position. Basically, the Polynesians imagined their canoes to be stationary and the world moving beneath them. The Etak Navigator replicates that thought process for the automobile. The map displayed on the console-mounted screen moves around an image of your car.

Etak's system is more aptly described as augmented dead reckoning because it relies on electronics. The hardware installed in your car includes a display screen and cassette player, computer, compass and sensors. Installation is no more difficult than a car audio system. The navigational sensors go near the nondrive wheels of your car. These sensors, along with a compass mounted by the rear window, connect to the computer and other electronics in the trunk. The 4½-inch screen mounts on a flexible stalk near the dashboard so you can angle it for the best view. You position the tape player wherever convenient in the passenger compartment.

Tapes constitute the critical element of the Etak system. They store computerized maps containing every street and address for an area about twice the size of an ordinary paper map. Outwardly similar to an ordinary audio cassette, they'll sell for about \$35 each. You'll need four tapes to cover an area the size of greater San Francisco, for example. Developing these cassette maps is no easy task. They're available only for the West Coast at this time. Etak estimates it will take two years before the system can be sold nationally, with all the appropriate maps.

These maps are what makes the Etak Navigator simple to use. As your car moves, its position on the display screen remains constant. The map actually moves around the car's position, which is marked by a small triangle. Your view of your position on the screen can be very general or very

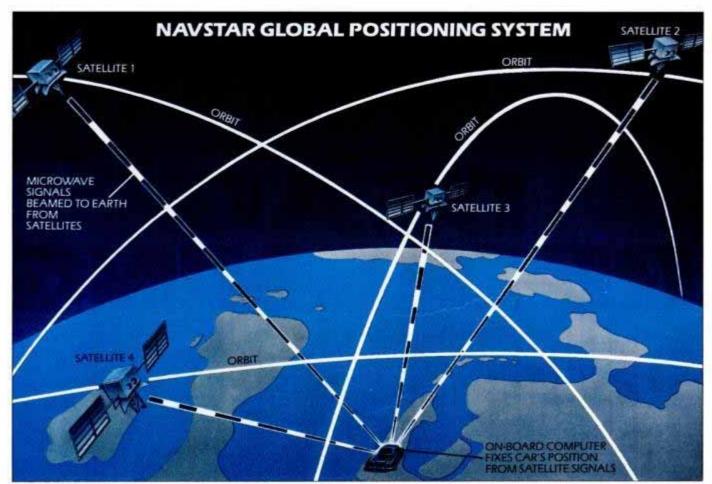
specific. For example, you can get detailed closeups of the area surrounding the car by activating the Navigator's zoom-in feature. The widest zoom level, by contrast, shows your car's position in relation to the entire metropolitan area. Accuracy is within 50 feet.

To get Etak started, you select the appropriate cassette-map for your area. Then, you scroll the map until your stationary position coincides with the triangle representing your car. After this, the Navigator takes over.

Once under way, the magnetic sensors near the wheels transmit distance information to a differential odometer, which scrolls the digitized map on the tape. When you make a turn, the Etak computer compares the information received from the compass and sensors against the data stored on its map to update your position.

Besides determining where your car is, the Navigator can locate its destination. By scrolling through a map's index, you can select and display a destination. It appears as a small flashing star, and the distance is indicated on the screen. This feature can translate into time and fuel savings.

You can retrofit Etak's Navigator to your car now. Moreover, it's to become an option on some General Motors cars in 1989 (GM has a stake in the compa-



On-board computer in cars of the 1990s will receive signals from four NAVSTAR satellites simultaneously. Computer then correlates

differences in time and direction of signals to determine the car's position. Accuracy is to within 30 feet.

ny). But another dead-reckoning system promises to hit the market next year. Developed by Dutch electronics giant Philips N.V., the CARIN (Car Information and Navigation) system is more sophisticated than Etak's in several respects. The most obvious difference is one you can see and feel. CARIN uses digital Compact Discs for map storage instead of cassettes.

The advantage is simple: One CD can store the same information as the four Etak cassettes needed to map the San Francisco Bay Area. Looked at another way, one CD can hold about 150,000 sheets of paper, each containing 50 lines of 80 characters. That would amount to a pile about five stories high. With that kind of capacity, a CARIN disc can also tell you the location of every gas station, hotel or chop suey parlor within the map area.

A more significant difference is CARIN's route-planning capability.

While the display screen can show you the best route to a destination, its real attraction lies in what happens when the car moves. For safety reasons, CARIN's display screen turns off when you put your car in gear. You'll still get directions, though.

How is this done? CARIN incorporates a speech-synthesis module that connects to your car's stereo system and speakers. Once you type your destination into CARIN's keyboard, the system literally tells you when it's time to make a turn or exit required to reach your destination. The system is so sophisticated that in Europe, discussions are under way to link CARIN to the proposed Radio Data System (RDS), a traffic information network. CARIN then would be able to suggest alterations in your route according to changes in road conditions. CARIN would instruct you how to avoid traffic jams, construction, icy roads and other hazards as soon as RDS reports them.

In the future, Philips plans to replace CARIN's keyboard with a touch-screen. You'll simply point to your destination on the screen, and the on-board computer will do the rest. CARIN also will be able to monitor your car's vital functions, verbally alerting you to a potential malfunction or even the need for gas. In the latter case, CARIN will direct you to the nearest gas station.

Though CARIN uses Compact Discs to navigate, it poses no threat to music lovers. Once route information has been extracted from the CD map, CARIN's computer memory stores the information. You can then eject the CD map and replace it with a music disc. CARIN will cut in over the music when it has information to deliver.

rates a speech-synthesis module that connects to your car's stereo system

CARIN will cut in over the music when it has information to deliver.

Navigation is one part of electronics package in Clarlon's concept car. Besides showing car's position and destination, screen also displays car diagnostics—even movies.

In the future, other navigation systems will use Compact Discs. Etak will upgrade to CD from cassette-maps as its product becomes more widely distributed. West Germany's Blaupunkt will use CDs for its EVA system. EVA's screen shows direction only by indicating with arrows. But like CARIN, its synthesized speech module tells you when to alter course, and how.

Another system of the 1990s, by Japan's Clarion, uses CDs—but has a twist. Like other systems, Clarion's C-AVCC (Car-Audio Visual Computer Communications) displays your car's position on a TV. But finding your destination is a more complicated process than in the European or American systems.

With C-AVCC, you use a built-in cellular phone to call your destination for directions. You receive instructions via a computer printout—also built into the car. If this seems excessive, there's a good reason—most streets in Japan have no name or number. This makes plotting a destination extremely difficult, if not impossible.

Dead reckoning limits

As advanced as these navigation aids might be, dead reckoning has some limitations. Magnetic interference caused by steel structures or even by the activation of some rear-window defoggers can cause tracking errors. Mistracking can also occur if you enter a parking lot from one street and exit onto another. How often errors might occur was shown by tests Etak did in San Francisco. The Navigator averaged more than 120 miles between errors. Fortunately, you can realign the system in about 20 seconds.

Dead-reckoning systems, though, might be nothing more than an interim solution to car navigation.

By the end of 1988, the U.S. NAV-STAR Global Positioning System (GPS) will be in operation. This system employs 18 satellites moving in six different orbits in space. Because each satellite orbits Earth in 12 hours, four satellite signals can be received at any moment anywhere in the world.

A future version of Philip's CARIN uses the GPS satellites. A satellite receiver, linked to CARIN's on-board computer, correlates the differences in time and distance for each of the four satellite signals. As a result, CARIN can determine your car's position to within 30 feet.

The GPS satellites will prove most useful for military and commercial applications at first. But auto designers expect to put GPS technology in the family sedan sometime in the early 1990s. However, its initial cost, about \$2000, is likely to keep dead-reckoning systems viable as a less expensive alternative for some years to come.



SENTIMENTAL

Pilots call it the Gooney Bird, and they expect the 50-year-old DC-3 to fly forever.



very pilot who touched her controls fell deeply in love. They gave her pet names like Gooney Bird, Dowager Duchess, Doug, Dizzy Three and a half-dozen others. With her 50th anniversary as an airliner coming up next month, fan clubs all over the nation are planning a nonstop party for the DC-3.

The maiden flight of the Douglas Sleeper Transport, later known as the DC-3, took off from a Douglas Aircraft Co. plant runway at Santa Monica, California, on Dec. 17, 1935, the 32nd anniversary of the Wright brothers' flight at Kitty Hawk. By June 1936, American Airlines had its first DC-3. History was to be made time and again by a twin-engine plane that was flightworthy in storms and, eventually, in combat.

"I believe she can run on empty,"
Charles Lindbergh declared prophetically after flying as a passenger in one of the first Douglas Sleepers.
The plane he flew in was equipped with a bed and bar in first class. But it had full fuel tanks and the flight was troublefree.

Prophesy came true in 1962, however, when a DC-3 cargo plane did run out of fuel over Missouri. Only the crew was aboard. The pilot set her on a glide path toward a large open area, then joined his crew in bailing out. Miraculously, the Gooney Bird sailed into a farmer's field and slid to a halt in the open. Its underbelly was severely damaged, but the plane was repaired and reentered service the next year.

Such is the history of the DC-3. Its greatness is recounted in story after story:

In World War II, a China National Aviation Corp. DC-3 was caught on the ground at Suifu, China, by Japanese aircraft. The pilot and passengers fled to a nearby wood and

The DC-3 was the first of the big-body airliners. Air-to-air photo shows an early model still in use after 50 years. PM PHOTO BY RUSSELL MUNSON

JOURNEY

BY DENNIS ESKOW, Science/Technology Editor





The DC-3 was first plane to land at the South Pole (top). It served in peace, and in war it became a transport and ambulance (right). The plane offered the first luxury accommodations (above). Until the DC-3, planes carried 14 passengers. It carried 21.

watched as the field was bombed repeatedly. A hole was blown through the right wing. Within days, a DC-2 spare wing stored in Hong Kong was delivered to Suifu, secured beneath the wing of another DC-2. The DC-2 wing was 5 feet shorter than the downed plane's wing, but it was installed ad hoc. Following a short test flight, the repaired DC-3 was flown all the way to Hong Kong, with the right wing dipped. So much force was needed to keep the wounded Gooney Bird on a stable flight pattern that a heavy wrench was tied to one spoke of the control wheel to keep it in place. The pilot flew the plane safely with hands off the wheel except for takeoff and landing. That DC-3 was affectionately dubbed DC-21/2.

The Old Three had a military version called the C-47, a plane that saw service as a troop carrier, flying ambulance and jump plane in World War II and Korea. But one military flight was made aboard a commercial version. Major General Jimmy Doolittle rode out of China after his 1942 Tokyo raid in a Chinese airline DC-3.

Pilot Moon Chin set the craft down in Burma on the way to India to pick up refugees. After 60 people were crowded aboard, Chin shut the door, sensing the plane was overloaded.

Chin didn't know who Doolittle was, so he didn't ask him into the cockpit. The Chinese pilot got into his seat, and took off. When he landed in India, 12 additional refugees climbed out of the



baggage compartment. The plane was supposed to carry 21 passengers.

Perhaps the most unbelievable DC-3 war story involves the incident in which a Gooney Bird made a kill in a dogfight with two Japanese Zeros. Capt. Hal Scrugham was about to take his C-47 up for a flight over the Himalayas. At cruising altitude, he found he had company: a pair of Zeros.

Scrugham put the plane into a dive with the Zeros in hot pursuit. The first fighter made a pass, but the C-47 was too close to the ground and the fighter zoomed up without making a hit. The second Zero made a run kamakazi style, intent on ramming the fat C-47. Scrugham slammed the throttles wide open and almost dodged the Zero.

The fighter did hit the tail, ripping off most of the rudder. Then the Zero went



American Airlines inaugurated DC-3 luxury flights in '36. Planes also carried mail. Over 1000 DC-3s are still flying today.

out of control and slammed into a mountain in a ball of fire. But the crippled C-47 managed to reach its destination.

If the DC-3 was first in war, it also has been first in peace. In April 1957, a Frontier Airlines DC-3 out of Phoenix defied the wind. Pilot Dave Welling received clearance to climb from 6500 to 9000 feet to get above a storm. As the plane started climbing, it hit a tremendous downdraft and began plummeting to earth. Welling struggled hard for control of the plane. It was only after he safely brought the plane back to Phoenix that Welling noticed that 10 feet of the left wing had been torn off. A few days later, the missing section was found on the side of a mountain about 50 miles north of Phoenix, where the DC-3 had brushed a mountaintop. The 26 passengers never realized how close they were to disaster.

The DC-3 was born in the first big expansion of airline passenger service. American Airlines President C.R. Smith called Donald Douglas in the summer of 1935 and said American needed a large, comfortable plane that could lure the luxury trade.

Douglas engineers went right to work, using the basic DC-2 design to work up the new luxury model. Six months later, the first Gooney Bird was being test-flown.

The first model carried seven upper and seven lower berths with a private passenger cabin up front. It was (Please turn to page 210)



The complex world of a 'simple' tool with 22 different variations on a theme.

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

he standard flat-blade screwdriver, or turnscrew as it was called originally, began as a simple tool to drive and remove slotted screws. But, the limitations of the slotted screw led to the development of many "better" screw designs. That is, a fastener that can be driven quicker, easier and with less tool slippage, known as cam-out. As each new screw was produced, however, another driver was needed.

Today, the two most popular fasteners are the slotted screw and the cross-point Phillips screw. But as a do-it-yourselfer, you must also be tooled-up to deal with other screws such as Torx, square recess, Reed and Prince, hex socket, Scrulox, Robertson, clutch head, Pozidriv, Supadriv and Quadrex, to name a few. Some of these screw types differ only by the manufacturer. For example, Scrulox and Robertson screws are square recess fasteners. And, Supadriv and Pozidriv screws feature the same cross-point design. Therefore, in certain instances, the same driver can be used on different screw types. But, remember, it's important to match the right size and type of screwdriver to the screwhead.

The screwdriver is probably the most used and certainly the most abused of all hand tools. Screwdrivers are routinely subjected to a variety of abuses, including being used as a chisel, pry bar, punch, scraper, paint stirrer and can opener. But the most common abuse is simply using a screwdriver that doesn't fit the screwhead. This practice abuses both the screwdriver and the screw. The results often include chewing up the screwhead

and causing excessive wear on the driver tip which, in turn, promotes cam-out.

Here are a few guidelines to follow to ensure safe, effective screwdriving.

Never use a screwdriver as a pry bar; an overstressed blade could shatter, causing an eye injury. Always match the tool's tip style and size to the screwhead. Keep the handle free of grease and oil to ensure a nonslip grip and don't use a screwdriver for any job other than its designed purpose. Now let's take a close look at the 22 screwdrivers shown.

1. Clutch-head—The clutch-head screw features a distinctive bow-tie shaped, recessed head. These screws are used commonly in mobile homes, cars, boats, appliances and electric motors. The Stanley 100 Plus screwdriver (\$3.69) has a ¾16-in.-dia. tip milled to fit clutchhead screws precisely. The driver features a 4-in.-long boron steel blade and a hexagon-shaped plastic handle. For details, contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

2. Square recess—Use this square-tipped tool for driving square-recessed fasteners such as Scrulox and Robertson screws. You're likely to find these fasteners in recreational vehicles, boats, mobile homes, hobby equipment and on furniture hardware. The driver shown (\$2.75) fits No. 2 screws





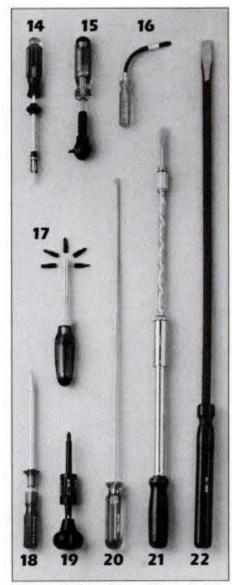
SCREWDRIVERS

features a hexagon-shaped, fluted plastic handle with a nonslip thumbrest and ball-shaped end. The chrome-vanadium steel blade is nickel plated and heat treated for durability. Sears offers this style driver in 17 sizes for both slotted and Phillips screws ranging in price from about \$2 to \$8 each. They are also available in economical 9-piece (\$23), 18-piece (\$40) and 21-piece (\$45) sets. For more information, contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.

- 5. Cabinetmaker's—Designed for shop work, this traditional cabinetmaker's screwdriver features a turned oval beech handle, a heavy steel ferrule and a chrome-vanadium steel blade. Note that the upper portion of the blade is flattened to accept a wrench when extra torque is needed. A set of five slotted screwdrivers costs \$27.70 from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.
- 6. Spiral-rachet—Drive screws quickly and easily with a spiral ratchet screwdriver. Simply push down on the spring-loaded shaft to turn the driver bit. Adjust the 3-position switch to drive screws, remove screws or to lock the shaft for use as a conventional screwdriver. The 9-in.-long driver (\$10) comes with three drill bits, two slotted screwdriver bits and a No. 2 Phillips bit—all of which store in the handle. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.
- 7. Torx—You may have noticed the use of a 6-point, star-shaped fastener on most late-model cars and trucks. These fasteners, called Torx screws, are also found on lawn and garden equipment, appliances and televisions. The Torx driver shown (\$5) is designed for use with T-20 size screws. It has a 3-in.long chrome-vanadium steel blade and a hexagon-shaped plastic handle. For further details, contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.
- 8. Crutch pattern—The large, flattened-oval handle of the crutch-pattern driver allows you to deliver tremendous torque to stubborn screws—especially in tight quarters since the tool is only 5¼ in. long. The 2½-in.-wide maple handle is fitted to a 1½-in.-long No. 2 Phillips driver. It's available for \$5.95 from Woodcraft Supply, 41 Atlantic Ave., Box 4000, Woburn, MA 01888. A crutch-pattern slotted screwdriver is also available for \$3.95.
- 9. Indestructible screwdriver—If you're tough on tools, try this superdurable screwdriver. It features a solid steel blade that extends all the way through the handle. Two hardwood inserts form an oval grip. A set of three slotted screwdrivers, with blade

lengths of 4, 6 and 8 in., costs \$19.90 from Constantine's, 2050 Eastchester Rd., Bronx, NY 10461.

 Extra-torque screwdriver—This British-made tool features the proven design of a traditional cabinetmaker's



14 Screw-holding driver; 15 Angle-driver; 16 Flexible-shaft driver; 17 Magnetictip driver; 18 Screw-holding driver; 19 Dial-a-tool; 20 Superlong driver; 21 Yankee screwdriver; 22 Giant screwdriver

screwdriver, but the handle is made of tough acetate. The oval-shaped handle and tapered neck provide a comfortable, powerful grip. A set of six drivers, including four slotted and two Phillips, costs \$11.99 from Fine Tool Shops, 20 Backus Ave., Danbury, CT 06810.

11. Worked-oval screwdriver—Here's another improved version of the traditional cabinetmaker's screwdriver. This tool features a wider, flatter handle to produce greater torque with less effort. The precisely milled blade has a flattened portion to accept a wrench for additional power. The blade is secured to the beech handle by a solid brass ferrule. A set of five slotted drivers costs \$49.30 from Garrett

Wade, 161 Ave. of the Americas, New York, NY 10013.

- 12. Workmaster—Stanley's popular Workmaster line of screwdrivers features tapered, triangular-shaped plastic handles designed to deliver greater turning power with less effort. The tools have high-strength boron steel blades with precision-ground tips. The Workmaster line includes a variety of slotted, Phillips and ratchet drivers including a versatile magnetic tip tool (see No. 17). Shown is a No. 1 Phillips driver (\$1.79). Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.
- 13. Insulated screwdriver—Designed for use by electricians, this fully insulated driver has a blade that is sheathed in a plastic sleeve. Only the very end of the tip is exposed. Insulated screwdrivers are intended only as a protective measure against shorting out a circuit. Never depend on an insulated driver to protect you from a constant flow of electricity. The 3-in. driver shown costs \$4.49. It's also available in 4-, 6- and 8-in. models. Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

14. Screw-holding driver—Use this clever tool to start slotted screws in tight, restricted spaces. The driver has two spring-loaded metal jaws that hold a screw securely on the tip to permit easy starting. Push the collar on the blade forward to spread open the jaws. Release the collar and the jaws close automatically. The screw-holding driver is available in 4-in. (\$5) and 5-in. (\$6) models. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.

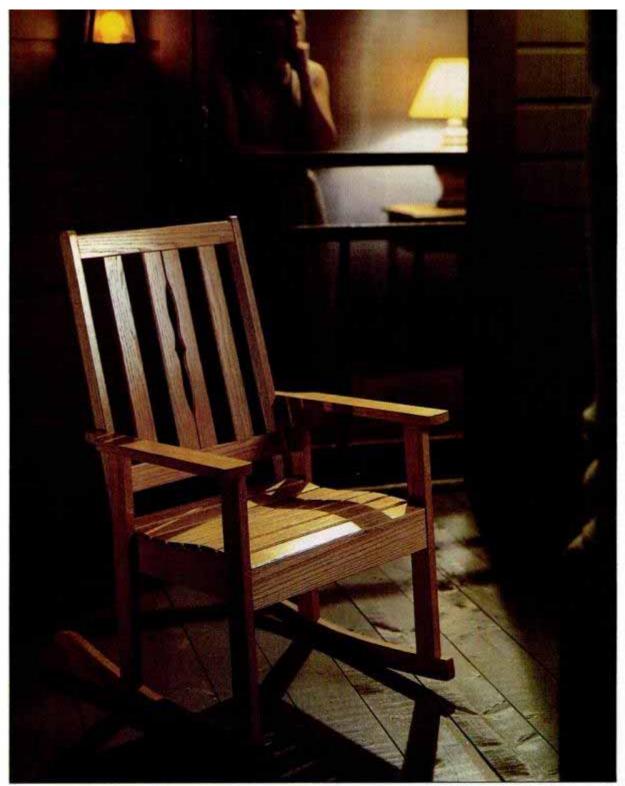
15. Angle-driver—Called a Skewdriver, this unique tool makes it easy to work in corners and at awkward angles. The tool's geared mechanism holds a driver bit at a 60° angle to the blade. Simply turn the handle to rotate the bit. The tool comes with two slotted bits and two Phillips bits that store in the hollow handle. It's available for \$18.90 from Brookstone, 782 Vose Farm Rd., Peterborough, NH 03458.

16. Flexible-shaft driver—The 1/4in.-dia. shaft of this slotted driver
(\$9.64) bends to work on hard-to-reach
screws. The 7½-in.-long tool has a hardened steel tip and a 3-in.-long fluted
plastic handle. It's also available with a
Phillips tip. Contact U.S. General, 100
Commercial St., Plainview, NY 11803.

17. Magnetic-tip driver—If you're tired of carrying four or five screwdrivers in your pocket, then try this versatile 5-in-1 driver. It comes with two slotted bits, two Phillips bits and a T-15 Torx bit—all of which store in the hollow, triangular-shaped handle. The 4-in.-long aluminum shaft is fitted with a magnet that allows the bits to hold steel screws securely. The driver costs

(Please turn to page 212)

Материлл, зашищенный авторским прав



SLOW MOTION

there are those hot, quiet summer nights when the air is still and humid and for some reason time seems to slow down. Those are the nights when you can see people sitting on back porches from Vermont to Virginia to rural Louisiana drinking something cool, watching the sun go down and wishing the air would move. It almost

This easy-to-build solid oak rocking chair is ideal for summer porch sitting.

BY NEAL BARRETT

Design: Harold V. Jones Color photos: J.R. Ross Black and white photos: Neal Barrett Technical art: Eugene Thompson Stylist: Gabe Herrick seems like the porch rocker was invented for nights like these. Its slow back-and-forth motion creates just the light breeze everyone wants.

Our version is based on an antique from the small town of Kemp, Oklahoma. It's made of solid red oak and was slightly refined for building ease. Do keep in mind that all parts except the seat and back slats

SLOW MOTION

are ¹³/₁₆ in. thick. The slats are ¾ in. thick. So if you don't have access to a thickness planer, be sure to have your lumber supplier dress some stock to the smaller size.

Stock preparation

Begin construction by using the jointer to true one edge of each piece of stock. Use the table saw to rip to width all straight chair parts. Then use the table saw and miter gauge, or radial-arm saw, to crosscut each piece to specified length. When possible, make use of stops on the saw for cutting multiple pieces of one size. Cut these from scrap wood blocks and attach to the saw fence—in the proper position—using a small C-clamp.

Following the drawing, make fullsize templates on stiff paper for each of the curved parts: the rockers, seat supports and armrests. **Note**: Two-dimensional grids are usually the best way to illustrate irregular shapes on a drawing. But when they are not printed full-size, they must be changed to the proper scale before they can be used. One good way to do this is to take the scale on the drawing—in this case, each square equals one inch—and draw this grid on a piece of heavy paper or cardboard. Then draw the contours of the piece onto the grid so the shape matches the drawing. When complete, simply cut out the shape, position it on the workpiece and draw the outline.

Once the parts are drawn onto their respective blanks, use the band saw or sabre saw to cut the shape. Be careful to cut on the waste side of the line. After all pieces have been cut, use a spokeshave or drum sander to remove the saw marks and refine the profile of each piece.

Boring dowel holes

Lay out the position of the dowels in the seat-support frame member. Clamp each seat support in the vise and use a doweling jig to bore the $\frac{5}{16}$ -in.-dia. holes in the ends of each piece. Use the drill press (or a portable drill and guide) to bore the holes in the front and rear seat-support rails. Clamp a fence to the table to ease positioning the work and readjust the fence for each row of holes. Accuracy is crucial if the holes are to align properly.

Again, use the doweling jig to bore the holes for the armrest and post joints, readjusting the jig as necessary to achieve proper hole locations. To bore the holes for the rocker and post dowel joints, begin by clamping the two pieces to the worktable in their proper relative position. Mark the dowel locations on the surface of the pieces and bore a hole for each dowel through the rocker into the post.

A piece of masking tape on the drill bit can serve as a depth stop for the holes. Make sure that these holes are bored parallel to the surface of the work. By clamping the parts together, then boring simultaneously, you are guaranteed proper alignment of the dowels. Just make sure the drill bit aligns precisely with the pencil marks as shown in photo No. 5.

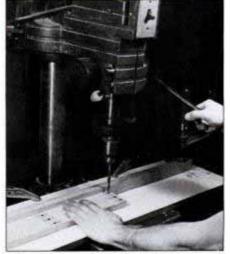
Subassemblies

To assemble the armrest, post and rocker, begin by spreading enough glue in the post dowel holes to cover the hole walls. Be careful to avoid filling the holes with glue, as this would prevent the dowels from seating completely. Lightly apply glue to each dowel and tap into place in the post. You'll need 1½-in.-long dowels for the armrest joint and 3½-in.-long dowels for the rocker joint.

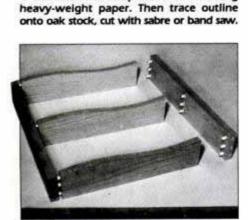
Next, apply glue to the armrest and



2 Cut seat-support members to shape then clamp in bench vise. Bore dowel holes in ends using doweling jig.

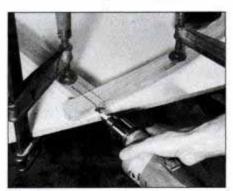


3 Carefully lay out matching dowel holes in front and back seat rails. Then bore using drill press or portable drill and guide.

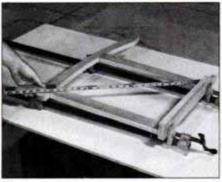


1 Make full-size template for rocker using

4 Dry-assemble all seat parts to check for proper fit. Apply glue to holes and dowels then clamp with bar clamps.



5 Clamp rocker and post to bench and lay out dowel holes as shown. Bore holes using pencil marks as alignment guides.

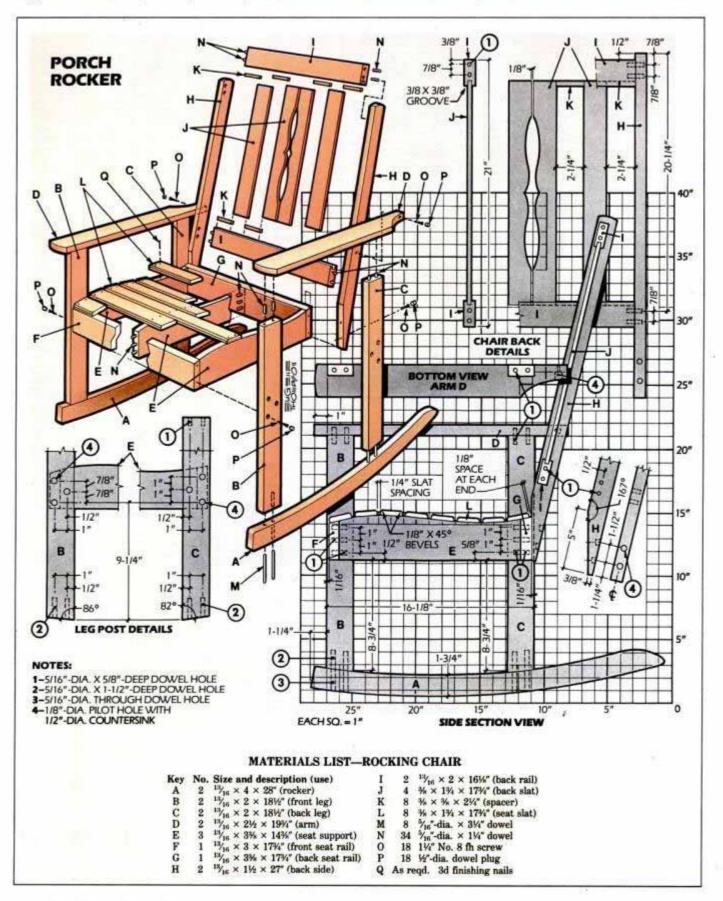


6 Glue and clamp together rocker, posts and armrest, then check for square by comparing diagonal measurements.

rocker dowel holes and align the pieces over the dowels. Use bar clamps to draw the joints tight and check the assembly for square by comparing opposite diagonal measurements. If the assembly is not square, readjust the clamps until it is, then set aside until the glue has dried. Repeat the procedure for the opposite side assembly. The seat-support frame can be assembled in like manner. Again use bar clamps to draw the joints tight and check that the frame is both square and flat.

While the glue sets in the above parts, use the dado blade in the table or radial-arm saw to plough the % × %-in. groove in the back rails to receive the back slats. Use the doweling jig to bore the dowel holes in rail ends and in the back side members.

Make a cardboard template for the center back slat cutouts and trace the pattern onto the two center slats. Use a



SLOW MOTION

band saw or sabre saw to cut the shape and sand each piece to remove the saw marks. Then rip a % × % × 24-in. strip to be used for the fillers between the slats in the rail grooves. Cut the filler strips to specified length given in the materials list.

Begin assembling the back by spreading glue in both rail grooves. Place filler strips and slats in position using small clamps to draw fillers into the grooves. Note that there is no filler between the center slats because the space is only ½ in. wide.

Apply glue to dowel holes in back sides and rail ends and slide the dowels into place. Use bar clamps to draw the joints tight. Again, check the assembly for square and readjust the clamps if necessary.

Next, use a chamfer bit in the router table to cut edge bevels on all the seat slats. If you don't have a router table, they can be cut on a table saw or formed by hand with a block plane.

Final assembly

Bore screw pilot holes as indicated for

7 Cut seat-back rails to size. Then using dado blades in table or radial-arm saw, cut groove in one edge to receive back slats.

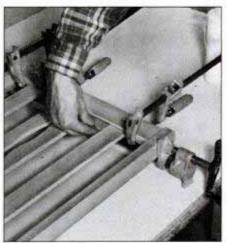
attaching all the chair parts. Use a ½-in.-dia. drill bit to countersink each hole approximately ¾ in. deep. Then cut covering plugs for all the screw holes from ½-in.-dia. wood dowel stock.

Sometimes, woodworking supply houses will stock red oak dowels in addition to the standard birch variety. If you can't find these, then either use the birch dowels for the plugs or cut your own red oak plugs for solid stock using a plug cutter.

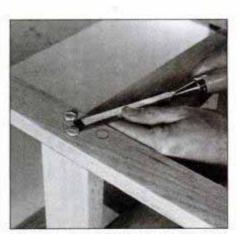
Be sure that the plugs are at least ¼ in. longer than the holes are deep, so they will extend above the surrounding surface and can be trimmed flush later with a sharp chisel.

Attach one rocker, post and armrest assembly to the seat support frame using 11/4-in. No. 8 fh screws. Put a small amount of glue in each hole and tap in a plug to cover the screw. Repeat the same procedures for the other side.

Attach the seat slats to the seatsupport frame using 3d finishing nails. Use a nailset to-drive the nailheads below the surface and fill the nail holes with red oak-colored wood putty. After it's dry, sand the putty flush to the surface.



8 Glue and clamp seat-back rails to sides. Then glue slats and spacers into grooves. Clamp spacers in place until glue dries.



11 Make sure screws are driven tight, then cut plugs and glue into holes. When glue dries, trim flush with sharp chisel.

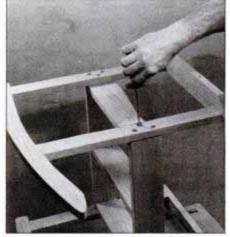
Attach the back to the seat frame and armrest with 11/4-in. No. 8 fh screws. Again apply glue to the holes and tap in plugs. When the glue has dried in the plug holes, use a sharp chisel to trim the plugs flush with the surrounding wood surface.

Remove any glue squeeze-out on the whole chair using a sharp chisel, then sand the entire chair with 120-grit sandpaper. Carefully brush off the entire piece and sand with 220-grit paper. Make certain that you wipe off all the dust with a tack cloth.

Finishing

To finish the chair, we chose a satin polyurethane by Benjamin Moore. Thin the first coat 33 percent with mineral spirits for good penetration in the wood. Allow this coat to dry fully and apply the next two coats full strength, sanding lightly with 220-grit sandpaper between coats. Allow each coat to dry overnight and be sure to wipe clean with a tack cloth.

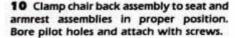
The final finish can be rubbed with 4/0 steel wool if desired to remove any dust contamination and to achieve the surface luster you desire.



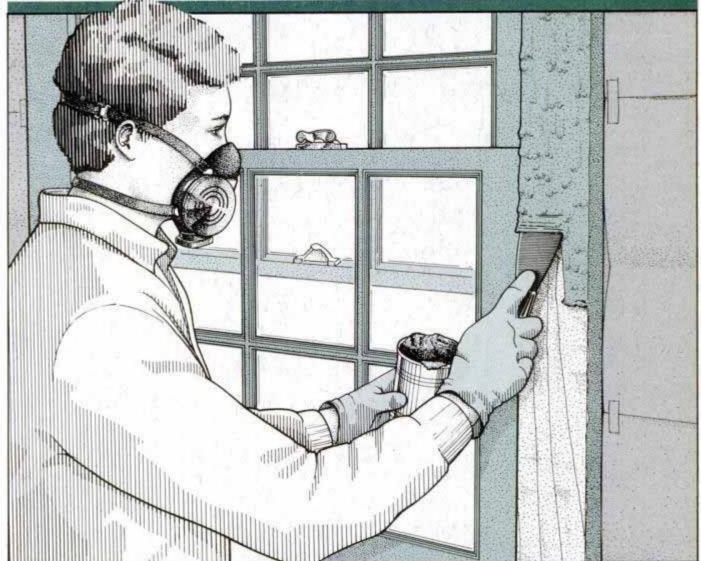
9 Join armrest assembly to seat-support assembly with screws. Countersink holes so screws can be covered with plugs.



12 Nail seat slats to support frame using 3d finishing nails. Set nailheads and fill with red oak-colored wood putty.







How To Strip WOODWORK

Removing old paint from woodwork is certainly one of the most time-consuming—and aggravating—tasks anyone can undertake. Of course, the rewards are great, too, especially if you are working on a classic home where the elaborate architectural details have disappeared after years of careless repainting. The crispness of line and subtlety of design are nothing but blurs, only a hint of what they used to be.

There are many different ways to approach this job and you should con-

BY ROSARIO CAPOTOSTO AND MARK McCAIN Illustrations by George Retseck

sider your alternatives carefully before going ahead. You should also factor in how much time you have available, how much money and how much patience. All of these, of course, depend on the size of the job.

If you are involved in restoring an old house and want to strip all the woodwork bare so it can be covered with stain or a clear finish, you are looking at an incredible amount of work. And the expense is no small matter. Buying chemical remover gallon after gallon for a job like this can break just about anyone's budget. For these reasons, most people will opt for removing all the trim, pulling out the nails from the backside and sending it all to a commercial stripper where the boards are dipped in vats filled with remover. This system works well, but it does have

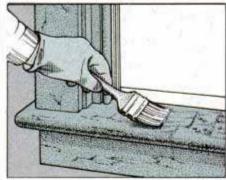


1 If old paint or other finish is loose on surface, first remove flaking areas with a scraper. Hold tool at low angle and pull.

some drawbacks. It can be expensive and when the boards return, they usually require a great deal of sanding, filling and repair to bring the stock into proper condition for a good finish.

On smaller jobs, for instance one or two rooms, the task is much more manageable. But still, you should seriously consider how important a natural finish is to you. Removing the last 10 percent of the old paint from a sash or molded casing can take nearly as much time as the first 90 percent. By repainting a properly prepared surface, the architectural detail will come through as if it were new, and you can save vourself a good deal of effort. It depends on the condition of the old paint.

If you only have a couple of coats on the woodwork and the top coat is simply veiled with grime and some minor flaking, then cleaning, scraping and sanding will normally suffice. But if the old paint has serious defects such as excessive peeling, blistering, alligatoring, or simply too many layers, you will have to go the stripping route.



2 Apply semipaste paint remover to horizontal surfaces using an inexpensive brush. Apply in a thick layer, don't overbrush.

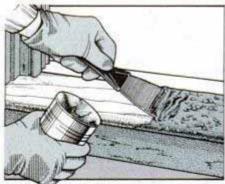
Stripping methods

There are three basic methods for removing paint. The first is by using paint and varnish remover. Available in liquid or semipaste, these chemical formulations soften the paint so it can be scraped off, or in the case of water soluble brands, washed off with a stream of water. The second method is by mechanical means. This involves the use of hand scrapers and power sanders.

The third is by using heat. When heat is applied directly to a painted surface, the paint is softened and can be scraped off with a putty knife. For this method, you should use only a flameless heat gun or an electric heat plate. An open flame torch should not be used in any circumstance. It presents a dangerous fire hazard inside the house and it's almost impossible to use without frequently scorching the wood.

Chemical strippers

Of the three methods, the use of a chemical paint remover is generally favored because the procedure requires



3 When paint wrinkles, remove by sliding dull-edged putty knife under sludge at low angle. Clean off knife in empty can.

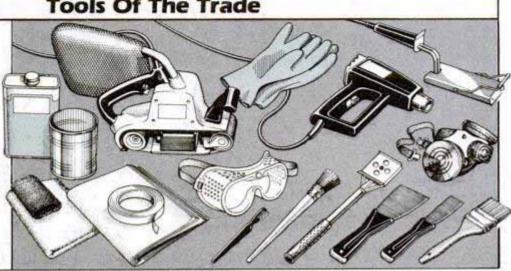
very little skill and cannot harm the wood, unlike the mechanical or heat methods.

There are two basic types of chemical removers: liquid and semipaste. And among them you can select ones formulated for solvent cleanup, water cleanup or no cleanup. Water cleanup removers work well but their use is often limited to outdoor applications because it's usually impractical to wash off the residue with a jet of water indoors. The no-cleanup removers also work well, but sometimes leave a bit of residue which must be cleaned with a solvent. For general purpose work, the solvent removers are your best bet.

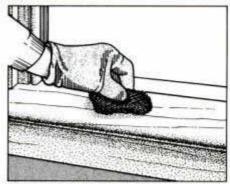
Removers are available in both flammable and nonflammable varieties, and since both kinds perform equally as well, the obvious choice is the latter, particularly for indoor applications. All removers are highly toxic so every precaution should be taken to protect the skin and eyes as well as the respiratory system. Be sure to read and observe all label warnings on the product

Tools Of The Trade

Depending on the stripping techniques you use, here's a sampling of required tools (from left to right): paint remover in liquid or semipaste form, empty can for cleaning the putty knives, steel wool and rags for final cleanup, newspaper and masking tape to protect surrounding surfaces, belt sander for broad flat surfaces, gloves to keep remover off hands, goggles for eye protection, heat gun or electric heat plate to soften paint, respirator with vapor filters, toothbrush and sash brush for tight spots, paint scraper, putty knives in several sizes and an old paint brush.



HE BETTER



4 Use steel wool to remove sludge from crevices and depressions where putty knife won't reach. Wear gloves to protect hands.

you buy. Also wear gloves, goggles, long-sleeved shirts and a respirator with appropriate vapor filters.

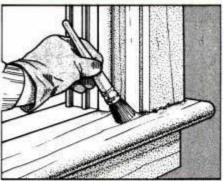
The liquid removers are generally fast acting and are used primarily on horizontal surfaces. The semipaste types work a bit slower but are better suited for vertical surfaces because they will cling without dripping.

Using a chemical stripper

To strip paint, apply a liberal coat of remover—the thicker the coat the better. Liquid remover can be poured onto a horizontal surface then spread with a brush or spatula. Semipaste remover is poured into a wide mouth can then applied with a fully loaded brush. With either type, the aim is to lay on the remover with as little brushing as possible. When applied, a waxy film forms over the surface of the material to retard evaporation, which allows the active ingredients to work into the paint. Overbrushing disturbs this film and thereby weakens the action.

Allow the remover to stand undisturbed for about 20 to 30 minutes or until the surface has wrinkled; this indicates the paint has softened. Then, use a putty knife to lift and slide the sludge off the surface. Hold the knife at a low angle and push it gently in the direction of the grain when possible. The corners of the knife should be slightly rounded in order to prevent gouging. You can either sand or file these corners to take away the edge.

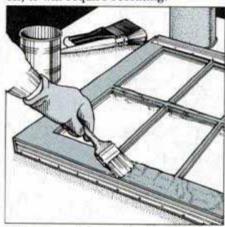
On irregular surfaces, a pad of 2/0 steel wool is used to remove the sludge. For crevices, corners and confined areas, you can use a toothbrush, oval sash brush or even a pointed or flat-ended dowel. If the first application has not completely penetrated and softened extra tough or multiple layers of paint, simply apply a second coat of remover. Small remaining patches of paint can



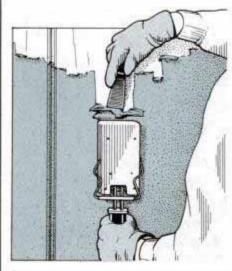
5 Use sash brush—or old toothbrush—to remove sludge from corners or confined areas. Brush can be cleaned with solvent.

usually be removed with steel wool moistened with remover.

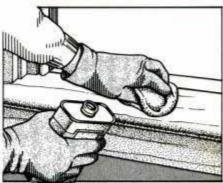
It is best to work no more than 2 or 3 sq. ft. of surface at one time because if the remover dries before you scrape it off, it will require recoating.



7 Remove window sashes from jambs before stripping paint. Otherwise, areas that fall behind sash stop will be inaccessible.



8 Electric heat plate works well on broad, flat surfaces like doors. It softens paint quickly but has tendency to scorch wood.

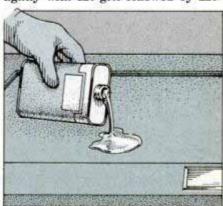


Once residue is removed, thoroughly clean surface with solvent-soaked rag. See container label for appropriate solvent.

The final step is to remove all residue from the surface. For solvent cleanup removers, this is usually done with paint thinner, but be sure to check the label instructions and use the recommended neutralizer. Saturate clean toweling or burlap and thoroughly cleanse the surface. A once-over will rarely be sufficient, so turn the rag over often or switch to fresh ones as needed to avoid redepositing any of the residue. Any remaining trace on the wood will interfere with adhesion and drying of the new finish later.

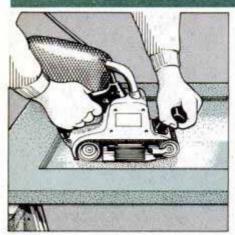
With water-solvent removers, you usually have the option of removing the sludge with a putty knife and following with a brisk water-hose rinse, or you can use the jet of water to remove the sludge. The latter results in a messy runoff that can mar the surroundings, so choose your location with this thought in mind. Also, some water-cleanup removers require no additional treatment, while others call for a final wiping with solvent. Check the label on this score.

When the stripped wood has thoroughly dried, usually overnight, sand it lightly with 120-grit followed by 220-



9 If using a chemical stripper, remove door and lay on horizontal surface. Use liquid type instead of semipaste.

THE BETTER



10 Use belt sander on wide, flat areas that have just a coat or two of paint. Keep sander moving or it will gouge surface.

grit paper to prepare it for refinishing. Wood that has been water-washed will require extra sanding because moisture always raises the wood grain. Water can also delaminate thin veneers and weaken nonwaterproof glue joints. So, remember this when selecting a remover.

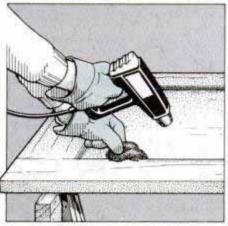
Mechanical stripping

A portable belt sander will remove paint fairly quickly from broad, flat surfaces. However, in order to obtain respectable results without marring the surface, proficiency in handling the tool is necessary. This sander cuts aggressively and could easily dig too deeply.

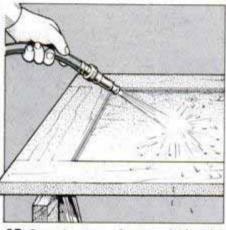
Practice using it on scrap, if necessary, until you acquire a good feel for "landing" the sander on the surface softly and evenly. Once contact is made, the sander must be kept in constant motion, on a level plane and with equal pressure applied to both handles. Make back-and-forth passes within comfortable reach of your arms, releasing the pressure slightly at the end of each pass before making the return trip. This feathers the bite, preventing gouging.

Use an 80-grit open-coat abrasive belt to remove a paint film a couple of layers thick. Then make a few passes with 100- followed by 120-grit belts to smooth out the coarse belt marks. Or you can use a finishing sander for the final smoothing. To strip extra-thick layers, start with a 50- or 60-grit belt.

Small areas of loose paint can be effectively removed with a pull-type paint scraper. This has a square, 4-edged reversible blade that allows for plenty of scraping between sharpenings. Two cutting edges are serrated and two are straight. The serrated edge



11 Heat gun is useful for stripping contours and irregular shapes. Soften paint with hot air, then remove with steel wool.



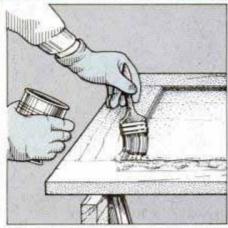
13 One advantage of water soluble strippers is that the workpiece can be washed off quickly outside with a garden hose.

chips the paint faster but leaves grooves in the surface of the wood. The straight edge is used for lighter scraping or to smooth out the marks left by the serrated edge.

This tool functions best when the angle is held close to—but angled slightly away from—the surface. Begin the scraping from a broken edge of paint and apply firm pressure as you pull the tool along. You'll know the grip angle is correct when the chips fly with little effort.

Stripping with heat

An electric heat plate rests on the surface of the woodwork and concentrates heat on the paint. This softens a path about 3 in. wide that is removed with a putty knife. It performs well on wide, flat surfaces and is held on the surface for about four to eight seconds, depending on the thickness of the layer. When the paint has softened, the plate is shifted to the adjacent area. In the meantime, the knife is used to lift and



12 Sometimes not even a heat gun will remove every trace of paint. Follow stubborn areas with a chemical stripper.

remove the softened paint. Prolonged heating will scorch the wood.

The heat gun is a good alternative to the heat plate and it's particularly useful for softening paint on narrow or irregular surfaces such as moldings or grooves. Hold the nozzle several inches from the surface and advance it very slowly. As you do this, follow along with steel wool or an appropriately shaped scraper to remove the softened paint. Wear heavy-duty protective gloves and make sure to keep the following hand clear of the hot air stream. These guns can deliver temperatures of 1000° F. With a little practice they are very easy to use.

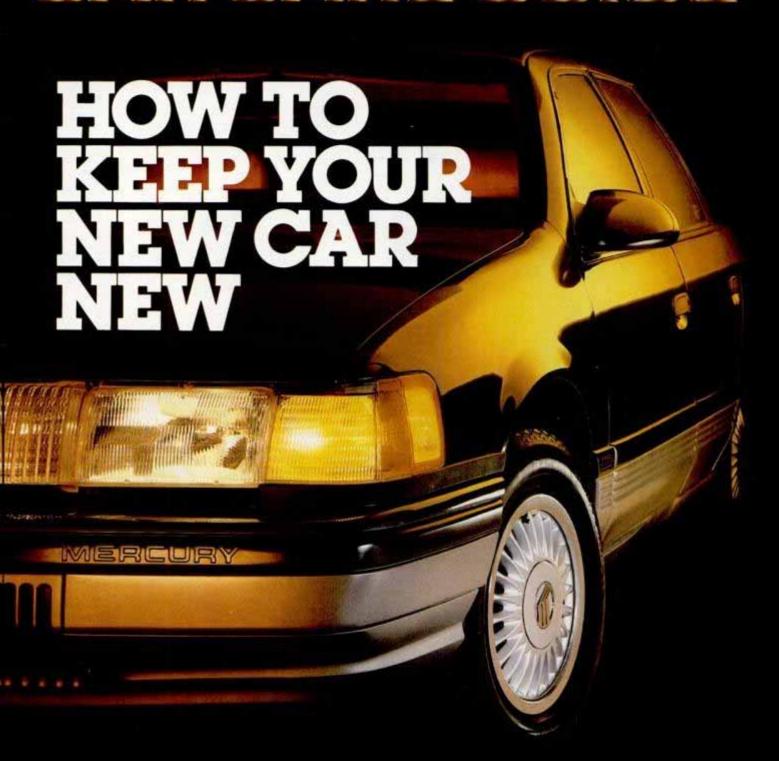
Safety note

If you have a house built before 1950, you're likely to encounter lead-based paint on your woodwork. Health experts regard it as a serious poison and that's the way you should treat it. Keep these points in mind:

- Do not eat or smoke near the worksite. Treat scrapings, dust, chemical residue and cleanup material as toxic waste. Discard them properly and immediately.
- High temperatures can release toxic lead vapor. If you use heat paint removal methods, provide good ventilation and wear a respirator.
- Sanding and scraping releases lead paint dust into the air. Wear goggles, gloves, a long sleeved shirt, long pants and a double-cartridge filter mask. Close off the room where you are working, but provide sufficient ventilation. Very fine lead dust will continue to sift down after you are through. Therefore, do not occupy the room for at least two days. Vacuum the room thoroughly before putting it to use.

Popular Mechanics MAY 1986

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Car Care Guide

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CAN YOU STILL DO IT YOURSELF?

What you can repair on new cars and what you shouldn't touch.

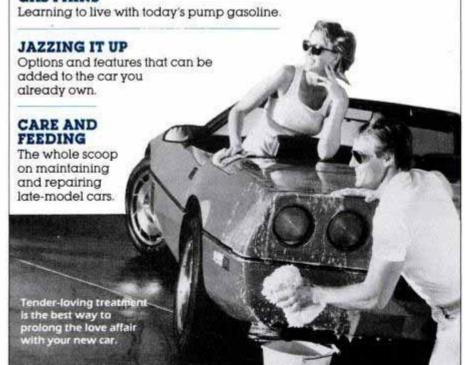
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Ins and outs of getting all that the new car warranty offers.

GAS PAINS



Cover: There's a special thrill to the purchase of a gleaming new car far beyond the need of basic transportation, and Mercury's Sable delivers the freshest profile of this year's crop. Photo by Bill Ashe.

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FOUR VALVE PER CYLINDER. COMBUSTION CHAMBERS

INTERCOOLER

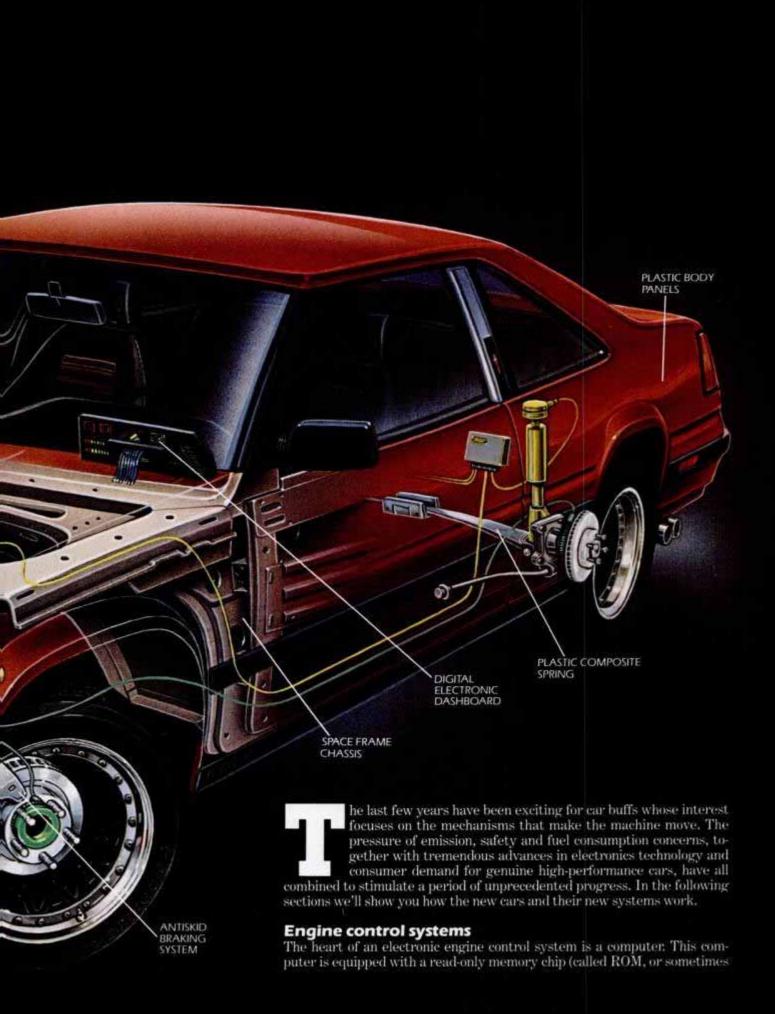
TURBOCHARGER

TRANSAXLE

PORT FUEL

Della

ELECTRONICALLY CONTROLLED SUSPENSION



PROM, for programmable read-only memory) that provides the computer's central processing unit (CPU) with a system plan and operating parameters for the engine. Armed with this information, the computer knows how to run the engine under different driving and atmospheric conditions.

The computer determines what those conditions are by means of electronic sensors that measure things like engine coolant temperature, throttle opening, manifold pressure, barometric pressure, air flow into the engine, engine speed and other factors. By combining this information with the directions in ROM, the computer makes its operating decisions.

The computer then directs its output signals to the various control points. In most cases, these include the air/fuel mixture, ignition spark timing, exhaust gas recirculation, emission canister purge, idle speed, air pump switching, torque converter clutch application and a variety of other engine accessories.

The computer can control an engine much more accurately than mechanical devices like carburetors, conventional distributors or vacuum-triggered components. This means engineers can tune the engine much closer to the limits imposed by spark knock, excessive leanness and other factors. If everything works as designed, the result is better fuel economy, improved driveability, reduced emissions and higher power output.

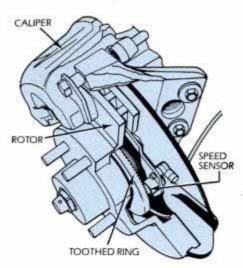
Most computer operating programs include a diagnostic routine, which checks various components as well as the computer itself as you drive. When it recognizes a fault, it stores a code in its memory. The technician who repairs the car can then read the trouble codes, which help him pinpoint the problem.

Distributorless ignition

Because the computer controls spark advance according to the parameters in ROM, a distributor is an unnecessary complication. All the computer needs to determine spark timing is input from a crank position sensor on the flywheel or harmonic balancer. The computer controls primary circuit voltage to the ignition coils, causing the plugs to spark at the optimum time. This type of system can be designed with one ignition coil per cylinder, as used on future Saabs, or one for every two cylinders, as on the current Buick V6.

Fuel injection

The computer can regulate air/fuel mix of either a fuel-injection system or a carburetor fitted with a computer-controlled enrichment device. However, since this type of control is very easy to achieve with fuel injectors that can be switched on and off to regulate mix,



Antiskid brakes electronically sense lockup and back off fluid pressure to compensate.

more and more cars are being built with fuel injection as standard equipment. What's more, direct-port fuel-injection systems (with one injector per cylinder) offer considerable advantages over carburetors in high-speed mixture volume and distribution accuracy.

Where port injection is too expensive, throttle body injection (TBI) systems are used. These mount one or two injectors on a throttle plate housing in the center of an intake manifold. This system adapts easily to an engine that was originally designed for a carburetor, but does not offer the accurate distribution or high-speed performance

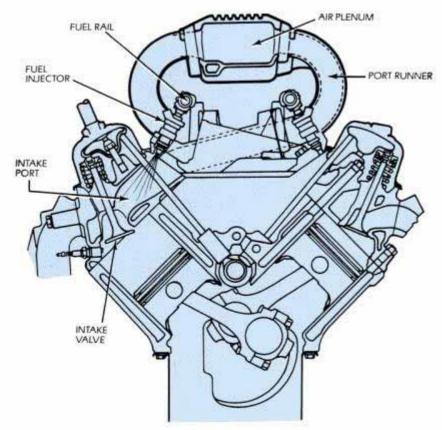
benefits of a direct-port system.

Fast burn combustion chambers

Advances in cylinder-head combustion chamber design have helped engineers deal with the problems that arose when lead-free, low octane fuel became the standard. By providing turbulent fuel/ air mix at low engine speeds, the socalled fast-burn design combustion chamber achieves a more complete combustion in a shorter time. Consequently, less heat is transferred to the head, allowing the use of a higher compression ratio or higher turbocharger boost pressure even when fuel octane ratings are moderate. Because combustion is improved, fuel economy numbers and low speed torque also benefit.

Dual overhead cams

Dual overhead camshaft (DOHC) engines have been used for more than 70 years. Because the position of the cams allow intake and exhaust valves to be placed on opposite sides of a hemispherical or pentroof combustion chamber, twin-cam engines are ideal for racing applications where they offer big advantages in high rpm mixture flow. What's more, because valve train mass is reduced, higher engine speeds can be achieved. Today, with the demand for high performance from small engines, DOHC passenger-car engines are becoming common.



Port fuel injection systems deliver atomized gas just ahead of the intake valve. Air flow is routed through long tuned intake runners, which optimize all-around performance.



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The DOHC design offers some durability benefits as well, because failureprone pushrods and rocker arms can be eliminated. The reduced mass of the valve train means that lower tension valve springs can be used.

Four-valve cylinder heads

Dual overhead cams lend themselves well to the use of a 4-valve-per-cylinder combustion chamber. Arranged in pairs in a pentroof chamber, the valves can be operated directly by two cams bearing on bucket-type tappets.

A 4-valve head offers excellent mixture flow at high engine speeds as the total circumference of two small valves exceeds that of a single large valve sized for the same engine bore size. This allows the 4-valve head to fill the cylinders much better at low valve lifts, when the valves first start to open.

When used with a butterfly throttle plate in one intake port of the pair used for each cylinder, a 4-valve head improves engine performance throughout the entire rpm range.

At low speeds each cylinder breathes through a single intake valve that ensures high mixture velocity for a good throttle response. At high rpm, the throttle plate opens to allow more flow, maximizing horsepower. The Toyota 16-valve Four uses this setup. Some motorcycle engines with four valves per cylinder use oil pressure to activate the rocker arm for the second intake valve, providing a similar effect.

Turbos

Turbochargers—rare just a few years ago—are now very common. Using an exhaust-driven turbine to drive a centrifugal compressor, they provide a high-pressure air charge in the intake manifold. This allows more complete filling of the cylinders, increasing the engine's horsepower.

The turbo's popularity is due to the present-day need to produce more power from small engines, and has been made possible by advances in turbo engine technology. Turbos require a high volume of exhaust gases to operate efficiently, so turbocharged engines act like normally aspirated engines until rpm and load reach a certain level. By regulating exhaust flow with a wastegate and shaping the turbine inlet and turbine blades for maximum efficiency, this "boost lag" time can be reduced. Cooling the turbocharged mix with an air-to-air heat exchanger, called an intercooler, will result in a denser and more powerful charge being delivered to the engine.

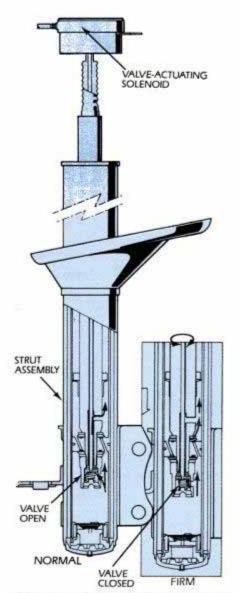
Future turbochargers will be equipped with adjustable turbine blades or inlet areas to further reduce lag. A limited number of variable ratio turbochargers are in use today.

Superchargers

Engine-driven superchargers are beginning to appear on passenger-car engines as well. Unlike turbos, positive displacement blowers provide maximum boost at very low engine speeds. This gives excellent throttle response with no lag, but fuel economy suffers. The use of an electronically controlled bypass valve that equalizes pressure above and below the supercharger, in combination with a supercharger drive clutch, has solved that problem.

Computerized suspension and drivetrain

Computer controls are being applied to components outside the engine compartment as well. A number of Japanese cars now offer electronic systems that adjust shock absorber damping rates automatically. These allow the driver to select a NORMAL or SPORT setting—or he can choose an automatic setting that leaves it up to the comput-



Choice of normal or sport suspension is accomplished by turning a valve in the strut's hydraulic circuitry with a solenoid.

er. With the system on the AUTOMATIC setting, sensors provide information on car speed, acceleration, braking, cornering and road surface, and the computer chooses the correct shock valving.

Automatic transmission gearshift points are another candidate for computer control, and the automakers have responded accordingly. Utilizing the same hardware as the engine control computer, transmission regulating devices determine optimum shift points based on engine speed, load and throttle position for better fuel economy.

Integral chassis and space frames

Today, most cars have integral body/ chassis units in which both the body and its inner panels serve as structural members. Properly constructed, this design is more rigid than the weighty metal frame rails and non-load carrying body used in the past. But even minor crash damage requires special welding techniques, and realignment of the vehicle can only be done on special equipment. Rust in critical areas can dangerously weaken suspension and drivetrain mounts.

For its Fiero sports car, Pontiac has abandoned the integral chassis in favor of a stamped steel space frame and plastic body panels. The space frame consists of welded steel stampings, shaped like the tube chassis and roll cage of a NASCAR stock car. The plastic panels are more resistant to damage than metal and are easily replaced.

Antilock braking systems

In keeping with the do-everything-better philosophy of today's engineer, a number of vehicles are now equipped with antilock braking systems (ABS). ABS prevents skids caused by wheel lockup during braking.

An induction-type sensor and a toothed ring, mounted on the wheel or rear axle pinion shaft, measure wheel speed. The computer analyzes the information from each wheel sensor and determines the amount of wheel slip that should be allowed. The computer then controls brake-line pressure by means of solenoid valves, releasing pressure to a particular wheel when it just begins to lock.

Coming attractions

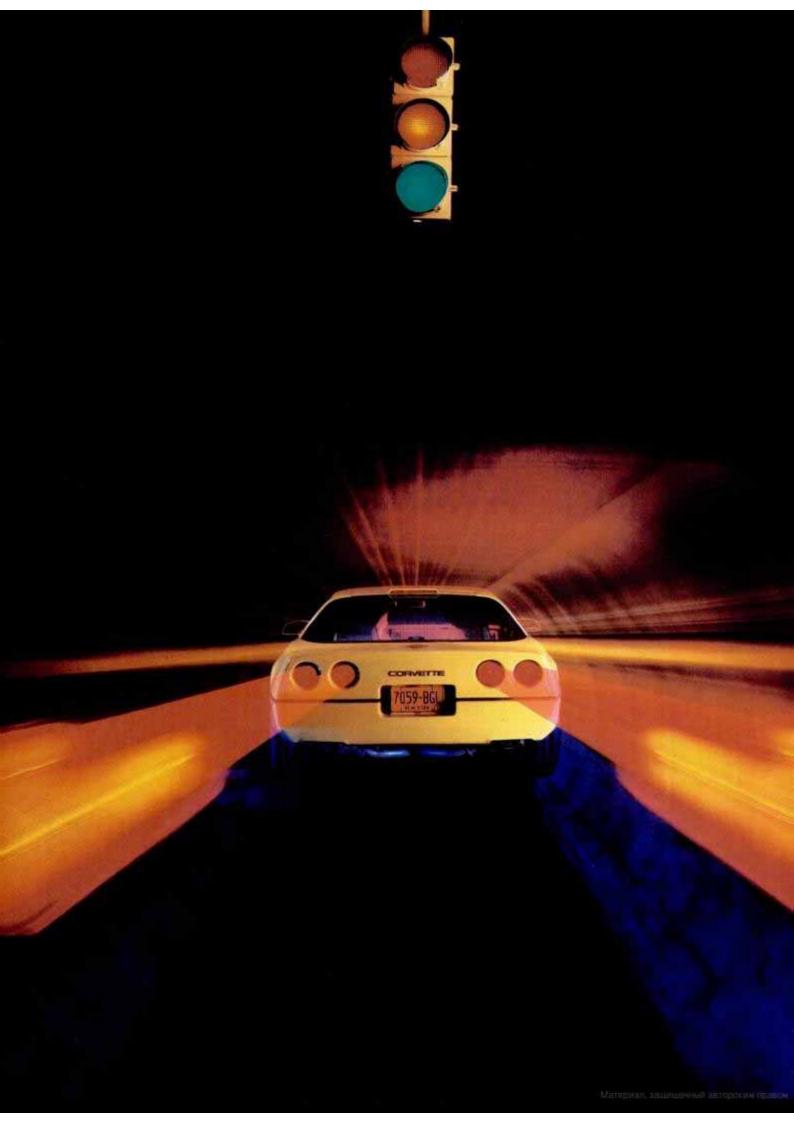
The future should provide even more excitement for the high-tech enthusiast. Electronic controls will be expanded to include more systems, while diagnostic functions will become more precise. Engineers are discovering ways to reduce internal engine friction, resulting in significant power and economy gains.

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A long life for your new car depends on proper break-in procedures.

ome carmakers claim their 1986 models don't have to be broken in; others state that they do. As you'll see in our chart, manufacturers suggest some period of restraint to prevent unnecessary stress on new vehicles.

During the break-in period, your goal should be to keep load levels low while the internal engine parts get acquainted with each other, as wear is most

rapid in this period.

When carmakers talk about severe service conditions, they are referring to almost every driving condition known to modern man, from off-road racing to normal stop-and-go commuting, short trips in which the engine barely warms up, trailer towing, and so on. Their idea of normal service is limited exclusively to long trips at 55 mph on level roads. In other words, the vast majority of new car owners should follow the severe service recommendations.

As a general rule, most carmakers recommend that you not only avoid drag race starts and panic stops for the first 300 to 1000 miles, but that you vary engine speed frequently. Driving at the same speed for long periods can cause abnormal wear patterns in a new engine. Letting off the throttle from time to time pulls oil up onto the cylinder walls.

NEW CAR BREAK-IN RECOMMENDATIONS

BREAK-IN

MANUFACTURER	PERIOD (miles)	BREAK-IN PROCEDURE	
AMC/Jeep/Renault— all except Alliance and Encore Alliance & Encore	600	 Don't exceed 50 mph for first 100 miles and 55 mph for next 400. Don't drive at constant speed for long and avoid excessive idling, full throttle, fast starts and hard stops, but an occasional firm brake application is recommended. Don't use oil additives; don't use vehicle for snow plowing. Operate 4wd vehicles in 4-wheel drive for first 200 miles and at least 10 miles per month thereafter. First service due at 7500 miles.⁽¹⁾ Don't exceed 55 mph; don't tow. Follow all other procedures above that apply. 	
Bulck	500	 Don't exceed 55 mph; don't drive at constant speed for long and do drive at moderate speed until engine is warm. Avoid wide open throttle starts and hard stops. Avoid towing during restraint period; afterward, don't exceed 50 mph for next 500 miles. First service due at 7500 miles or 12 months (2), whichever occurs first. 	
Cadillac	See Buick	TO THE STREET OF	
Chevrolet	See Buick	See Buick and footnote(3)	
Chrysler	300	 Don't exceed 50 mph for first 60 miles and 55 mph for next 240; don't drive at constant speed for long. Give engine brief periods of full-throttle acceleration within limits of traffic laws, but avoid wide open throttle in low gear. First service due at 7500 miles or 12 months, whichever occurs first—if a turbo, 7500 miles or 6 months.⁽⁴⁾ 	
Ford	1000	Don't exceed 55 mph; don't drive at constant speed for long; avoid heavy braking. Don't tow for first 500 miles; don't add oil additives. For turbocharged engines—don't exceed 4500 rpm in FOURTH or FIFTH gears for first 2000 miles with manual transmission, or in THIRD gear of D with automatic; avoid continuous boost levels. For Bronco, Aerostar, Ranger, Econoline, light truck, club wagon—tighten single rear	

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		wheel lug nuts to specification at 500 and 1000 miles; tighten dual rear wheel lug nuts at 100 and 500 miles. • First service due at 7500 miles or 12 months, whichever occurs first. (5)	
Honda	600	 Avoid full-throttle starts and cruising for extended periods at a constant speed. For the first 200 miles, avoid hard braking. First service due at 7500 miles or 6 months, whichever occurs first. (2) 	
Mazda	600	 Drive at varying speed without straining the engine; don't race the engine. Avoid hard stops and full-throttle starts. First service due at 2000 miles. 	
Mercedes-Benz	1000	 Drive at moderate speed. Avoid full-throttle driving, high engine rpm and automatic transmission kickdown. 	
Mitsubishi	300	 Drive at moderate speed; allow the engine to warm up after starting. Avoid racing the engine; avoid abrupt fas starts, high-speed driving and abrupt application of brakes. Don't overload the vehicle; don't tow. First service due at 7500 miles or 12 months, whichever occurs first. [2] 	
Nissan	1000	 Don't drive at high speed before the engine is warmed up; avoid fast starts and full acceleration; vary driving speed. Don't let the engine labor in any gear; don't race the engine; avoid extended idling and heavy braking. Don't use 4wd for the first 300 miles. First service for gasoline engines due at 7500 miles or 6 months, whichever occurs first⁽²⁾; first service for diesel and turbocharged engines due at 5000 miles or 6 months, whichever occurs first. 	
Oldsmobile	See Buick		
Pontiac	See Buick		
Saab	1000	 Don't drive at full throttle except for brief periods. First service due at 1000 miles 	
Subaru	1000	 Don't exceed 4000 rpm; don't race the engine; don't drive at constant speed for long Avoid rapid starts and acceleration, severe braking, overloading and high-speed driving on rough roads. Downshift when climbing hills to avoid straining the engine. First service due at 7500 miles or 7½ months, whichever occurs first. [2] 	
Toyota	1000	 Don't exceed 55 mph; don't drive at constant speed for long; avoid full-throttle starts and hard stops. Don't drive slowly with transmission in high gear; don't tow for first 500 miles. First service due at 10,000 miles or 12 months, whichever occurs first⁽⁶⁾ 	
Volkswagen	600	 Don't use full throttle; don't overstrain the engine. First service due at 7500 miles for gasoline engines⁽²⁾; 1000 miles for diesels. 	
Volvo	1200	Don't strain the engine; don't use the kick- down gear of an automatic transmission.	

If vehicle sees severe use, cut this time in half.

(2) Cut this time to 3000 miles or 3 months if the vehicle is used under severe conditions or has a turbocharger.

miles.

(3) For the Chevette diesel, the first service is due at 3750 miles or 12 months, whichever occurs first, under normal use; 2000 miles or 3 months under severe use. For the 6.2-liter diesel, the first service is due at 5000 miles or 12 months, whichever occurs first, under normal use; 2500 miles or 3 months under severe use. For Chevy Nova, the first service is due at 10,000 miles or 12 months, whichever occurs first, under normal use; 5000 miles or 6 months under severe use.

Cut this time to 3000 miles or 3 months if the vehicle is used under severe conditions.

(5) First service due on turbocharged engines at 5000 miles; cut time to 3000 miles or 3 months for both nonturbo and turbocharged engines if the vehicle is used under severe

(6) Cut this to 5000 miles or 6 months if the vehicle is used under severe conditions. First service for diesel engine is 5000 miles or 6 months, whichever occurs first-2500 miles or 3 months under severe conditions

down gear of an automatic transmission.

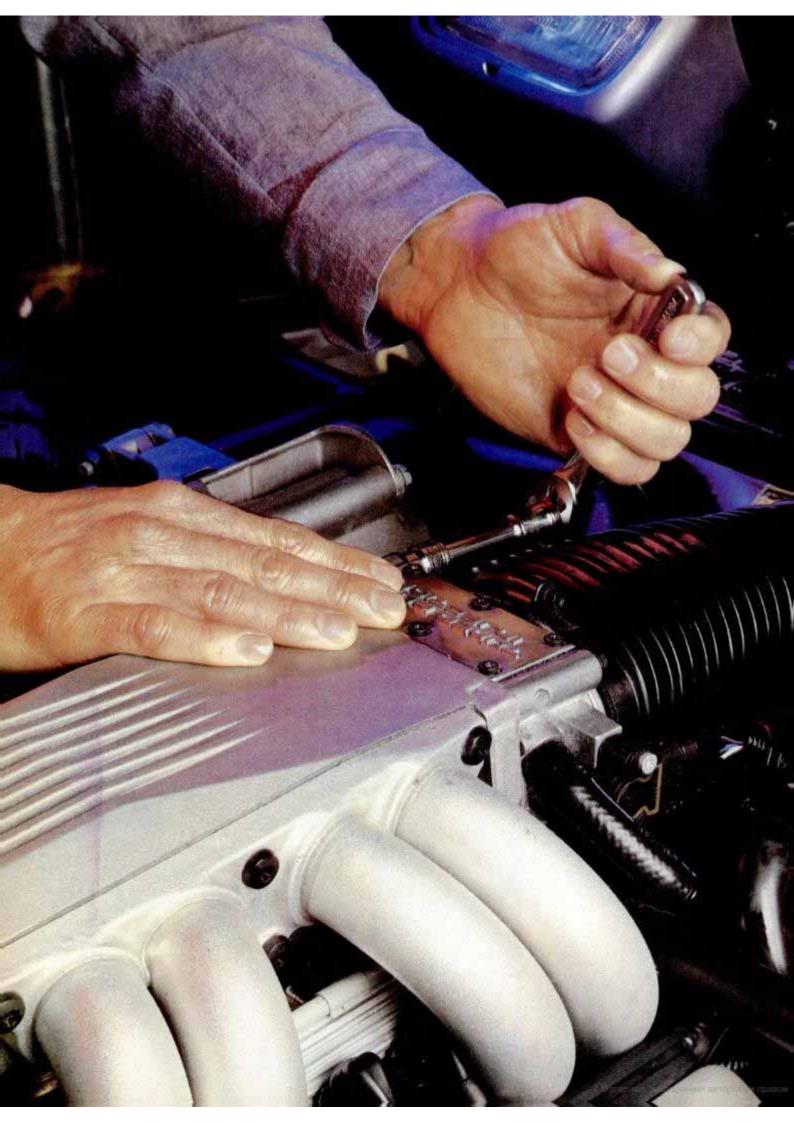
First service due between 600 and 1200

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Car Care buide

CAN YOU STILL DO IT YOURSELF?

What you can touch and what you should leave alone on the high-tech new cars.

here was a time when someone who simply knew about cars could repair most any machine on the road. Today's new cars, though, are much more complicated. Tremendous technical advances in the last 10 years allow automakers to build vehicle systems of entirely new designs, and while some are easy to repair, others are quite complex. Which jobs can you do yourself and, even more important, which ones should you avoid?

The answer to that question depends a great deal on your own abilities and experience as well as the tools and information you have available.

Maintenance jobs

Systematic vehicle maintenance is always a great way to prevent problems before they start. For the most part, you can still do the regular service yourself. Most Saturday Mechanics tell us that the first task they ever attempted was changing the oil and filter. For the novice driveway mechanic, this kind of basic maintenance is the right place to begin. But before you just dive right in, be certain that you know what you're doing. You'll find PM's general maintenance guide (Care And Feeding) on page 174 in this issue.

Check your owner's manual so you know exactly what checks or services are required at every interval and see to it that they're carried out. Keep a detailed written record, along with receipts. This is particularly important while your car is under warranty. The maintenance chapter of your car's factory service manual will also help you determine what work is necessary.

Minor electrical repairs

Light bulb and headlight replacement is a straightforward job, well within the abilities of the novice. For some cars, you may need special screwdrivers to loosen retaining screws, but aside from that, most bulb replacements are still simple tasks.

If you have a test light and some knowledge of electricity, you can locate open circuits in conventional wiring, such as that used for taillights, horns, heater motors and radios. If you have a more advanced knowledge of electricity and a volt/ohmmeter, you can solve charging and cranking circuit problems. You'll find specific instructions for this type of diagnosis in PM Saturday Mechanic articles and your shop manual.

If you find that you must get a professional mechanic for starting or charging system work, make sure he's equipped with a load-test device, a professional battery charger and conventional electronic diagnostic tools, including voltmeter, ohmmeter and ammeter. If your battery discharged without cause, you might want to ask him how he will determine whether the alternator or voltage regulator is causing the problem. He should tell you that he'll "full field" the charging system.

Electronic control systems

Regular readers of Saturday Mechanic now realize that engine computer system diagnosis is well within the reach of many home mechanics. This is due in part to the system's built-in diagnostic capabilities. When the diagnostic mode is triggered, it displays trouble codes, directing you to faults in a certain component or subsystem.

For Ford and GM, you need a shop manual to pinpoint faults, and for a carbureted Chrysler you need a special tool to read the codes and perform some troubleshooting operations.

In a few isolated cases, the troubleshooting routine for a given code calls for plugging in a new part that is known to be good. This can be an expensive method for the driveway mechanic since you don't have your own parts department, and electronic parts cannot be returned to the auto parts store.

A strictly hands-off item is the computer itself. While home-computer buffs replace chips in their micros and minis, this isn't possible with automotive computers, as plug-in connectors are not used.

The difficulty of diagnosing and repairing the various computer systems now used to control some suspension, braking and steering components varies widely. Some of the computer systems have built-in diagnostics, some don't. Part-substitution troubleshooting techniques make this job tough for most new car owners.

For the time being, it's probably best to see your dealership for diagnosis of more complicated electronic systems. It's not that this work is so difficult; most independents have just refused to get involved.

Great Timing

A PM survey of organizations that own or lease large numbers of cars, light trucks and vans reveals that most are servicing their vehicles according to manufacturer recommended maintenance schedules. You might think that fleet operators, who often sell off vehicles long before useful service life has ended, might shortcut their service intervals. But the fact is that many are following manufacturer severe driving maintenance recommendations.

Frito-Lay is typical of the companies questioned. According to a spokesperson, "Most of our cars and light trucks are used under stop-go city traffic and with the engine idling-that is, under driving conditions defined by the manu-

Regular maintenance performed at the proper intervals is vital to every car's health.

facturer of these vehicles as severe. We find that changing engine oil at three months or 3000 miles and performing other maintenance according to the severe operational guidelines laid down by the manufacturer is the best preventive medicine for our cars and trucks."

Although vehicle manufacturers are in agreement concerning what constitutes normal driving conditions, they sometimes differ in concepts of severe

For example, Chrysler, Ford and Nissan say that sustained high-speed driving during hot weather is severe. On the other hand, GM, Honda and Toyota don't consider hot weather as a criteria in the definition of "severe."

Since the way in which a car is operated is the key element concerning how often maintenance should be performed, car owners should be acquainted with the exact way each manufacturer defines severe driving conditions.

In addition to following the maintenance schedule recommended by the manufacturer, there are other things to do that help prolong the life of your car, ward off sudden failures and keep it in safe driving condition. To make sure each of these important checks are performed, we recommend that you do them as specified in the chart.

INTERVAL

WHAT TO DO

When filling the . Check engine oil level. fuel tank

- · Check coolant level in coolant recovery tank
- · Fill windshield washer fluid container, if necessary.

Once a month

- · Check tire pressure (include spare); examine tires for cuts and abnormal
- · Check that all lights work.
- Check ground beneath parked car for fluid leaks.

Twice yearly

- · Check power steering fluid level.
- (spring and fall) . Check brake fluid level.
 - · Check automatic transmission or manual transmission fluid level.
 - · Check fluid level of hydraulically operated clutch.
 - · Check fluid level in rear axle.
 - · Check protection level strength of coolant.
 - Inspect drive belts.
 - · Inspect radiator, heater and airconditioner hoses
 - · Inspect exhaust system components for rust-through; retighten clamps.
 - · Rotate tires if mileage traveled since last rotation conforms with tire manufacturer rotation recommendation (usually after the first 7500 miles and every 15,000 miles thereafter).
 - · Examine fwd axle boots for cracks, leaks.
 - · Examine battery and starter motor cable terminals for corrosion.

Yearly

- · Inspect brake lines for cracks; inspect brake pads/linings for wear (do this twice a year if most driving is stop and go).
- · Lubricate all lock cylinders.
- · Lubricate body points: door hinges, hood hinges and latches, trunk hinges and latches, fuel door hinges.
- · Lubricate door weatherstripping.
- · Test ability of parking brake and PARK position of automatic transmission to hold
- · Flush underbody with water and clean off mud and salt buildup

While driving

Be aware of following abnormal conditions if they develop:

- Vibration
- · Brake pedal softness and brake noise
- · Steering wheel pull
- · Automatic transmission noise or slipping
- · Clutch chatter or slipping
- Exhaust system roar
- No horn
- Windshield wiper streaking
- · A warning light that comes on or a warning gauge that shows an abnormal

Engine fault diagnosis

Determining the cause of an engine performance problem like stumble, hesitation, poor cold driveability, backfire or any number of other symptoms is one of the most difficult tasks that any car owner can attempt. It requires a logical, systematic approach based on extensive knowledge of how the various components interact.

This job should not be attempted by the novice home mechanic. But if you've been working on cars for a number of years and have a specific guide for troubleshooting the problem, either in a shop manual or one of our Saturday Mechanic articles, it's worth giving it a try. If you fail to pinpoint the fault, it's best not to start replacing parts at random. You may not solve the problem, and you'll undoubtedly spend a lot of money.

When looking for help, choose a mechanic who is equipped with recentmodel engine diagnosis equipment. To accurately diagnose new cars, he must have an oscilloscope, a 4-gas analyzer, a cylinder leakage tester and a full range of conventional mechanical and electronic test instruments.

Internal engine repairs

In some ways, internal engine repairs can be easier than diagnosis because there are definite mechanical symptoms and specific procedures for the work. For many engine repair jobs, a knowledge of precision measuring tools and engine assembly techniques is required. If you've never attempted this type of work, start with something less challenging, like replacing an intake manifold gasket or rocker arm. A second step might be cylinder head or timing belt removal and replacement. Only advanced mechanics should attempt bearing and ring work or complete engine overhaul, especially since this almost always requires engine removal on new front-wheel-drive cars.

Even among pro mechanics, most don't get involved in internal engine repairs beyond the cylinder head remove-and-replace level. Many, however, have developed a relationship with an engine rebuilder they trust. They will remove your engine and deliver it to the rebuilder or, with large-production rebuilders, exchange your engine for a fresh unit.

Automatic transmissions

A number of relatively minor automatic transmission problems can be solved without removing or disassembling the unit. Factory shop manuals cover maintenance and repairs, including fluid and filter replacement, linkage adjustments and simple external service work. While these techniques won't solve every transmission problem, they are





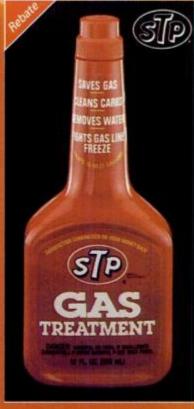


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car up and your costs down.





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11.97 K MART SALE PRICE -2.00* MFR'S REBATE

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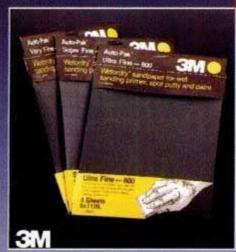


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Cassette Stereo with Auto Reverse — High sensitivity, electronic tuning, digital LED readout, 8 station presets, drift-free reception, balance/fader controls, more. Our reg. 139.97

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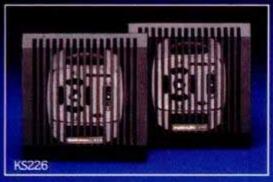


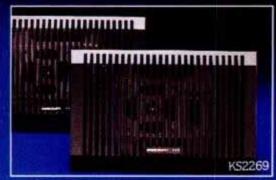


















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Both feature combination air suspension woofer, dome horn tweeter and midrange drivers, 20 oz. magnet, up to 50 watts output. Style may vary.

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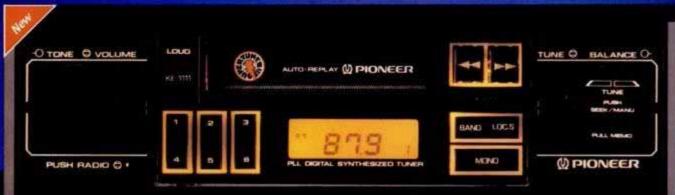




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easy enough for most driveway mechanics to handle.

Complete auto trans or transaxle disassembly and rebuilding can be extremely complicated and is not a good job for the driveway mechanic to undertake, new car or not. Assembly sometimes requires difficult techniques that are nearly impossible to do without special tools.

Manual transmission service is definitely tougher on new cars. Front-drive cars generally require engine removal for clutch service and the transaxles are complex mechanisms. Even rear-drive cars have become harder to work on. Transmissions using rail-type shifters, instead of external linkages, require special fixtures for reassembly and may be too tricky for your own garage workbench.

Other drivetrain repairs

Replacement of a driveshaft single universal joint requires a special technique, but with step-by-step instructions, the job is certainly within the scope of an experienced Saturday mechanic. Changing the double-cross constant-velocity universal joints used on some rear-wheel-drive cars is only a little more difficult.

The constant-velocity joints used on most front-wheel-drive cars can be serviced by an experienced work-at-home mechanic. The difficulty of servicing the CV joints and their protective boots varies significantly from model to model, so check your shop manual and past issues of POPULAR MECHANICS before pulling things apart.

Differential service, either on a reardrive third member or in the ring-andpinion section of the transaxle, is best left to professional rear-end shops to handle.

Brake system

The replacement of worn disc brake pads or drum brake shoes is reasonably easy and well-suited to the experienced driveway mechanic.

In fact, on recently produced cars, brake pad replacement is very easy, but when brake pads wear down to their metal backing plate, caliper and disc damage usually results. Replacement and repair of these parts is usually more difficult, and, if you are uncertain about the proper procedures, it's best to leave the job to a professional.

The same precaution applies to repair of brake hydraulic problems. While leaking tubing or hose can be replaced quite easily, caliper leaks and mastercylinder problems are more difficult. Replacement of these components can be done by experienced car owners, but rebuilding of the units requires special care to ensure safety.

All hydraulic repairs necessitate the bleeding of air from the brake system. For this you'll need a helper or a special bleeding kit. Professional mechanics often are equipped with a power bleeding device that can help push the air out of every nook and cranny, and home-use kits of several designs are available at auto parts stores.

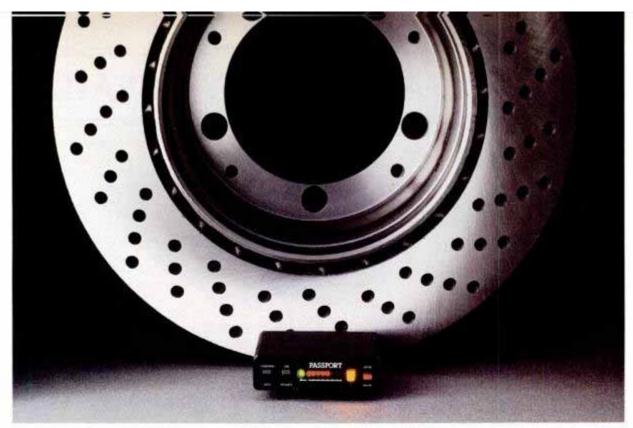
Suspension and steering

Steering and suspension repair is a suitable task for the average home mechanic. Replacement of worn ball joints and tie-rod ends is still something you can do in the driveway, but special tools are required in most cases. Often, those tools can be rented at auto parts stores.

Replacement of a complete steering box is a direct bolt-on, but rebuilding the units, particularly power-assisted ones, can be difficult and is best left to an experienced pro.

Shock absorber replacement is easy if the nuts and bolts haven't rusted excessively. It's still one job you can tackle at home. MacPherson strut replacement is trickier, since strong coil springs require very careful handling, but it's still possible for the experienced home mechanic.





Small Wonder

It's here, pocket-size radar protection.

Imagine a superbly crafted electronic instrument, powerful enough to protect against traffic radar, miniaturized enough to slide into a shirt pocket, beautiful enough to win an international design award.

Small means nearly-invisible protection

That could only be PASSPORT. It has exactly what the discerning driver needs, superheterodyne performance in a package the size of a cassette tape.

This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. It's no surprise that such a superlative design should be greeted by superlatives from the experts.

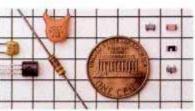
"In a word, the Passport is a winner," said Car and Driver.

The experts report excellent performance. Simply switch PASSPORT on and adjust the volume knob. Upon radar contact, the alert lamp glows and the variable-pulse audio

Small means the size of a cassette tape

begins a slow warning: "beep" for X band radar, "brap" for K band. Simultaneously a bar graph of Hewlett-Packard LEDs shows radar proximity.

As you get closer, the pulse quickens and the bar graph lengthens. Should you want to defeat the audible warning during a long radar encounter, a special switch provides silence, yet leaves PASSPORT fully armed for the next encounter. A photocell adjusts alert lamp brightness to the light level in your car. PASSPORT was designed for your protection and your convenience.



In PASSPORT, 102 SMDs (right) do the work of ordinary transistors, resistors and capacitors.

PASSPORT comes with a leather case and travels like a pro, in your briefcase or in your pocket—to the job for trips in the company car, on airplanes for use in far-away rentals. Just install on dashtop or visor, then plug into the lighter. PASSPORT keeps such a low profile. It can be on duty without anyone noticing.

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Isn't it time for a PASSPORT of your own?

\$295 (OH res. add \$16.23 tax) Slightly higher in Canada





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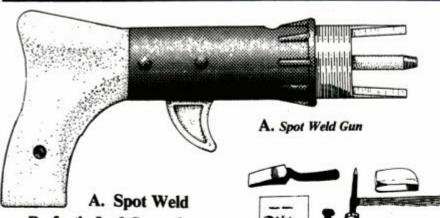


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weld. Because the heat is confined to a small
area (the ¼" diameter electrode) it avoids
warpage or distortion. Allows for accurate
control that lets you make consistently
uniform welds.

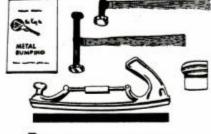
Easy to Use — Even for Beginners
Hook it to the electrode holder of your A.C. arc welder (set at 50 amps) and ground to car body. Just pull back trigger to retract electrode, line up weld point and press head against the metal. Metal must be free of rust, paint or grease. Release the trigger and allow the electrode to contact the metal and glow for 1-2 seconds. Then raise the electrode with the trigger and allow an arc to form a molten puddle of metal (always use welding goggles or shield). Each weld takes about 5-6 seconds. Auto manufacturers used spot welds to build your car; you can restore it with the same authentic technique.

Converts an Arc Welder to a Spot Welder It welds any steel between 18-26 gauge. (Auto body sheet metal is between 18 and 22 gauge). Ideal for welding replacement panels, floors, brackets, clips, braces, etc. Welds from one side so it can even do blind panels that ordinarily can't be spot welded. Comes with two pressure heads — four prong for control on flat areas and two prong for reaching into edge and recess work. Proper replacement electrodes available through Eastwood. Gun comes complete with connection wire, spare electrode, 2 pressure heads and complete instructions.

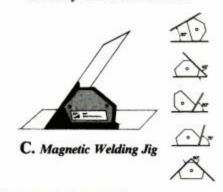
4355 Spot Weld Gun — \$35.95 4321 Package 10 electrodes — \$9.75 4343A Powerpack for welder-\$109.00

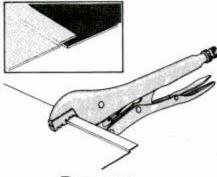
B. Body and Fender Tool Kit

Professional quality body and fender tools work as a comfortable extension of your hand. The feel is just right — so are the results. Fairmount uses the correct alloy steel, which is drop forged and heat treated for tough body shop use. Then each piece is hand-ground and polished to the perfect shape for body work, as well as balanced for



B. Body and Fender Tool Kit





D. Panel Flanger



E. Shrinking Disc



predictable bounce-back (unlike inexpensive models which bounce all around). The dollies fit naturally in your hand to back up the hammer blows. On rough areas our sharp English file (with holder) smooths the high spots and shows low areas which need work.

The eight-piece set includes: 2 Hammers, 158G and 150G; 2 Dollies, General Purpose and Toe; Light Dinging Spoon; 14" Flat Flexible Body File; Adjustable Metal Holder and a copy of The Key to Metal Bumping. 1324 8-Pc. Body & Fender Tool Kit—\$99.00

C. Magnetic Welding Jig Holds At Many Angles

Setting up a weld is easy with our magnetic jig. Has over 12 lbs. of holding power — enough for most sheetmetal or tubing jobs. Housing is 4" by 2½" by ½", with permanent magnet enclosed. Accurately reproduces 30°, 45°, 60°, 75°, and 90° angles. 6523 Magnetic Jig — \$14.95

Two or more - each \$13.95

D. Flangers For Flush Fit Panels

Adjust tool to metal thickness, flange repair area and lay in patch panel. Lets you weld flush with body metal, which minimizes grinding and filling. Works in tight areas and on sharp curves. Perfect results with very little effort.

6286 Panel Flanger - \$29.95

E. Smooth Dented Body Panels In Minutes

Just attach this 9", 18 gauge stainless steel disc to your heavy-duty body grinder and you'll level stretched metal to its original factory-smooth shape. The secret's in the unique blade that creates heat to shrink metal back into shape. It has a %" arbor to fit standard grinders (maximum speed 8000 r.p.m.; 5000 r.p.m. ideal).
7001 Shrinking Disc — \$29.95

F. Convert Your Arc Welder For Mig-Like Results

Most arc welders have been designed for joining ¼" metal; our stitch welder attachment controls welding heat to produce smooth, even welds on body panels — limits distortion and burn-through.

The current's directed through an electrical solenoid and diode circuit. The solenoid, which pulses thousands of times per minute, gives you normal welding amperage while allowing you to weld thin pieces. Although the arc never appears to break, the reciprocating electrode action pulls the electrode in and out of the weld puddle to limit welding heat.

Welding's easy: once you strike the selfstarting arc, lay the rod on the metal and let the machine do the work. Resulting bead is smooth and even, with slag coming off in large pieces. Easy to master with practice.

The stitch welder's five foot power cord attaches to any A.C. arc welder's electrode holder (must run at 80 amps or less). Uses arc welding rods up to 3/32" steel and stainless. Tool body cast aluminum with vinyl insulated grip for positve control. Electrodes held with set screw and can be easily replaced. Designed for years of trouble-free service.

4369 Stitch Welder — \$49.95 4372 Arc Welding Rods (2mm dia, 3 lb. pkg. approx 120 rods) designed with special flux for welding sheetmetal — \$9.95

4343A Powerpack for stitch welder-\$109.00 Welding gloves — your hands deserve the right protection.

9612 Gloves - \$8.95

G. Nibbler Cuts Metal Fast

Our nibbler cuts curves, straight lines — any shape you need. Leaves flat, no-distortion; burr-free finish. Uses less effort than ordinary snips. Chromed steel construction with cushioned vinyl grips. Heat-treated tool steel jaws. Cuts up to 18 gauge steel, 16 gauge aluminum. Jaws replace easily.

6281 Nibbler - \$28.95

6284 Replacement Blades (pkg. 2) - \$9.95

H. Fabricate Panels With A Sheet Metal Bender

Will form 90° angles in 20 gauge up to 18" wide. Bends heavier gauge metal in smaller widths. Great for reproducing body panels, covers, etc. All-aluminum. Bolts or screws to workbench.

6260 Bender — \$29.95 6261 Clamps — \$4.50

I. The Ultimate Guide For Home Arc Welders

At last — a welding book that explains techniques in plain English. Takes all the mystery out of arc welding. Also gives a guide for selecting the right welder for specialty jobs. Many sample weld beads analyzed so you can improve your work. Over 170 pages. 6630 Electric and Gas Welding — \$8.95

J. Cut Spotwelds In Seconds

Remove spotwelds without cutting through the lower panel. 4" arbor has adjustable pilot to insure perfect cuts without damaging metal. Pilot pops out slug after cutting. Works on air and electric drills (900 rpm max) with 4" chuck. Use with sheetmetal up to 3/16". 3219 Spotweld Cutter — \$12.95 3220 Replacement Cutter — \$4.50

K. Sandblast Away Rust

Our sandblaster is field proven (thousands in use) and priced right. This sandblaster gives you the ability to remove rust, scale, paint and corrosion in minutes. Also doubles as air gun/degreaser for cleaning parts.

The Eastwood sandblaster package includes all-metal power (same as used on our larger units), ten foot hose, 14" pickup



tube, spare nozzle and complete instructions. Just attach to 1 HP compressor, insert pickup tube into sand or other abrasive and you're ready.

8532 Sandblast Gun — \$30.95 9536 Blast Hood w/Replacable Lens – \$19.95

L. Remove Rust Without Harming Good Metal

Oxi-Solv removes rust and corrosion fast on any metal. Just spray, dip, or brush on and see it work!! Oxi-Solv is non-flammable, non-toxic, non-caustic and odorless.

Extra bonus: After removing rust, Oxi-Solv gives a zinc phosphate coating to metal for better paint adhesion. Reusable.

3430 Oxi-Solv, 16 oz. — \$8.95

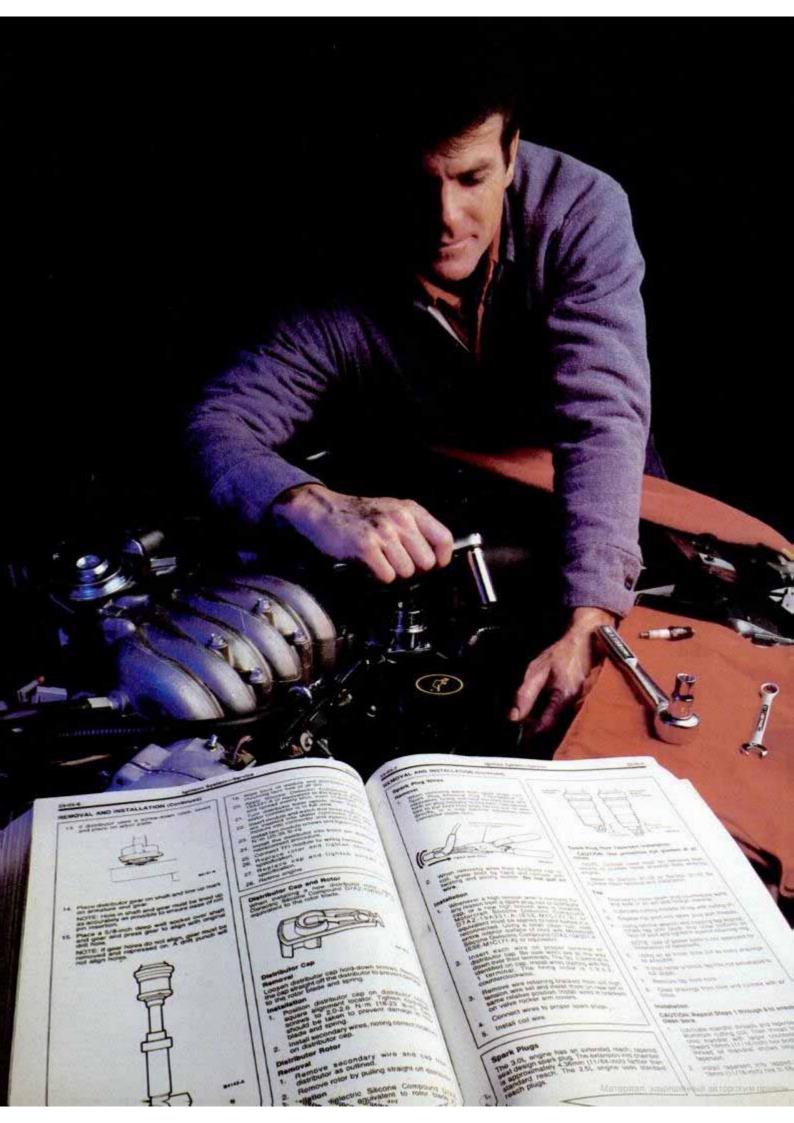
3432 Oxi-Solv, 1 gallon — \$24.95



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The Eastwood Compan 147 Pennsylvania Ave. Malvern, PA 19355	





BE A BOCKWORM

The key to making repair work simple is the information found in service manuals.

ou've heard it from us time and time again: Refer to your factory service manual for exact specifications and procedures. It may look like the easy way out for the article's author, but the fact is, that thick book may well be just as important to getting the job done right as any wrench in your tool chest.

For the new car owner who would like to perform his own maintenance and repairs, the shop manual is a vital key. Most cover service procedures for a single year and single model of vehicle, with different sections for body/ chassis, electrical, suspension and engine repairs.

With the widespread use of computers to control engine and accessory functions, the factory manual becomes even more precious. Onboard self-diagnostic systems included on new cars will note and store malfunctions in the memory section for later retrieval. Regular readers of the Saturday Mechanic series know that a dashboard indicator light or voltmeter is all that's needed in many cases to track down problem areas. With the full listing of trouble codes and their followup routines, a driveway mechanic can diagnose many of his car's malfunctions.

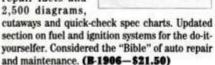
SHOP MANUAL SOURCES

MANUFACTURER	ORDER FROM	PRICE		
AMC/Jeep/Renault	AMC:Jeep/Renault dealer or Myriad Services, 8835 General Dr., Plymouth, MI 48170	Encore/Alliance & Jeep CJ-7— \$32.90; Eagle & Jeep Grand Wagoneer— \$33.40; all other models—\$36.75		
Alfa Romeo	Parts Dept., Alfa Romeo Inc., 250 Sylvan Ave., Englewood Cliffs, NJ 07632	\$30		
Buick	Service Publications, Buick, PO Box 1901, Flint, MI 48501	\$75; \$25 additional for binder		
Cadillac	Helm Inc., PO Box 07130, Detroit, MI 48207	All models \$30, except Cimarron, which is \$25		
Chevrolet Heim Inc., PO Box 07130, Detroit, MI 48207		Astro & S-10 light truck—\$15; van & pickup truck—\$18; Sprint—\$19,50; Chev- ette—\$22; Cavalier & Celebrity—\$23; Camaro, Caprice, El Camino & Monte Carlo—\$25		
Chrysler Corp.	Chrysler Corp., c/o Dyment Distribution Service, 20026 Progress Dr., Strongsville, OH 44136	\$30		
ord Motor Co. Helm Inc., PO Box 07150, Detroit, MI 48207		All models \$35, except the following: Aerostar—\$48; Bronco—\$49; Merkur—\$63; Bronco II & Ranger—\$70		
Honda	Honda dealer	\$24.95		
Isuzu	Isuzu, cro Retail Publications, 2300 Pellissier Place, Whittier, CA 90601	\$28.75		
Mazda	Mazda dealer	B2000—\$28.90; 323—\$34.35; RX7—\$36.70; 626—\$38.80		
Mercedes-Benz	Service Publications, Mercedes-Benz of North America Inc., 1 Mercedes Dr., Montvale, NJ 07645	Engine manual—approx. \$30; chassis and body manual—approx. \$40 (Note: Manuals will not be available before October 1986.)		
Mitsubishi	Mitsubishi dealer or Service Publica- tions, Mitsubishi, 10540 Talbert Ave., Fountain Valley, CA 92728	\$24.95		
Nissan	Nissan dealer or Pendant Industries, PO Box 387, Harbor City, CA 90710	\$24		
Oldsmobile Lansing Lithographers, PO Box 26128, Lansing, Mt 48909		Toronado—\$31; Custom Cruiser, Cutlass Supreme, Cutlass Salon & 442—\$35; Calais, Cutlass Ciera, Delta 88, Firenza & 96—\$52		
Pontiac	Helm Inc., PO Box 3518, Highland Park, MI 48203	\$26		
Subaru	Subaru dealer	\$73		
Toyota	Allied Graphics, 750 West Victoria St., Compton, CA 90220	\$29.95		
Volkswagen	Volkswagen Service Manuals, Robert Bentley Inc., 1000 Massachusetts Ave., Cambridge, MA 02138	\$24.95 - \$49.95 depending on model and year		
Volvo	Publications Dept., Volvo, Rockleigh, NJ 07647	DL—\$88; 740—\$75; 760—\$95		

Popular Mechanics BOOKSTORE OF HOW-TO INFORMATION

Auto Repair Manual '80-'86 Covers more than 1,900 domestic car models, with over

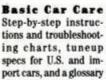
55,000 essential service specs and repair facts and 2,500 diagrams,



TO ORDER Send your name and address with check or money order to: Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101. Please specify the proper "B" number.

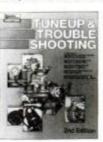
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port cars, and a glossary of car care terms. Includes sections on preventive maintenance, fuel, starting and cooling systems, brakes,

tires, and air conditioning. (B-1901-\$16.95)



Tuneup & Troubleshooting Newly revised with over 700 illustrations. Valuable information on tuning your engine, including spark plugs, breakerpoint ignitions, compression and vacuum service and lubrication. Specs on most U.S.

models and popular imports made between '80-'84. (B-1902-\$14.95)

Bodywork & Painting Color photos, diagrams and instructions tell you how to eliminate rust, fix dents, spray paint, repair grills and bumpers, keep interiors clean and bring out your car's lustrous shine—



without expensive equipment. (B-1903— \$19.95; B-1903A (paper)—\$12.95)



Imported Car Repair Manual '79'85
Comprehensive information on cars by 28 foreign manufacturers. Over 1,300 pages. Covers all areas including cooling, electrical and exhaust systems, brakes, steering, sus-

pension, ignition and transmission. (B-1904— \$25.00)

Light Truck & Van Repair '79'85 1,200 pages of information on AMC, Chrysler, General Motors and Ford trucks and vans. 2,000 illustrations plus step-by-step instructions for the tuneup and care of engines, brakes, suspension, and more.

(B-1905-\$27.50)



MOTOR REPAIR
AUTO REPAIR
MANUAL
EARLY MOORLS

Auto Repair Manual '74-'79 A handy reference of facts gathered from over 300 factory manuals for domestic cars. More than 1,000 illustrations and data on such areas as electrical, fuel and cooling systems, suspension, brakes, steer-

ing and transmission. (B-1907-\$22.00)



Beatkeeper Keep your boat ship shape. This book covers all areas of

maintenance, repair and improvement for both power and sailboats. Includes electrical systems, anchoring gear, tools, cabin comfort and sealants and adhesives. From the boating columns in Motor Boating and Sailing. (B-1909—\$17.95)

Beatman's Handbook A complete guide to such important boating topics as safety, seamanship, emergencies, weather and piloting. Plus you get listings of boating organizations, schools, regulations by state, sources for publications and

> documents and more. (B-1908— \$10.95)



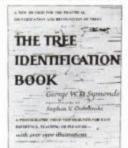
The Guide to Self-Sufficiency More Plancy a list live we have plant year color for any financial part of the self-sufficiency with the self-sufficiency with the self-sufficiency and the self-sufficiency with the self-sufficiency and the self-sufficiency with the self-sufficie

Guide to Self-Sufficiency Learn to be totally self-sufficient. Find

and prepare your own food, raise farm animals, brew beer, thatch a roof, create your own electricity, tan a hide and much more. Over 600 two-color illustrations and step-by-step instructions show you how. (B-1912—\$10.00)

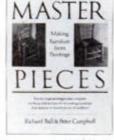
The Tree Identification Book Ever wonder about that tree in your front yard? Or what your oak table looked like before the wood was cut for lumber? This book, with over 1,500 illustrations, takes you on a nature walk to identify the shape,

leaves, bark, and branches of more than 100 trees. (B-1913—\$10.95)



Master Pieces Bring masterpieces

of art to life by building the furniture they depict. This book has designs and complete instructions for re-



creating furniture that appears in 20 classic paintings—among them, Van Gogh's "Chair and Pipe" and Picasso's cubist "Still Life on a Sideboard." Beautiful color reproductions. (B-1910 —\$22.95)

Old-Fashioned Wooden Toys Enter the enchanted world of wooden seesaws, doll cradles, fire engines, rocking horses, spinning tops and

biplanes. Build these and other charming toys from detailed plans, easy instructions and color photographs. Over 31 projects shown. (B-1911— \$17.50)



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PM's Computer Home Workstation—This three-piece desk keeps everything neat and gives you plenty of room to work. This is for a state-of-the-art home computer system. An efficient work station you cannot buy, it can blend with your home decor and, it is more advanced than any office workstation you've seen. Plans and material list. (PL-1828—\$6.95)



Remote-Controlled Plane—An engine-driven model that is operated by radio or flown free. It's powered by carbon dioxide, which makes fueling simple. Great fun for the flying enthusiast. Plans include photos and instruction booklet. (B-1276—\$5.49)



Portable Ironing Center—Unscrews from the wall to move when you do. Plans feature a receptacle for the iron, a fluorescent light and storage space for all materials. The ironing board folds up behind louvered doors. (PM-1005—\$5.95)



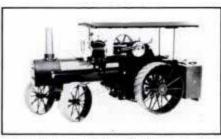
Bookcase Wall—Turn your wall into a great display area for books and other items. Our bookcase goes from floor to ceiling with outof-sight storage space on the bottom. The five cabinets can be adjusted to any width to fit your wall. (PM-1008—\$5.95)



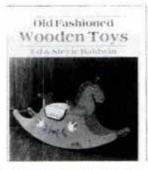
For Nostalgia Buffs: A Roll Top Desk You Can Build Back in the era of the trolley car and Model-T, the roll top desk was popular in both home and office. Today it's a cherished antique. Build one yourself in fine cherry and you can own and take great pride in this charming heirloom. You build it as two separate units, a base and a roll top. Plans and material list are included. (PL-1736—\$5.95)



Model SS United States—The glorious, record breaking flagship of the U.S. Merchant Marine. Though now retired at Norfolk, VA, no passenger ship has ever approached her top speed. The professional quality model is described in detail on 3 full size blueprints. Over 2 ft. long of wood and metal. (PL-1200—\$9.95)



Model Steam Tractor—Challenge of a lifetime! The famous J.I. Chase threshing machine steam tractor, 16 separate plans sheets plus instruction booklet. The finest detail work. Stacks firewood but burns alcohol. 9 separate gears in the transmission alone. What a thrill to see it huffing and puffing under its own power. (PL-1272—\$11.95)

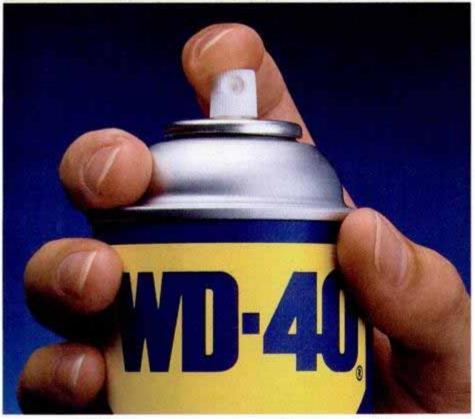


Old-Fashioned Wooden Toys—Enter the enchanted world of wooden seesaws, doll cradles, fire engines, rocking horses, spinning tops and biplanes. Build these and other charming toys from detailed plans, easy instructions and color photographs. Over 31 projects shown. (B-1911—\$17.50)



(PL-1/30—90.93) under its own power. (PL-1272—\$11.95) a dolly. (PL-1745—\$4.95)

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If it moves, shoot it.

Take a shot at tools with moving parts, lawnmowers, sticky locks and squeaky hinges. Anything that moves. WD-40. America's troubleshooter.

Dupli-Color turned Bea into an auto touch-up expert



You can do an expert touch-up job, too. It's easy with Dupli-Color's exact original color match and easy, step-by-step

Scratch-Fix®-For late model vehicles. Comes with handy Brush-In-Cap applicator. Auto Spray[®] Touch-Up-Convenient 5 oz. aerosol can

for larger touch-up areas. Truck & Van Paint-For pickups, vans and RVs. Great for accessories, too.



The factory manual is also a valuable library of wiring schematics and color codes. Even if you fully understand the principles of electricity, you still can't do much troubleshooting or diagnosis without a map of wire routing.

Maintenance schedules often differ between body styles and equipment options. Specialized service that is only required once in a great while, such as windshield wiper motor replacement, gets full disassembly and reassembly treatment in the factory manual, too.

The chart lists where to buy factory service manuals for most 1986 cars. When ordering, specify the make and model of the car.

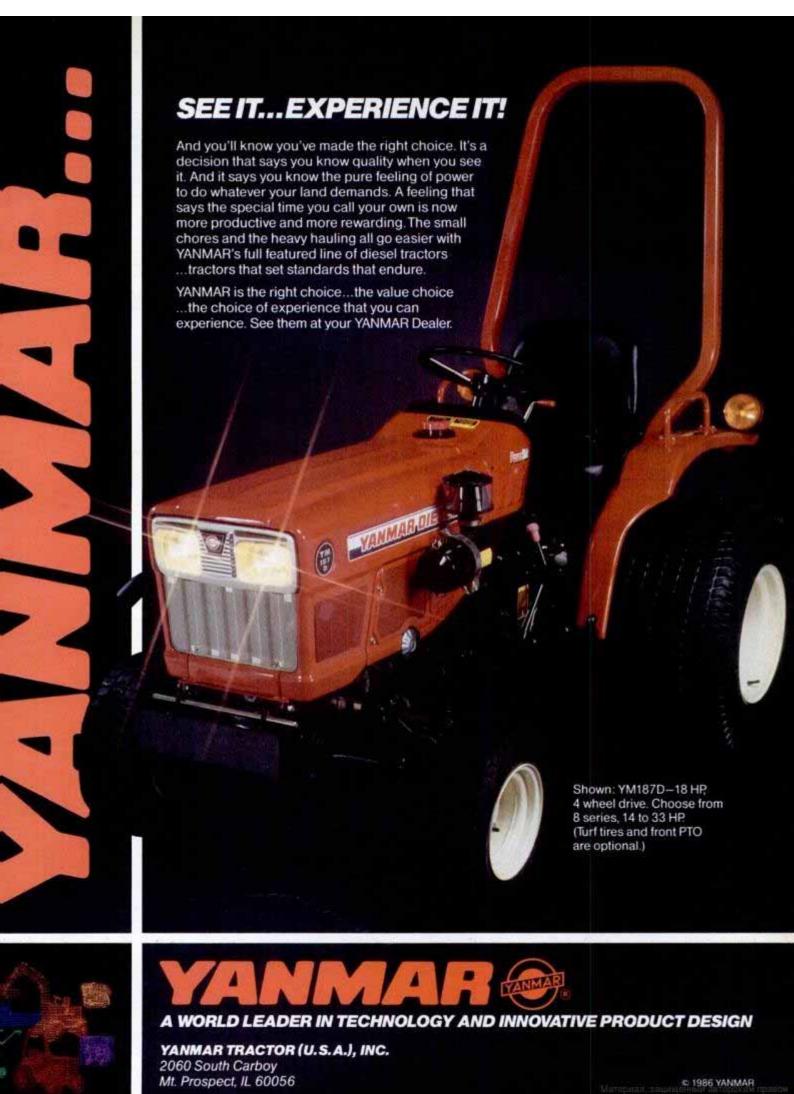
For those who own a number of cars, the cost of owning all the corresponding factory manuals could be quite high. And if you're the type who leaves major repairs to the pros and needs mostly tuneup and fluid capacity specs, there are general coverage books that will do.

Motor Auto Repair Manuals are the standard at many shops, and cover the range of year models in a number of volumes. Vintage Car editions cover 1935 to 1953 and 1953 to 1961; early model editions are available 1962-'68, 1969-'75 and 1974 to '79 ranges. The 1986 version covers cars from 1980 to the present models, and there's an Imported Car Manual (1979-'85) plus a Light Truck And Van Repair Manual which covers the same model year span. Cost ranges from \$21.50 for the general auto repair books to \$27.50 for the truck and van manual. Pick them up at B. Dalton book stores or order directly from Motor Publishing, 555 West 57th St., New York, NY

One of the few shortfalls of the official service manual is that it may be too advanced. Prepared mostly for the professional mechanic, these manuals don't take the space to explain basic service techniques, such as packing wheel bearings or adjusting idle. For the less repairman. home knowledgeable there's a variety of POPULAR MECHAN-ICS car care books that cover service procedures in detail.

Basic Car Care, a PM book of stepby-step instruction, troubleshooting charts and tuneup specs is a bargain for the work-at-home novice at \$16.95. Another PM publication, Tuneup & Troubleshooting, gives specific information and specs on regular maintenance, and the Bodywork & Painting manual covers dent and rust repair through the final steps of repainting. The tuneup book sells for \$14.95 and the bodywork manual costs \$19.95 hardbound or \$12.95 in paperback. To order any of these send your name and address with check or money order to: POPULAR MECHANICS, Box 1014, Radio City Station, New York, NY 10101.

1601 Nicholas Blvd., Elk Grove Village, IL 60007







FINE PRINT

What's covered and what isn't? Here's how to shop for warranties and get the most out of the warranty you have.

n a letter to PM's Car Clinic,
A.R. Wilson of Sioux Falls,
South Dakota, told of buying a
1984 minivan with 39,000 miles
on the odometer. Although he
was the second owner, Wilson assumed
the vehicle was still covered by the 5
year/50,000 mile powertrain warranty.
He soon learned otherwise when he had
to pay \$532 for engine repairs. Wilson
summed up his disappointment with
these words: "THE LARGE PRINT
GIVETH; the small print taketh
away!"

Since Wilson didn't mention the make of his vehicle, we couldn't determine if the warranty could have been transferred to him by the first owner for a small fee. But maybe at this point he really wouldn't want to know.

Being able to transfer a warranty is one example of how today's new car warranties are more liberal than before. Unfortunately, many new car buyers don't bother to read the agreement, so they don't know what their rights are. To get the facts on transferability of the factory warranty on a secondhand vehicle you consider purchasing, you should ask at the manufacturer's zone office.

A new car warranty is a contract

between the buyer and the manufacturer. Like most legal agreements it contains "ifs, ands & buts." If you violate the terms of the contract by doing something that's forbidden by the warranty, the contract becomes null and void. The following clause from the AMC/Renault warranty exemplifies the "forbidden" aspect of warranties generally followed by all vehicle manufacturers:

"Damage caused by accident, negligence, modification to the vehicle, misuse, environmental damage, improper maintenance, and unauthorized parts or service are not covered."

On the other hand, if you believe the car manufacturer has violated the terms of the contract, you can sue. If you win, the manufacturer will have to pay the cost of damages and the cost of litigation.

The bother of going to court can usually be avoided, because manufacturers and states provide ways to resolve warranty disputes before they reach such a confrontation. The first step is for you to determine what the contract covers. Most warranties provide 3-part coverage: basic, powertrain and body rust-through. Some manufacturers also provide major assembly (other than powertrain) and electronic components coverage. The chart accompanying this article lists the coverage offered by vehicle manufacturers for 1986 models.

Basic coverage applies to the entire

STANDARD WARRANTIES

MANUFACTURER	PERIOD OF WARRANTY (Years/Mileage*)	DEDUCTIBLES'	ADDRESS OF CUSTOMER RELATIONS DEPT.	INDEPENDENT ARBITRATION AGENCY
AMC/Renault**	 Basic: 1/12,000 Powertrain: 2/24,000 (AMC); 5/50,000 (Renault) Rust-through: 3/36,000 (AMC); 5/50,000 (Renault) 		PO Box 442 Detroit, MI 48232	Autoline
Audi	Basic: 3/50,000 Rust-through: 6/unlimited	None	888 W. Big River Rd. Troy, MI 48099	Autoline
Buick**	Basic: 1/12,000 Major assembly/power-train ⁽²⁾ : 3/36,000 Rust-through: 5/100,000	\$100 on major assembly/ powertrain re- pairs ⁽³⁾	902 E. Hamilton Ave. Flint, MI 48550	Autoline
Cadillac**	Basic: 1/12,000 Major assembly/power-train ⁽²⁾⁽⁴⁾ : 4/50,000 Powertrain only ⁽⁵⁾ : 3/36,000 Electronic components ⁽⁶⁾ : 4/50,000 Rust-through ⁽⁴⁾ : 5/100,000 Rust-through ⁽⁵⁾ : 3/unlimited	\$100 on major assembly/ powertrain ⁽³⁾ or on powertrain only repairs	2860 Clark Ave. Detroit, MI 48232	Autoline
Chevrolet**	Basic: 1/12,000 Powertrain ⁽⁵⁾ : 3/36,000 Electronic components ⁽⁷⁾ : 3/36,000 Rust-through: 3/unlimited	\$100 on power- train repairs	30007 Van Dyke Ave. Warren, MI 48090	Autoline

Chrysler**	Basic: 1/12,000 Powertrain: 5/50,000 Major assembly 3/36,000 ⁽⁸⁾ ; 5/50,000 ⁽⁹⁾ Rust-through (all except outer panel): 3/unlimited Outer panel perforation: 5/50,000	\$100 deductible on powertrain and major as- sembly repairs	Detroit, MI 48288	None ⁽¹⁰⁾
Ford**	Basic: 1/12,000 Powertrain ⁽¹³⁾ : 3/unlimited Major assembly/power-train ⁽¹³⁾ : 4/50,000 Rust-through ⁽¹¹⁾ : 3/unlimited Rust-through ⁽¹²⁾ : 5/100,000	\$100 deductible on powertrain and major as- sembly repairs, except electron- ic instrument cluster	Dearborn, MI 48121	None ⁽¹³⁾
Honda	Basic: 1/12,000 Powertrain: 2/24,000 Rust-through: 3/unlimited	None	100 W. Alondra Blvd. Gardena, CA 90247	Autoline
Isuzu	Basic: 1/12,000 Powertrain: 2/24,000 Rust-through: 3/unlimited	None	PO Box 2280 City of Industry, CA 91746	Autocap
Mazda	Basic: 1/12,000 Powertrain: 2/24,000 Rotary engine: 3/50,000 Rust-through: 3/unlimited	None	Eastern Region PO Box 16305 8313 Bay Center Rd. Jacksonville, FL 32216 Great Lakes Region PO Box 2008 618 Kenmoor Ave., SE Grand Rapids, MI49506 Gulf Region 10445 Corporate Rd: Sugarland, TX 77478 Northwest Region 8621 S. 180th St. Kent, WA 98031 Pacific Region 9451 Toledo Way Irvine, CA 92714	Autocap
Mercedes-Benz	Basic: 4/50,000	None	1 Mercedes Dr. Montvale, NJ 07645	None
Mitsubishi	Basic: 1/12,000 Powertrain: 2/24,000 Structural rust: 3/unlimited Outer body rust-through: 5/50,000	None	10540 Talbert St. Fountain Valley, CA 92708	Autocap
Nissan**	Basic: 1/12,000 Powertrain: 2/25,000 Rust-through: 3/unlimited	None	18501 S. Figueroa St. Gardena, CA 90247	Autoline
Oldsmobile**	Same as Buick	Same as Buick	920 Townsend St. Lansing, MI 48921	Autoline
Pontiac**	Same as Chevrolet	Same as Chev- rolet	One Pontiac Plaza Pontiac, MI 48053	Autoline
Subaru**	Basic: 1/unlimited	None	7040 Central Highway Pennsauken, NJ08109	Autocap
Toyota**	Basic: 1/12,500 Powertrain: 2/24,500 Electronic components: 3/36,000 Rust-through: 3/unlimited	None	19001 S. Western Ave. Torrance, CA 90509	Autoline
Volkswagen	Basic: 2/unlimited Rust-through: 6/unlimited	None	888 W. Big Beaver Rd. Troy, MI 48099	Autoline
Volvo	Basic: 3/unlimited Surfacecorrosion:3/unlimited Outer panel rust-through: 5/unlimited(*) Structural rust: 6/unlimited		Rockleigh, NJ 07647	Autoline

Warranty expires at the end of the time or mileage period, whichever occurs first.

Manufacturer's extended warranty offered.

(1) What you must pay toward the cost of repair after the basic warranty has lapsed.

(2) This major assembly/powertrain warranty covers engine (excluding diesel), transmission/transaxle, front- or rear-wheel-drive unit, cooling system, fuel system, steering, front suspension, brakes, factory air conditioning, electrical system and electronic instrument cluster.

(3) No deductible on electronic instrument cluster.

(4) These major assembly/powertrain and rust-through warranties apply to DeVille, Fleetwood Prougham, Eldorado and Saville.

Brougham, Eldorado and Seville.

(5) This powertrain warranty, covering only the engine, transmission/transaxle and front-wheel-drive unit, and this rust-through warranty apply to Cimarron, Fleetwood Limousine, and all Chevrolet and Pontiac models. The only exception is that a diesel engine is covered by warranty for 3/50,000.

(6) This warranty applies to the following electronic components in Cimarron and Fleetwood Limousine: instrument panel cluster, driver information center, heater and air-conditioner control systems, and fuel

economy panel. There is no deductible.

(7) This warranty covers electronic components listed in (6) for all Chevrolet and Pontiac models.
(8) Applies to New Yorker only. Covered are such things as air conditioning, brakes, electrical system, steering, cooling system, electronic instrument cluster, fuel system and front suspension. See warranty agreement for complete list.
(9) Applies to Fifth Ave. only. Covers all items listed in (8)

(10) Arbitration of warranty disputes must be submitted to the Chrysler Customer Arbitration Board.
(11) All models except Lincoln and Merkur.
(12) Lincoln and Merkur. For idea of major assembly components, see (8).
(13) Arbitration of warranty disputes must be submitted to the Ford Consumer Appeals Board.
(14) To keep Volvo's rust-through warranty in force, the car must be inspected by a Volvo dealer once a year, at no cost to you.

vehicle, except for a limitation or two such as tires, which are covered by the tire manufacturer, and maintenance items (filters, belts, sparkplugs and the like). Powertrain, rust-through, major assembly and electronic components coverage guarantees that specific parts of the car won't fail because of defects in material or workmanship for specified periods of time. In some instances, a deductible applies that makes you responsible for paying a portion of a repair bill.

Powertrain coverage generally applies to the engine, transmission, differential and drive axle. Examples of major assembly and electronic component coverages are given in footnotes to the chart.

Warranty dispute

If there's a dispute between you and your dealer over the warranty or if he fails to fix a malfunction, you have to first take the matter to the manufacturer's zone, district or regional office nearest you. These offices are listed in the owner's manual. You can contact the office directly or ask the dealer to do it for you.

In any event, a zone, district or regional factory representative will meet with you and the dealer to try to resolve the problem.

If the complaint can't be worked out on this level, send a letter describing the situation to the Customer Relations Department at the address of the manufacturer's headquarters listed in the

During the entire procedure—from the moment you first voice a complaint to the dealer and through each step, put everything in writing. Keep a copy of each related document and ask the other person involved to sign and date it at the time he gets the original. If you mail a letter to the manufacturer, make sure you keep a copy. Send the letter certified mail, return receipt requested. Keeping receipted copies is a precaution in case the matter eventually has to be resolved by an arbitration panel or in the courts.

Arbitration panels

Assuming the manufacturer doesn't resolve the complaint, the next step as far as most manufacturers are concerned is to turn the case over to one of two independent third-party arbitration panels-either Autoline, Council of Better Business Bureaus Inc., 1515 Wilson Blvd., Arlington, VA 22209 (800-228-6505), or Autocap, National Automobile Dealers Assn., 8400 Westpark Dr., McLean, VA 22102 (703-821-7144). Some manufacturers don't participate in third-party arbitration programs, and Chrysler and Ford have their own arbitration bureaus.

Win the Mobil 1 Corvette



and save up to \$3.

Now you can enjoy savings as well as extra motor oil performance from Mobil—the oil used by the 1985 SCCA Endurance Cup Champions! We'll send you a \$3.00 cash rebate when you mail proofs-of-purchase of 5 quarts of Mobil 1 Motor Oil, or a \$1.25 cash rebate when you mail proofs-of-purchase of 5 quarts of Mobil Super or Heavy Duty Motor Oil. See details on Certificate.

SWEEPSTAKES OFFICIAL RULES—NO PURCHASE NECESSARY

Great Corvette Giveaway Sweepstakes when you submit your githis certificate. Due to State taws, rebate certificates obtained at epstakes drawing in the following states: Maine, New Hampshire,

4. During the week of August 18, 1986, winners will be selected at random from all valid entries received. Glendinning Associates, Inc., an independent judging organization whose decisions are tinal on all malt relating to this sweepstakes. Participants whose entries are selected will be notified by mail and may be request. relating to this sweepstakes, Participants whose entries are selected will be notified by mail and may be requested to sign and return within 30 days of orbification, a form certifying their eligibitity for participation in this promotion and release regarding prize awards. In the event of non-compliance with the 30-day time period, an afternate winner will be selected. All prizes inturned to the exponsions or to Glendinning Associates, inc. as underiverable will be awarded to alternate winners. Limit one prize to a larmly or household. Prizes are not transferable and no substitution is allowed. Dealer peep charges, license and registration not included. Please allow 6-8 weeks after validation for prizes are the sole responsibility of the winners. The odds of winning are determined by the number of entries received.

5. Sweepstakes participation is open to all ticensed drivers that are residents of the U.S. except the employees and thor immediate families of Mustol OX Corporation, its subsidiaries, agents and Glendining Associates, Inc. This offer is void wherever prohibited or restricted by law and subject to all Federal, State and local laws and resolutions.



Rebate applies to all viscositiesplastic and fiber containers

MAIL-IN CERTIFICATE

To receive your Mobil Rebate, check the appropriate box:

Send me a \$3.00 rebate, I have enclosed 5 proofs-of-purchase (aluminum seals) from 5 quarts of Mobil 1 Motor Oil (plastic only), and a dated original proof-of-purchase receipt with the price of the oil diricled. To remove the aluminum seals from the plastic containers, simply cut around the inside of the necks carefully with a single-edge blade. Record the UPC Code number in the space provided below.

blade. Record the UPC Code number in the space provided below.

Send me a \$1.25 rebate. I have enclosed 5 prochs-of-purchase (5 UPC Codes (fiber container) or 5 aluminum aeats (pisatic container) from 5 quarts of Mobil Super or Mobil Heavy Dury Motor Dil, and a dated, original proof-of-purchase receipt with the price of the dil circled. To remove the 5 UPC Codes from the fiber containers, simply cut around the inside of the necks carefully with a single-edge blade. To remove the aluminum seals from the plastic containers, simply cut around the inside of the necks carefully with a single-edge blade. Pecord the UPC Code number in the space provided below.

ut this coupen and mail it with your proof-of-purchase UPC Codes or aluminum seals and receipt to:

MOBIL REBATE, P.O. Box 4593, Reidsville, NC 27322-4593

w requests must be postmarked no later than July 21, 1986.

STREET

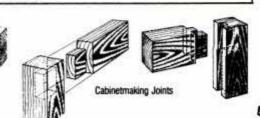
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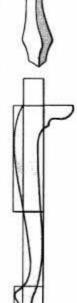
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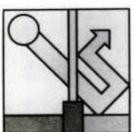
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If the arbitration panel rules for the manufacturer, the ruling is not binding. Only if the panel rules in your favor is it binding. Therefore, if arbitration goes against you and you still want to pursue the matter, it's time to sue. This can be done under the provisions of the Warranty Enforcement Law if your state has this law on the books, or under the provisions of other laws providing for failure to fulfill a contract.

So far, 39 states and the District of Columbia have enacted Warranty Enforcement Laws, which most of us know as lemon laws.

The Center for Auto Safety, 2001 S St. NW, Suite 410, Washington, D.C. 20009 (202-328-7700), has available The Lemon Book—a 236-page manual describing lemon laws. Selling for \$8.65, this manual provides instruction on how to use lemon laws effectively. Generally, most lemon laws call for refund or replacement when a substantial major component defect can't be fixed in four attempts, or the vehicle is out of service for 30 days being repaired or awaiting parts.

Emissions controls

The emissions controls of all cars are guaranteed by law for five years or 50,000 miles by the car manufacturer to perform according to clean-air standards. Furthermore, if the vehicle doesn't pass an emissions test because a nonemissions component fails, the vehicle has to be repaired by the manufacturer free of charge during the first 30,000 miles.

Some manufacturers sell manufac-

turer-sponsored extended warranty plans that go into effect after the warranty that comes with the vehicle runs out. A dealer can fill you in on plan coverage. But let me tell you something he won't. The cost is negotiable. Although manufacturers have a suggested retail price for each of the extended warranty plans, individual dealers set their own fees.

Shop around

If you want an extended warranty plan, shop around from dealer to dealer. You don't have to buy the plan from the dealer who sells you the car.

Dealers also usually sell warranty plans provided by independent insurance companies. Although the latter plan may be offered at a lower price, consider the fact that manufacturerbacking of his product may be more reliable.

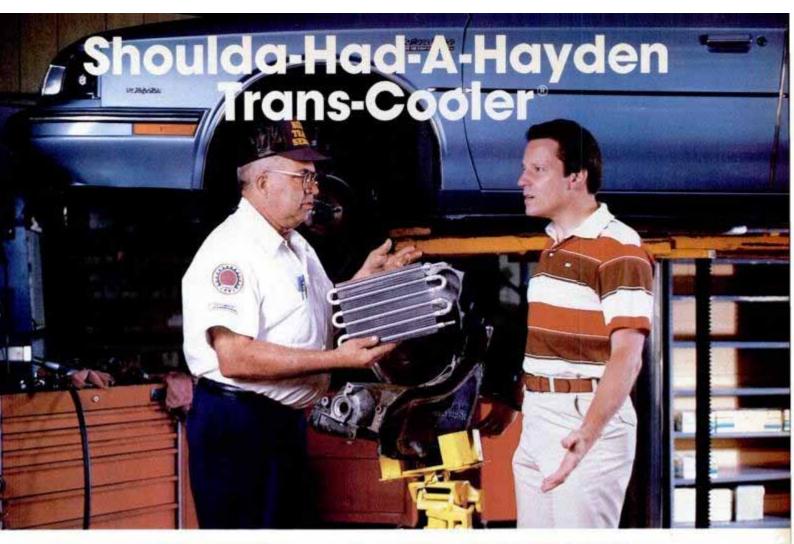
Are extended warranty plans worth the money? As with any insurance policy, if you collect from an extended warranty because of a component failure, then you'll think the plan is worth it. If, for example, you buy a 3-year extended warranty for \$295 and within that time you need a new engine or transmission, the plan certainly would have paid for itself—plus. Otherwise, consider the \$295 as payment for peace of mind.

To give you some idea of manufacturer dealer suggested retail prices for extended warranty plans, the chart below lists the costs of the various plans provided by General Motors for 1986 models.

GM EXTENDED WARRANTIES— SUGGESTED LIST PRICES

PASSENGER CARS 36 MONTHS/MILES 48 MONTHS/MILES 60 MONTHS/MILES MODELS 36,000 Unlimited 50,000 Unlimited Unlimited Chevrolet Cavalier, Chevette, Nova, Sprint, Spectrum; Pontiac T-1000, Fiero, Sunbird, Grand Am; Oldsmo-bile Firenza, Calais; Buick Skyhawk, Skylark, Somerset; Cadillac Cimarron \$295 \$410 \$440 \$555 \$650 Chevrolet Camaro, Celebrity, Monte Carlo, Caprice; Pontiac Firebird, 315 430 485 600 715 6000, Grand Prix, Bonneville, Parisienne; Oldsmobile Cutlass Ciera, Cutlass Supreme, Delta; Buick Century Regal, Le Sabre, Estate Wagon; Cadillac (rwd) Fleetwood Oldsmobile fwd 98 Regency, Toron-ado; Buick Electra, Park Avenue, Ri-465 580 700 Cadillac fwd DeVille, Fleetwood, El-700 Pontiac 6000 STE 170 285 400 Chevrolet Corvette 225 350 475 LIGHT-DUTY TRUCKS AND VANS

All 2-wheel drive including El Camino and Caballero	\$360	\$535	\$550	\$725	\$750
4-wheel drive	465	740	745	1020	1070



Over 13 million people didn't last year —and paid the price.

If you delay, you pay. Fact is, over 13 million* transmissions failed last year. Nine out of ten failures were caused by overheating. A small investment in a Hayden Trans-Cooler can save \$500 to \$1200 on repairs. Remember, each 20°F drop in temperature doubles oil and equipment life.

*Courtesy ATRA (Automatic Transmission Rebuilders Association)

Quick do-it-yourself installation. If you can change the oil in your car you can make this installation yourself.

Free Road Atlas and \$5 rebate coupons on the purchase of Hayden Products. Check with your local retailer for details on how to receive a free Rand McNally Road Atlas and Travel Guide. Plus rebate coupons for \$5 on the purchase of any Hayden Trans-Cooler, Electric Fan and Thermal Fan Clutch and up to \$300 worth of travel discount coupons good nationwide at major motel and amusement centers with your purchase of a Hayden Trans-Cooler.





Typical Hayden Trans-Cooler kit with everyday household tools.
 Place clamps on end of hose and push hose onto oil cooler fittings.
 Attach adhesive cushion pads to oil cooler.
 Insert Hayden's patented Quik-Mounts through radiator and cooler. Install locking fastner and cut off excess.
 Install Hayden's patented Quick-Connect coupler into radiator.
 When completed your Hayden Trans-Cooler installation will look like this.

Don't delay. Purchase a Hayden Trans-Cooler today at your local auto parts store, automotive chain store, RV dealer, mechanic or installer. The car's life you save may be your own.

To receive direct ordering information call toll

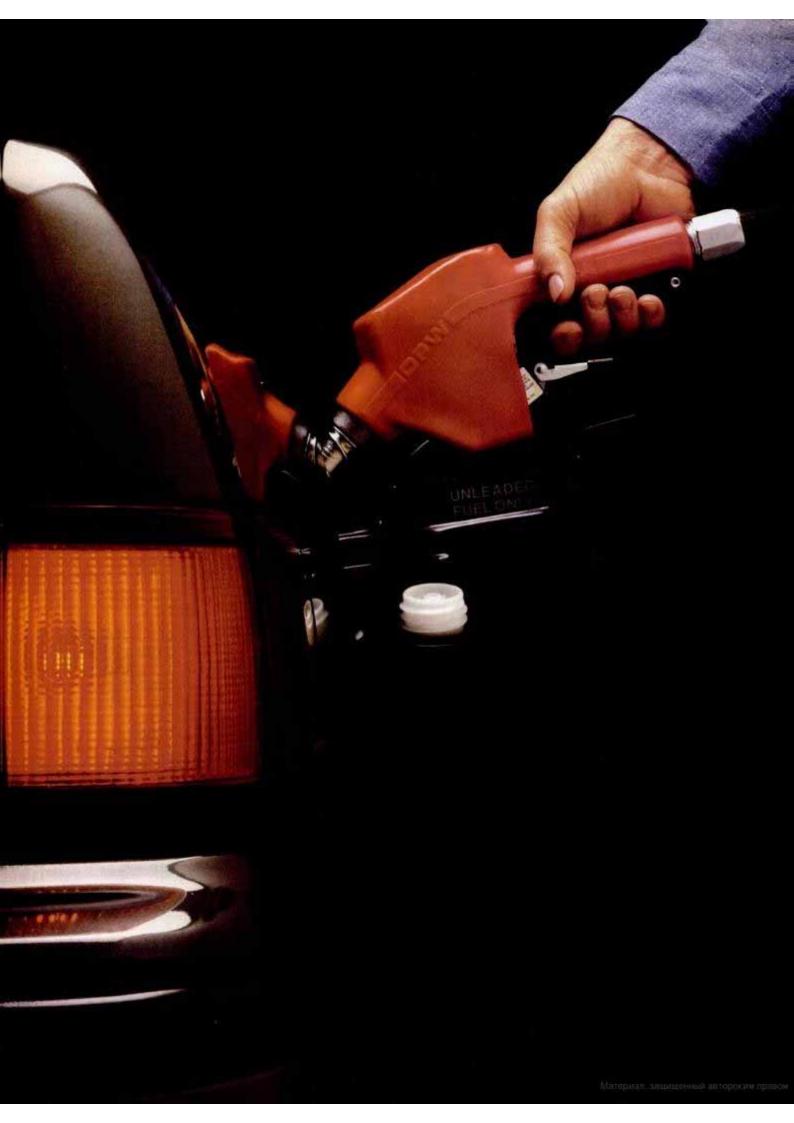
FREE outside CA 1-800-854-4757 or 1-800-443-2665

Hayden Trans-Cooler. If you have money to burn . . . you don't need one.

Write today for a free product brochure.



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CAR CARE CUIDE

GAS PAINS

How will your car run on today's low-lead, low-octane, alcoholadditive fuels?

etters to PM's Car Clinic indicate wide concern about the effect today's gasoline is having on engines. GM recently sent a letter to oil companies demanding better gasoline to prevent fuel-injector clogging. Gas companies are running ads with conflicting claims, adding to the confusion. Another area of concern is the availability of leaded gasoline for the high-compression engines in older cars.

Leaded gasoline will be around until 1988—perhaps beyond. As of Jan. 1, 1986, lead was reduced to 0.10 gram per gallon. It was not eliminated. The previous standard, adopted on July 1, 1985, was 0.50 gram per gallon.

The main reason most engines without catalytic converters require lead is for the cushion that lead provides between valves and valve seats. Valve seats may be too soft in these engines to withstand the extended valve wear and tear. Cars with catalytic converters have hardened valve seats and don't need lead to prevent abnormal wear.

The EPA's drive to get the lead out of gas accomplishes two things: First, it reduces lead emissions thrown into the air and any accompanying hazards to health. Second, it attempts to stop the illegal use of leaded gas.

MAJOR DISTRIBUTORS OF ALCOHOL/BLENDED GASOLINE

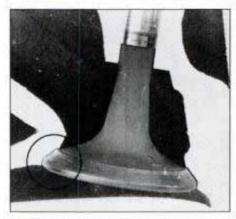
DISTRIBUTOR	ALCOHOL	WHERE SOLD
Amber	Ethanol	TX
AMOCO	Ethanol	IL, IA, KS, MN, NE, ND, SD
ARCO-Atlantic	Methanol	NY, PA
Ashland	Ethanol	IN, IA, KY, OH, MI, MN
Beacon	Ethanol	CA
B-T Energy	Ethanol	KY
Canal Refining	Ethanol	LA
CENEX	Ethanol	ND
Certified	Ethanol	ОН
Chemical Fuels	Ethanol and methanol	NC, SC
Chevron	Ethanol	KY, TN
CITGO/ Southland	Ethanol	AL, CA, CO, FL, IL, IN, IA, KS, KY, LA, MN, NM, OH, TN, UT, VA, WA
	Methanol	TX



With proper additives, valve-seat area (circled) shows little evidence of wear.

SOUTH ON BUSINESS		mumme seems
Clark	Ethanol	IL
CONOCO	Ethanol	IL, KS, MO, NE
Crown	Ethanol	AL, MD, VA
Derby Refining	Ethanol	KS, NE
Diamond Shamrock	Methanol	TX
E-Z Serve	Ethanol	FL, LA, TX
Farmland	Ethanol	NM
Fireline/ Cumberland	Methanol	CT, NY
Farms	Ethanol	FL
Getty	Ethanol	IA, KY, NE
Indiana Farm Bureau	Ethanol	IN
Kerr-McGee	Ethanol	ND
Koch Refining	Ethanol	MI, MN, TX
LaGloria Refining	Methanol	TX
MAPCO	Ethanol Methanol	KY, TN, TX AR, KY, TN, MS

DISTRIBUTOR ALCOHOL WHERE SOLD



Under Lubrizol Corp.'s high-speed tests, low-lead gas caused valve seats to recede.

DISTRIBUTOR	ALCOHOL	WHERE SOLD
Martin	Ethanol	IL
Mobil	Ethanol	Chicago, MN
Pester Refining	Ethanol	IA
Phillips	Ethanol	IL, IN, IA, MO
Pilot	Ethanol	TN, VA
Racetrac	Ethanol	AL, GA, TX, VA
Rock Island	Ethanol	IN
Shell	Ethanol	Chicago
Somerset	Ethanol	KY
Sun/Stop-n-Go Foods	Ethanol	FL, MN, OH
Tenneco	Ethanol	FL, LA, TN
Texaco	Ethanol	IL, MN, OK
Texas City	Methanol	TX
Thriftway	Ethanol	NM
Total Petroleum	Ethanol	CO, IN, IA, KS MN, NE, ND
Total Refining	Ethanol	MI, NM
Union Oil	Ethanol	FL, OH
United American	Methanol	AZ
United Refining	Methanol	NY, PA
Vickers	Ethanol	co
Western	Ethanol	CO
Wickland	Ethanol	CA
Zephyr	Ethanol	MI

About 20 percent of cars on the road can legally use leaded gasoline. Yet, 36 to 40 percent of the car population is using it. Why do people engage in this illegal practice? Until recently, leaded gas has cost as much as 11¢ per gallon less than unleaded gasoline. Furthermore, leaded gas has had an octane value about two points higher than unleaded regular.

With its lead phase-down order, the EPA hopes to eliminate these advantages. The price of new leaded gasoline will approach the price of unleaded since it will be more expensive to produce. With a reduced amount of lead, the new gas will have an octane value approaching that of unleaded regular.

To sum up the leaded gasoline issue:

The lead in gasoline currently available is ample to protect valves and valve seats, so stop worrying. There's no need to modify your engine or look for an additive that substitutes for lead.

Amoco Oil Co. has been selling leadfree gasoline in the East and South for 70 years, and some of its customers use it exclusively. Amoco claims that lead is not needed to protect valve seats on older cars that are driven normally.

Naturally, companies like The Lubrizol Corp. of Wickliffe, Ohio, which sells a gas additive intended to replace lead, disagrees with Amoco. Lubrizol has

horrifying photos of valve-seat wear caused in lab engines run on gas without lead.

Amoco counters that it is easy to cause valve-seat damage in lab tests by running engines at full throttle and load for long periods. But they point out that it is impossible and illegal to drive that way in the U.S.

■ If the lower octane of the new leaded gas causes engine ping, you can retard spark timing up to 6° from the recommended setting to see if the ping diminishes or disappears. Another remedy is to fill the gas tank half full of leaded regular gas. Then top it off with unleaded premium gas.

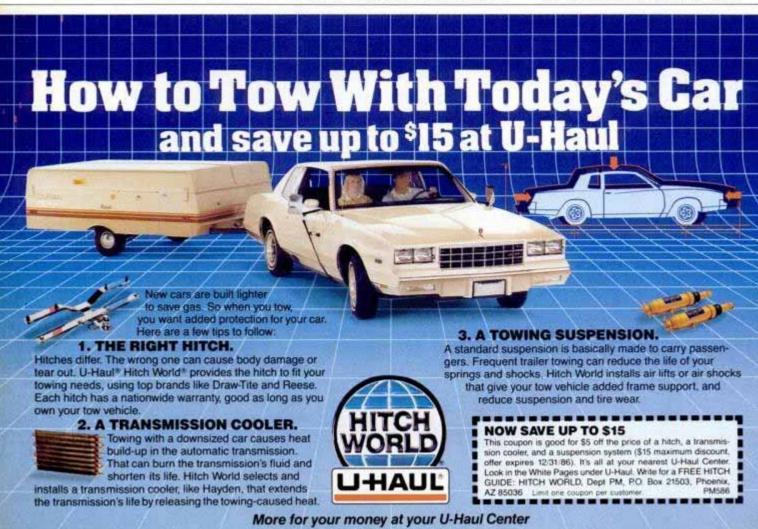
As for what's going to happen to leaded gas in 1988 and beyond, no one can tell us. If the EPA does decide to ban the sale of leaded gas, there are several possibilities you can try to keep a clunker or classic without emission controls on the road. By the time the total ban edict is announced, lead-substitute additives may be available. Failing this, installing hardened valve-seat

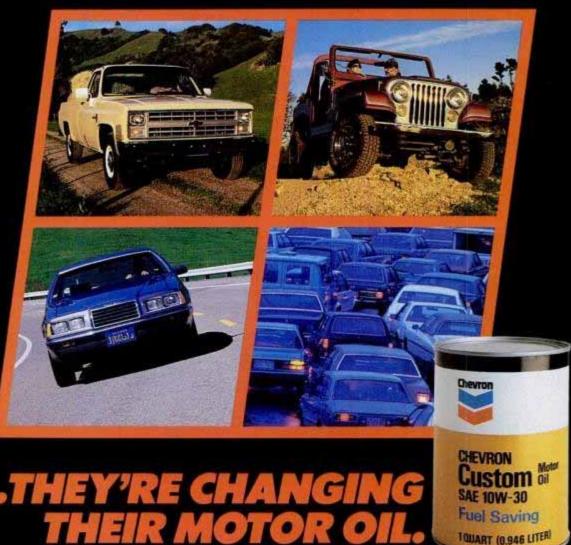
Trouble over alcohol

The worry about alcohol-blended gasoline has been fanned by carmakers themselves.

inserts would be another alternative.

The reason behind blending metha-





Quick starts. Vicious weather. Tough terrain. Big loads. Stop-and-go traffic... Even if you're driving a high-reving turbo, 4x4, or pickup—if you're driving it hard, you want maximum protection.

You're looking at it: Chevron Custom Motor Oil.

FACT: Chevron Custom exceeds the performance specifications of every single U.S. and foreign car manufacturer.

FACT: Every drop of Chevron Custom gives you the added confidence of built-in viscosity stabilizers and patented anti-wear compounds.

MAXIMUM PROTECTION: Against friction, corrosion, excess engine wear. Maximum performance—for maximum confidence.

Chevron Custom Motor Oil. The oil hard drivers are changing to.



nol with unleaded gasoline is to raise octane at reduced cost. Oil companies have two options when it comes to octane: They can use alcohol as an additive to get gasoline of a particular octane, or they can build additional refining facilities and process additional oil to obtain that same octane. In some areas, methanol-blended no-lead sells for 10 cents a gallon less than nonalcoholic gas.

Why don't more oil companies blend methanol into gasoline? Because the jury is still out on the effects of methanol on certain plastic and rubber fuel system parts. Chrysler, Nissan, Mazda, Subaru, Volkswagen and Volvo all warn that the company won't pay for damage done by methanol-blended gasoline to fuel-system components if the new car warranty is still in effect. Conversely, AMC/Renault, Ford, GM, Honda and Toyota state that the blend is acceptable as long as it doesn't contain more than 5-percent methanol and has an equal amount of cosolvent and corrosion inhibitor mixed in.

Ethanol vs. methanol

Only two manufacturers—BMW and Volvo—threaten warranty action where ethanol is properly blended with unleaded gasoline. Ethanol is alcohol produced from wheat, corn, alfalfa, soy beans or sugar cane and is often called grain alcohol.

A 90-percent unleaded gasoline/10percent ethanol blend, commonly called gasohol, became available during the fuel crises of the 1970s. Gasohol is still sold in some regions where grain production is high and state tax subsidies offset the high cost of ethanol (see chart).

Both ethanol and methanol are forms of alcohol. Methanol is more corrosive, and is more damaging as the amount in the gasoline blend increases. The EPA therefore limits methanol additives to 12-percent.

Methanol problems

The problems blamed on methanolblended gasoline are engine damage, hard starting, hesitation, stalling, reduction in fuel economy and higher emissions.

Engine damage allegedly caused by a methanol/gasoline blend falls into two categories:

- Damage to fuel-system components caused by methanol that separates from the blend. Phase separation, as it's called, is the division of the fuel into two layers—one of alcohol and water, the other of gasoline—when water mixes with the fuel.
 - 2. Engine damage brought about by

methanol altering the effectiveness of engine oil.

Let's dismiss the latter possibility first. According to 1984 tests conducted by Southwest Research Institute (SRI) in San Antonio, Texas, a 5-percent methanol/95-percent gasoline blend, which is the ratio most blenders use, will not alter engine oil. Tests were also made with a fuel consisting of 15-percent methanol and 85-percent gasoline. Even at this potency, SRI reports, "There was no significant behavioral difference between lubricants. Nothing was found to indicate that oil additive effectiveness might be influenced by the presence of methanol."

Other studies indicate that a cosolvent and corrosion inhibitor added to the blend will prevent phase separation and its damage to fuel system parts. The cosolvent—ethanol, propanol, butanol or some mixture of these—reduces phase separation. The corrosion inhibitor supposedly prevents methanol attack on fuel-system parts.

Hesitation and stalling

Even a 2-percent addition of methanol to gasoline will raise its vapor pressure more than 3 psi, which is sufficient to produce vapor lock in many fuel pumps. Vapor lock will cause hesitation and stalling.



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I've seen how dirty deposits can hurt a carburetor—and gum-up an engine. But what most folks don't know is how little it really takes. Or how fast those harmful deposits accumulate.

Experts say it takes dirt that's only one-thousandth of an inch thick to cripple a carburetor jet. And that thin layer of dirt can quickly become a dirtier, gummier mess.

A mess that'll settle in your carburetor. A mess that could make your car stall. Run rough. Start hard. A mess that'll creep into the PCV Valve, and cause rough idling. Acid corrosion. And heavier than normal oil and fuel consumption.

And because these dirty areas are so hard to see—and reach—most folks figure a costly professional cleaning is the only way to wipe it out.

But what I recommend is a really powerful jet spray cleaner. Jet-Spray Gumout® Carburetor & Choke Cleaner. It's preferred 3-to-1 over any competitor. And believe me, it's for a lot of good reasons. It gets to the gum and dirt. And cleans up your carburetor and choke like no other cleaner. With regular use, I've found you can keep your carburetor and choke virtually dirt-free—and that means saving gas, money, even the life of your engine.

Just spray Jet-Spray Gumout®

on the outside of the carburetor. On the carburetor linkage. On the automatic

choke. And on the inside of the carburetor throat. After that, spray it directly into the open end of the PCV Valve.

As it cleans your carburetor and linkage, it helps to stop that rough-running and stalling.

As it cleans the inside of the carburetor throat, it helps to stop that rough idling.

As it cleans the choke, it keeps it from sticking.

And finally, as it cleans your PCV Valve, your engine can start giving you a cleaner, better performance.

So for engine dirt that's quick-to-form and hard-to-reach, I recommend Jet-Spray Gumout® Carburetor & Choke Cleaner.



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Enough butane can be removed from gasoline, however, so the blend's vapor pressure is reduced to that of straight gasoline. A properly blended methanol/ gasoline fuel usually won't cause hesitation and stalling.

In parts of the country during the summer of 1984, some fuel delivery companies poured additional amounts of methanol into correctly blended alcohol/gasoline mixtures and also into straight gasoline. By using relatively inexpensive methanol to dilute the fuels they received from refineries, they extended supplies and made more profit. EPA inspectors making checks in response to complaints by consumers uncovered several firms engaged in this practice.

Motorists should be on guard against this kind of thievery. If your car suddenly starts hesitating and stalling, suspect a load of fuel "watered down" with alcohol. You can buy alcohol-detection kits from Sealed Power Corp., Kent-Moore Allied Div., 29784 Little Mack, Roseville, MI 48006, and from Miller Tool Co., 32615 Park La., Garden City, MI 48135.

Alcohol aftereffects

Let's run down other objections to alcohol-blended fuel, and the facts:

- Mpg reduction—There could be a loss in fuel economy with an alcohol/gas mixture caused by the lower energy content of the alcohol. For example, there are 3½ percent fewer BTUs per gallon of blended fuel containing 5-percent methanol and 5-percent cosolvent compared to straight gasoline. However, the lower price per gallon would compensate for the loss in mpg.
- Increased emissions—Whether alcohol blends produce greater air pollution depends on the definition of the term "emissions." A properly blended methanol/gasoline fuel gives off less hydrocarbons (HC), less carbon monoxide (CO) and less nitrogen oxide (NOx) than straight gasoline. On the other hand, the emission of aldehydes is slightly higher when alcohol-blended fuel is burned. Aldehyde emissions are not regulated.

Injector clogging

Port-type fuel-injector nozzles are made to microscopic tolerances and are easily clogged with deposits left by evaporating gasoline. Clogged injectors cause stalling and hesitation. GM's vice chairman, Howard Kehrl, sent a letter to the oil companies late last year asking them to "market and advertise" high-detergent gasolines "that will prevent injector deposits." Kehrl mentioned Mobil Oil by name as the only company presently doing so. Mobil adds the extra detergent only to its premium unleaded, however.

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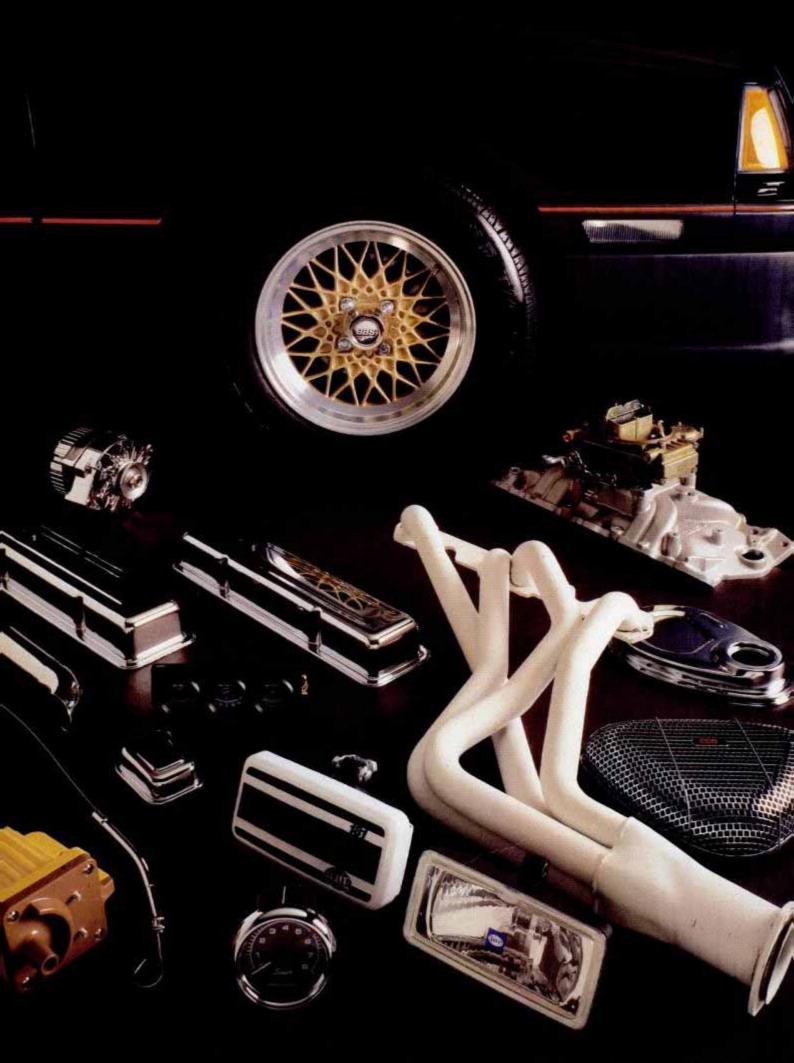
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With sound systems, for example, you can often do a lot better in terms of sound quality and features by going with an aftermarket setup. And you can get the newest and ultimate wrinkle in car audio, the Compact Disc player. Even if you don't opt for high-tech car audio, you can add a power antenna for under \$100. Cruise control and intermittent sweep windshield wipers are two popular items. Rear window defogger/deicers are easily installed and feature cut-off timers.

Top-line seats deserve a test drive. They are anatomically designed and have many adjustments.

Don't like cranking your windows up and down? No problem. Power window kits are under \$300.

If you really want to know what's going on under the hood, check out a gauge package. Lighting is another popular accessory. Halogen units replace sealed beams with no modifications necessary. Power door lock kits retrofit virtually all domestic and import cars.

In the performance arena, look at 4barrel carbs, tuned intake manifolds, dual exhausts and headers. Big boosts come from superchargers, turbochargers and nitrous oxide kits.

With automatic transmissions, higher-stall-speed torque converters lock up at higher rpm, and you can get more precise gear selection with aftermarket shifters. For handling there are new springs, swaybars, shocks, wheels and tires.

Add-on body pieces—a variety of spoilers, wings and air dams—give a slippery shape. So go to it!

Some accessories you can install on your car include, from top to bottom:

Spoked wheels from BBS are model No. 7015P (\$900 per 4-wheel set). They're light-weight, good looking and are prominent personalizers for your car. BBS of America, 33 Murray Hill Dr., Spring Valley, NY 10977.

Holley 4-barrel carburetors feature modular design for flexible tuning for performance or economy by changing fuel blows and internal parts. The 600-cfm models are \$244 to \$537. Holley Carburetor Div., 11955 Nine Mile Rd., Warren, MI 48090.

The Holley is shown mounted on a Torker II intake manifold designed for performance up to 6500 rpm. Unit must be used with manual or electric choke carbs. Small-block Chevy model is \$144.95. Edelbrock Corp., 411 Coral Circle, El Segundo, CA 90245.

Aries chrome alternator for engine dress-up (\$150) is a remanufactured unit that uses a heavy-duty internal voltage regulator. Out-

put is 60 amps. Ram Automotive, 201 Business Park Blvd., Columbia, SC 29203.

Proform small block Chevy chrome engine dress-up kit No. 668515 (\$60) contains Original Equipment design valve covers, push-in breather cap, dipstick, timing cover and timing tab. Specialty Auto Parts, Box 306, Roseville, MI 48066.

Blackjack Series 3000 headers are engineered for economy and maximum power in the low- to mid-rpm range. Units feature die-cut exhaust flanges for perfect fit. The headers list from \$111 to \$160 depending on application. Blackjack Headers, 19007 South Reyes Ave., Compton, CA 90221.

Suntune triple gauge kit No. 7995 (\$36) comes with 60-amp ammeter, 0 to 100-psi mechanical oil pressure and 100 to 280°F. water/oil temp gauges. Sun Electric Corp., One Sun Pkwy., Crystal Lake, IL 60014.

The Pro Flow air cleaner (\$24) is a lowprofile design and has a reusable element that cleans up with soap and water. The unit features low-restriction breathing and flame-retardant element. Edelbrock Corp., 411 Coral Circle, El Segundo, CA 90245.

Hella halogen driving and fog lights (\$125) use a 12V 55W H33 bulb and cover 500 feet for fog lights, and 5500 feet for driving lights. Includes all wiring and hardware needed for installation. Hella Corp., 42 Jackson Dr., Cranford, NJ 07016.

Accel Super Coil (\$55) works with virtually any ignition system and provides up to 45 percent higher voltage output compared to conventional coils. Features vibration-proof spring-loaded core assembly. Accel, Rt. 139, Branford, CT 06405.

Sun Super Tach II No. CP7901 [569] reads out 0 to 8000 rpm and works with 4-, 6- or 8-cylinder engines with most ignition systems. The tach features an internally illuminated 3%-inch dial and mounts on steering column or dash. Sun Electric Corp., One Sun Pkwy., Crystal Lake, IL 60014.



Car Care Cuide

CARE AND FEDING

Even computerized cars need proper care and maintenance to remain like new. Here's yourstep-by-stepguide.

or the dedicated Saturday mechanic, one of the most enjoyable things about a new car is the opportunity to poke around under the hood. In addition to the joy of working in a clean, new engine compartment, there's the excitement of all the new technology and the challenge of learning to work with it.

Whether your car is brand new or a few decades old, the best way to keep it happy is to perform all recommended maintenance on schedule. Regular maintenance will help preserve that silky smooth new-car performance and prolong the life of the oldest machines.

A systematic approach to car care can also help keep repair costs under control. Little problems that arise when maintenance tasks are ignored, like a sticking choke, beget big problems like ruined catalytic converters and oxygen sensors. Replacing worn parts and making necessary checks and adjustments on time will keep repair costs to a rock-bottom minimum.

Of course, anyone who aspires to do a significant amount of work on his or her own car should be equipped with a copy of the factory service manual. These books aren't written for do-it-yourselfers (as our maintenance guide is), but because they're vehicle specific, they can provide tremendous assistance when used in conjunction with instructions aimed at the home mechanic. You'll find a list of sources for factory repair manuals on page 146.

Oil change

Changing the oil and filter is usually the first job that the novice Saturday mechanic tackles. But you don't want to waste time while you're under there waiting for the dirty oil to drain. The best mechanics perform a quick undercar inspection as a part of every oil change. Chassis parts can also be lubed at this time, and, when mileage intervals so dictate, you can do a brake inspection, tire rotation, and ball joint check. You'll find instructions for these procedures in following sections.

It's also good to remember that you can't change your oil and filter too often. Combustion byproducts always work their way into the oil, undermining its ability to lubricate the moving parts of your engine. No matter how you slice it, changing your oil and filter frequently will prolong the life of your engine. Many professional mechanics still change oil in their personal cars at 2000- or 3000-mile intervals, despite the manufacturer's more liberal maintenance schedules.

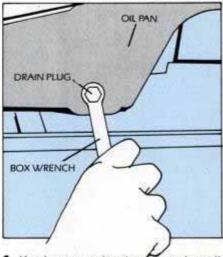
Make sure the engine is fully warmed before changing the oil. You'll have to drive the car for at least 20 minutes. Just running the engine won't bring the oil to full operating temperature. When you're sure the oil is warmed, shut off the engine and raise the car on jack-stands or ramps so that it's level. You'll have to raise both the front and the rear

for the oil to drain properly and to allow you to do the under-car inspection.

Locate a drain pan that is big enough to hold all of the oil that will drain from the engine. If you're not sure, check it with water and a measuring cup. Place the pan so that it's centered under the oil pan's drain plug. Then, using a box wrench, loosen the drain plug (Fig. 1). Some cars may have a square drive hole in the plug or a hex drive hole in the plug. If so, you'll need to use the square drive of a ratchet or a large socket drive (Allen) wrench to loosen it. Using a box wrench rather than an open end or an adjustable crescent will help prevent stripping the corners off of the plug's hex head. And, make sure you have a new oil drain plug washer on hand, if one is used on your car.

Replacing the oil filter

Allow the warm oil to drain completely.



1 Use box wrench when removing oil drain plug to avoid rounding off corners.



While it's running out, you can change the filter. If your drain pan isn't big enough to catch the oil that will run out when you loosen the filter, use a second drain pan or bucket. Use a filter wrench, available at auto parts stores, to loosen the filter. This tool is a band with a lever attached. When you pull on the lever the band tightens around the filter. Make sure you pull in a counterclockwise direction when looking at the filter from its lower end.

On some new cars, access to the filter is severly limited and the filter wrench handle is difficult to reach when installed on the filter. For such applications use a ratchet-driven filter wrench (Fig. 2).

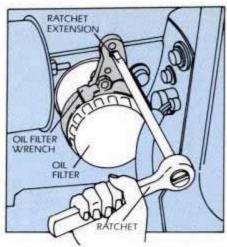
Once the old filter is off of the engine, check to make sure that its gasket came off with it. Then clean the filter mounting area and partially fill the new filter with some of the fresh engine oil. Lube the filter gasket with this clean oil as well. Then install the filter, tightening it according to the directions printed on it or 3/4-turn after the gasket makes contact with its mounting flange. You can usually tighten a filter sufficiently by hand; you shouldn't have to use the wrench. Of course you should use a filter wrench if it's a tough reach with your hands. But if you really muscle it down, you may have a tough time trying to get it off the next time you change oil.

Allow enough time for every drop of the old oil to drain, then reinstall the drain plug. Take care that you don't cross thread it; tighten it with moderation. Use a wrench no longer than 10 in. and, once again, don't make it as tight as you possibly can.

Oil viscosity and grade

Because many of the new engines run at higher temperatures than powerplants of earlier design, oils have been improved accordingly. Make sure you use only the manufacturer's recommended oil when refilling. The automakers recommend SF, SF/CC or SF/CD grade oils for the latest gasoline engines and SF/CC or SF/CD oil for diesels. Some also specify viscosity, usually opting for 5W30 in most climates. Some carmakers may not repair your engine under warranty if the dealer thinks you caused the rings to stick by using the wrong viscosity oil. If your car is under warranty, make sure that your parts store receipt includes grade and viscosity and then save it as part of your maintenance record, noting the mileage and date at which the oil was changed.

For older gas-engine cars you can use SF oil even if SE or another grade is specified in your owner's manual. SF is just an improved formulation that stands up better under the rigors of



2 Use ratchet and extension-driven filter wrench to remove filters in close quarters.

high temperature and contamination.

Once you're certain that you have the right oil for your car, fill the crankcase with the recommended amount, start the engine and run it for a few minutes. While it's running watch closely for leaks from the filter or drain plug. If everything's okay, shut it off and check oil level on the dipstick. If you're certain you used the recommended amount for a change with a new filter but the dipstick shows low or overfilled, stop by your dealer with the dipstick and make sure it's the correct one for the engine.

Between changes, make sure you check your oil level at every other gas fillup. And, when it's low, add the same type of oil you used when you changed it last.

Under-car inspection

While you've got your car up in the air for an oil and filter change, you should inspect the underside. It's a good way to prevent little problems from becoming big problems, while making sure that your vehicle is safe to operate.

Begin by inspecting the complete exhaust system. An exhaust leak that works its way into the passenger cabin can kill you. Look for broken, missing or mis-positioned parts, including the rubber and steel hangers that attach the exhaust parts to the chassis (Fig. 3). Check for open muffler seams, holes and loose connections.

Check both front and rear suspension for worn bushings, loose parts and physical damage. Make sure all shock absorbers are firmly attached at both ends. It's a good idea to grab a wrench and check the tightness of all bolts that aren't fitted with a cotter pin. Check power steering lines and hoses for leaks or physical damage. If your car is equipped with manual steering, check the box for seal leakage. If you own a front-wheel-drive car, clean and inspect the drive-axle boot seals (Fig. 4). If they're torn, they must be replaced.

Steering and suspension inspection

At 15,000-mile intervals, your undercar inspection should include a pieceby-piece check of steering and suspension components. Grasp each rod end and shake it to test for excessive looseness (Fig. 5). While tie rod ends should allow some movement, they should not allow unrestricted movement.

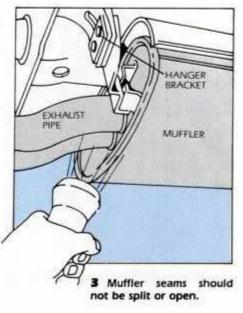
Almost all cars produced today are equipped with wear-indicator ball joints. Most wear-indicator joints have a collar around the grease fitting that protrudes from the lower surface of the joint. As the joint wears, this collar sinks below the surface of the joint, indicating that replacement is necessary. Other wear-indicator joints, including those used on most Chrysler products, are checked by attempting to rotate the grease fitting. If the fitting is loose in the joint, the joint is excessively worn.

Check all strut and control arm bushings for looseness and wear. On front-wheel-drive cars make sure you check the bushings in the struts that join the engine and trans sub-chassis assembly to the car's integral body/chassis unit (Fig. 6).

Chassis lube

Lubricate all grease fittings in the suspension and steering linkage (Fig. 7). Some new cars come with plugs installed in the places where grease fittings normally go. If you find this to be the case, you can purchase the fittings at a parts store, remove the plugs with a small box wrench and install the fittings. Use a water-resistant EP chassis lube in a grease gun. Pump grease in until the dust cover of each suspension joint swells slightly (Fig. 8). If a component won't take any grease wiggle it a bit while you pump the grease gun.

Using a light oil, lubricate transmission or transaxle shift linkage, hood and





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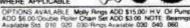
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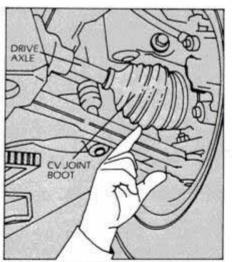
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Closely examine CV joint dust boots on front-wheel-drive cars; replace if needed.

door hinges, and parking brake linkage on older cars with an exposed cable-and-lever mechanism. Use white lithium grease on the hood latch, parking brake cable guides and any underbody brake cable contact points. Clean the power antenna mast and apply a thin coating of the lithium grease. On rear-wheel-drive, manual transmission cars, lubricate the clutch cross-shaft lever and, if necessary, adjust clutch linkage freeplay following manufacturer's instructions for your particular model.

Check differential and manual transmission lube levels on rear-drive cars. On most cars this is done by removing a plug from the side of the unit. Many vehicles use a hypoid-type lube in the rear end. If your car has a limited-slip differential, it may require special lube. Check fluid level on automatic trans cars or manual transaxle front-drivers. Both are equipped with underhood dipsticks. Most are supposed to be checked warm. See your owner's manual for fluid requirements.

Check brake master cylinder fluid level, and fill to the FULL line or to within ½ in. of the top (Fig. 9). Use fluid that meets DOT 3 specifications. Don't use fluid if it hasn't been stored in a sealed container. It could be contaminated with moisture. Don't use fluid if you can't find an indication of its DOT specification on the can. Some fluid loss is normal on disc brake cars, but it can be an indication of pad wear. Severe fluid loss requires immediate attention.

Check power steering fluid level, and, on cars with hydraulic manual clutches, clutch cylinder fluid. Follow manufacturer's recommendations, which can be found in your owner's manual, for refill. Some power steering units require special fluid, others use power steering fluid. Some new cars have remote power steering reservoirs (Fig. 10).

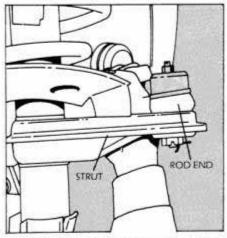
On automatic transmission cars it's a good idea to change the fluid and in-pan filter at 30,000-mile intervals. If the pan doesn't have a drain plug, drain fluid by removing all bolts except one in a corner. Then gradually loosen the remaining bolt to lower the opposite corner of the pan. As the fluid drains, loosen the bolt more. Change the filter before reinstalling the pan.

Reviewing the rubber

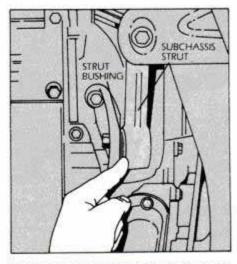
Check tire air pressure at every other fillup; develop a habit of doing it when you check oil level. Keep your own tire gauge in the trunk or glovebox so that you will get comparative readings each time. Inflate to the manufacturer's recommended level. You won't gain traction by underinflating tires.

If your tires have not worn evenly you've either been inflating them incorrectly or your wheels are misaligned. On bias-ply tires, wear that occurs only on both outer edges of the tread is a sign of underinflation. Wear that occurs only in the center of the tread is a sign of overinflation.

Radials won't necessarily wear unevenly due to incorrect inflation, but they won't perform properly either, so frequent checks are even more impor-



5 Check rod ends for looseness by grasping the tie rod and shaking it vigorously.



6 Examine bushings of struts that join engine and trans subassembly to chassis.

tant with radial tires than bias-ply.

Wheel alignment problems will affect both radials and bias-ply tires. Excessive camber causes one side of the tread to wear more than the other. Incorrect wheel toe in or toe out settings cause the edges of the tread to feather. Unbalanced tire and wheel assemblies or failure to rotate tires will sometimes cause cupping, scalloping or bald spots.

Tire rotation

To equalize wear, tires should be rotated after the first 7500 miles. After they've been rotated once, 15,000-mile intervals are frequent enough. This is particularly important with radial tires as the front tires tend to scrub off the shoulders quite rapidly. Follow the rotation pattern provided in Fig. 11. If your car has a full-size spare use the rotation scheme for five tires. If you have an undersize spare, rotate only the four standard tires.

Retighten the lug nuts using a torque wrench in the sequence illustrated (Fig. 12). With four lugs use a crisscross pattern. You'll find a spec for wheel torque in your service manual. First torque each lug to half of the recommended figure, tightening them in the order indicated in the illustration. Then bring each to full torque. If you can't find a wheel lug torque spec for your car, torque ½-in.-diameter lugs to 85 ft.-lb. and ½-in. lugs to 70 ft.-lb.

Disc brake inspection

You can check for excessive brake pad and/or lining wear at the same time you rotate tires, as the recommended intervals are the same. Closely examine the master cylinder, calipers, wheel cylinders and every connection in the hydraulic system for leaks. If you do find fluid leakage, the problem must be fixed before the car is driven again. Leakage from a master cylinder, wheel cylinder or caliper will require rebuilding or replacement of the component. Leakage from a line or fitting calls for replacement of the part. After any hydraulic repairs you must bleed the brake system.

If there are no signs of leakage, inspect the brake pads and drum brake shoe lining to see if they've worn to the point where replacement is required. Many disc-brake-equipped new cars have wear indicators that contact the brake disc when the pads have worn out (Fig. 13). If you see that this indicator is within $\frac{1}{16}$ in. of the brake disc or if the indicator has contacted the disc and squeals when you drive the car, replace the pads.

If your car has disc brakes without wear indicators and you know for sure that your brake pads are of the bonded type, rather than of the riveted type,

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you can probably inspect lining thickness through a hole in the top of the caliper (Fig. 14). The thinnest section of the friction material should be thicker than the pad backing plate. If it isn't, the pads must be replaced.

If you're not sure whether the pads

are riveted or bonded, you'll have to remove the caliper to check pad thickness. In most cases, the job is quite easy. On most Japanese imports you can simply remove one of the caliper bolts and swing the caliper up off of the disc. On GM and most Chrysler cars

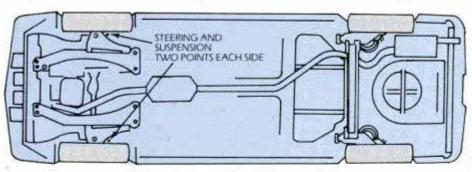
you'll have to remove both caliper bolts. Most Fords have a retaining key that must be removed to disengage the caliper. Rear-wheel disc brakes that incorporate parking brake mechanisms can be quite complex.

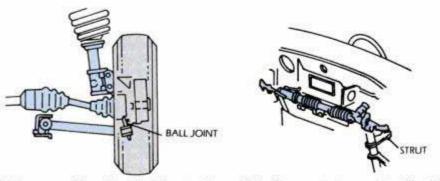
Drum brake inspection

Most cars still have drum brakes at the rear. To check these, the drums must be removed. On some front-wheeldrive cars this will require removal of the wheel bearings. On front-wheeldrive cars with sealed bearing and hub assemblies in the rear, or on rear-drive cars, the drum is simply pulled off of the lug nut studs.

If your car is new and the drums have never been removed, you'll probably find a retainer washer on one stud of each drum. Simply cut this off with a pair of side cutters (Fig. 15). To prevent breathing brake shoe particles which may contain asbestos, cover your nose and mouth with a breather mask like those sold in automotive paint stores, then attempt to remove the drums. Sometimes on low mileage cars, the drums can be pulled right off of the studs. In most cases, however, you'll find that the brake shoes must be retracted before the drums will come off.

To retract the shoes on most vehicles with self-adjusting drum brakes, you'll





7 Many cars with rack-and-pinion steering and MacPherson strut suspension, like this GM J-car, have only four points where grease must be applied with a grease gun.

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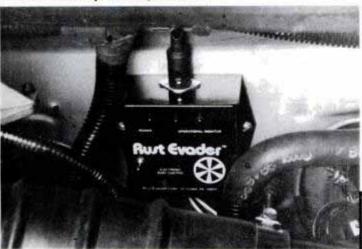
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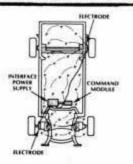
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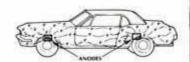
This electronic rust control device protects your car's body and frame panels as well as painted outer surfaces against corrosion. It inhibits the obvious types of corrosion that can turn small stone chips into ugly, scabby rust spots. It fights hidden corrosion in body parts subjected to stress, or vibration, in highly vulnerable welds and joints, in panels that are bent, nicked or scratched. The system is a low current-draw design giving you a 45 day static storage life. Driving your car 50 miles per

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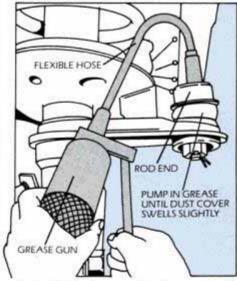
need a brake adjusting tool. This tool, which looks like a miniature pry bar, is used to turn a star wheel inside the brake drum. The star wheel is attached to a threaded device between the two brake shoes. When the wheel is rotated to make the threaded section shorter, the shoes retract.

The adjusting tool is inserted into the brake through a slot, either in the backing plate or in the drum. The slots should be filled with rubber insert plugs. On cars with slots in the backing plate, reach in with a small screwdriver and lift the self-adjusting lever away from the star wheel. Insert a brake

adjusting tool in the slot alongside the screwdriver. With the adjusting tool engaged in the teeth of the star wheel, pull it up or down to back off the adjustment. Most often the adjusting tool is pushed upward to retract the shoes.

If your drum brakes have adjusting slots in the drums, use a hook to hold the self-adjuster lever away from the star wheel. Insert the brake adjusting tool next to the hook to turn the star wheel.

With your breather mask in place, pull the drum off of the brake shoes. Examine the inside of the drum. If it's



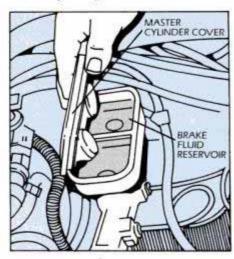
8 Pack joints by pumping in grease until the dust boot swells slightly.

been damaged by contact with brake shoe metal or shoe rivets, it will have to be machined or replaced. If it's blue or cracked from too much heat, it must be replaced.

Check for lining wear. Linings that are bonded to the shoe (no rivets) should be replaced when they have \(^1\)/₁₆ in. or less material. Riveted linings should be replaced when they wear to within \(^1\)/₃₂ in. of the rivets (Fig. 16).

Maintenance tuneup

If you've fallen into the habit of replacing engine wear parts only when the engine starts to run poorly, it's time you changed. Today's automobiles, with oxygen sensors and catalytic converters in the exhaust stream, are easily damaged by a poor running, misfiring engine. On-time servicing of engine wear parts can prevent such damage. This maintenance tuneup should be performed at 15,000-mile intervals on cars with electronic ignition or at 10,000-mile intervals on cars with breaker-point ignition.



To remove the cap from a late-model GM master cylinder, pull up on side tabs.



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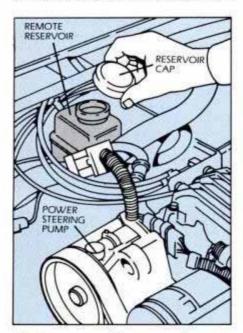
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Sparkplugs

To remove sparkplugs on engines with limited access, particularly those with transverse V6 engines, you'll need a swivel-head plug socket, an extension and a %-in. drive ratchet (Fig. 17). On some applications, a swivel-handle ratchet with a rigid socket may work better.

Take care when you pull off the plug cables. Don't tug on them. Grasp the rubber boot that fits over the plug and twist it back and forth a bit until it loosens its grip on the plug. Then pull off the cable while twisting the boot. Some of the very newest cars have large cable boots that facilitate this.

On some cars, the arrangement of the plug wires in the wire loom corresponds directly to their position on the engine. If this is the case, you won't have to mark them. But if you can't tell where each wire goes by looking at the loom, number them before you take them off.



10 Some new cars have reservoir-mounted remote from the power steering pump.

Once the cables have been removed, remove the plugs with your ratchet and plug socket, taking care that the socket is placed squarely over the plug. If you hold it on an angle, you might crack the plug's porcelain. As each plug is removed, place it in a compartmentalized and numbered tray so you'll know which cylinder it came from.

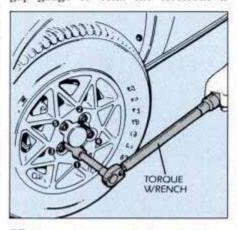
Once all of the plugs have been removed, inspect them carefully. They should all be of approximately the same color, ranging from gray or brown to white or tan, depending on the type of fuel used. If you find that one or more is coated with wet fuel, burned oil, metal deposits or heavy black deposits of carbon, an engine diagnostic routine must be performed to determine the cause of the problem.

11 You can follow these patterns for rotating bias-ply or radial tires.

If the edges of the plug's inner and outer electrodes are noticeably eroded, replacement is necessary. If erosion is accompanied by severe blistering of the insulator, the cause of excessive combustion chamber temperatures must be determined.

With breaker-point ignition you should replace the plugs after 12,000 miles even if they look good. With high-voltage electronic ignitions, you can clean and gap them and put them back in for another 15,000 miles or more.

Purchase replacement plugs of the same heat range recommended by the manufacturer. Don't experiment with hotter or colder plugs. The plugs in use today have a broad heat range to cope with all normal driving conditions, and use of a hotter or colder plug could adversely affect engine calibration. Find the manufacturer's specification for plug gap in your service manual. If you don't have a manual, check the spec in a parts store plug catalog. Gap the plugs, using a wire gap gauge (Fig. 18). The wire that will just pass between the two electrodes indicates the size of the gap. Use the tool at the end of the gap gauge to bend the electrode if



12 Torque lug nuts as indicated; tighten to half of spec first time, then do again.



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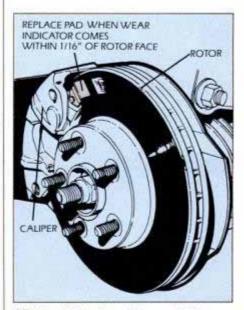
necessary. Don't bang the plug on anything or try to bend the electrode by prying it with other tools.

Install the plugs and tighten them with moderate pressure. Don't muscle them down or you'll crack the insulator and lock them in place-permanently. If you have the access, use a torque wrench and tighten them to 20 lb.-ft.

Plug cables

Before reinstalling the plug cables, examine them carefully for brittleness, cracking, cuts, burns or corrosion of the plug-end terminals. Under normal conditions they'll last several years, but if exposed to road salt they may fail much sooner.On newer cars with electronic engine controls, don't attempt to clean the plug cable terminals as they may be coated with dielectric silicone grease to prevent electrical interference.

When installing a new set of wires, remove one old wire at a time and match it to a new one. Use all looms and separators and route the wires exactly



13 On disc brakes with wear indicators, replace pads before the telitale squeal.

as they were originally. And, by all means, don't replace the heavy-duty silicone-jacketed wires used on today's high voltage ignitions with cheap offbrand wires. It pays to buy the best.

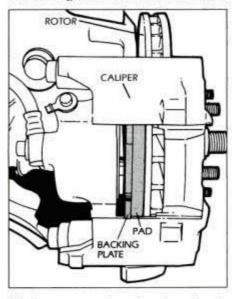
Distributor cap and rotor

Remove the distributor cap. On some new cars you may have to remove the cap end of each plug cable before the cap can be disengaged from the distributor, as on the Chevrolet Cavalier V6 illustrated. If so, mark each wire and each location on the cap with a grease crayon or other marker before removing the wires (Fig. 19). The cap is retained with two or three screws on most cars (Fig. 20). On some GM caps, particularly large ones, the screws are pushed down and turned a half turn to

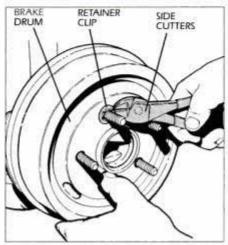
release two spring-loaded latches. On a few models, the cap is retained by spring clips which can be disengaged by prying with a screwdriver.

Once the cap is off the distributor, check the inside of the cap for cracks, fractures or any evidence of carbon tracking between terminals. Replace the cap if it is damaged. On older cars without computers you can clean the inside of the cap with a rag and scrape corrosion from the terminals with a knife. However on many new cars, the terminals are coated with special silicone grease made for this purpose and should be left alone. A small amount of corrosion mixed with the grease won't hurt anything. If the cap is severely corroded it should be replaced, and the silicone grease should be renewed. When you install a new cap don't overtighten the screws or you'll crack it.

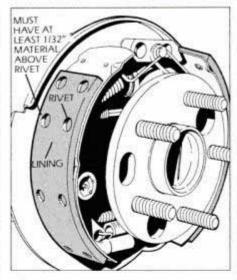
Remove the rotor from the distributor shaft. It may simply be sitting on the shaft or it may be attached with two screws. Check the rotor for damage. Make sure the center contact has not been arcing to the distributor shaft. On



14 You can examine the edge of pads through an opening in top of caliper.



15 To get brake drums off a new car, you'll have to remove the retainer clips.



16 Lining on riveted shoes is worn out if it isn't more than 1/32 in. above rivets.

cars without computers, clean any corrosion from the rotor terminal or tip with a knife. If it is corroded to the point where it can't be cleaned easily, replace it. On new cars, the rotor is probably coated with silicone grease, so don't attempt to clean it. Replace the rotor if it is severely corroded or damaged in any way. When installing a new rotor, apply silicone grease made for this application as before.

Replacing points and condenser

It's been a long time since an American car was produced with a contact breaker ignition system, but our sources in the parts business tell us they still sell a lot of point sets. To us, that means that many of you are still tuning older cars.

To replace contact points, begin by turning the engine until the rubbing block of the points is on the high point of the distributor cam. Disconnect the two wires that are attached to the point set. One is the distributor's primary circuit lead, the other is the condenser wire. Once the wires are disconnected, remove the contact points. On cars where the base of the breaker point set is slotted for the screws, just loosen the screws enough to slide out the point set. On cars where you have to remove the screws completely, don't drop them or you may have to remove the distributor to get them back.

To remove condensers that are not spotwelded to the bracket, you can just loosen the retaining screw enough so that the condenser slides out of the bracket. If the bracket is attached to the condenser, you'll have to take the whole thing out.

Install the new points and condenser, locating the new condenser in exactly the same position as the old one. After making sure that the rubbing block of the contact pointer set is touching a high point of the distributor cam, adjust

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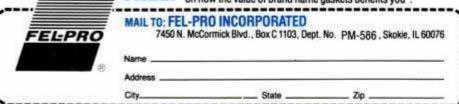
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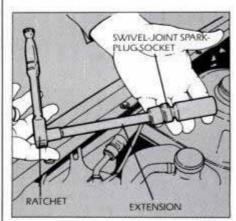
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the point gap to specification using a feeler gauge. Lubricate the distributor cam with a small amount of cam lube or white lithium grease. A very small amount is enough. If the distributor is equipped with a lubricating wick that touches the cam, don't attempt to oil it. Replace it instead.

After reinstalling the cap and rotor, start the engine and check point dwell with a dwell meter and compare to the manufacturer's spec. If it's not right, readjust the points and try again. On GM cars with an access window in the distributor cap, you can adjust the point gap with an Allen wrench while the engine is running.

Adjusting spark timing

Once you've completed all ignition maintenance procedures, you should check and, if necessary, adjust spark advance. You'll need a timing light. This stroboscopic light allows you to see the relative position of an index mark on the crank and an indicator on the engine when the No. 1 plug sparks (Fig. 21). The timing light's pickup is attached to the No. 1 plug cable, either by means of an inductive clamp that surrounds the cable or an adapter that goes on the end of the cable. Never attach equipment by piercing a cable. Unless your timing light is of the very inexpensive variety, it will also have two leads that connect to the battery. Timing lights that are not powered by



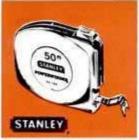
17 To reach plugs in tight engine compartment, use a swivel-joint plug socket.



18 Insert wire of plug gauge between inner and outer electrodes to check gap.



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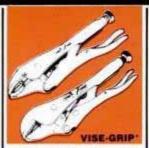
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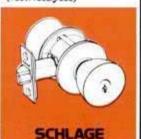
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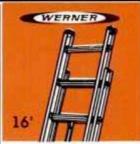
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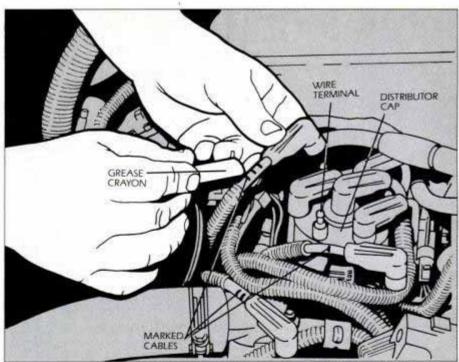
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19 If you have to disconnect plug wires to remove distributor cap—as you do on Chevrolet 2.8 liter V6 shown here—mark wires and cap towers with grease pencil.

the battery are dim and difficult to work with.

On some cars, particularly older ones, you have to disconnect the vacuum advance hose before adjusting timing. You can determine exactly what preparations are necessary by referring to the Vehicle Emission Control Information label, found under the hood. You'll also find specs for spark

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timing on this label.

On cars with vacuum and centrifugal advance mechanisms, once initial timing has been set, disconnect the vacuum advance hose, accelerate the engine to 1500 rpm and reconnect the hose. If you have your timing light aimed at the indicator, you should see timing advance. If you don't, make further

checks of the vacuum advance mechanism by checking input vacuum with a gauge and vacuum diaphragm operation with a hand vacuum pump. Replace the diaphragm if it's defective.

On most of the engines produced during the last few years, a computer controls spark advance. In most cases you can determine if spark advance is functional by simply revving the engine and watching the timing indicator with your timing light. As with older engines, timing should advance as engine speed increases. On many systems the computer system will set a trouble code and turn on a CHECK ENGINE light if the spark advance program is not operating properly.

PCV valve

Because the PCV valve relieves crank-

case pressure buildup and routes crankcase gases into the engine where they can burn, a defective PCV can cause oil burning and/or gasket and seal failure. While factory recommendations usually call for PCV inspection only at tuneup time many professionals tell us they replace the PCV valve and PCV filter every time they do a maintenance tuneup.

You'll find the PCV valve attached to a hose and plugged into the intake manifold or rocker cover (Fig. 22). To replace it, simply unplug it from the engine and remove it from the hose. If the hose is damaged, cracked or brittle, replace it as well. On many cars you'll find the PCV filter in the air cleaner housing. On newer cars you may find it

POPULAR MECHANICS • MAY 1986

on the oil filler cap. Replace it when you replace the PCV valve. Check the condition of the hose that joins the air cleaner to the engine crankcase and replace it if necessary.

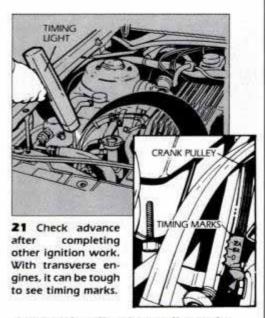
Air filter, carb and choke maintenance

Replace the air filter element when you perform your maintenance tuneup. On new cars with port fuel injection it may be mounted in a corner of the engine compartment (Fig. 23). In areas where there is a lot of airborne soot or dust, you may have to replace your filter more frequently. Keep an eye on it.

Late-model 3.8-liter V6 Fords and some new GM engines have a solenoid that controls EGR operation. This solenoid is equipped with a filter that should be replaced when the air cleaner element is replaced (Fig. 24).

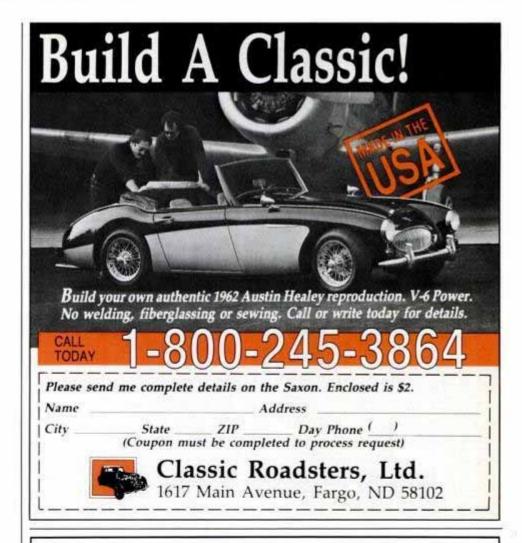
On carbureted cars or those with throttle-body fuel injectors, check to make sure that all carb mounting bolts are tight. Loose carburetors are a major cause of rough idle. On carbureted cars, clean the choke mechanism and carb linkage with carburetor cleaner. Then start the engine and make sure that the choke functions. If the engine is cold, the choke plate should snap closed and the fast idle cam should swing into place under the idle screw when you open and close the throttle. As the engine warms, the choke should gradually open. When you rev the warm engine, idle speed should drop.

If the choke mechanism doesn't oper-



ate properly, adjust it according to the manufacturer's specs.

Once you're sure that the choke is working as it should and the engine is fully warmed, hook up your engine tachometer and adjust idle speed to the manufacturer's recommended setting. You'll find this spec on the vehicle's Emission Control Information Label.



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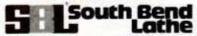
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which is located under the hood.

Hot air system check

If your car is carbureted or equipped with throttle-body fuel injection, you can help prevent driveability problems like spark knock and hesitation by checking your hot air system at every maintenance tuneup. The hot-air system provides heated inlet air during warmup, drawing from a stove surrounding the exhaust manifold.

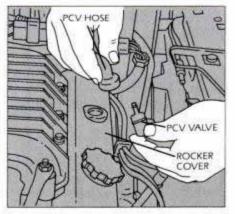
On most cars, the hot-air duct is controlled by a vacuum motor. The vacuum supply is turned on and off by a thermal switch in the air cleaner. When the intake air is cold the motor closes a door in the air cleaner, forcing the carb or throttle body to draw its supply from the stove. As the intake air warms, the switch shuts off the control vacuum, and the door returns to the heat-off position.

After checking to make sure that the duct hose is in place between the manifold stove and air cleaner (Fig. 25), use a mirror and a flashlight to make sure that the door is in the heat-on position with the engine cold. Then watch while it warms to make sure the door moves to the heat-off position.

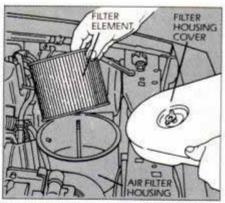
If you find that the door is in the heatoff position when the engine is cold, either the door itself is jammed, the vacuum motor that moves the door to the heat-on position is not operating, or the thermal switch is defective. If the door remains in the heat-on position after the engine has warmed, check for vacuum at the vacuum motor connector when the engine is warm. If you find vacuum, the thermal switch is defective. If you don't have vacuum, the door is stuck.

EGR inspection

EGR testing should be a part of the 15,000-mile maintenance tuneup. Once again, it will return big dividends in preventing spark knock and other driveability problems. The test should answer three questions. First, is EGR control vacuum present at the specified



22 PCV valve is usually found in the rocker cover or intake manifold.



On some cars with port fuel injection, air cleaner housing is off to the side.

level? Second, does the EGR valve open when control vacuum is supplied during cruise conditions? And third, are the exhaust gas passages in the valve and engine allowing the flow to get to the combustion chambers?

The most basic EGR systems use a ported vacuum signal to open the valve. Because it's taken from above the carb throttle plates, a ported vacuum signal is not present at idle, so the valve doesn't open until the throttle plates are partially open. The ported vacuum is routed through a temperature control switch to prevent exhaust gas from being delivered to the intake until the engine warms up.

If your car is equipped with a basic system, make sure control vacuum is present at the EGR valve when the engine is warm and running at about 2000 rpm. To make sure the valve is opening and the exhaust is flowing, apply vacuum to the EGR valve with a hand vacuum pump while the engine is idling. The EGR flow should cause the engine to stumble or stall. If there is no change in performance, the valve is defective or the exhaust flow is blocked

To determine which-broken valve or blockage-feel the underside of the valve diaphragm while you apply vacuum. Wear gloves as the valve may be quite hot. If the diaphragm doesn't move when the vacuum is applied, the valve is defective. If the valve appears to be opening, but there is no change in idle when the valve opens, the exhaust passages are plugged.

Remember that many EGR valves won't open when only vacuum is applied. They are regulated in respect to both vacuum and exhaust backpressure. If this is the case on your car, you might want to confine your test to a check of vacuum lines and on-the-road observation of EGR operation. By this, we mean simply noting how the engine runs under heavy load when using the recommended fuel and with spark timing adjusted to specs. If it sounds like you have marbles in the hubcaps every time you climb a hill, you better pull the

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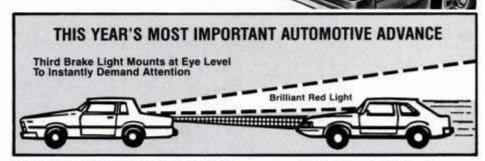
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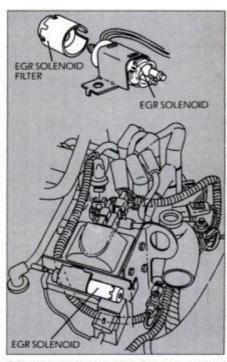
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EGR valve off the engine and test it. However, if everything seems to be okay, you can get by with just a visual inspection of the system.

After you've checked your EGR system, examine all other vacuum hoses on the engine. A loose connection or cracked hose will make the best-tuned engine idle roughly. Tug on the ends of each hose to make sure they're firmly attached to their connectors. Examine the hoses for swelling, brittleness or cracking.

If no visible damage but rough idle causes you to suspect that a leak exists, squeeze off vacuum lines one at a time using a needle nose pliers. If the idle suddenly becomes smooth, you know you've located a leak. To check for leaks at intake manifold gaskets, spray non-flammable solvent on the gasket edge while the engine is running or use a propane leak detection probe available at auto parts stores. If the idle clears up, you've found a leak.



24 Some EGR solenoid filters should be replaced when engine air filter is replaced.

Fuel system

Replace the fuel filter at tuneup time. On carbureted cars, it's either in the fuel line between the pump and carb or behind the inlet fitting on the carburetor. Place a rag under the connections to catch any spilled gas. Use two wrenches to remove the fuel line from the inlet nut on cars where the filter is in the carb inlet. One wrench must hold the inlet nut while the other, preferably a tubing wrench, loosens the fuel line. Replace in-line filters by disengaging the neoprene hose from each end.

In either case, make sure you install the new filter so that it's positioned the same as the old one. On most inlet nut filters, the check valve goes toward the outside. In-line filters usually are marked with an arrow.

Manufacturers seem hesitant to make recommendations for fuel-injection fuel filter replacement intervals. In most cases, they recommend that the filter be replaced when it becomes clogged or restricted. Of course, the only way you'll know that it's clogged or restricted is when you're stranded somewhere with a dead engine. Some of our independent mechanic contacts tell

us that they replace any external fuelinjection filters when they perform a maintenance tuneup. In-tank filters are replaced only when they fail.

However it is extremely important that you do not attempt to replace a

filter or do any other fuel line work on an injected engine without first relieving fuel pressure. See shop manual for

specific details.

Once pressure has been relieved, disconnect the fuel lines from the filter, using two wrenches: one to hold the

Getting That Fine Shine

reglected cars get old in a hurry, but a well-cared-for car can retain that showroom look for years. A weekly cleanup coupled with waxing at regular intervals is the key. The procedure outlined below is designed for 6-month application intervals.

Dirty work first

Corrosion usually starts underneath and then rises to the surface. By cleaning road salt from the underside panels and inspecting undercoating on a regular basis, you can avoid this.

Use a soft brush, soap and a garden hose or the pressure washer wand at a selfservice car wash to scrub the inside of the



Apply wax to one small area at a time and polish by hand, using a soft, clean cloth.

wheel wells, the inside of the door-mounting areas, the underside of the front and rear bumpers, and as much of the chassis as you can reach. Rinse off all of the soap. Then check carefully for corrosion.

Shower power

For your topside wash, use a product that is formulated for washing cars. If you use soap intended for washing clothes or dishes, you might remove the wax. But make sure you get a product that is meant to be mixed with water and rinsed off. The flushing action is an

important part of the wash job.

Do the job in the shade and start with the roof, then work your way down. As you apply soap with a soft sponge or cloth have the garden hose standing by and rinse immediately. For a perfect job, use a soft toothbrush to clean the grille and any other tight spots. Dry the car with a chamois that has been soaked and wrung out.

Finish protection

With so many car wax products on the market, it's tough to decide what offers the best protection and shine, so we asked a pro. John Herman is owner and operator of a Baltimore-based chain of auto detailing shops known as The Wax Man, and has developed a 3-step wax operation.

You'll need three products: a very fine grit rubbing compound-sometimes called polishing compound-that is designed for hand application, a polymer sealant, and a pure carnauba wax. If your car has metallic paint, purchase a cleaner designed for metallic finishes rather than the rubbing compound.

Before you begin the polish procedure, remove any bug or tar spots using solvent formulated to remove this goo. Work in the shade and apply the cleaning compound to a 2-foot-square area using a damp cloth or rubbing pad. Rub lightly, particularly on edges, to avoid excessive paint removal.

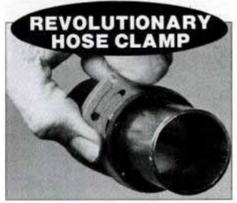
Once the car has been compounded, rinse it thoroughly with warm water and dry it with a chamois. Once it is completely dry, apply the polymer following the directions on the can.

To make that shine 6-feet deep, apply the pure carnauba wax on top of the polymer, after allowing time for the polymer to dry. It's essential that the wax does not contain any abrasive or it will remove the polymer.

Inside job

Don't forget the interior. Vacuum it throughly, then scrub the carpets with a carpet shampoo. If you have cloth seats, you can use the carpet shampoo on them as well. Use saddle soap on leather interiors and a vinyl cleaner on vinyl upholstery. Protect carpeting and cloth seats with a water-repellent fabric protector, and use a vinyl protector on other surfaces as recommended on the product's package. A Q-tip dipped in a lemon or pine fragrance household cleaner will get the dirt out of air-conditioning and heater ducts and other tight spots in and around the dashboard and windshield area.

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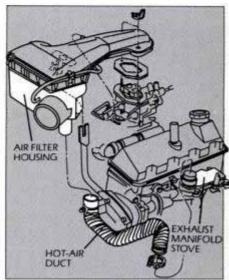
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fitting on the filter and one to turn the fuel line fitting (Fig. 26). It's best to use a tubing wrench to turn the fuel line

Once the lines have been disconnected, remove the screw that joins the filter bracket to the vehicle underbody. When installing a new filter, make sure that a good O-ring is used at each end of the filter (Fig. 27).

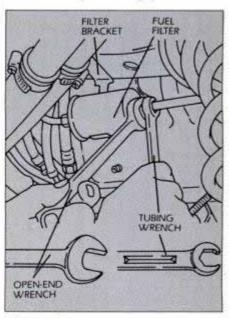


25 Make sure that your engine's hot-air duct is securely in place at both ends.

Battery care

Take care of your battery and it will reward you with a fast crank even in moderately cold weather. But remember that batteries are not permanent. Four or five years is generally tops, and some batteries will lose their zip after only three years. A battery that is not properly maintained may throw in the towel much sooner.

You should service your battery when you're performing your 15,000-



26 Use tubing wrench on GM filters to avoid rounding off corners on the fitting.

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Includes toothpick

and tweezers

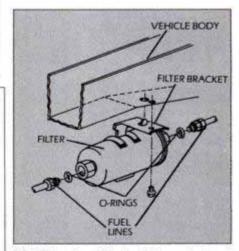
mile maintenance routine, but you should clean the battery and cable terminals at every other oil change.

Begin the cleanup procedure by removing the battery cables, negative cable first. Then clean all parts of the battery and terminals with a small wire brush (Fig. 28). Dip the brush in a paste made from baking soda and water. If heavy corrosion has accumulated, remove the corroded metal from terminals and from battery posts using a small knife or battery post cleaning tool. When reattaching side terminals don't overtighten the screws or you'll break the terminals inside the battery.

Nearly all batteries produced today have a built-in hydrometer that indicates approximate state of charge by changing color. Take a look at this eye whenever you're cleaning the battery. In most cases, a green eye indicates fully charged, a dark eye indicates a discharged battery, and a clear or white eye indicates that the battery is defective and cannot be charged or jumped.

You can also get a good idea of battery charge by measuring voltage, and many new cars are equipped with dashboard voltmeters for just that purpose. However, if your dashboard voltmeter isn't calibrated accurately enough for you to read voltage in half volts, you'll have to attach a remote voltmeter to your battery. With the engine off, the battery should store at least 13.5 volts.

If you find that your battery is not fully charged, connect a trickle charger for at least several hours, until you get a fully charged indication. A maintenance-free battery that has been almost

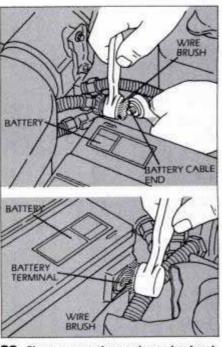


27 When installing fuel filter on injected GM car, install new O-rings, too.

fully discharged may have to be charged with a high-amperage professional-type battery charger for a long period of time. If your battery never reaches full charge, replace it.

Belts and hoses

Carefully examine all of the drive belts as part of your 15,000-mile maintenance procedure. Replace any belt that shows excessive wear, severe glazing, cracking on the bottom of the belt or frayed cords. If a belt still looks good after four



28 Clean connections using wire brush dipped in paste of baking soda and water.

Fuel Injection Cleaners Just Became Obsolete.

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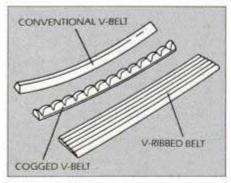
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years, replace it anyway, and toss the old one in your trunk as a spare.

Once you've examined the belts, check tension. The best way is with a tension gauge. This tool, placed over the belt in a position where it won't touch the pulley, gives you a tension reading that you can compare to manufacturer's specs. If you don't have a belt tension gauge, press firmly on the belt in the middle of a span. It should not deflect more than about 1/2 an inch. This test is only good for conventional V-belts; use a tension gauge for checking cogged or ribbed belts (Fig. 29).

Check all hoses for cracking, swelling or oil and grease contamination. Carefully examine each hose right next



29 Three different types of accessory drive belts are used on today's cars.

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to its clamps. You may find that a clamp has started to cut its way into a hose

Look at the coolant as it runs through your radiator. Black flecks can be a sign that hoses are deteriorating on the inside. But an absence of flecks is not certain proof that the hoses aren't shot. Again, four year replacement is good insurance against unexpected failures.

Cooling system flush

Regular cooling system flushes are necessary to prevent corrosion damage. Begin by turning on the heater and removing the radiator cap. Then warm the engine fully. Open the drain petcocks in the radiator and engine block. If you can't loosen the petcocks on an older car that has not been regularly serviced, drain engine and radiator by removing the lower radiator hose.

The best way for the home mechanic to flush out the system is through use of a flushing tee inserted into the upper heater hose. This tee is available at almost all auto parts stores. Once the tee is installed, connect a garden hose to it and run water through the system. Continue until the water runs clear.

Thermostat test

If your heater didn't keep you warm last winter or if your engine runs hotter

Super Bronc 3

or cooler than it should, you ought to check your thermostat before refilling the cooling system. The thermostat is usually located under the housing attached to the upper radiator hose. To get to the thermostat, just disconnect the upper radiator hose and remove the two bolts that connect the housing to the intake manifold or water box. On some newer GM 4-cylinder engines you'll find the thermostat in a housing that is topped by a radiator cap.

You can test the thermostat's opening temperature by hanging it in a pan of water along with a thermometer. Heat the water on a stove and note the temperature at which the thermostat begins to open. If opening doesn't occur at the temperature indicated on the thermostat's body, it must be replaced. You'll usually find the temperature indication on the button shaped temperature probe, located on the engine side of the thermostat.

Fill the cooling system with a 50- to 70-percent solution of antifreeze in water. Fill the recovery tank to the COLD FULL level. Do not overfill the system. Don't allow the concentration to exceed 70 percent or you'll lose freeze protection. If your car has aluminum engine parts or radiator make sure you use an antifreeze formulated for use in aluminum systems.



My son (age 12) and I put it together in 12 hours!" Mel Foltz. MO

Mark

Hauler







LAP OF LUXURY

(Continued from page 97)

same body, with only taillights and grilles to distinguish them. The three new cars not only look like each other, but are similar to every other recent GM model.

We seriously question the wisdom of giving every GM coupe and sedan, from the \$8000 Grand Am to the \$25,000 Eldorado, the same notchback formal roofline, wedge profile and drooping nose. Those famous Lincoln advertisements in which even the owners can't tell their Cadillacs, Buicks and Oldsmobiles apart are not only humorous, but sadly true.

The new Toronado has a full-width grille with hidden headlights, carrying on a tradition established back in 1965. Our testers thought it the prettiest of the three GM luxury coupes.

None of the testers liked the Toronado's interior styling, though. The ergonomics are straight from the '60s with flat, uncomfortable seats, old-fashioned controls, a U-shaped shifter like that on a 1961 Starfire and the general ambience of an American luxury car from two decades ago.

Oldsmobile is one of the most successful automotive nameplates in the world, so they're obviously doing something right. The Toronado is pretty, handles well and costs less than its direct competitors. The interior will no doubt appeal to traditional Oldsmobile buyers, even if it failed to excite our test crew.

Ford Thunderbird Turbo

The Thunderbird is the surprise star of this test. At \$5000 to \$10,000 less than the other Americans-and \$45,000 less than the Mercedes-it was ranked third by our road testers. What do we like about it? Well, its rounded contours seem like the timeless sculptures of Henry Moore. Then there's the interior. Our testers called it functional and very Germanic. It has the same feeling as the Merkur, with its white-on-black gauges, great bucket seats and logical ergonomics.

This looks and feels like a real driver's car, which makes it fun to be in and fun to drive. In just about every way, the Thunderbird interior is as good as that in the Mark VII, and better than any of its GM rivals.

The Thunderbird chassis is virtually the same as that under the Mark VII. with the exception of the air-spring suspension. Slalom, skidpad and braking performance are practically identical. Where the Thunderbird falls down is in the engine compartment. Both the Mustang GT and Mark VII LSC are available with Ford's 200-hp High Output 5-liter V8. The top Thunderbird performance option is the 175-hp turbo 2.3-liter Four from the SVO Mustang and Merkur.

Lamented one tester, "Engine is down on power, noisy, complicated and has poor torque characteristics for this car. Where's the V8? By denying T-Bird buyers the more powerful and responsive 200-hp HO V8, Ford forces them into the far-from-perfect turbo-Four. This might be good for Ford's corporate average fuel economy, but bad for customer satisfaction."

Surprisingly, the T-Bird 4-cylinder and Mark VII V8 have identical EPA figures and in our testing, the Mark VII was actually more economical-even though it's 500 pounds heavier and substantially faster.

Buick Riviera T Type

The Riviera is an Olds Toronado with a formal grille. It looks precisely like a Somerset Regal, which costs half as much and outperforms it in almost ev-

A velour-covered dashboard and velour door panels are complemented by velour seats made from reversible cushions held in place with Velcro-Velcro that shows when it's not supposed to. As one unimpressed tester wrote, "How tacky. The seats look ugly, feel worse." Although the seats adjust 16 ways via seven switches, several testers could not find comfortable settings.

We were impressed by the Riviera's instrumentation. The digital gauges are cleverly hidden behind a black plastic panel, while most controls are run by a CRT set into the dash. To tune the radio, for instance, you just touch the appropriate area of the CRT screen. Same goes for the climate control, trip computer and diagnostic functions. The CRT is actually easier to use than the dozens of poorly labelled buttons, switches and wheels found on most modern dashes.

Like the Toronado, the Riviera has excellent over-the-road performance, although the ride of the T Type is a bit jiggly on rough roads. As you'd expect, the two cars posted virtually identical figures at the track. There was something wrong with the Buick's brake booster, causing premature lock-up and long stopping distances. With this repaired, it would be right up there with the Olds. Choosing between the two then becomes a matter of picking the image and interior you like best. Of the three GM cars, our road testers preferred the Buick.

Cadillac Eldorado Biarritz

The Cadillac Division has a problem similar to that of the Reader's Digest. Its elderly customers are dying off-

(Please turn to page 204)



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LAP OF LUXURY

(Continued from page 203)

literally-and younger people aren't interested in what a Cadillac stands for. If Cadillac changes to appeal to a younger group of buyers, it'll lose its current market. If it doesn't change, its market will expire.

Cadillac's idea of a luxury coupe is putting a half-vinyl roof, stand-up grille, body side moldings and whitewall Uniroyal Royal Seal tires on the basic GM-20 body package. The 4.1liter Cadillac V8 engine produces less power than the Buick/Olds V6, which means that the Eldorado accelerates about as quickly as a \$5500 Nissan Sentra or Honda Civic.

If you've ever wondered just how much difference tires really make, the Eldorado was over 10 mph slower than the Toronado through our slalom test and more than 0.1 g slower around the skidpad. This brand-new \$25,000 luxury coupe, in other words, is one of the poorest performing cars we've ever tested.

Over-the-road performance was a lot better than the car's track numbers would indicate, however. In several weeks of commuting, the car performed satisfactorily, in the quiet, unobtrusive manner the traditional Cadillac buyer would expect.

Cadillac's traditional customers also will no doubt like the typical Cadillac interior. To us, Cadillac is operating from an obsolete premise for cars of this type, and that's why they're having trouble attracting younger buyers. We think they need to spruce up their cars, mixing in more performance plus functional European touches as Ford and Lincoln have done so well.

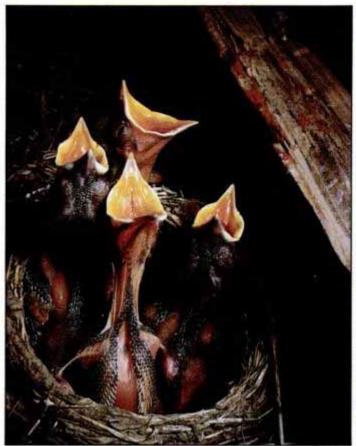
Conclusion

It must be reassuring to Mercedes-Benz buyers to know that the 560 SEC is as good as its reputation, and that for an obscene amount of money, one really can purchase the best automobile in the world

If you can afford the initial buy-in, the 560 SEC is probably a bargain, especially when you figure in Mercedes' minimal depreciation, troublefree reliability and the tax advantages most buyers in this class can arrange.

For those with thinner pocketbooks but expensive taste, the Mark VII LSC seems a reasonably priced alternative and also a great joy to drive. We would like the Thunderbird just as well, if only Ford would make the HO V8 an option.

Then there are the three new General Motors luxury coupes. "If I were GM," said one tester, "I would be worried about losing this whole market niche."







Robins in the nest won a boat for their photographer, James Patty. When Patty and his family arrived in New York City, we had his boat waiting at the curb. Flanking Patty in the photo below are PM Publisher Dan Coleman and Editor Joe Oldham. Runners-up in our photo contest were Gene Mohr of Sheboygan, Wisconsin, and Fred J. Keulen of Albuquerque, New Mexico. Mohr shot the crystal formation, and Keulen stood perfectly still in ice-cold water up to his waist to get the hot-air balloons.

PM's PHOTO CONTEST WINNER

then Managing Editor Bill Hartford suggested that PM's Water Sportster contest be based on the best photograph a reader ever took, we knew he had a great idea. But we didn't expect over 4000 entries.

The final decision was tough. Boating/Outdoors Editor Tim Cole and Electronics/Photography Editor Steve Booth took about two weeks to narrow down the entries to the three best. Editor-In-Chief Joe Oldham finally chose James Patty from Cannon Falls, Minnesota. His photo was not only technically excellent, but posed a difficult logistics problem as well.

Patty, 39, photographed a bird's nest with four newly hatched robins crying to be fed. The nest rested on an outside ledge of his chicken coop. To get his prize-win-



First-prize winner towed home our specially set up 16-foot Grumman Water Sportster.

ning shot, Patty built a makeshift tripod for his Nikon camera and mounted it to the side of the coop. While the mother robin attacked him, Patty tested his focus and flash by estimating the distance and exposure required. The final photo, printed here, is certainly a

tribute to Patty's perseverance.

Patty, a photo lab technician, drove to New York with his wife, Diane, and their two children, Matthew and Michelle, to pick up his new Grumann Skiddadle, Mariner 75 motor and Cox trailer (See PM's Water

Sportster, page 80, Feb. '85). After dinner at the fabulous Windows On The World restaurant high atop the World Trade Center Building, the Pattys spent the night as PM's guests at Marriott's Essex House. The next morning, the 10-year PM reader visited the POPULAR MECHANICS offices, met Publisher Dan Coleman and the rest of the staff, hooked up his prize to his Dodge Daytona, and took off for Cannon Falls. It was Christmas Eve and, as Patty pulled away, he leaned out the window and said, "Thanks, Pop-ULAR MECHANICS. What a Christmas present!'

As for our next big contest, we have a bunch of ideas that we'll be announcing soon. So stay tuned. We may hold a contest tailored just for you. And the next prize will be as great as the last.—Deborah Frank

(Continued from page 103)

water, she alighted with a minor tail walk and a splash instead of a whack. Can't complain.

Sea Ox 1800

Passenger comfort and superb handling on plane were the reasons we chose the Sea Ox as No. 2 in our overall ranking. Although the boat was the second slowest in our comparison (speed alone does not a good design make) it far surpassed the others in tracking and rough-water handling. We attributed Sea Ox's strength in this area to her somewhat narrow deep-vee hull form (18-ft., 3-in. LOA, 87.5-in. beam, compared to the Wellcraft's shorter 17-ft.. 10-in. LOA and 93-in. beam). The Sea Ox cleaves through the water with incredible grace and agility as a result. Moreover, the skipper's position is conveniently close to the steering wheel without impinging on legroom during stand-up operation. That means you can sit back in the roughest water without straining for the wheel, steer the boat with one hand around the corners, and let the Sea Ox hull form do all the rest. No doubt about it, this boat drives great!

You pay a price for this kind of performance, though. Because it's a little narrower than some of her peers, deck area is a little cramped as a consequence. You have to squeeze around the console to move forward, and the distance between the console and the forward platform is minuscule. Sea Ox would prefer to build in a larger forward platform for easting and for working hooked fish, but some other boatslike the Robalo-achieve a nice blend between seating space and forward platform area. In addition, committed Whaler fans complain about the Sea Ox's high freeboard when boating large fish. We concluded that these deficiencies would indeed take some getting used to. But they weren't sufficient to downgrade our high opinion of the Sea Ox, based on her exceedingly impressive seaworthiness. Handling is her strong suit.

Boston Whaler 1800 Outrage

The rest of the center-console world has gone to school on Whaler, still the biggest player in the center-console field. They've expanded upon the Whaler's original blend of speed and functionalism, and there's plenty to be said for Whaler's incredibly tough, foaminjected construction process—one element that keeps a Whaler's resale value high. The company has also gone in for some rather prudent detailing—on the Outrage, improvements like chafe-re-

ducing hawseholes for stern mooring cleats and nonskid teak on the cockpit coaming.

But the Outrage suffers in the deck space/stowage area department in several important ways. Although there's a provision for rod stowage port and starboard under the gunwale, they're short enough to be suitable for boat or trolling rods only. And the stowage space under the forward platform—accessible by lifting out an unhinged shock-cord secured slab of fiberglass—is shallow and wet.

In addition, the console on the Outrage is smaller than that found aboard the other boats that we tested, offering less of a shield against rain and spray. It's also positioned out of the center of the boat farther forward, which makes for plenty of unobstructed deck space aft but also translates into a rougher ride for passengers.

In smooth water, the Whaler fired out of the hole and registered brisk numbers in our 0-40 test and at the top end. It also tracked very well in the flat stuff. In rough water, though, the boat's low freeboard and small console makes the driver feel exposed to the elements, and when the boat's modified cathedral hull pops out of the water over a swell, it tends to come down on its edges a bit. Nothing to worry about—after all, you're driving a Whaler-but these characteristics become somewhat unsavory when compared to other boats in the field. A simple case of pupil surpassing teacher.

Robalo 1800

She's an extremely attractive boat, with a prim functional canopy, sensible use of teak and balanced deck plan. In fact, the Robalo and the Wellcraft sparred for top honors in our fit-and-finish category, with the final nod extended to Wellcraft on the basis of its rod-stowage area and superior console design.

Like Boston Whaler, Robalo owes a great deal of its strength in this area to its beefy foam-injected construction technique. The Robalo, like the Wellcraft, also enjoys a nicely balanced layout, with ample space granted the forward platform, console and working space aft.

However, while the boat has vertical rod stowage around the console—which is fine for short-term, flat-water or slow-speed trolling—we strongly felt the Robalo could benefit from more secure horizontal rod stowage along the gunwale. As it stands, the boat has side pockets in the area that is normally reserved for rod stowage, and we spent a fair bit of time trying to figure out

what you could logically stow there. Life jackets? Too bulky. Loose fishing tackle? It would start flying around the cockpit the moment you hit your first swell. Your lunch? Ditto.

The Robalo's lackluster top end and time to plane, or hole shot, can be forgiven when you factor in the Robalo's heavyish hull (1900 pounds, less engine) and windage-inducing removable canopy. But the boat puts up a real fight around corners-on flat and rough water. You have to oversteer a lot to keep her on track, and the stern skids through the kind of turn that the Sea Ox can handle with full-throttle ease. Handling quirks are compounded by placing the seats too far from the helm. As a result, you can't steer from a comfortable position while seated. Robalo could close that distance by 5 in. and still have sufficient room for standup operation.

Aquasport Osprey

Like Boston Whaler, Aquasport has been one of the names in center-console boats for going on three decades. So we were pleased to include the Osprey in our test. Our firsthand suspicions proved correct. A 10- to 12-in. increase in LOA and a corresponding increase in beam means the Osprey can achieve important advantages in stowage space and deck area. The Aquasport uses the extra space wisely, rating No. 2 in our static categories. One glance at the 3tiered rod-stowage compartments port and starboard, Igloo seat/food stowage area and its expansive forward platform and you know this boat has an edge in these all-important considerations.

The Aquasport is fast, too, offering a pretty blistering hole shot and top end in smooth water. But, like the Robalo, the boat can be a supreme handful around the curves and in the rough stuff. It skids during hard cornering, and in the extremely rough water we powered through out at sea, the Aquasport pounded severely, several times hard enough to pop open some hatches and rattle nerves. These handling dilemmas were vexsome enough to completely outweigh the Osprey's stowage advantages.

But, reverting to the original cop-out that we hoped to avoid, something positive can be said about all these boats. There wasn't a turkey in the bunch, which only meant that we had to be as tough as possible in testing the group as a whole. Ultimately, we decided that the real winner in a center-console shootout is the design itself—it is a truly logical marriage of hull, deck and operator.

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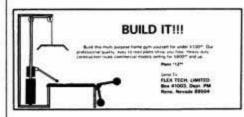
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THE CUTTING EDGE

(Continued from page 106)

the concepts in this category are as interesting as they are varied.

The folding Switchblade II from Star Sales Co. in Knoxville, Tennessee, is presented mostly as a collectible. It comes with three blades-drop-point, clip and spey-that are etched with attractive animal scenes.

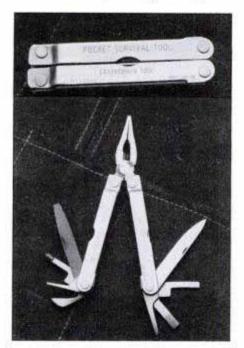
The Parker Sales Co. of Chattanooga, Tennessee, has a nonfolding straight blade of two different designs.

Gerber Knives' interchangeable blade instrument will answer probably 75 percent of the needs of the average outdoorsman. It has three bladesdrop point, skinner and saw-that attach with a special bolt-action to a handle made from DuPont's Zytel. To insert a blade, hold the bolt back and place the blade in the handle in the same half-open position.

Kershaw Knives approaches the interchangeable blade knife question from a different angle. The Kershaw Blade Trader Jr. comes in a Cordura nylon holster and has three blades: Clip-point, filet and saw. Each of these blades fits into a handle and is locked in place with a rotating metal clip.

Unlike the Gerber, the Kershaw must be carried broken down. It's less handy than the Gerber knife, but has the advantage of being larger.

The Kershaw Blade Trader ("Sr.") works like the Blade Trader Jr., but is larger. The blades-cook's blade, frozen-food blade, carving blade, saw



Pocket Tool Chest combines just about anything you can imagine for home and shop repair, including needle-nose pliers.

blade, bread knife and boning bladeare all about 7 in. long and would be more appropriate for home use.

More and more, interchangeable blade knives are being custom-made, and the instrument produced by Billy Mace Imel is perhaps the best example. Imel's folding interchangeable blade is a work of art. He makes three types: a slip-joint nonfolder, lock-back nonfolder and folding lock-back. Since they're all custom-ranging in price from \$600 to \$1000-the blades can be designed to suit the needs of the owner.

Imel's creations also represent the high end of an increasingly complex field. Nowhere can you find necessity producing so much invention.

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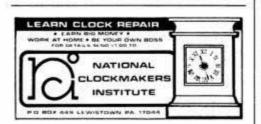




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SENTIMENTAL JOURNEY

(Continued from page 112)

later dubbed "the honeymoon hut." Following the maiden flight, Smith ordered 20 DC-3s for \$110,000 each. On June 25, 1936, the first DC-3 began flying the New York-Chicago route nonstop. Later that year, American started Skysleeper service coast-tocoast. The first ticket was sold to child film star Shirley Temple.

Most airliners flew 14 passengers in those days, but Smith realized that by removing berths, he could add seats. An additional 21 DC-3s fitted for 21 passengers were ordered at the end of 1936.

Increased cabin space in the DC-3 brought all sorts of innovations to passenger flying. Hot meals served on comfortable tables or trays were introduced, and so was comfortable airconditioning and sound-proofing. The change worked magic with the general public. Within two years, air travel doubled in the United States. "The DC-3 freed the airlines from dependence upon government mail pay," American's Smith said in 1939. "It was the first airplane that could make money just by hauling passengers."

Delighted flight crews

If the plane pleased passengers, it simply delighted pilots and flight crews. It was a grandson of the DC-1, a superbly engineered craft itself. The twin-engine design was a low-wing monoplane with wings that had innovative honeycomb construction. That made them sturdy but lightweight and resilient in high winds. The wheels retracted into the engine nacelles for better flight aerodynamics. Inside the cockpit, the pilot could control the pitch of the plane's tri-blade Hamilton propellers. The 710-hp Wright Cyclone air-cooled radial engines would give the plane the kind of power needed to beat out two Japanese Zeros. The pilot also had the luxuries of Sperry's new gyroscope and autopilot. The DC-3 also had a bigger, more flexible fuselage.

With a decade of trustworthy passenger and military flight behind it, the DC-3 became known as the Super DC-3. But the airliners were now looking for bigger and more powerful planes to do their work. Most of the Super Threes went to the Navy as transports. The airlines ordered only 11. By 1948, Douglas halted production with 11,000

DC-3s to its credit.

For most airplanes, this is where the story ends. But the DC-3 is a durable die-hard aircraft. In 1948, the Soviet Union stunned the world with their Berlin Blockade, but Harry Truman decided to stun the Soviets. Starting in June, a fleet of C-47s took part in the historic 3-month Berlin Airlift, making more than 12,000 trips to Berlin and bringing in almost 40,000 tons of food, fuel and materials. The blockade was broken.

On May 3, 1952, a C-47 specially fitted with skis became the first airplane to land at the South Pole. It carried the first three men ever to set up camp at that pole. A second plane, a 4-engine Navy transport, landed at the South Pole a short time later and got stuck in the ice. A DC-3 had to be flown to their aid with a mechanic and spare

Still in service

More than 1000 DC-3s remain in service today. Almost 400 of these are in regular airline service, a tribute to the survivability of a plane built to last indefinitely. Several airlines around the world use the DC-3 as a regular schedule keeper. But many who want to fly in the Gooney Bird are not as interested in the destination as they are in the plane itself.

A small West Virginia company called Sentimental Journeys has a completely renovated DC-3 called Skytrain. From the logo on the aircraft to the flight crews dressed in 1940s costumes, the plane is a trip into the past. Passengers see an in-flight videotape on the history of the beloved craft while on special charter trips. The plane flies to Hilton Head Island, South Carolina; Atlantic City, New Jersey; and other American playgrounds.

The fifth DC-3 ever delivered is still on the FAA register as N133D. Originally delivered to American Airlines in 1936, the plane now is flown by the Air

Academy of Griffin, Georgia.

Provincetown Boston Airlines (PBA) establishes a record for the DC-3 every time its N136PB takes off. In 1985 it had a flight history of 87,000 hours, the longest log for any DC-3, and perhaps

for any plane.

Some people can't bear being away from the Gooney Bird. H.L. "Smokey" Roland of Cardiff-by-the-Sea, California, bought a DC-3 from a junkyard in 1973. He made it into a mobile home. Another of the famous craft serves as a wind shelter at the airport in Whitehorse, Canada.

No one is taking bets on how long the DC-3 will continue flying. But in a recent PM interview, Doolittle said he expected "the thing to fly as long as

they can find sheetmetal.

That may be true. When the Argentinian internal airline lost a DC-3 in a freak fire two years ago, it decided to rebuild the plane. The ground fire caused no injuries and only the rear cabin and tail were damaged. It will be flying again next year. Maybe they'll nickname it the Phoenix.

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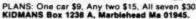
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SCREWDRIVERS

(Continued from page 116)

\$6.39. Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

18. Screw-holding driver-Here's another version of a screw-holding driver (see No. 14). The blade is split in two halves. As you push the sliding collar forward, the blade halves become wedged in the screwhead's slot. Once the screw is started, pull back on the collar to release the blade. Continue driving the screw with a conventional screwdriver. The tool has a 1/4-in.-dia. × 8-in.-long blade and costs \$10.60 from U.S. General, 100 Commercial St., Plainview, NY 11803.

19. Dial-a-tool—This unique screwdriver has a barrel built into the shaft that houses six bits-three slotted, two Phillips and an awl. To select a bit, pull back on the handle, rotate the barrel to the desired bit and push the handle forward until it locks in place. The six bit profiles are printed on the barrel to make selection easy. It's available for \$18.90 from Brookstone, 782 Vose Farm Rd., Peterborough, NH 03458.

20. Superlong driver-You'll never come up short on the job again with this 241/2-in.-long screwdriver. The round, fluted handle and 20-in.-long blade deliver extra power. The driver shown comes with a 20-in.-long slotted blade or No. 2 Phillips tip. The pair costs \$20.40 from Sporty's Tool Shop, Clermont Airport, Batavia, OH 45103.

21. Yankee screwdriver-The Yankee spiral-ratchet, quick-return screwdriver provides the fastest, easiest way to drive screws manually. A favorite of carpenters for more than 40 years, the Yankee has a spring-loaded shaft that can be set for driving screws, removing screws or locked for use as a conventional driver. When extended fully, the tool is 25 in. long without the bit. Contracted and locked, it measures about 17 in. Always store the driver in the extended position and when releasing the lock, point the tool away from you, hold the chuck securely and allow the shaft to extend gradually. It comes with a 3/32-in. slotted bit and a No. 2 Phillips bit for about \$36.29. Contact Stanley Tools, 600 Myrtle St., New Britain, CT 06050.

22. Giant screwdriver-Here's one screwdriver you're not going to keep in your back pocket. In fact, you may have trouble fitting this colossal 331/2-in.long driver (\$19) in a toolbox. Designed for No. 20 and larger slotted screws, this tool features a 1/2-in.-dia. hexagonal-shaped steel blade and a 91/2-in.long fluted plastic handle. Also, this is the only screwdriver that I know of that is recommended for use as a pry bar and lever. Contact Sporty's, Clermont Airport, Batavia, OH 45103. PM





193 MANUFACTURERS' FACTORY HOUSES

12-page brochure from The Building Institute lists the names and addresses of manufacturers of factory-made houses you can build yourself. Houses include log, dome, A-frame, classic and contemporary models. \$1.00

194 SATELLITE TV BUYER'S GUIDE

A 24-page buyer's guide from Satman gives details about 100-channel satellite TV and lists low priced equipment. It also tells how to shop for an earth station and how to install your own quickly and easily. Free

195 AUTO TOUCH-UP GUIDE

This 20-page brochure from Dupli-Color explains how to condition and retouch your car's paint job. Step-by-step instructions guide you through refinishing minor surface damage, spray painting and troubleshooting. Free

196 WEATHERPROOF YOUR HOME

Certainteed Corp. offers a brochure illustrating insulation as a way to save energy and money. Step-by-step instructions for attic crawlspace and sidewall insulating. Plus recommended insulation requirements for entire U.S. Free

197 MASTER SHOP GUIDE

An A to Z guide on nails, screws, moldings, sandpaper, wallpaper, lumber, floor tiling, wood finishings, electrical and plumbing supplies and more. Printed on large laminated cards that can hang in your workshop for easy reference. From POPULAR MECHANICS. \$5.95

198 WOOD-LOOK SIDING

Wolverine Technology's restoration solid vinyl siding gives you the look of painted wood without the expense of painting. Brochure displays the Restoration Collection—siding and other authentic vinyl details for the exterior of your home. Free

199 THE CUTTING EDGE

Forrest Manufacturing Co. gives the complete story of their carbide-tipped saw blades. Find out about the advantages of hard, long lasting carbides and multitoothed dado sets. Learn how you can cut like the "pros." \$1.00

200 ALL DECKED OUT

46-page, full-color brochure from Boston Whaler lists their complete line of boats ranging from 9 to 27 foot size. Each model is shown with illustrations, photos, standard features and specifications. Free

201 KITCHEN IDEAS FOR TODAY

24-page, full-color booklet from Tappan is filled with concepts and guidance to help you plan your kitchen remodeling projects. Included are scaled appliance cut-outs, graph paper and a four-page planning questionnaire. \$4.00

202 AIR COMPRESSORS TO COUNT ON

Get the latest brochure on American IMC compressors that range in size from 1 to 25 hp. They can be used by the do-it-yourselfer or pro craftsman. Free

203 SAIL THE SEAS

This four-page brochure from Boston Whaler features their inflatable dinghies and sports boats. Each boat has Hypalon® coating, marine grade plywood floor-boards and a 5-year warranty. Free

204 FIGHT ENGINE FRICTION

TUFOIL® is a patented lubricant and friction modifier comprised of a blend of synthetic and mineral oils. Information kit explains how it may benefit your car and make it run more smoothly. Free

205 LOG HOMES OF DISTINCTION

Lincoln Log's brochure gives floor plans and descriptions of over 50 build-it-yourself log homes. Kits come complete with precision-milled Eastern White Pine logs, pre-fab roof trusses, company financing and a 100-year warranty, \$9.95

206 COMPONENTS CATALOG

Brand new 1986 48-page catalog is available from American Design Components, a distributor of electronic and computer-related parts and components. Lists IC's semiconductors, blowers, fans and motors for the hobbyist, teacher or design engineer. Free

207 WOODWORKING PLANS

Popular Mechanics' catalog of plans lets you build everything from a doll cradle to a hovercraft. Hundreds of plans listed—furniture, outdoor sheds, toys, tool boxes, boats, models and much more. \$1.50

208 OUTSIDE BASEMENT ENTRY

This instructional brochure tells how to break through your foundation, build a block stairwell and install a Bilco basement door in homes without direct outside access. This direct entry can help make your basement more convenient and useful. Free

209 EARLY WARNINGS RADAR DETECTOR

Informative brochure from Whistler describes the features of Spectrum 2—the high performance radar detector. Its unique Digital Display with numerals from 1 to 9 provides audible and visual warning of radar transmissions. Comes with 3-year warranty.

210 LIBERTY COINS

Full-color brochure describes the limited edition commemorative coins honoring the 100th birthday of the Statue of Liberty. From The Historic Providence Mint.

211 DON'T BE STUMPED!

This brochure from Stumpster Company highlights their tractor-mounted Stumpgrinder—operating on 23 hp or more. This newly patented design makes it possible to grind stumps of any size or type of wood. Free

212 BE A CHIMNEY SWEEP

This comprehensive information kit from August West System shows the possibilities of how you can earn \$50.00 an hour helping people prevent chimney fires. Kit includes a 12-page booklet, brochures and a record. Free

213 REDWOOD PATIO FURNITURE

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214 REVVING UP YOUR CAR

Moroso Performance Products Inc., makers of racing components for two decades, offers a 1,500 product catalog. Includes spark plug wire, engine sealers and octane boosters that relate to street and off-road applications. \$3.00

215 UNCOMMON FINDS

Lehman Hardware's 88-page catalog contains a diverse selection of "how-to" books, hard-to-find tools, unusual hardware and old-fashioned housewares. Includes special sections on woodworking, wood heaters and gas refrigeration. \$2.00

216 OUTBOARD MOTOR MADNESS

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(Continued on next page)

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(Continued from preceding page)

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TIME MACHINE

75 YEARS AGO: May 1911



A winged hydroplane races.

Royal racer

The Duke of Westminster wanted something new for the Grand Prix International Cup boat race at Monte Carlo. So he ordered a hydroplane from Germany. The new boat was a 50-ft. hydroplane with a 60-hp engine that was designed to take the winged craft more than 40 knots. The Duke of Westminster had won the race in 1910 with the speedboat Ursula, which established a world record by attaining a speed of 38 knots. The more advanced boat died in the middle of the 1911 race.



Two for one

Take a close look at the locomotive above and you'll see two locomotives linked together. The Atchison, Topeka and Santa Fe railroad experimented with the idea in 1911, seeking greater power for long hauls. The idea was dropped after the double-bill developed welding problems and began to fall apart at the seams. Church key

Why do people fall asleep in church? A 1911 report by an engineering consultant suggested bad lighting. The big mistake, the engineer noted, was the widespread use of unshaded light. The glare "excites the optic nerves," he said, and this leads to sleepiness. Churches today use a range of lighting fixtures. Some folks still doze.

50 YEARS AGO: May 1936

Treasure troves

Navy Capt. John D. Craig reported on his diving exploits. He and a crew of camera men had spent years making films on the sea and underwater life. During his adventures, Craig had located the wreck of a 19th century merchant ship. For days, he and his crew climbed all about the wreck, encountering sharks and other perils, in hopes of finding a treasure chest. Craig and his men did manage to locate an old sea locker, but all it contained were the remains of several broken bottles.



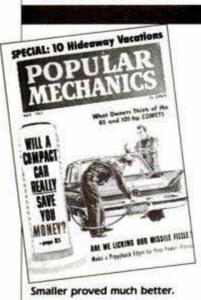
Tankful flight

In 1936, inventor Walter J. Christie proposed bolting a tank to the underbelly of an Army twin-prop plane. The photo above is his own composite. Early tests failed to produce the first armored cavalry. The concept was tried later, when tanks were loaded *inside* planes.

Tennis anyone?

Tennis pro Ellsworth Vines Jr. gave POPULAR MECHAN-ICS readers tips on mastering the game. Don't try to knock the cover off the ball, he wrote. Don't wear fancy shoes. And don't loaf during a volley. Always stand sidewise to the net, and always hold your racket tight.

25 YEARS AGO: May 1961



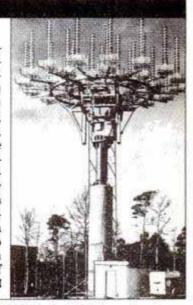
Sunken treasure was pure glass.

Compact cash

Compact cars were coming into popularity in 1961, and PM asked the logical question: Do they really save money? In tests of 11 compacts, we found that the lighter cars did save an average of \$400 in owning and operating costs over a 3-year period. Best gas mileage in the tested cars was by the Ford Falcon, a whopping 27.5 mpg. The Rambler American was second at 24.5 mpg. The mileage game has brought us to where even today's larger cars yield good mpg.

Ears to hear

NASA's first advanced antenna was a giant Lazy Susan with receiver prongs arrayed around its disc. The antenna, opera... Wallops Island, Virginia, facility, was designed to replace the heavier and larger dish antennas. The 33 antenna elements followed a rocket by rotating during launch. Its main weakness was interference. It couldn't pull in a strong signal. But it led to the multiphase radar, which does an admirable job of tracking rockets today. PM



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