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OCTOBER 1988 \$1.95

Popular Mechanics

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TOOL
TESTS**

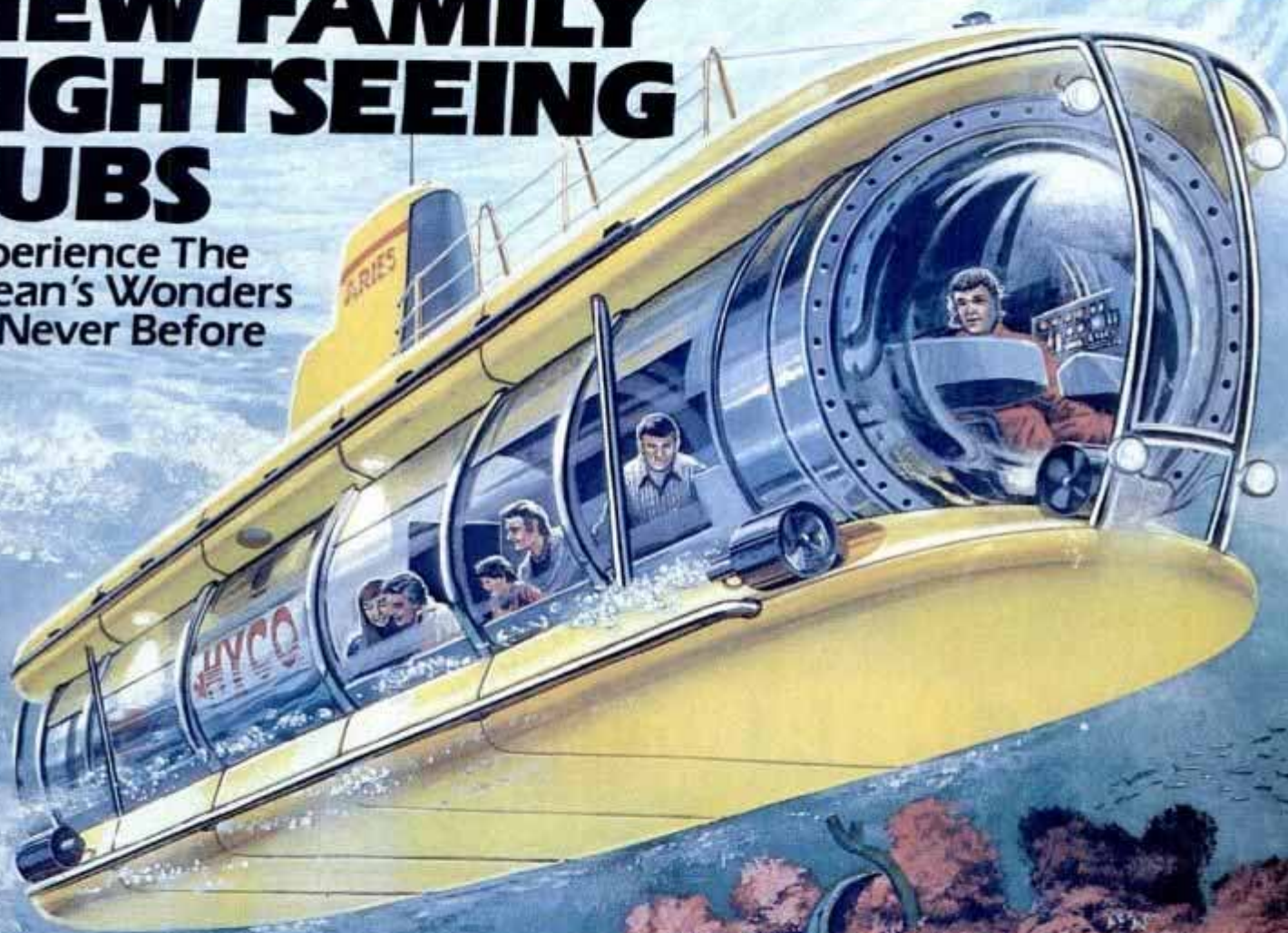


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DETROIT 1989
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All The New Cars

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Car Of Tomorrow

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The Laser Knife Makes
Operations Quicker
And Less Painful



Models • Features • Options • Tech Changes





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TO STAY #1.**

TOUGH '89 BIG FORD PICKUP- AMERICA'S BEST-SELLER.

Year after year, Americans have chosen tough Ford pickups over all others.* And they're satisfied with their choice — because Ford has the highest percentage of *repeat* buyers of any full-size pickup!** Last year Ford's F-Series pickups beat Chevy again by a big margin. That's truck leadership! Ford's built aerodynamic, Hi-Tech and tough — and even better for 1989!

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This One



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Ford's maximum payload exceeds Chevy's for each series — up to 1,000 lbs.

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Fords also come with standard equipment the Chevy C/K doesn't. Features like AM radio with digital clock, cigar lighter and four gauge package.

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Now's the time to buy or lease a tough Ford pickup!

SPECIFICATIONS

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4.9L EFI Six
145-hp.
5.0L EFI V-8
185-hp.
5.8L EFI V-8
210-hp.
7.5L EFI V-8
230-hp.
7.3L diesel
180-hp.

PAYLOADS

F-Series 4x2
pickups: 1575 to
5270 lbs.
F-Series 4x4
pickups: 1750 to
4295 lbs.

CABS

Regular 3-Man Cab
Ford 2-Door
SuperCab
Ford 4-Door Crew
Cab

MAJOR STANDARD EQUIPMENT

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shocks
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& clock
Full instrumentation

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Based on an average of owner-reported problems in a series of surveys of '81-'88 models designed and built in North America. At Ford, "Quality is Job 1."

*Based on 1988 model year manufacturers' reported retail deliveries through July.

**Based on 1987 New Car And Truck Buyer Study.



FORD PICKUPS
BUILT FORD TOUGH

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*Plus \$1.50 postage and handling. See participating dealer for details. Contest ends 1/31/89. Void in VT, MD, NJ, AZ and where prohibited.



68 COVER STORY

A new generation of see-through submersibles will transport amateur aquanauts to unprecedented depths for a panoramic view of the ocean's wonders. —PM Illustration by Tom Freeman



75 Beyond the blade



84 Bath grooming



71 Tomorrow's car today



78 Big-lake warriors



61 Detroit '89: Sweating the details

AUTOMOBILES

- 22 Car Clinic** Got a car question? We've got the answer.
- 34 Imports** New all-wheel-drive cars are ready to roll.
- 37 Inside Detroit** Plastic prototypes abound.
- 42 Motorsports** New talents mean big budgets.
- 61 Detroit '89: Sweating The Details** Powertrains, key models and refinements highlight Motor City's new offerings.
- 93 Detroit '89: Emphasis On Engineering** America's '89 new-car story goes beyond skin deep.
- 98 Volkswagen Passat** Our firsthand drive report.

HOME/SHOP

- 26 Old House Restoration** Floor refinishing.
- 54 Shop Tools** A do-it-all miter saw.
- 84 Bath Grooming** Accent your bathroom with our easy-to-build clothes hamper and circular mirror.
- 89 Workshop Winners** We run five new tools ragged to find out what works and what doesn't.
- 115 The Better Home**
 - How to regROUT ceramic tile
 - Homeowners' Clinic • Appliance Clinic

SCIENCE/TECHNOLOGY

- 13 Tech Update** The latest in space, electronics, military.
- 40 Science** Home satellite weather maps.
- 58 Aviation** Piper's Super Cub is reborn.
- 68 Touring The Deep** Submersibles made of transparent acrylic spheres offer a new way to view the ocean's fascinating riches.
- 75 Beyond The Blade** Advancing at the speed of light, lasers are changing the way doctors operate.

ELECTRONICS

- 46 Electronics** A digitized system for sing-alongs.
- 50 Home Video** Personal video on the move.
- 71 Tomorrow's Car Today** Navigation, diagnostics, security and communications: Our concept car has them all, with hi-fi and video to go.
- 82 Oldies But Goodies** Mystique makes vintage radios collectible. But condition, rarity and styling make them valuable.

BOATING/OUTDOORS

- 30 Outdoors** Human danger versus animal extinction.
- 78 Big-Lake Warriors** We tackle wind-whipped, freshwater rollers in a 6-way shootout to find the ultimate small-boat fishing rig.

DEPARTMENTS

- | | |
|-------------------------|-----------------------|
| 4 Editor's Notes | 55 Hints |
| 6 Letters | 123 Hotlines |
| 10 Time Machine | 154 Next Month |

EDITOR'S NOTES

IF YOU'RE not a scuba diver, until now you've had a slim-to-none chance of ever seeing any of the ocean's wonders up close and personal. Yes, you might see some things on television, perhaps, or in one of the undersea exhibits such as the Living Seas Pavilion at Disneyworld's EPCOT Center. But that's a far cry from actually penetrating the ocean's depths and observing other life forms face to face. Scuba enthusiasts were the only ones capable of such intimate contact with the inhabitants of the briny depths. But now, thanks to the inventiveness of Phillip Janca of Hyco Technologies, and other entrepreneurs, the sea's treasures will soon be accessible to all of us. In fact, you can take a trip right now in a submarine off Grand Cayman Island. And you'll see sights you never thought you'd see. But when the new generation of glassed-in, clear-walled sightseeing subs arrives next year, the vessels will "revolutionize the submersible industry," as Janca likes to say. To get this month's cover story, regular contributor Greg Pope traveled to Grand Cayman Island to take a ride on a current-generation tourist submersible and bring you a full report on what's coming.



Auto Editor Swan chats about Chevy's futuristic Venture with engineer Betsy Jackson at GM's Milford, Michigan proving grounds.

Swan, traveled literally around the world—Detroit, Phoenix, Los Angeles, San Francisco, White Sulphur Springs, Burlington, Geneva, Paris, Stuttgart, Tokyo, Osaka. The list, and the expense reports, go on and on. It cost a lot of money and a lot of man hours. But it's the only way we can bring you the firsthand information you expect. In the course of fact-gathering, our editors drove not only the current crop of 1989 offerings,

but also several prototype cars of the future. We think the effort was well worth it. I hope you agree. . . . Speaking of cars of the future, you'll remember our series earlier this year titled, appropriately enough, "Car Of The Future." In the series of six articles, we chronicled much of the technology that will be in the next generation of automobiles, perhaps around the year 2000. As we discovered, much of the technology exists now. It just hasn't all been packaged into one car yet. Sounded like a good project for our Automotive and Electronics Departments, so we decided to build our own version of the car of the future. Much of the future lies within the world of electronics, so we wanted to start with today's most electronically sophisticated automobile. Right now, that's the Buick Riviera, which incorporates such nifty items as dash-mounted computer screens and on-board computers that talk to each other. You can see the results of our project on page 71. A navigation system, rear-vision video capability, and lots of other hardware transform our once-sedate Riviera into a peek at the future. You'll have to decide for yourself what's more appealing—today or tomorrow. 'Til next time.



This is what our Buick Riviera looked like when we began our project. Check page 71 to see how we made it into a car of tomorrow.

You'll find this intriguing article on page 68. . . . Fall brings with it not only a vigorous snap in the air and golden leaves, but also the new-car season. And this issue, like every October issue for umpteenth years before, is our domestic new-car issue (we'll bring you the imports in December). To bring you the two articles on the 1989 new cars (pages 61 and 93), our Auto Department editors, writers and photographers, headed up by Automotive Editor Tony

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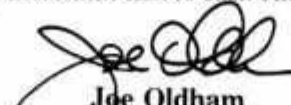
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Joe Oldham

Every day, millions of men leave for work with the morning paper.

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*Money-back offer not good on 2.5 oz. trial size and expires on March 1, 1989. Mail the remaining portion of Cut Guard along with your name and address on a 3" x 5" card to: P.O. Box NB-359, El Paso, Texas 79977.

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LETTERS

A Personal Coupes Speakout

I AGREE totally with your conclusions in the PM Comparison Test "American Flyers" (page 109, June '88), especially in the last paragraph on the Ford Thunderbird Sport. I've always loved the looks and styling of the Turbo Coupe and desired the HO V8 of the GT Mustang. If they combined the two they'd have the ultimate American Flyer indeed.

BRETA GEREN
SAN DIEGO, CA

more powerful engines and a lot of the bugs worked out.

PHILIP C. DENISE
BROOKLINE, MA

American Flyers indeed! Great to look at, but would I ever buy one? No way. Why not? Because the mileage is so awful. It really is unconscionable for Detroit to continue building low-mpg cars. 1973 will repeat itself. I'll keep on driving my 40-mpg Corolla.

PATTY MILLER
PITTSFIELD, NH

I enjoyed "American Flyers." I'm pleased to see Detroit building cars of this caliber.

However, this article reaffirmed my belief that front-engined, V8-powered, rear-wheel-drive automobiles will be around for quite awhile. The Thunderbird is the longest, heaviest, most powerful and still gets the best mileage! So much for the front-wheel-drive/small-engine concept. Long after CVJs and turbos are worn out, the V8 in the Ford will be humming right along. In the long run, I think this is what most Americans want—a car they can drive for some time and do basic service on themselves.

GORDON SMOKO
HIGHSPIRE, PA

I have looked at and driven all the cars in your comparison test. I found the Chrysler LeBaron Turbo to be peppy and to be a good handler, but found the car to be totally uncivilized. I found the Buick to be a nice car for an old lady who wants people to think she is young again. I, too, liked the Grand Prix SE and the Olds Cutlass Supreme International Series but found them to be somewhat underpowered. I also found that neither the Olds or the Pontiac could match the Thunderbird in fit, finish or quality of materials used or overall build quality. My decision—to wait for the 1989 models when the Thunderbird will be "all new" and the Pontiac and Olds will, I hope, have



Goin' Like 60

Your comments in the PM Perspective part of the "LeBaron Owners Report" (page 108, Aug. '88) about the age of owners ("fully 40 percent of LeBaron coupe buyers are over 60") should be brought to the attention of marketing experts. When drivers reach the gray-hair stage, they don't necessarily change auto-buying habits.

I've had my share of convertibles, XLs, XR-7s, Rivieras and so on. And they've had all the bells and whistles—big V8s, turbos and more. Now I'm supposed to be a hot prospect for a Crown Victoria or a Caprice. No way.

Someday the experts will understand the over-60 market for cars, and other goods and services.

By the way, I like the LeBaron coupe but it's not in the same class with my Supra.

D.J. SIGLER
GREENVILLE, SC

I enjoyed your article on the Chrysler LeBaron, but was really surprised by your statement about older buyers.

I bought my Camaro Berlinetta in '79 and keep finding it more and more fun to drive. My son hot-rodged it a bit, but it's all mine and my vanity plate says so. My car is nimble, powerful, quick to react, easy to control. What more could a 73-year-old woman driver want?

JULIET H. CULBERT
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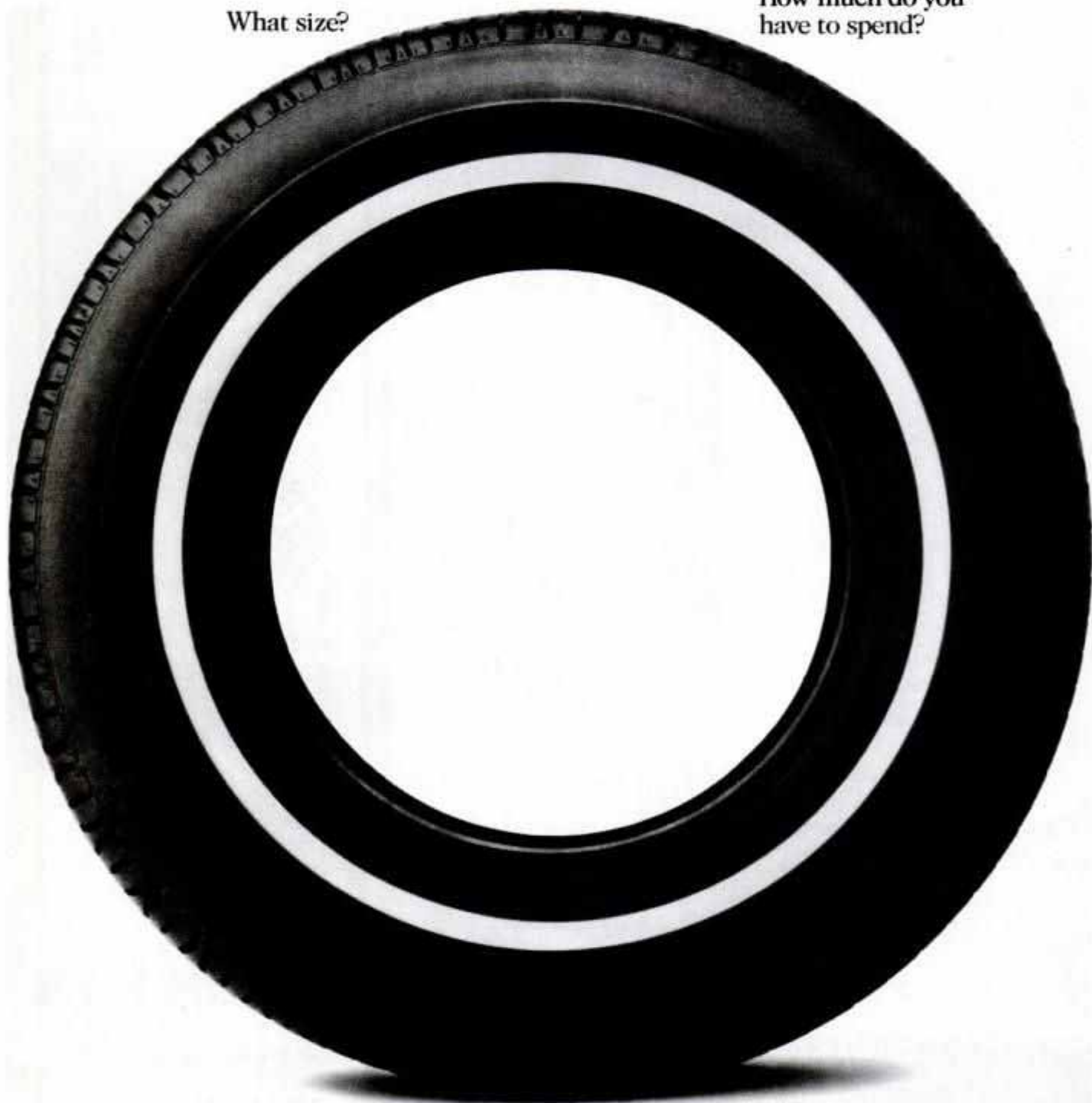
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What size?

How much do you
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Who else in your family drives your car?

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Etc, etc, etc...

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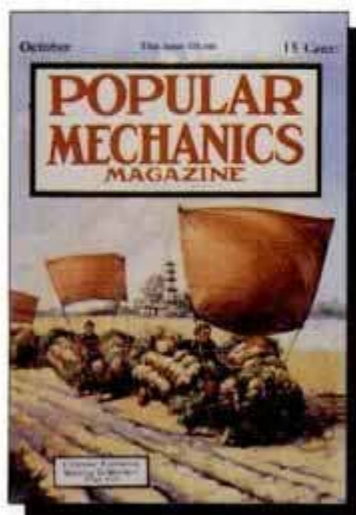
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75 YEARS AGO: OCTOBER 1913



Barrow Boats

The sailing wheelbarrows of China tacked across PM's cover 75 years ago, early evidence of an emerging spirit of curiosity. Shensi farmers could deliver up to 1500 pounds of produce with little effort when a 20-knot breeze filled their monowheeled square-riggers. Stern sheets could be easily manipulated to allow the wheelbarrow to sail at right angles to the true wind direction. Reefing arrangements permitted stability and control in a blow.

"Rec" Tech

Here at home, the advent of the internal combustion engine was opening up a wide range of recreational possibilities. Speedboats naturally led to aquaplaning, a watersport we introduced to a fun-hungry readership. Standard equipment: a 6-ft. x 2-ft. plank. The board was attached to a simple bridle system fastened to the stern cleats of a motorboat. The lone rider grasped the dual reins to maintain balance and skimmed away at the exhilarating clip of 35 mph. We also took care to admonish: "This new sport is hardly to be recommended to women and children . . ."



rating clip of 35 mph. We also took care to admonish: "This new sport is hardly to be recommended to women and children . . ."

50 YEARS AGO: OCTOBER 1938



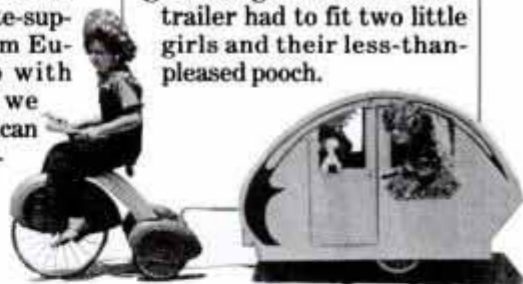
Plane Crazy

Continuing our fascination with flight, PM's cover 50 years ago captured the air racer: a stripped-down, beefed-up projectile that a pilot "wore" as he sprinted around the pylons. We took our readers into the cockpit with Art Chester—and survived a blown crankcase that nearly shook the wings off. A brisk 250-mph airspeed saved the hour when Chester was able to switch off the 550-cu.-in. powerplant of his flying gnat, climb to a safe

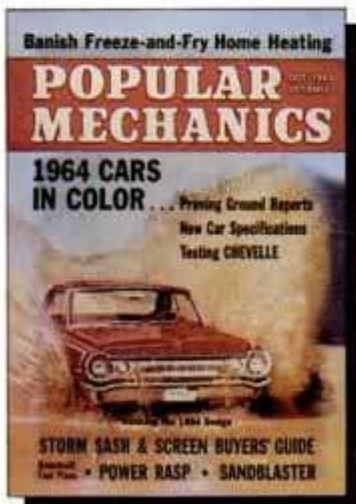
altitude, then glide to the nearest aerodrome for a dead-stick landing. We also peered behind the scenes at the National Air Races, where private American innovators struggled to keep pace with state-supported entries from Europe. Making do with fixed-pitch props, we showed how American pilots were retrofitting in-line Liberties and Allison in a push to aviation's outer limits.

Trike Tracks

Demonstrating the kind of inventiveness that would one day make California famous, a PM reader fashioned this recreational vehicle for his granddaughters. The micro-trailer had to fit two little girls and their less-than-pleased pooch.



25 YEARS AGO: OCTOBER 1963



Back To Basics

Our conclusion after a proving-grounds torture test of Detroit's '64 model year? The automakers had finally abandoned style in favor of substance. Finicky pushbutton automatic transmissions were out. Single driveshafts were eliminating multi-universal designs.

The emphasis was on roominess, stowage capacity—and subtle improvements under the skin, like the Buick Special's squeak-damping body mounts.

Hands On

We also gave our readers a glimpse from the cockpit of an F-104 Starfighter, the Mach 2 interceptor then being outfitted for a ground-attack role. Aviation Editor Kevin Brown played back-seater to pilot Charles E. Tofferi, winner of the 1963

Air Force fighter-weapons meet. The mission? Demonstrate aerial tactics in the California high desert from the 104's menu of munitions.

PM was even treated to a treetop delivery of a simulated nuclear bomb. Anything to get out of the office. **PM**



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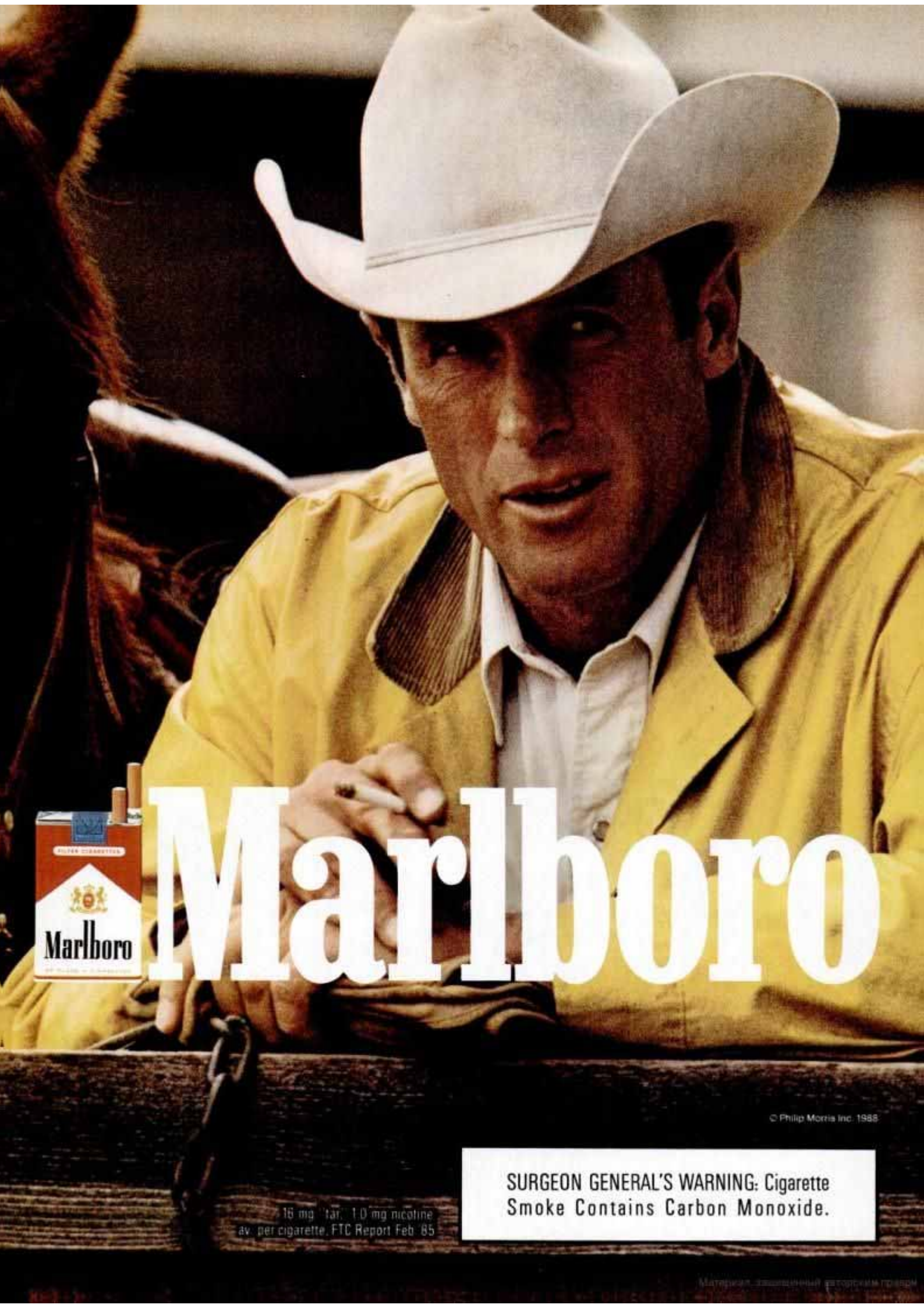
comes **1st Prize**. \$50,000 toward re-creating the house of your dreams. Wall to wall. Top to bottom. The works. And, of course, the collection of power tools.

So get going. 'Cause whatever you win, you'll have it made.

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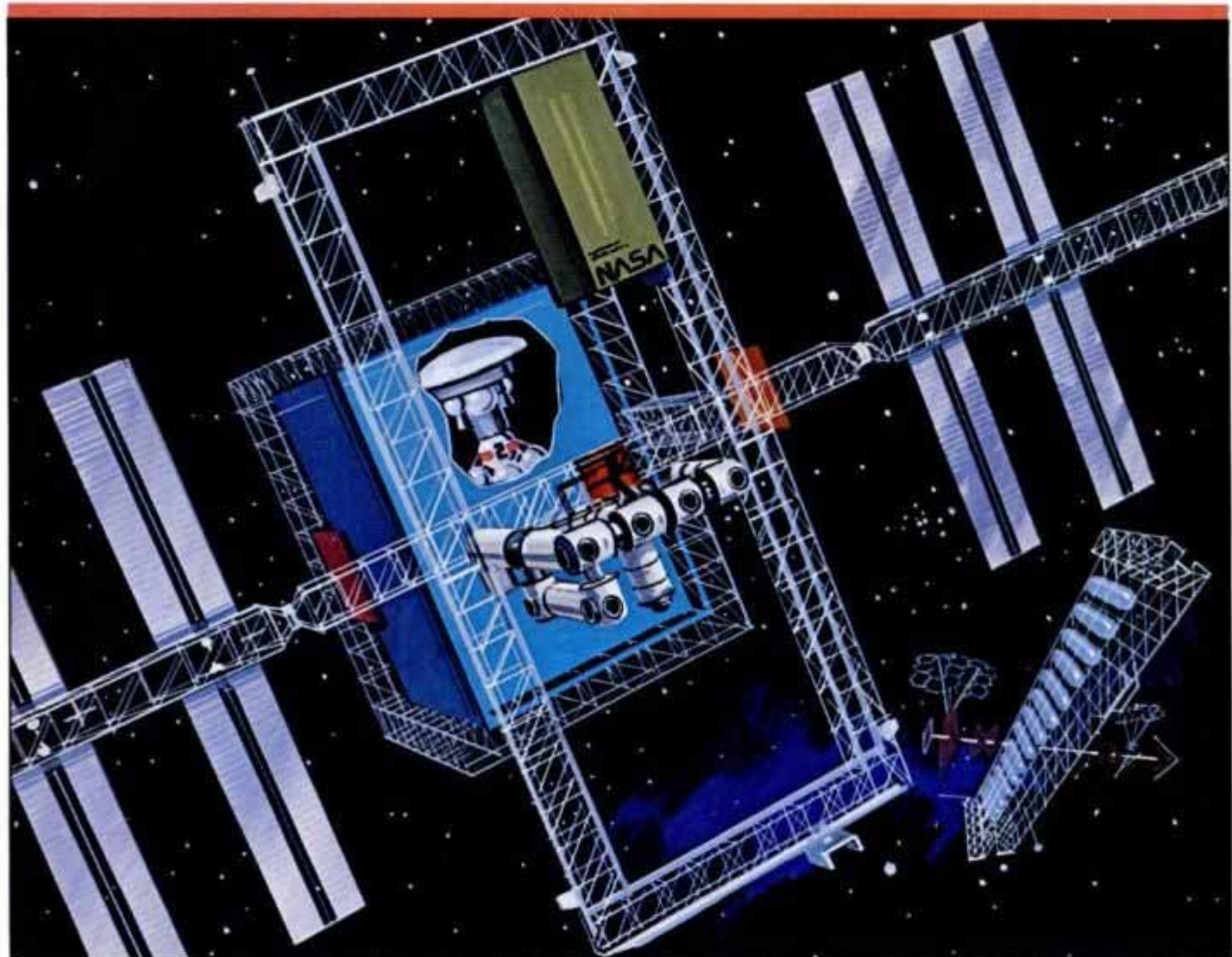
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16 mg "tar," 1.0 mg nicotine
av. per cigarette, FTC Report Feb '85

**SURGEON GENERAL'S WARNING: Cigarette
Smoke Contains Carbon Monoxide.**

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TECH UPDATE



Space Station Hangar To Launch Manned Mars Ship

HAMPTON, VA—Man's first venture to a neighboring planet should begin at the Space Station, according to a study by NASA's Langley Research Center.

Launch of a 6-million-pound Mars vehicle from low Earth orbit, instead of Earth's surface, would save propellant. Heavy-lift boosters could transport the construction materials. A

Space Station assembly hangar (above) with co-orbiting propellant tank farm. Sprint (right) with two reusable boosters.



Station-based hangar would house the Mars craft during assembly, while a co-orbiting cryogenic propellant tank farm stored fuel.

The ship that figures prominently in the Langley study is the so-called Sprint vehicle. Its huge dish-like aerobrake surfaces would eliminate fuel-eating propulsive braking. Sprint would take a year to reach Mars.

Editor: Tim Cole
Assistant Editor: Gregory T. Pope
Contributors: Mike Fillon,
Nick Nichols



An electrochemical cell provides magnetic field.

Electric Plastic Made Easy



Electron micrograph (x2000) of magnetically aligned acetylene.

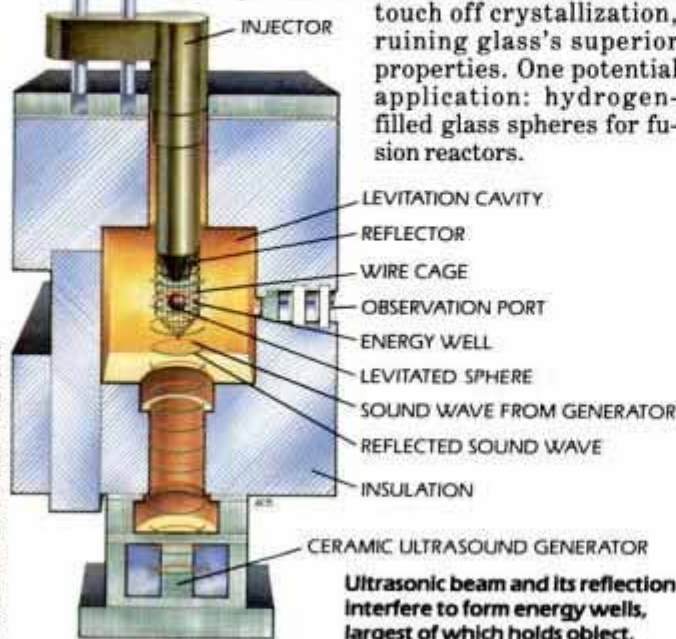
LOS ALAMOS, NM—A government researcher has achieved a breakthrough in electrically conducting plastics. Acetylene fibers must be straightened to conduct efficiently, but the process is time-consuming and difficult. Matt Aldissi injects acetylene gas into a magnetic field. The acetylene forms long molecular chains that the field pulls straight.

Levitating With Ultrasound

NORTHBROOK, IL—Techniques for suspending materials with ultrasound are under investigation at Intersonics Corp.

A beam of intense sound pushes against any object it encounters. Two beams can interfere with each other, canceling their energies and forming an energy well. An object in the well feels no acoustic force, but can't drift out because surrounding forces push it back in.

The phenomenon will allow containerless processing of glass preserving its nonorderly arrangement of molecules. Container walls touch off crystallization, ruining glass's superior properties. One potential application: hydrogen-filled glass spheres for fusion reactors.



Ultrasonic beam and its reflection interfere to form energy wells, largest of which holds object.

Propfan Tank/Helo Hunter



Antihelicopter arms would include six missiles and a 30-mm gun.

KINGSTON UPON THAMES, ENGLAND—Hostile helicopters and tanks could face an unprecedented new air threat in a close air combat plane conceived by British Aerospace.

The small, agile battlefield aircraft—SABA—would rely on two counter-rotating propfans for high thrust at low speeds. Canards would enhance maneuverability. Other design criteria include a 1000-ft. takeoff requirement and a minimum turn radius of 500 ft. at speeds as low as 120 knots.

British Aerospace asserts that the plane would be able to outmaneuver anything within range of its air-to-air missiles. Equipped with Maverick air-to-ground missiles, SABA could easily become a tank killer to support friendly troops. The U.S. Air Force is currently debating close air support needs.

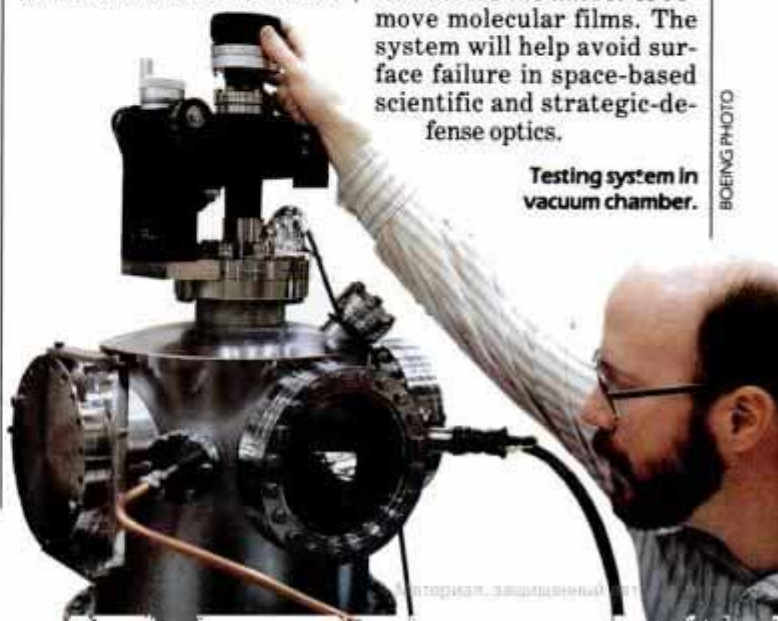
Space Scope Mirror Cleaner

SEATTLE, WA—Boeing Aerospace is developing a telescope that cleans itself.

Under an Air Force contract, Boeing is integrating mechanisms that remove contaminants from a space telescope's mirror. Such contaminants include rocket-ex-

haust particles and condensate from nearby gases. The system will use an infrared laser beam to spot space dirt. Ultrasonic transducers on the mirror's back will shake off particles. Finally, an ion gun will sputter a pulse of ions across the mirror to remove molecular films. The system will help avoid surface failure in space-based scientific and strategic-defense optics.

Testing system in vacuum chamber.



Brighter Lasers On Chips

LAUREL, MD—Finger-nail-size lasers that emit visible light may emerge from research in the Applied Physics Laboratory at Johns Hopkins University.

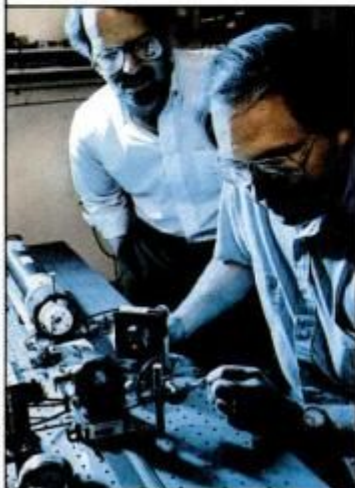
Semiconductor lasers are commonly found as chips in supermarket checkout scanners and compact disc play-

ers. When an electric charge is applied to such a chip, it gives off laser radiation in infrared wavelengths.

The semiconducting material in these infrared lasers is gallium or aluminum arsenide. Semiconductor lasers that emit shorter wavelengths of visible light require nitrogen-based compounds such as gallium nitride. The problem: Making these compounds requires high temperatures, and the nitrogen tends to evaporate. The resulting imbalance means the material can't be treated to make the slightly positive and negative layers of a semiconductor.

The Hopkins researchers have beaten this obstacle by showering metals with an argon ion beam in the presence of nitrogen. The beam's impact furnishes the energy needed to make metal nitrides at low temperatures.

Possible applications include flat-screen televisions and optical storage devices with greater capacity.



Hopkins' Kistenmacher and Bryden with optical apparatus.

JOHNS HOPKINS UNIVERSITY PHOTO

Armored Mortar



Automatic loader will feed tipped-muzzle mortar in 2-man vehicle.

EAST ALTON, IL—A team of defense contractors led by Olin Ordnance are developing a mortar that gunners can operate from within a diminutive tracked vehicle.

FAMS—short for Forward Armored Mortar System—involves a separable segment of barrel at the mortar's muzzle end. The segment can be tipped forward to allow insertion of a firing

round. When the segment is closed, the round drops down onto the firing pin.

Subcontractors are providing an assortment of 120-mm ammunition, including antiarmor mines, smoke bombs, sensor-fused munitions and fiberoptically guided projectiles.

The system should enhance battlefield survival of mortar crews.

PM ILLUSTRATION BY DEAN ELLIS

Hitting The Beach In The 1990s

WASHINGTON, DC—Amphibious assault planners will soon benefit from increased tactical flexibility, as technology catches up with military requirements.

Last spring, the long-awaited rollout of the Bell Boeing V-22 Osprey took place in Arlington, Texas. The hybrid transport vehicle—with a combat radius of over 1000 miles—will make over-the-horizon amphibious assault a real option.

Naturally, the Marines are Bell Boeing's first and biggest customers, having ordered 552 of the tilt-rotors. Delivery will begin in 1992. Outfitted for rapid deployment, each Marine V-22 can insert 24 fully equipped troops or 5 tons of assault-support cargo. An Air Force special operations version is also under development.

Meanwhile, both the Navy and the Army have resurrected the concept of the air-cushion



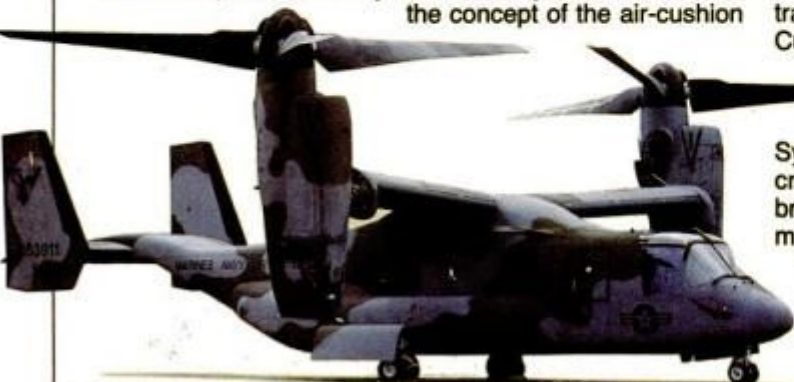
Navy's LCAC shuttles troops and cargo from ship to shore and inland.

PM PHOTO BY BRIAN WOLFF

transport platform—the Navy with its LCAC (Landing Craft Air Cushion), the Army with its LACV-30 (Lighter Air Cushion Vehicle). Both are essentially amphibious high-speed barges. But a new generation of ACVs

—recently introduced by Textron Mariner Systems—promises to expand the role of the military hovercraft. Designated Eagle, the 4- or 6-man craft will take on a broad mission profile, including surveillance, infiltration, command and control, and search and rescue.

The trend toward hovercraft miniaturization could lead the special operations community to adopt a 2-man model akin to off-the-shelf civilian sport models. At the other end of the spectrum is the Soviet Union's Pomornik-class air cushion landing craft, a well-armed 187-ft. vehicle with a 350-ton displacement.



Huge wingtip prop-rotors and twin tail boom distinguish Osprey.

INTERNATIONAL DEFENSE IMAGES PHOTO

TECH UPDATE

Burt Rutan's Reno Racer

MOJAVE, CA—The latest from Scaled Composites, Inc., is this Voyager-esque prop plane for the 1989 Reno air races. The Pond Racer features canted surfaces on the tail booms for extra stability during speed record attempts.



Pond Racer (below) with record-holding P-5 Mustangs. Nissan V6 (above) will power the plane.

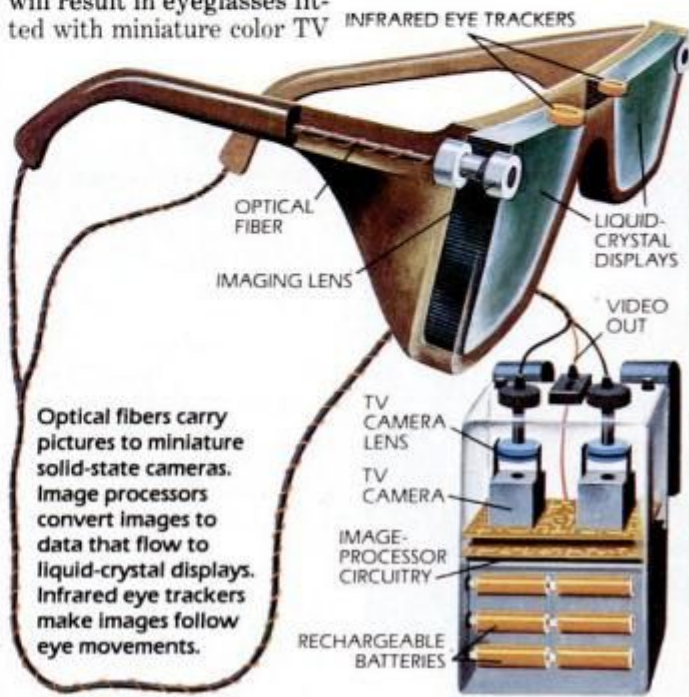


DEAN STOKES ILLUSTRATION

TV Glasses For Poor-Sighted

BALTIMORE, MD—Digitally enhanced images to help patients with impaired eyesight are under development at Johns Hopkins' Wilmer Eye Institute. The project will result in eyeglasses fitted with miniature color TV

screens. In a battery-powered belt-worn processing pack, tiny cameras will produce images in real time. It's derived from NASA's telerobotic sensory systems.



PM ILLUSTRATION BY DEAN ELLIS

New Ways To Put Pep In Your Step

NEW YORK, NY—A new contender has entered the fight against foot fatigue. Reacting to the success of Nike's Air line, Converse has introduced "Energy Return" to cushion athletic shoe soles.

The material is actually a polyolefinic foam, derived from a heavyweight relative of trash-bag polyethylene. According to Converse, the material is lighter and bouncier than the polyurethane foam used in the Air shoes, and more

resilient than ethyl vinyl acetate foam in other brands.

But Illinois inventor Ken Welter says new foams are all hype. He's patented an insole insert based on a plate of spring steel. Welter claims that the insert, mounted under the heel, returns 100 per-

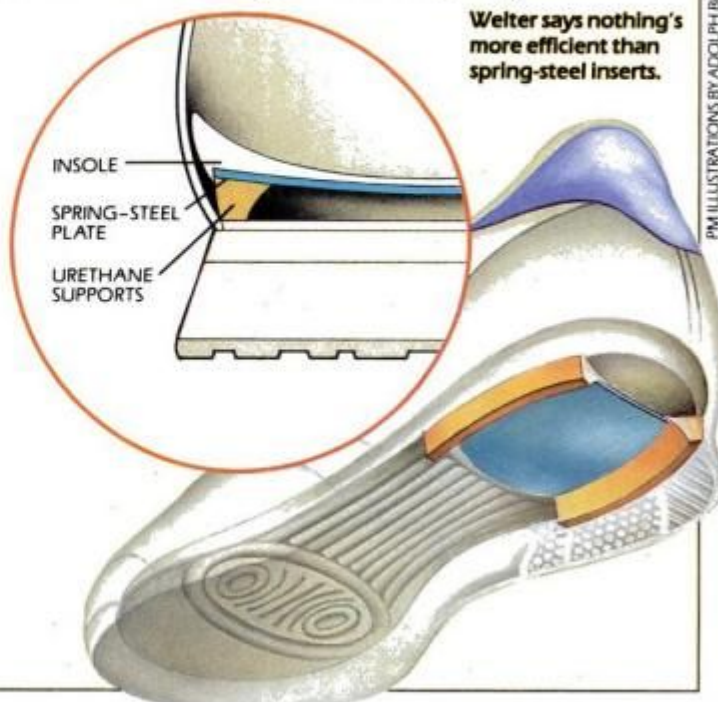
cent of the downward force in a stride, while cradling the rear of the foot. Steel is also more durable than plastic foam. While admitting that

shoe manufacturers are turned off by the steel-cushion concept, Welter says marathon runners and hikers like his prototype.

Converse says Energy Return doesn't wear out.



MODIFIED POLYOLEFINIC FOAM SOLE



Welter says nothing's more efficient than spring-steel inserts.

PM ILLUSTRATIONS BY ADOLPH BROTHMAN

HERE'S \$100 FROM TRANE

And that's just the beginning of your savings when you buy a Trane XL 90 high efficiency gas furnace.

Get a one-hundred dollar rebate. Buy and install a Trane XL 90 high efficiency gas furnace between August 29 and November 19, 1988, and Trane will send you a rebate check for \$100.

Save on home heating for years to come. The XL 90 delivers a lot more warmth for every fuel dollar than older, less efficient furnaces. So, if your present furnace is getting on in years, it can pay to replace it now with a high efficiency XL 90. Then, every winter you'll enjoy the unmatched comfort of gas heat at big savings.

Call your Trane dealer. Why wait? Upgrade to a high efficiency Trane gas furnace and start saving right away. You'll find your Trane dealer listed in the Yellow Pages.



Airborne Smuggler Spotter

BURBANK, CA—The Customs Service will soon be tracking suspected drug run-

ners with a P-3 Orion patrol plane that Lockheed has outfitted with early warn-



ing and control equipment.

Radar signals and data from an identification friend-or-foe (IFF) transponder interrogator will feed into the plane's computer. A display terminal will map out targets and distinguish planes that return IFF messages from potential smugglers who don't respond. The modified P-3 also offers low-cost military early-warning capabilities, says Lockheed.

Rotodome on P-3 (left) houses radar. Flat-screen display (right) tracks targets.



Special Report: All-Purpose Spacecraft For Science

PASADENA, CA—A versatile generic spacecraft could handle the deep-space exploration projects for the 1990s, say Jet Propulsion Laboratory engineers.

Called Mariner Mark II (MMII), the modular craft can be reconfigured to accommodate scientific packages for a variety of targets—comets, asteroids, the outer planets and their moons.

Mission requirements call for the craft to maintain its orientation during flight. Articulated, movable platforms will permit long-term instrument pointing, while a high-gain radio antenna faces back at Earth. The craft must also carry additional propulsion to position itself for target rendezvous.

To meet these and other criteria, MMII will use proven hardware, leftovers from projects like Viking, Voyager and Galileo. But the project will also require new technology.

The craft's command and data subsystem will capitalize on today's supercompact microprocessors and memory. Waste heat from the radioisotope thermoelectric generators will feed into a new temperature control subsystem. Other newly developed components include a fiberoptic gyro, star tracker, attitude-control system and instrument-platform actuator. MMII's first incarnation will

probably be Comet Rendezvous Asteroid Flyby (CRAF). Though launch date and trajectory will depend on funding, the craft will go up aboard a Titan IV-Centaur G' expendable booster.

Under current plans, the craft will fly through the main asteroid belt,

passing by 170-mi.-wide Eumonia. After visual and infrared mapping of the asteroid, the craft will perform some deep-space propulsive maneuvering to bring it into

formation with a comet called Wild 2.

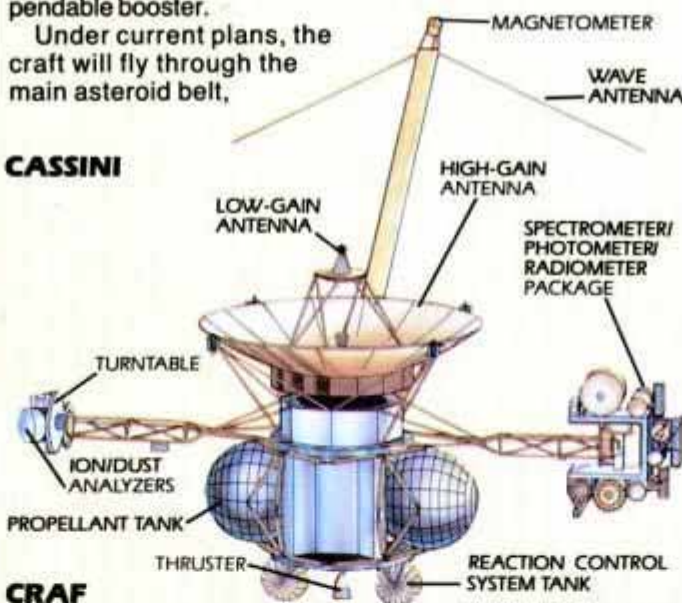
As CRAF approaches the comet, scientists will gauge the risk of damage by rocks or ice fragments near the comet's nucleus. Then, for about a month, the spacecraft will orbit the comet only 30 miles from the nucleus. During this phase the craft will map the nucleus, search for a spot to inject the penetrator probe, and analyze the surrounding dust, gas and plasma. For the next three years, CRAF will fly alongside Wild 2 as the comet arcs around the Sun.

A second MMII craft—named Cassini after the 17th-century astronomer—will orbit Saturn. MMII's modularity will allow two of the craft's four propellant tanks to be replaced by a probe and its relay antenna. Developed by the European Space Agency, the probe will touch down on Titan, Saturn's satellite whose nitrogen-rich atmosphere is believed to resemble that of Earth before life arose here.

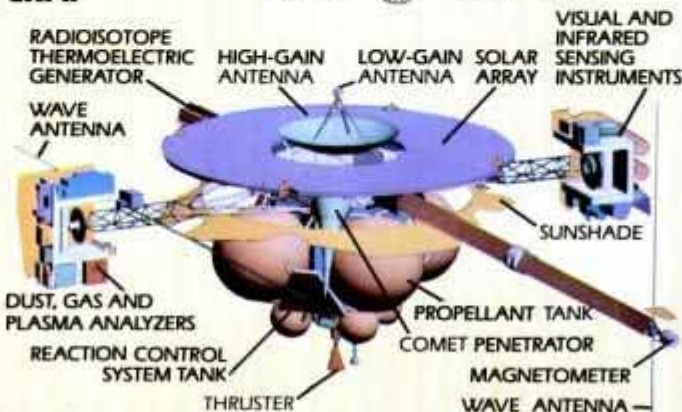
Other MMII projects may include asteroid rendezvous, Uranus flyby/probe, and comet nucleus sample-return missions.

The use of standard-issue spacecraft with individualized science packages should allow NASA to fulfill its planetary goals with great financial efficiency.

CASSINI



CRAF



Spacecraft add-ons differ: Cassini has bigger antennas, probe and relay antenna (not shown), and science packs.

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CAR CLINIC

BY MORT SCHULTZ

Taurus "Steam" Engine

I HAVE A problem with a 1987 Ford Taurus GL 4-cylinder engine. On three separate occasions since I bought this car 10 months ago, the dealer has failed to find out why it has lost 4 gallons of coolant. The dealer swears there are no leaks and there is no trace of antifreeze in the oil. A person I work with owns the same model car and has the same problem. Do you know of others? Where is the antifreeze going?

FRANK FERRER
PERRIS, CA

Let's assume your dealer has gone by the book in an attempt to find a coolant leak. He has pressure-tested the cooling system and has analyzed the oil for traces of

coolant. Is antifreeze just disappearing into thin air?

Ford has had a problem with this type of coolant loss (and also oil leakage) in engines of the 1986-88 Taurus, 1984-88 Tempo and Topaz, and 1987-88 Sable and Aerostar. I said "had," because once the repair I'm about to describe is done, the trouble usually goes away.

In the case of models with 2.3- and 2.5-liter engines, which includes your Taurus, coolant can seep from the engine at the cylinder head-to-block mating surface and vaporize as you're driving along because of a deficient head gasket. The leak can usually be stopped by installing a newly designed head gasket (part No. E83Z-6051-A) made of a graphite compo-

sition. The repair, which is outlined in Technical Service Bulletin (TSB) 88-8-8, is covered under the terms of the basic warranty and powertrain provisions of the warranty. If the warranty is no longer in effect, but you're on record as having reported the condition before the warranty ran out, the repair is also covered.

As for those cars equipped with 3-liter engines, the repair is to install a new head gasket and new head bolts. The document you want to draw your dealer's attention to is TSB 88-8-7.

Likes Tension

My 1981 Citation, 1987 Corvette and 1988 GMC pickup truck all have seatbelts that annoy me. The shoulder harness portion doesn't maintain constant tension across the chest.

Unlike the GM harness, the harnesses in other vehicles I've driven, such as the Jeep Wagoneer and BMW, stay tight when I lean forward to tune the radio or adjust the heater or air conditioner. With the GM harness, I have to pull on the belt to get it to snap taut across the chest again. Can the mechanism be modified to keep harnesses tight?

STEPHEN R. BAILEY, M.D.
MONROEVILLE, PA

It can't be done. The "comfort-position" chest harness, as it's called, is a feature that auto-makers figured would make seatbelts more acceptable to people who felt uncomfortable when restrained.

Future vehicles, however, may soon have to be equipped with full-time tension shoulder harnesses. This will be in line with the National Highway Traffic Safety Agency's evaluation of full-time taut

shoulder harnesses as being safer than the comfort-position type.

Dancing In The Dark

I own a 1985 Dodge Omni that stalls repeatedly until the engine warms up. The dealer recommended a carburetor cleaning and then an overhaul, both of which did nothing. Now he wants to install an electric fuel pump, which is quite costly. I'd go along with this if I could be sure it would help. Will it?

RICHARD T. NASH
ASHLAND, KY

If I were the dealer, the first thing I'd do is consult Driveability Test Procedures for the 1985 2.2-liter carbureted engine, which is a booklet Chrysler published to guide mechanics in troubleshooting. The step-by-step procedures are very good in getting a technician to settle on the nub of a problem, especially if it's the electronic feedback system of the carburetor. Electronics, incidentally, is not the most common cause of cold-engine stalling. An incorrect cold-engine (fast) idling speed and a misadjusted or damaged automatic choke are still more notorious, as they always have been.

If the reasons for cold-engine stalling given in Driveability Test Procedures fail to reveal the cause for your problem, it's time to look elsewhere. That's what I've done to uncover two relevant possibilities, neither of which involves adding an auxiliary electric fuel pump.

The first possibility (also the least expensive) is to install a heated air-delay valve (part No. 4201385) in the vacuum line to the heat-control-door vacuum diaphragm.

(Please turn to page 24.)

Filter Fill Up

Don't you just love easy-to-do, no-time-at-all maintenance tips that help protect your car's engine? Here's one, courtesy of John Van Tassel of Gaines, Michigan. It will get oil to the innards of the engine in no time flat during the first start following an oil change.

"When changing your oil and filter, remember to pre-fill the new filter. Hold it vertically and pour fresh oil into it before screwing it on the engine."

It's easy-to-do and doesn't take any time at all, yet is the sure way of eliminating that lapse in time until fresh oil is pumped from the crankcase to the engine—during which parts work without protection.

You're remembering to lubricate the gasket with fresh oil anyway, right? So you'll already have a quart of clean oil open as you're installing the filter. It's a great tip for bottom-mount filters, but might be too messy for side-mounts.





Only one kind of oil can take this kind of heat.

Temperatures inside a car's engine can reach 570°F. Only synthetic motor oil can effectively take this heat.

Tests show that Mobil 1® Synthetic Motor Oil protects vital engine parts under these extreme conditions better than any

conventional motor oil.

Mobil 1 costs more. But more people use it every day—because it doesn't pay to play with fire.

Mobil 1. Isn't your car worth the extra protection?

CAR CLINIC

(Continued from page 22)

Failure of the heat-control door system—also called the thermostatically controlled air cleaner—is another reason.

The heated air-delay valve keeps the heat-control door closed for a longer time to prevent cold air from creating freezing conditions. Ice may be causing the heat-control door to bind in a partially closed position, creating a rich-fuel condition that causes the cold engine to stall. If this rich-fuel condition is the reason for your problem, installing an auxiliary electric fuel pump as the dealer wants to do will only aggravate matters. If the heated air-delay valve doesn't work, take it off the engine and explore the second possibility. It involves modification of the choke unit and installation of a new coolant valve, solenoid kicker and thermal-bowl vent valve. All parts needed to make the repair are included in a Driveability Package carrying part No. 4419409. Instructions on how to install them are outlined in TSB 18-33-86.

Play Misty For Me

Condensation sometimes forms inside the headlights of my 1987 Pontiac Bonneville. The dealer refuses to do anything about it, claiming it's normal. Before I take action, I need verification that it isn't supposed to be this way. Can you assure me?

JOHN MONAHAN
LANCASTER, PA

Nope. Your dealer has a point. These are composite headlamps and condensation on the insides of lenses is common. The lamps, in fact, have vent tubes—one upper and one lower—attached to them to keep condensation to a minimum. If the tubes aren't kinked or obstructed, condensation that forms when conditions are right—that is, lenses being cool enough and ambient temperature being warm enough—is normal and should not be cause for concern.

You may not have noticed, but after the lamps are on for a few minutes and the insides of the lenses get warm, condensation disappears.

GM's Power Steering Offer II

Few items in 25 years of "Car Clinic" have gotten such a huge response as the one about GM's power steering system (page 38, June '88).

To refresh your memory, I reported that 1982-85 GM front-wheel-drive cars are covered by the GM offer to repair a power steering system that is powerless for periods ranging from several seconds to as long as 2 minutes upon starting a cold engine, especially when the ambient temperature is low.

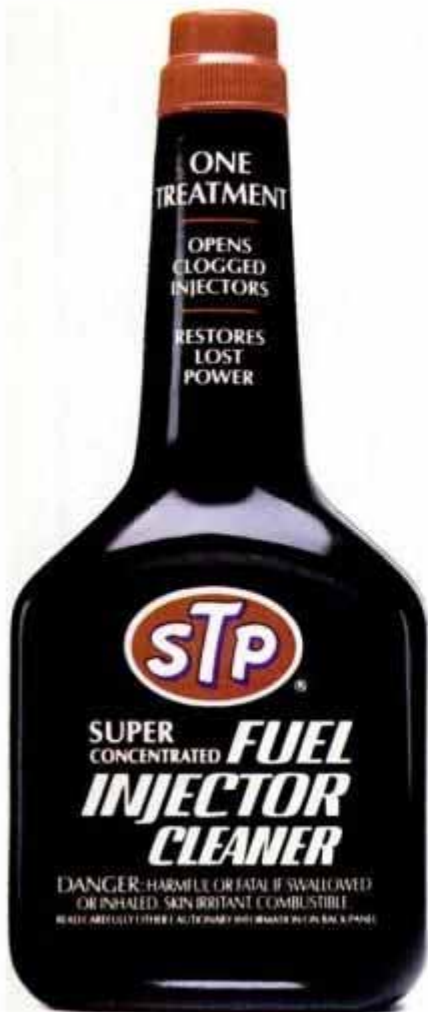
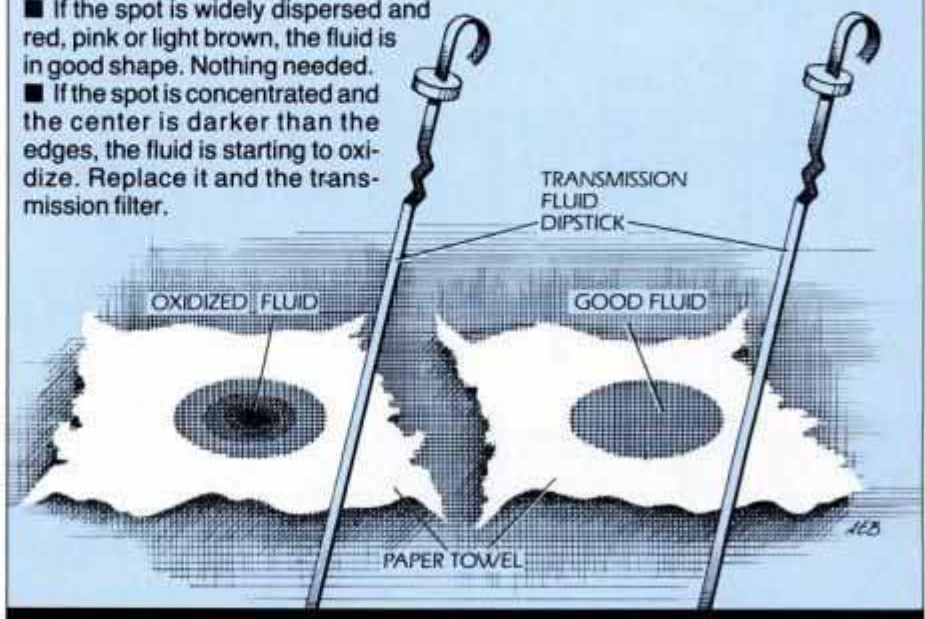
Many people wrote to tell us their cars were repaired free of charge, thanks to us. Others wrote and said that their

Bull's-Eye Troubleshooting

Automatic transmission fluid that's in good condition looks clear and doesn't give off a burned odor. Contaminated fluid, on the other hand, is dirty or cloudy looking and—phew! But when you think about it, this long-standing method used by Saturday mechanics to determine the condition of transmission fluid doesn't provide a way of determining whether fluid is just beginning to oxidize.

Ford Motor Co. advises pulling out the dipstick and allowing a few drops to fall on a paper towel. After a couple of minutes, examine the stain as follows:

- If the spot is widely dispersed and red, pink or light brown, the fluid is in good shape. Nothing needed.
- If the spot is concentrated and the center is darker than the edges, the fluid is starting to oxidize. Replace it and the transmission filter.



The power to merge.

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

If it doesn't, dirty fuel injectors could be robbing your engine of power.

But one bottle of STP® Super Concentrated Fuel Injector Cleaner quickly dissolves deposits and unclogs grimy injectors. It helps restore lost power and improve acceleration. Helps eliminate tough starts and rough idling, too. And it's so easy to use, just add it to your gas tank.

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



B FIRST BRANDS

dealers told them "Car Clinic" was all wet—no such policy existed.

For those in the latter category, here word-for-word is the advisory issued by General Motors:

"General Motors is making available a special policy of 5 years or 50,000 miles (whichever occurs first) to cover a temporary reduction in power steering assist on some 4.6 million GM front-wheel-drive cars produced between 1982 and 1985.

"Some of the vehicles may experience reduced power steering assist upon first starting the car, primarily in cold weather. Once the system warms up—usually in 1 or 2 minutes—normal power steering assist is restored. The phenomenon does not occur while the vehicle is being driven after warmup.

"GM dealers will repair, free of charge, power steering systems that exhibit the problem for 5 years or 50,000 miles, whichever comes first. GM will reimburse owners who in the past paid to have the problem corrected, within the time and mileage limits of the special policy, provided they present proper receipts to their dealer.

"Specific models included are as follows: 1982-84 Buick Skyhawk, Skylark and Century, Cadillac Cimarron, Chevrolet Cavalier, Citation and Celebrity, Oldsmobile Firenza, Omega and Cutlass Ciera, Pontiac Sunbird, Phoenix and 6000, and 1985 Buick Electra, Cadillac de Ville and Oldsmobile 98."

Time Marches On

I was at my brother's place watching him change the engine oil and filter in his 1987 Honda Civic.

He screwed a new filter on the engine and then did something I always thought was a no-no. He placed an oil-filter wrench on the new filter and tightened the filter with the wrench.

I was taught that you tighten oil filters by hand and said so. His silence more or less told me to mind my own business. Is he in for trouble?

DAVID ELLISON
EVANSVILLE, IN

By rights your brother should have used a torque wrench. By not doing so, he may indeed be in for trouble if he has overtightened the filter. Here's why:

Filters carrying the Honda name for 1985-88 Honda models specify in lb.-ft. how tight to make the filter. For most 1985-87 models that specification is 18 to 22 lb.-ft. For most 1988 models, it is 15 to 17 lb.-ft.

It's impossible for most of us to turn a filter to this tightness without using a wrench. Experiments conducted by Honda found that unless a person has

unusual strength, he's unable to turn an oil filter more than 16 lb.-ft.—when the filter is at waist level—and no more than 13 lb.-ft. when attaching the filter to an engine in a car from underneath. And even less, I'm sure, when your hands are greasy from removing the old filter.

The reason Honda is specific about tightening a filter is to prevent an oil leak if the filter isn't tightened sufficiently. But even more so, it's to prevent damage to the metal surface that comes into contact with the seal of the Honda oil filters. In some cases that surface is an aluminum block—in others it's an engine oil cooler. If the filter is overtightened, which is possible to do when using an ordinary oil filter wrench rather than a torque wrench, these surfaces can be easily damaged. Then a very expensive repair may be needed.

Aftermarket filters designed for use on Honda engines don't specify tightening with a torque wrench—just hand tightening. Engineers at Honda offer no advice about this, stating that the recommended filter for Honda engines is one that bears the Honda name. **PM**

SERVICE TIPS

■ To keep from feeling awful one of these days when you find a crack in the hood of your cherished 1985-88 Corvette, check to see if the hood touches the forward end of the inlet-manifold plenum. A new plenum (part No. 10108443) has been issued to prevent this potential occurrence.

■ If you think your Camry or Celica is using too much oil, you may have a point if it's equipped with a 2S-E engine. New valve stem seals (part No. 90913-02075) and new piston rings (part No. 13011-74021) have been issued to reduce oil use to nil.

■ Ford TSB 88-12-3 instructs dealers to install aerosol-foam insulating material between the two metal panels that comprise the floor pan to stop a popping noise, called "oil canning," below the brake pedal of a 1988 Scorpio.

■ Chrysler 1988 models equipped with 4-cylinder engines, turbos and automatic transmissions that die at idle when the engine is warmed up and the air conditioner or defroster is engaged may need a different single module engine controller (SMEC). So says TSB 18-05-88. What no TSB says—to date anyway—is that if you have the same setup in your car and the engine stalls under all conditions, you may need a new pickup in the distributor. If your dealer has a problem agreeing with this, ask him to get verification from the technical assistance center at Chrysler.

DO YOU HAVE A CAR PROBLEM?

Just ask Mort about it. Send your question to 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.

Will your new car outlive your new car loan?

Introducing STP® Supra Wear Control for Newer Cars—formulated to help your engine run like new longer.

If you've purchased a new car recently, you know what a huge investment it is. To help make sure that investment pays off, add new STP Supra Wear Control regularly to your new car's oil. It's an easy way to give your engine extra protection against heat and stress. So down the road, you'll have something to show for your money.



OLD HOUSE RESTORATION

BY BOB VILA

Alternatives To Floor Refinishing

IF YOU can't face the thought of refinishing your old wood floors, this column is for you. The sanding, dust and fumes associated with this time-consuming, messy job aren't something most folks look forward to.

Although a properly maintained wood floor can last a lifetime, years of neglect and abuse make some old floors practically beyond repair. In extreme cases, a floor can be so worn that another sanding will expose tongue-and-groove joints!

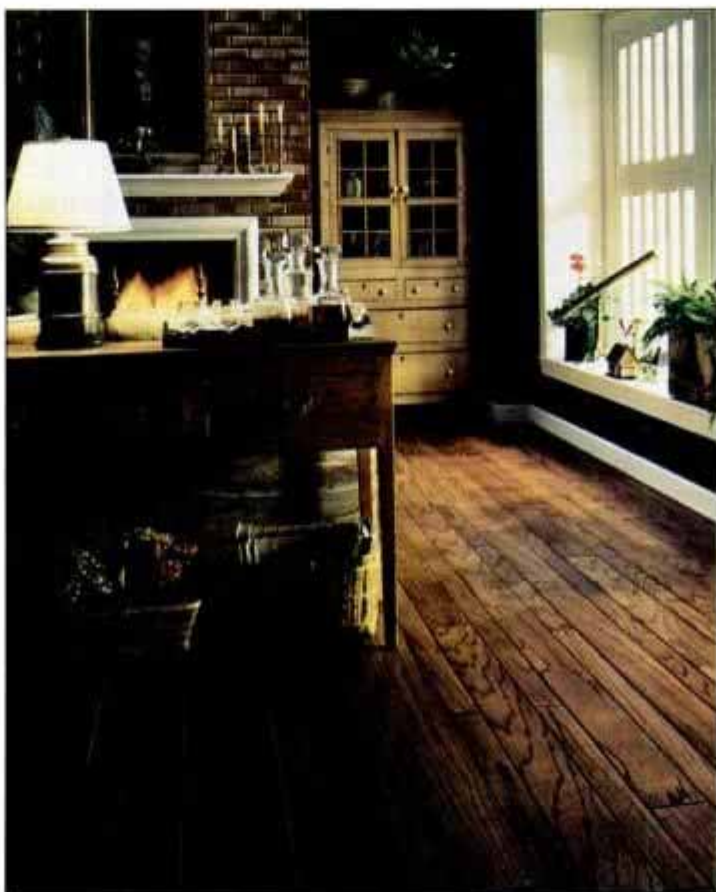
There is an alternative to floor refinishing that may appeal to some old-house owners. It involves installing a new prefinished laminated wood floor right over the old. (Some folks even go as far as installing a new prefinished solid wood floor. But this usually involves pulling up the old flooring.)

While using new flooring won't appeal to purists, some of today's products look quite authentic and will be perfectly acceptable to many old-house owners.

No matter how abused your old wood floor is, it must be sound to successfully accept a new wood covering. By this, I mean that old floor must be flat with no buckling or loose boards. The boards must be repaired first, along with any cracks or spots where the wood moves up and down. If you've got any offensive squeaks, do your best to eliminate them now, because you're likely to find the squeaks in the same spots in your new floor.

Your best repair option is to simply face nail—or screw—the boards into the

Contributing Editor Bob Vila is host of public television's "This Old House."



Installing laminated wood planks is a good alternative to refinishing an old worn floor. Bruce's Sierra Plank oak is glued in place and features tongue-and-groove joints and beveled edges.

floor joists. Just make sure that the nail or screwheads are flush or set below the surface of the old flooring before installing anything new.

Laminated flooring

One of the easiest alternatives to floor refinishing is choosing to cover that old, damaged floor with a prefinished laminated planking. Although you'll find different offerings from the various manufacturers, I'll make some generalities here so you'll know what to expect with this type of flooring.

Most laminated flooring is $\frac{1}{2}$ in. or $\frac{3}{8}$ in. thick and, as its name implies, is composed of several layers of wood. The lamination of these layers

improves the floor's stability and restricts movement. That's why a laminated floor won't bow or warp like a solid wood one can.

For example, the laminated plank flooring I'm most familiar with is 3-ply oak, with each ply $\frac{1}{8}$ in. thick. The top grain runs one way, say North to South, while the middle ply or core runs the other way, say East to West. The back or bottom ply runs North to South again. So, even though the wood is bound to expand and contract, this cross-grain lamination means that wood is pulling against itself, which won't allow expansion. That's why laminated wood flooring is considered more

stable than the solid wood products.

Glued down or floating

There are generally two different types of laminated flooring systems, which differ in how they are installed. Much of the $\frac{3}{8}$ -in.-thick flooring is glued to the subfloor which, in this case, is your old wood floor. (Always place the planks at either a 45° or 90° angle to the original flooring to prevent the old floor's natural expansion and contraction from affecting your new floor.) As an added bonus, the elastic properties in the adhesive, like the laminated wood's cross-grain construction, also help stabilize the floor. Glued-down laminated flooring comes in many different styles, including planks that are 3 in., 5 in. and 7 in. wide. You can also find laminated plank flooring with pegs for added charm. Beveled edges create a groove or channel between the boards, completing this old-time look.

The other type of laminated wood flooring is called a floating floor system. What this means, is that the laminated planks, usually about $\frac{1}{2}$ in. thick, are layered over a thin ($\frac{1}{8}$ -in.) foam pad. Other than the glue used to secure each tongue-and-groove plank to each other, no adhesive or nails are used. As its name implies, the floor literally floats on its foam pad. The advantage this floor has over the glued ones is that it is easier and quicker to install. Also, the foam can better bridge irregularities in the floor below (so it can also be installed over cement slabs, in basements for example).

Floating floor systems

(Please turn to page 28)

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OLD HOUSE RESTORATION

(Continued from page 26)

usually come in relatively large pieces. One of the styles I'm familiar with imitates the old strip flooring. Each piece is about 7 in. wide \times 8 ft. long, and looks like three strips of $2\frac{1}{4}$ -in. flooring put together. The sides and ends are milled with tongues and grooves for easy, tight installation. You'll find, too, that most floating floors are square edged, rather than beveled.

If you're interested in parquet, take a look at some of the glue-down fingerblock parquet floorings. I usually

recommend using a very thin ($\frac{1}{4}$ -in.) plywood overlay over the old wood floor. Since the original floor is going to expand and contract, gluing the parquet to plywood will make the new floor more stable. Fingerblock parquet comes in different sizes. Many are solid wood, $\frac{5}{16}$ in. thick. Some common sizes include 6 \times 6-in. and 12 \times 12-in. squares.

Choosing solid wood

Solid strip floors are beautiful and long-lasting, but installation is more time-

consuming and difficult than laminated products. Although most of these products are used in new construction, they can, if desired, be added over an existing wood floor.

I must caution you, however, that this isn't easy. Since solid wood flooring is usually $\frac{3}{4}$ in. thick, this added height can cause some problems, especially if you can't—or don't want to—remove the old flooring first.

If you choose this route, be prepared to undercut doors and casings to make room for the new boards. In most cases, the baseboard won't have to be removed as long as it has a shoe molding in place. By simply removing the shoe and reinstalling it after the floor is installed, you can avoid raising the entire baseboard. Keep in mind that all floor fixtures—such as furnace grates and floor-mounted electrical receptacles—must also be raised.

As far as cost is concerned, there isn't too much difference between the laminated and solid wood products, that is, if you do the installation yourself. So, really, your choice boils down to the effort and time involved in the job, and the relative complications involved in raising the height of your floor.

Whatever you decide to do with that old floor, it's nice to know there are some options to refinishing. I used to think nothing could match the beauty of a restored and refinished wood floor. But I must admit that some of today's flooring products come pretty close. **PM**

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Laminated flooring also comes in planks that float on a foam pad. The planks are glued together, but not to the floor underneath. Harris-Tarkett's prefinished Longstrip Oak planks are a good example of this system.

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OUTDOORS

BY JOE SKORUPA

Gators Under Glass



FRANCOIS GOPHER/AUDUBON COLLECTION/PIR PHOTO

Most people don't mind 14-ft., 500-pound gators in the Everglades, but not in their neighborhood pond.

ALLIGATORS *Mississippiensis*, or gators as a friend of mine from Florida calls them, are a controversial species in the Sunshine State. They were the subject of a recent firestorm of headlines there and, not surprisingly, opinion was divided.

"They're going to put up glass walls," says my Florida friend, a lifelong resident of the Tampa area. "Pretty soon towns are going to erect domes and nothing living will be allowed in except people." "And when it happens," I reply, "condos in a bubble will sell fast enough to make a developer's head spin."

My friend is the self-reliant type, a pilot and boat owner, who knows how to handle himself in the wild. But the truth is people have reason to fear gators, which can weigh as much as 500 pounds and grow to be a threatening 14 ft. long.

Most of the time gators try to avoid people, but records kept in Florida since 1948 document 100 unprovoked attacks and six fatalities.

Gators were once hunted to near extinction, because their hide could be made into fashionable shoes and handbags and other irreplaceable items. But they've been protected from hunting since 1962 and put under the care of the Endangered Species Act in 1973.

Back from brink

Despite poaching and loss of natural habitat, gators are prolific breeders, averaging about 40 eggs per nest, and have made a strong comeback. Too strong, according to some.

The Florida Game and Fish Commission (FGFC) estimates there are about a million gators in Florida today, with a roughly similar number outside the state in a belt extending from Texas to South Carolina.

Earlier this year, a pretty 4-year-old girl was walking her dog around a man-made drainage pond in a housing development in Englewood, Florida. It was just after supper and she was accompanied by two older boys, ages

9 and 12. All were playing, wading, throwing stones.

At about 6:30 p.m. a 10-ft., 350-pound gator rushed at the girl, knocked her down and dragged her to the water. The girl screamed. The boys ran to help, but they were too late. Police-men recovered the girl's body later that night and the gator was shot.

"Alligators can show up in any body of water. They crawl through drainage pipes and go from pond to pond," says Scott Ball, a specialist with the FGFC. "There were no complaints about the alligator in the Englewood housing development even though residents knew it was

there. People thought it was cute to feed it marshmallows. They'd go to a nearby grocery store, buy food and feed the gator."

The gator problem in Florida is analogous to that of grizzly bears in the Northwest, with some differences. Human populations are increasing and natural habitat is decreasing—a deadly combination, usually for the animals. The grizzly population, for example, is down to about 1000 in the lower 48 states.

Gators, on the other hand, are thriving. Their problem isn't extinction, but human contact, especially by those who don't understand wildlife. (Alligator status was recently upgraded from endangered to threatened.)

Keep them wild

Most outdoorsmen realize that throwing food at large, toothy predators is unhealthy for both man and beast. It leads to a phenomenon called habituation, which Mark Duda, a wildlife biologist for the FGFC, says is a condition when a wild animal begins to associate people with food.

Rather than feeding gators near populated areas, concerned residents should call on the FGFC's Nuisance Alligator Program. Last year, according to Scott Ball, 3400 alligator complaints (Please turn to page 33)



A rare Florida sight: A West Indian manatee surfacing to breathe.

LUS CASTANEDA/IMAGE BANK PHOTO



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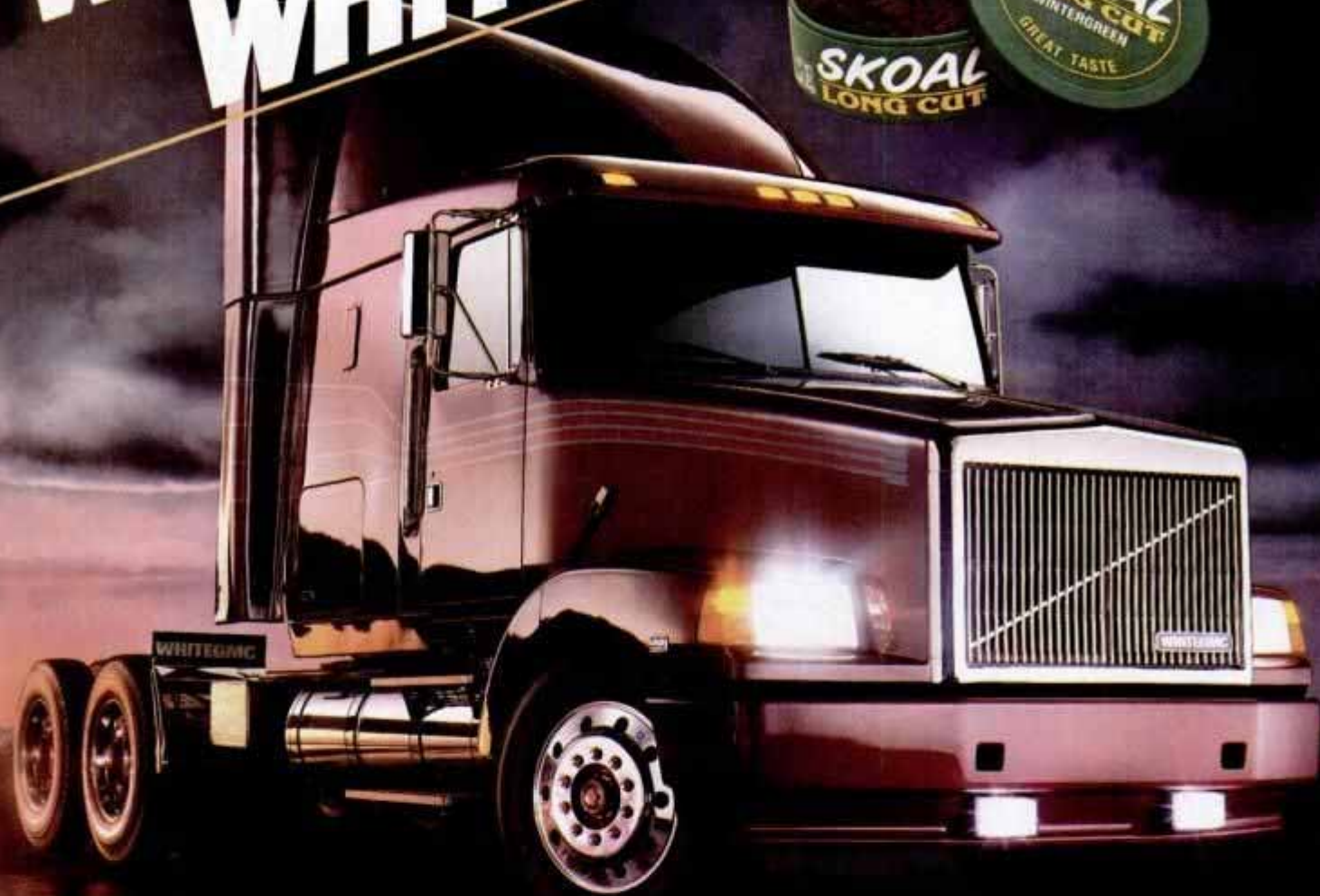
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OUTDOORS

(Continued from page 30)

were handled successfully.

Can alligator-human contact be eliminated entirely? Probably not. Last year a man was snorkeling in a state park near Tallahassee. He entered water clearly posted as alligator habitat and swam a quarter of a mile beyond danger signs. He was easy prey for the first large gator he encountered and was pulled under and drowned. His body, ghoulishly, was discovered by sightseers on a glass-bottom tour boat.

With a population of a million gators in Florida and human contact on the rise, the time has come for a management response by the FGFC. Outdoorsmen will be happy to learn that a limited gator hunting season was inaugurated this year with a goal of 3500 gators. Texas, Louisiana and Georgia are contemplating similar programs.

With so much bad news coming from the state of our environment, the rejuvenated gator population is a welcome success story. The saga of the manatee, on the other hand, appears headed in a different direction.

Vanishing Manatee

I spend a lot of time in Florida coastal waters, but until my last trip I'd never seen a manatee. This isn't surprising since there are only about 1200 of these shy, seal-like mammals left in the United States. Like old-money bluebloods, manatees spend their winters in Florida and range northward from Louisiana to the Carolinas in the summer.

Although manatees have been a protected species since the turn of the century, they're slow breeders and their numbers remain low. Twins are extremely rare for these completely harmless herbivores, which grow to be 13 ft. long and weigh as much as 3000 pounds. They're known to have a life expectancy of at least 35 years in captivity, but too often their lives are cut short. Loss of habitat is the main culprit, although they're sometimes caught in canal locks and dam flood gates. But the biggest problem is boats, or propellers more precisely.

The Faka Union Canal, in southwest Florida, is a 3-mile-long entryway to the wildlife-rich 10,000 Islands area of the Everglades. Last October the canal was designated a manatee area and declared a no-wake zone. Since then, at least 12 manatees have been killed by boats ignoring the no-wake designation and speeding through the canal.

When I was on the Faka Union Canal last spring, I witnessed the trademark manatee gulp of air followed by a tail-waving dive several times. More frequently, however, I witnessed boats roaring through the canal at full speed.

One wildlife biologist I spoke with put the situation into perspective, "people don't care about the manatee."

To be fair to anxious fishermen, it's a real pain to travel 3 long miles at no-wake speeds. But to be fair to manatees, if you don't do it they might die. Manatees are gentle, slow-moving creatures that are sometimes crushed against the bottom in shallows by large boats, but most deaths are caused by props. Certainly, we should all obey posted signs regardless of our desire to land a trophy fish, but I would like to offer Florida boaters a mechanical solution to help solve the manatee problem—jet power.

Propless Power

I spent some time recently in the shallow, protected waters of Captiva Island running jet-powered boats. Although the crystalline water between various inlets and islands is wide, it's also extremely shallow. Even small boats are confined to narrow channels and their mobility severely limited.

With propless power, on the other hand, I felt like a king of the waterways. Jet power increased my area of usable water by at least a factor of 10. And, more importantly, it more than doubled the chances of survival for a manatee that I might hit—of all manatees killed by boats 50 to 60 percent died from wounds suffered by the prop.

It would be foolish to suggest that all Floridians convert from props to jet power just to save manatees, but over the years I've seen fishermen try all manner of shallow-water modifications. For boaters like these, jet power has attractive advantages. Mounted on a flat-bottom boat, a jet can literally run through inches of water. I can't imagine a better way to open up opportunities—for fishing and for manatees.

Propless power, as Judith Delaney Vallee, of the Save the Manatee Committee points out, isn't a complete solution to the manatee problem. Increased public awareness and creation of more protected habitat are the real keys to their survival. However, I believe jet-power is on the rise and will help contribute to a safer manatee environment.

To contact the Save the Manatee Committee, which is chaired by popular singer/songwriter Jimmy Buffet, write to them at 1101 Audubon Way, Maitland, FL 32751, or call (407) 539-0990.

Glass domes, like my friend from Florida suggests, may indeed be the wave of the future. For alligators, domes will be a way to prevent them from coming into contact with humans. For manatees, they'll be a way to keep humans from coming into contact with them.

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IMPORTS

BY BILL HARTFORD

Cars With All Wheels Working



Subaru sedan with 4wd and smoother, more rounded styling arrives by the middle of next year as an '89½ or 1990 model.

FOUR-WHEEL drive for passenger cars got a grip on auto-makers' imaginations during the '80s. But that wasn't the only exciting thing to happen down there where the rubber meets the road. More sophisticated control at those four contact patches was a major development of the decade: Antilock brakes (ABS), 4-wheel steering and electronic suspensions—along with 4wd—packed brains and brawn behind every wheel on the car. And development continues—with antispin control of driving wheels under acceleration, for example. Mercedes-Benz is closest to a fully automatic system (4Matic) where 4wd

is engaged and disengaged as needed, while ABS is ready to do its job as soon as you hit the brake pedal.

Ready To Roll

Meanwhile, as the '89 imports are readied for introduction, we can look forward to an impressive lineup of 4wds ranging in price between the \$8000 Subaru Justy and the mid-\$30s BMW 325iX and Audi Quattro.

At the entry level is the Justy with its On-Demand pushbutton 4wd system and transverse-mounted, 66-hp Three with three valves per cylinder. The 5-speed gearbox of the front-wheel-drive model was modified by adding a bevel gear to direct

power 90° to the rear. Ride height of both models is identical, but the 4wd is about 100 pounds heavier due to the weight of the new transaxle case, center driveshaft, rear halfshafts and vacuum-actuated transfer gear assembly. Justy gets new skin for '89,

take on whatever the weather and the road can dish out—and have fun doing it.

BMW split the iX's torque 37/63—for good reason. Under hard acceleration, weight shift puts up to 63 percent of the iX's weight on the rear wheels. So, on dry



BMW 325iX is a full-time 4wd with a 37/63 front/rear torque split.

and a continuously variable transmission (CVT), initially available in the fwd model. Subaru, whose 4wd models account for half its sales yearly, will introduce a redesigned top-of-the-line sedan (spy shot above) next year.

At the high end of the price and performance curve is the latest entry on the 4wd list, and the model that kept us amazed and amused while driving it in Utah snow: BMW's 4-wheel-drive version of its 325, the iX. Full-time all-wheel traction along with 168 hp and ABS let you

pavement, you can take off at max power and wheel spin will be zilch. And handling is kept the way BMW wants it: with a rear-drive, oversteer bias, as opposed to the understeer bias (50/50 or 60/40) that manufacturers of front-drive cars prefer when they set up their 4wd models.

There are many other 4wd passenger cars—from Audi, Honda, Mazda, Mitsubishi, Nissan, Toyota and VW—and we'll have an update on them as part of our special "1989 Imports" section coming in December. **PM**



Audi 200 Turbo Quattro for '89 uses a 50/50 front/rear torque split.

INSIDE DETROIT

BY JIM DUNNE

Ford LIV Concept Car

THIS 2-seat roadster is a concept car that uses a Ford Fiesta chassis to show Ford's interest in advanced materials. Called the Low Investment Vehicle, the car has a body made of reinforced fiberglass panels in place of steel. The low investment comes from the use of plastic molds instead of steel stamping dies to form body panels. In short production runs of up to 40,000 units, the investment in tooling for plastic body parts is less expensive than for steel body panels.

Ford planners say that specialty models like this roadster can be built in low numbers for a relatively small number of buyers. Note the profile of the hoodline that runs from the front bumper up to the top of the cowl. Plastic materials make



Plastic roadster is Ford's rolling test bed for fabrication of car bodies without the use of steel.

(photo below) that reportedly served as a prototype for Saturn testing. While the front end has a unique appearance, the rear is taken mostly from a Fiero. The tiny air scoop in the middle of the hood indicates that some kind of enhanced engine breathing was used in early testing of Saturn's 1.9-liter 4-

cently—mid-1988—it was expected that Saturn would have steel for its body material. As late as January of this year, a report prepared for another auto company mistakenly assumed 2-sided galvanized-steel body panels, but correctly speculated that the body would be warranted against rust for 10 years. "Also reported is a lifetime warranty against rust," read the report in part. With plastic, there is no problem of rust, as Corvette owners will testify. Look for Saturn to compete against Camry and Accord and sell in the \$10,000-\$15,000 range.

Plastic Cab

More plastic seems to be showing up on Detroit's proving grounds. Ford showed a slick version of its Ranger pickup as part of a report on plastic progress. A plastic hood and plastic upper for the cab give the vehicle a smoother appearance, as panels are extended and seams are eliminated. The hood stretches farther rearward and partially covers the wiper hinges, while at least two seams in the A-post at each side of the

windshield have been eliminated. In addition, Ford engineers claim that the cab structure is stronger. A ride in this pickup confirms Ford's claim that the plastic, because of its sound-absorbing quality, lowers the noise levels inside the cab.

No-Leak Allante

Cadillac changed the design of the header seal on its Allante convertible tops to stop water leaks.

At the same time, owners of earlier model Allantes can get their tops leak-proofed at no charge.

The improved seal that is now being installed on all new Allantes will be installed on older models, according to Cadillac officials.

Those cars have been plagued with the problem of dripping rainwater coming in at the tops of the A-posts.

(Please turn to page 38)



Early plastic prototype for GM Saturn is headed for the crusher.

this shape easy to form, where it is difficult, if possible at all, in steel. Three different types of plastic are used in the body of the LIV, structural panels that form supports underneath the skin, nonstructural parts that simply act as styled covers, and highly formed plastic that takes compound curves not possible to produce in stamped metal.

Early Saturn

Headed for the scrap heap is an unusual 2-seat sporty car

cylinder, possibly a turbo-charger. The rough edges of the body panels on this car, plus the rounded shapes, indicate that plastic was used in place of steel.

The plan is to use plastic body panels in the new Saturn automobiles. The GM subsidiary will build three models for sale starting in early 1991, a 4-door sedan and two coupes. According to insiders, the cars will have plastic body panels with a steel underbody structure, much like Fiero. Until re-



Ford Ranger pickup cab is another body part that is being tested in plastic.



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INSIDE DETROIT

(Continued from page 37)

V8s For T-Bird

After one year of using 6-cylinder engines exclusively, Thunderbird will return to V8 power when the 1990 models are introduced next fall.

The engine will be an all-new design, of 4.6-liter (about 281-cu.-in.) displacement. This V8 will be the first working version of Ford's modular engine program. Other versions, including a V6, will be built later.

The modular engine is designed with a combustion chamber and cylinder size that can be used in a variety of engine types and sizes.

A V8, V6, Four or a V12 would use the same basic cylinder size and combustion chamber.

The advantage is that only one type of combustion chamber would have to be developed for all engines, and one type of automatic machine line in the engine factory would be needed to produce them.

Even though the proposed V8 is smaller in displacement than Ford's 5.0-liter V8, there should be no drop off in performance. Ford insiders say that with four valves per cylinder and overhead camshafts, the new V8 will turn out a solid 225 horsepower.

Little-Known Best Seller

That's any car's owner's manual. Millions are sold each year with some going into 10th printing years and longer. One problem is getting folks to read them. Any parent who demands a complete reading before the kids get a key to the family buggy knows this can be a struggle. Now, GM has devised an illustrated manual that makes reading easier and faster.

All Buick, Oldsmobile and Cadillac 1989 manuals will have color photos and drawings, and a simpler explanation of how the car's systems work with lots of white space in place of solid type. Anyone can breeze through this book—or parts of it—and pick up hints that every driver should know.

Or, if there is an emergency like a flat tire, the new GM book makes it easy to find the right fix.

2-Stroke Fords

Ford apparently plans 2-stroke powerplants for its future small cars. The company recently signed an agreement with Orbital Engine Co., of Australia, to produce a 2-stroke "if . . . technical . . . developments now under way

prove successful." Adoption of a 2-stroke engine in a passenger car would be a breakthrough of immense importance to the automaker.

Today, all cars sold in the United States are of the 4-stroke design—intake, compression, combustion, exhaust—meaning four separate movements of the piston. With a 2-stroke, the movements are reduced to two. The result is power delivery from each cylinder for each turn of the crank.

With more power delivery, engines can be built much smaller and many pounds lighter in weight, and that translates into smaller engine compartments and better fuel economy. Cheaper too, because 2-stroke engines are not new. Many have been used in cars of the distant past.

But dirty emissions have been a persistent problem. To beat that defect, the Orbital design blows into the combustion chamber a charge of pre-mixed gas/air, and starts it burning earlier. Estimates are that the earliest Ford can get a 2-stroke on the road is late in the '90s.

Plastic On The Way

Buick is putting plastic front fenders on its Reatta and LeSabre T Type models,

ZEREX



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PROTECTION UNDER THE HOTTEST, THE COLDEST, THE MOST EXTREME CONDITIONS.

but the division is not making a big deal out of it. Now, Ford is planning similar front fenders for its Taurus within a year, and Chrysler is not far behind with one of its own. While fenders are a small part of the car body, look for doors and hoods to be the next target of plastic suppliers.

GM is testing a variety of plastic body parts now on some of its full-size passenger-car prototypes. Benefits of plastic include light weight, no rust and the ability to take a 3-in. dent from a shopping cart and bounce back to its original appearance.

Newer plastics are different from those used on Corvettes. They must go through the same 250° F baking oven to cure paint with the rest of the car.

In the early days of plastics, you'd get a meltdown at those temperatures. Still, for all the advances, it appears that the average owner is not really concerned about what is used for the body of his car. Just as long as it stays looking good.

Iron Duke Declines

GM plans to replace the 151-cu.-in., 2.5-liter 4-cylinder "Iron Duke" engine within a couple of years with versions of its newest engine, the 140-cu.-in., 2.3-li-

ter Quad 4. Plans are for a new Quad 4 to be built with a single-overhead cam in place of the double-overhead cam now used. This version is to be cheaper, simpler in construction and lower powered. GM has never reached the promise of the original Iron Duke—that of a dependable engine with loads of low-speed torque and acceptable horsepower. Changes like roller lifters and better cooling did nothing to offset problems like leaking or cracked castings that showed up in recent production runs.

Pray For Rain

GM's Sunraycer, the solar-powered car that won the 1950-mile World Solar Challenge race in Australia last year had some help from on high. The winning margin for Sunraycer over the second place finisher was 2½ days, or 620 miles. But GM gained an edge from an unlikely source. Sunraycer spurted ahead of its 25 solar-powered competitors at the start of the race, and beat a rainstorm that cut across the course. The competition was left in the dark, so to speak, with no sunshine to recharge on-board batteries. So Sunraycer sped along at an average speed of over 41 mph while competitors pulled out um-

brellas. That's not to say Sunraycer was not the fastest. In early summer of this year the Sunraycer, still powered by 8800 gallium arsenide and silicon solar cells pasted to the outside of its body, set a world speed record for its species of 48.7 mph.

First Gas Guzzler

Allante for 1989 becomes the first American mass produced car to qualify for an official gas-guzzler label. Its 20.5-mpg average fuel economy is 1.5 mpg short of the standard needed to escape the \$650 tax penalty that goes with low mileage, as defined by the EPA. Why Allante when higher-performing cars like Corvette, Mustang GT and IROC Camaro don't have to pay? "It's an involved story," say Cadillac engineers. "But the features needed to keep Allante competitive make gas guzzler necessary." Among those features are an automatic transmission, shift points that are set for performance, not economy, smooth shifts and a 200-horsepower V8 that lets the car reach 130-mph top speed. It should be noted that Allante's competitors also are in the gas-guzzler tax bracket, probably for the same reasons as Cadillac's. **PM**

BY TIM COLE

Home Satellite Weather Maps

FARMERS in America's drought-stricken grain belt know the problem. So do fishermen in New England. Construction foremen in Chicago. Aviators. Surveyors. Anyone who has to live and work out in the open.

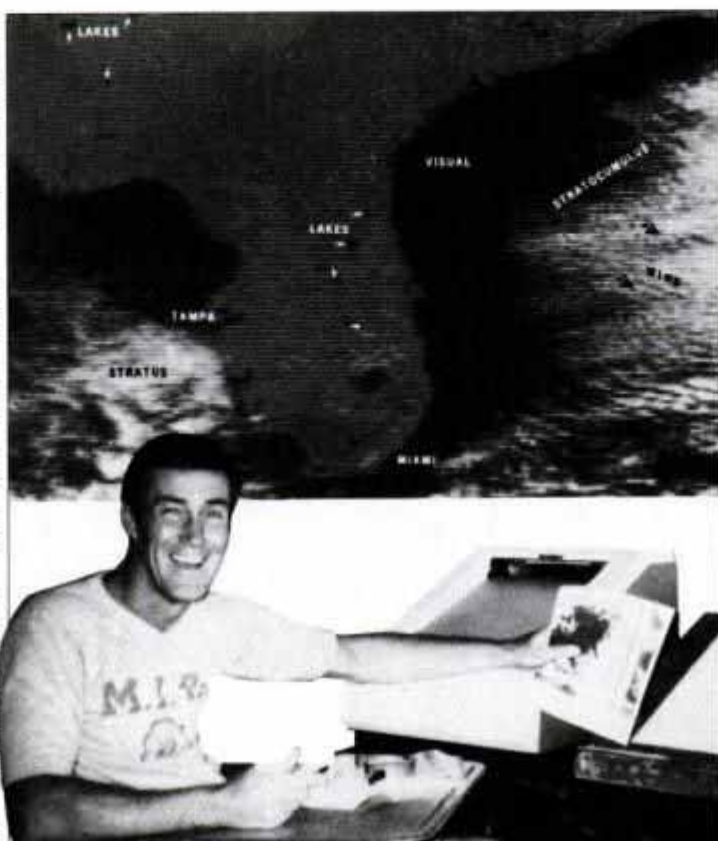
Where can you find quality, instantaneous weather maps that give a clear interpretation of impending meteorological conditions? If you're Hank Brandli of Melbourne, Florida, you reach into the heavens with a homebuilt satellite-image receiving station and capture the sky.

Brandli, a former Air Force meteorologist, has perfected a means of receiving the imaging signals from the polar-orbiting American and Soviet weather satellites that pass overhead every 100 minutes.

"Two American NOAA satellites in Sun-synchronous orbits take, record and transmit infrared and visual photos of the same location at approximately 9 a.m., 9 p.m., 3 a.m. and 3 p.m. The Soviet Union has three Meteor satellites that transmit visual photos of a 1200-mile-wide swath."

Brandli assembled his receiving station for under \$1000. A PVC pipe and welding rods serve as a suitable antenna. A receiver connects to the antenna, and an interface card in a standard PC can digitize the signals. A used facsimile machine furnishes image output.

If you'd like to learn more about how you can downlink top-grade satellite images, write Hank at 3165 Sharon Dr., Melbourne, FL 32904. He can provide a parts list, instructions and other information. Please include \$5 for postage, handling and photocopies.



Hank Brandli of Melbourne, Florida, and a weather facsimile of Earth retrieved from a Soviet Meteor spacecraft.

Future Farmers

Brandli's device serves as an introduction to the subject of climate. Mounting evidence suggests we're experiencing gradual global warming due to the greenhouse effect. Atmospheric pollutants trap the Sun's heat, raising surface temperatures.

Researchers at Duke University are trying to help farmers and policy makers anticipate the effects of this dire climatic change, by duplicating conditions we can expect 50 years from now—if present trends continue.

Using the Duke Phytotron, a research facility with 40 artificial growth chambers and six glass houses, botany professor Alan Teramura is examining how an increase in both ultraviolet radiation and carbon dioxide over the

next half century will affect plants. In addition, the experiments with ultraviolet light will illuminate the effects of ozone depletion. Atmospheric ozone reduction at the poles caused by chlorofluorocarbon release is increasing Earth's budget of ultraviolet radiation.

According to Teramura, "even if we stopped polluting the atmosphere now, the effects would continue for decades."

And The Winner Is . . .

Three years ago PM ran a contest for readers interested in designing an experiment for the Space Shuttle's Get-Away Special canister (GAS). Our intention was to send the winner and his family to Cape Canaveral to

watch his experiment blast into space, then be on hand at Edwards AFB in the California desert to watch it land. Of course, the *Challenger* explosion changed the timetable.

We still had a winner, however. John Chiment of Trumansburg, New York, designed a fascinating way to test plant viability in orbit by measuring glutathione. His work may have an impact one day on life sciences in space. To collect his prize, John and his family joined me last May for a technology tour of Kennedy Space Center and Disney World's nearby EPCOT Center.

We got an up-close view of pad 39B, which was awaiting the rollout of a refurbished *Discovery*, and toured Kennedy Spaceport's "rocket garden," which contains full-size copies of America's past space fleet.

Combining a pleasing mixture of science and entertainment, EPCOT superbly demonstrates leading trends in energy research, agriculture, transportation, communication and other vital fields.

Our next trick? Building John's experiment into a GAS canister (PM is still in line) and making it fly. Stay tuned. **PM**



Space Shuttle contest winner John Chiment and family at NASA's Kennedy Spaceport.

Street Smart.

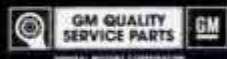
At 2:30 a.m., every lane on the freeway's an express lane.

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MOTORSPORTS

BY TONY SWAN

The High Cost Of Low-Bucks Racing

WITH A regularity that rivals the seasons, motorsports sanctioning bodies are forever dreaming up new series designed to attract entry-level racers. After all, development of new talent is the wellspring of this or any other sport.

But few sports are as cash intensive as racing. The well-heeled competitor has a far better chance of winning than the guy who's operating on heart and hope. Which is why the entry-level concept has a way of becoming a professional series, with attendant escalations in cost.

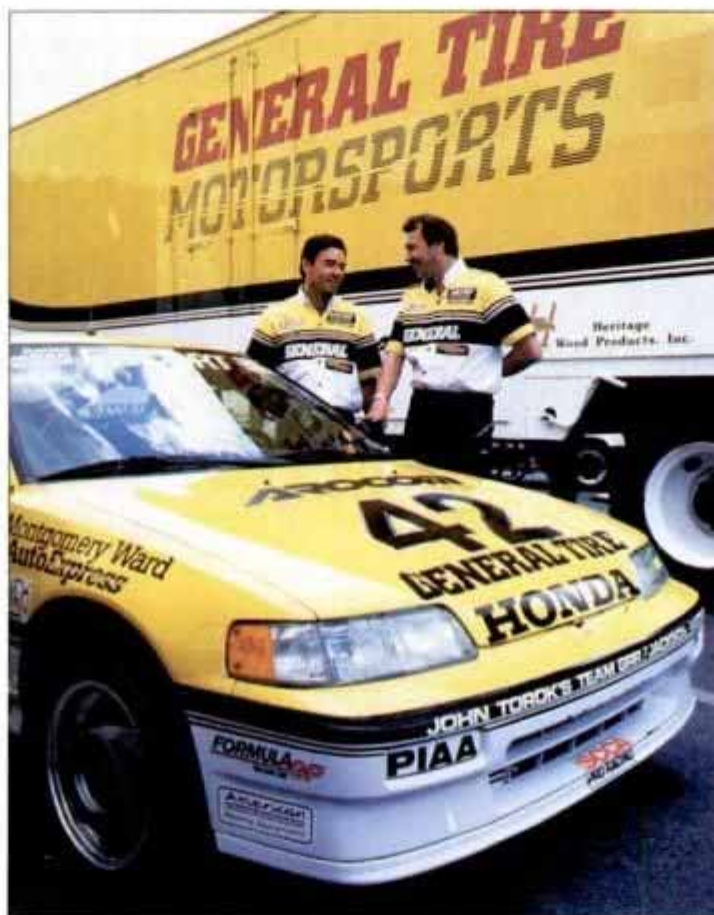
An excellent case in point is the so-called showroom-stock concept. Conceived by the Sports Car Club of America in the '70s to provide a cheap-as-possible route to competition for would-be racers, this idea has since spawned two competing pro endurance racing series, one sanctioned by SCCA, one by the International Motor Sports Assn. (IMSA).

And from its humble origins—a car that a guy could drive to and from the race, as well as in it—showroom stock has become very sophisticated.

The John Torok/Oscar



Torok/Jackson Honda CRX team took first and fourth places in the season opener.



Honda racers Jackson (left) and Torok discuss racing finance.

Jackson Honda CRX team shown here makes an excellent example of this phenomenon. With sponsorship from General Tire and Montgomery Ward this team contends in the SCCA Escort Endurance series—eight races, ranging from 3 to 24 hours, spread out over six months and most of the continent.

Running in Class B, the Hondas aren't really in the hunt for overall victory in any of these events. But that doesn't mean the racing for class honors—1987 series champion Volkswagen is the principal adversary—isn't just as intense. Or just as expensive.

"We figure doing it right, with one car, is about a \$100,000 proposition," says Torok. "Running two cars

can take it up as high as \$150,000."

Doing it right entails a lot more than just showing up at the track. There are countless hours of preseason testing and preparation, something Oscar Jackson's organization has excelled at in the past few years.

Jackson Racing, in Westminster, California, has established itself as one of the best places in the country to buy go-fast stuff for Hondas, and Jackson-prepped Hondas have been consistent front-runners in this form of racing since the CRX first came along in 1984.

While intensive preparation and development eat up plenty of cash, the logistics of getting the team to and from the race is the biggest single

cost associated with any racing effort.

"Lodging, food and transportation eat up about 40 to 45 percent of the budget," says Torok. "Preparation also comes pretty close to that. The actual racing is only about 20 percent."

Escalating cost is perhaps the biggest reason Torok, a heavy-equipment salesman from Ohio, and Jackson have pooled their talents. John works on financing, Jackson bolts together bulletproof race cars.

At this writing, the alliance has yielded class victories in the season's first three races. The team's No. 2 car came home 4th, 3rd and 2nd in the same events.—T.S.

Indy Pacing

Retired Brig. Gen. Chuck Yeager got to have the real fun, of course, but prior to the running of the 1988 Indianapolis 500 a few journalists were invited to the speedway to drive the Olds Indy pace car. I was fortunate enough to be one of them.

This was an interesting assignment for a couple of reasons. First, the car, the topless Cutlass Supreme, fabricated by Cars & Concepts, has a number of inter-

(Please turn to page 45)



Driving the Indy pace car 110 mph on the speedway is like driving 30 mph on a street.



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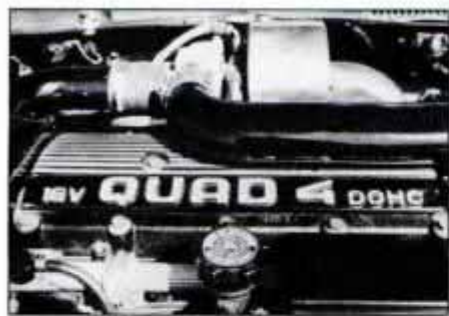
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A REPUTATION FOR PERFORMANCE

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| 1979 | 1980 | 1980 | 1981 | 1982 | 1983 | 1983 | 1985 | 1987 | 1987 | 1987 |
|--|---|---|--|---|---|---|--|---|--|-------------------|
| Car and Driver | BMW Roundel | Car and Driver | BMW Roundel | Car and Driver | BMW Roundel | BMW Roundel | BMW Roundel | Car and Driver | BMW Roundel | Popular Mechanics |
| <ul style="list-style-type: none"> ▶ 1st Escort ▶ Bearfinder ▶ Fuzbuster ▶ Double Nickel ▶ Hawk Eye ▶ Snooper ▶ Radar Sentry ▶ Super Eliminator ▶ Whistler ▶ Fox ▶ Super Buster ▶ X-Kaliber | <ul style="list-style-type: none"> ▶ 1st Escort ▶ Whistler ▶ Fox ▶ Radar Intercept ▶ Fuzbuster ▶ Fox ▶ Sidewinder ▶ Fuzbuster ▶ Bearfinder ▶ Snooper | <ul style="list-style-type: none"> ▶ 1st Escort ▶ Fox ▶ Whistler ▶ Radar Intercept | <ul style="list-style-type: none"> ▶ 1st Escort ▶ Gul ▶ Whistler ▶ Fuzbuster ▶ Fox ▶ Radar Intercept ▶ Snooper | <ul style="list-style-type: none"> ▶ 1st Escort ▶ Gul ▶ Bel ▶ K40 ▶ Radar Intercept ▶ Whistler ▶ Radio Shack ▶ Fuzbuster ▶ Fox ▶ Phantom | <ul style="list-style-type: none"> ▶ 1st Escort ▶ Whistler ▶ Bel ▶ Fuzbuster ▶ Cobra ▶ Fox ▶ K40 ▶ Gul ▶ Radar Intercept ▶ Radio Shack | <ul style="list-style-type: none"> ▶ 1st Passport ▶ 2nd Escort ▶ Whistler ▶ K40 ▶ Fuzbuster ▶ Uniden ▶ Cobra ▶ Bel ▶ Snooper ▶ Whistler ▶ Bel ▶ Fox ▶ Fox ▶ Bel | <ul style="list-style-type: none"> ▶ 1st Passport (Escort not tested) ▶ Cobra ▶ Uniden ▶ Radio Shack ▶ Bel ▶ Whistler ▶ Sparkomatic ▶ Fox ▶ Gul | <ul style="list-style-type: none"> ▶ 1st Passport ▶ 2nd Escort ▶ Bel ▶ Whistler ▶ Maan ▶ Radio Shack ▶ Uniden ▶ Fox ▶ Cobra ▶ Bel ▶ Snooper ▶ Fuzbuster ▶ Sparkomatic ▶ Sunyang | <ul style="list-style-type: none"> ▶ 1st Escort ▶ 2nd Passport ▶ Bel ▶ Snooper ▶ Uniden ▶ Whistler ▶ Cobra ▶ Gul ▶ Radio Shack ▶ Sparkomatic ▶ Maan | |

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Pace car's Quad 4 turbo makes 250 hp.

esting mechanical touches that we wouldn't be surprised to see in future production models.

Most welcome in this category is the car's turbocharged and intercooled Quad 4 engine, capable of 250 hp at 6000 rpm and 250 lb.-ft. of torque at 4000. Muscle like this gives the Cutlass a top speed in the vicinity of 150 mph.

The car has 4-wheel disc brakes and Delco Moraine ABS to go with its speed potential, and the tires are Goodyear's new ZR-rated Eagles—225/50ZR-16s.

Another particularly interesting feature is the pace car's Head-Up Display, a system that projects a holographic image of certain key information—speed, turn signals, high-beam repeater and low-fuel warning—into the lower range of the driver's vision. Look for HUD to appear on some GM cars in 1989. We wish it were here right now.

HUD and Quad 4 turbo notwithstanding, though, the thing that really drew me to this session was the prospect of driving on the Indianapolis Motor Speedway. Although the pace car was governed down to a top speed of 110 mph, I was nevertheless happy to be cruising around a place I regard as a national monument.

A speed of 110 mph seems to be a mere crawl at Indy—the track is big enough, at 2.5 miles, and smooth enough to swallow such a pace.

However, as I sailed down the back-straight near the end of my laps, a couple impressions burned themselves into my brain, one contingent on the other. As a driver approaches turn three, he can look up and check a wind sock mounted atop the grandstands.

Although there was enough breeze to get the sock pretty well extended during my drive, it was a little while before the significance of this innocent-looking installation sank in. While an extended wind sock might not mean anything to someone cruising an empty track at 110 mph, it would certainly mean something to an Indycar driver screaming along that same section of track because he'd be going over twice as fast as I was. I humbly pulled into the pits, parked and went to the Speedway Museum.—*T.S.*

Rally Weapons

Trees whipped past inches from the door handles as the Mazda soared off the crest of a gentle rise.

"The road is straight—don't lift!" My codriver's voice sounded far too calm in my helmet intercom.

We crested the hill at full throttle, almost exactly 100 mph, the magnesium skidplate striking sparks in the loose shale of the road surface as the suspension bottomed on landing.

This section of our run, a closed-off special stage, was an access road through the Delaware State Forest in eastern Pennsylvania. The occasion for all this boonie bashing was the 1988 Mazda/Pocono Rally, sanctioned by the Sports Car Club of America.

Although performance rallying enjoyed a brief period of popularity in North America about 10 years ago, it is again becoming a sport restricted large-



Mazda's 4wd 323 GTX on the rally warpath.

ly to cultists, who truly enjoy ricocheting off trees in the middle of the night.

I was driving at the invitation of Steve Potter, who works with Mazda Motors of America East. Steve was driving an identical 4wd 323 GTX, rally-prepared with roll cage, driving lights, stiff springs and performance shocks. Screwing down the turbo's wastegate gave the dohc 16-valve engine about 185 hp. The car was otherwise unmodified—in fact, the air conditioning even worked.

The 323 GTX carried codriver Sean O'Connor and me to a third-place finish, which was respectable considering this was my performance-rally debut. And among other things, it proved to me that Shawn is an extremely brave person.

The car was equally impressive, running without a hiccup through almost 12 hours of bashing around in the woods.

When it was over, I found the whole thing added up to a consciousness-raising exercise.

Rallying may not enjoy the popularity of some other forms of motorsport in this country, but I know now why the people who love it are willing to go to the considerable trouble—and expense—of supporting it.—*Mike Allen*

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Let's get it together. Buckle up.

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BY STEPHEN A. BOOTH

Follow The Bouncing LED

STUDY this machine on the right. Study it carefully, and note the coin slot in its upper right corner. This product of the digital age could change the way we entertain ourselves in public and at home. It's a Laser Karaoke player, a digitized, electronic version of the sing-along pastime so popular in Japan, and already it has turned up on the West Coast, where so many fads begin.

You might recall that the term karaoke (pronounced kah-rah-oh-kay) appeared in last month's "Audio" column (page 48). As our globe-trotting contributing editor Frank Vizard pointed out, the sing-along is immensely popular in Japan, especially in establishments that serve beverages stronger than tea. Would-be crooners step up to the mike, and provide the vocals to a song with the accompaniment of a tape recorded, instrumentals-only soundtrack. Usually, the singer reads the lyrics from a songbook containing selections as diverse as "Tennessee Waltz," the theme to "Rawhide," or even "Pop Goes The Weasel." Usually, the volume is quite loud, with enough reverb to make everything unintelligible. Get the picture?

Stateside, this unsolicited torment probably would provoke, not necessarily in this order, (A) the ejection of the performer, (B) a fight, or (C) the mass exodus of the patrons (a fitting response, as karaoke is Japanese for "empty orchestra"). In Japan, the same situation provokes polite applause.

For better or for worse,



Pioneer's karaoke player supplies lyrics and instrumentals for sing-alongs.

Pioneer Electronics plans to make a go at establishing karaoke in the United States—in a high-tech way. Laser videodiscs supplant the songbooks and instrumental tapes. Instead, the videodiscs display lyrics (bouncing ball included) on a TV monitor, while at the same time sending the digital audio soundtrack to loudspeakers. Each 12-in. videodisc holds 28 musical selections, including lyrics and background visuals. A catalog of 50 discs covers a variety of musical genres, from '50s rock to nursery rhymes.

Pioneer's model LK-V350 Laser Karaoke (\$1500) is the home-use version of the coin-op system pictured here. It trades in the coin box for other worthwhile features.

Specifically, the LK-V350 is a self-contained music system. A 30-watt amplifier drives a built-in loudspeaker. Inputs for three microphones send vocals to the amp—and to the built-in cassette deck, should you wish to record your efforts.

You can balance the mike inputs, say, to make the lead vocal more prominent than the harmony section.

Sound-enhancement fea-

tures include a 5-band graphic equalizer, digital reverb and an optional control that can adjust the key of the song to suit your vocal range.

The song discs, by the way, do contain prerecorded vocals. You can use these for practice, for canned entertainment, or mute them with the press of a button to go it alone.

If you develop laryngitis, or an earache, the LK-V350 is more than an electronic doorstop. The same unit will play regular laser videodisc movies when you feel like being entertained instead of entertaining.

Tapeless TADs

Karaoke isn't the only thing that's dropping magnetic tape for digital technology. TADs—telephone answering devices—are trading in magnetic memory for memory chips.

First on the block with digital TADs is Code-A-Phone. The company's new 6200 series of products dispenses with tape cassettes completely—for both incoming and outgoing messages.

Instead, your outgoing salutation and the messages

that callers leave for you are recorded on RAM (random access memory) chips. This offers a number of advantages—but one handicap as well.

On the plus side, the use of chips in place of tape and a tape transport eliminates a host of moving parts. This reduces the chance of equipment failure. Additionally, chip storage gives you direct access to a message: Instead of scrolling through a tape, you can go directly

to a specific memory bank. This also means you can erase or save messages selectively.

As far as sound quality goes, the voice chips suffer no loss of fidelity compared to slow-speed cassettes. If the digital system has one shortcoming versus tape, it is in recording capacity.

At this time, you're limited to a 21-second outgoing message. Incoming messages up to 19 seconds can be recorded in each memory-chip bank. There are seven incoming banks in Code-A-Phone's Model 6200 TAD (\$150) and Model 6250 ITAD (\$200)—the I indicating that the TAD is integrated within a multifunctioned telephone.

(Please turn to page 48)



Code-A-Phone uses memory chips instead of magnetic tape.

SPRAY ON THE POWER.

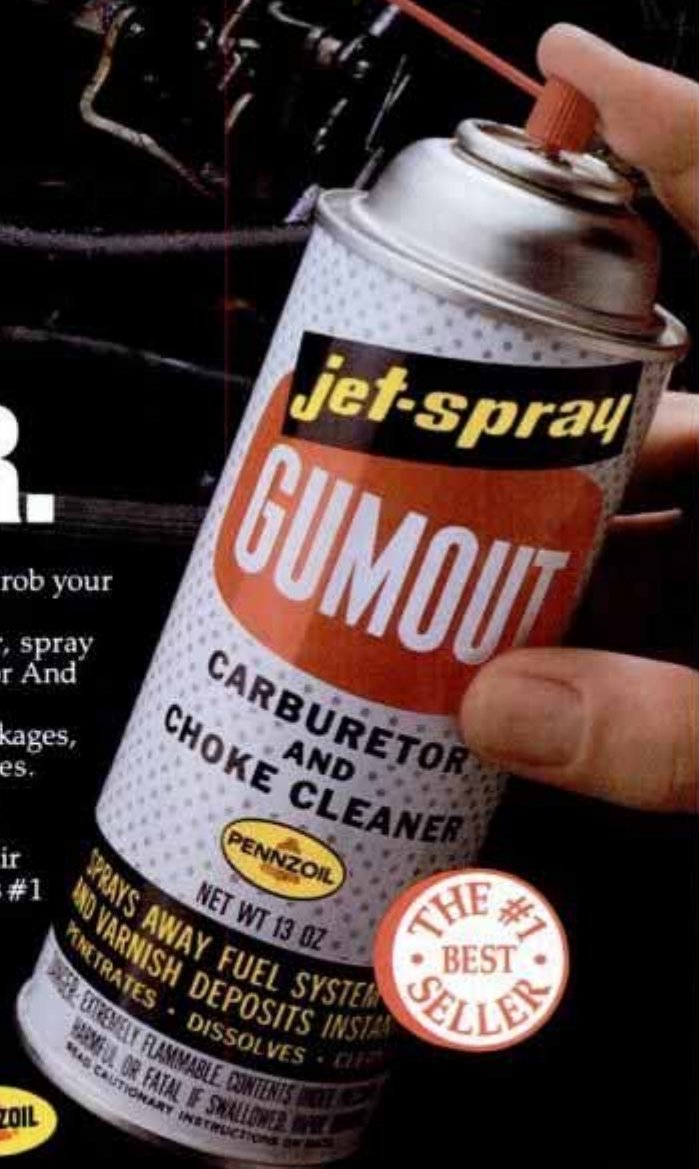
A dirty carburetor, choke, or linkage can rob your car of some great performances.

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So if you expect great performances out of your car, spray on the power. The power of Jet-Spray Gumout®.



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ELECTRONICS

(Continued from page 46)

Portable Storage

We Americans are a mobile people, and we like to take our entertainment on the road. There's a plethora of mobile and portable electronics products that makes this possible: car stereo, headphone stereos, boomboxes and battery-powered CD players. Even a videogame console is compact enough to make the trip, for hookup to a TV set in the hotel room or vacation home at the other end of the road.

Of course, just about all of these entertainment sources require some software, or programming, to put on a show. This means you have to portage cassettes, CDs or videogames with your skivvies. There are hundreds of software carrying cases on the market—but the Savoy Softsider line merits attention for a particularly practical feature.

Savoy Manufacturing produces a broad line of home storage devices for records, tapes and games, in addition to carrying cases. These home storage units come as interlocking modules, so you can build a storage center as your software library expands. The storage racks and trays can be stacked, or wall-mounted. These selfsame racks and



Storage tray in Savoy case pops out to display CDs or videogames at home.

trays are used to keep your software neatly stowed for travel in the Savoy Softsiders.

The trays, therefore, do double-duty—at home or on the road. The CD Softsider (\$13) shown here holds 16 compact discs or eight Nintendo videogames, and comes in a variety of colors. The company offers an assortment of carrying cases, including a prewashed

denim model (\$15) whose removable tray holds 36 cassettes.

Old-Time Music

One form of entertainment you can enjoy anywhere, without lugging software, is radio. The programming weighs no more than the air that carries it. You can buy a brand-new radio for \$10 or less today, but not necessarily an old one—at least an old one in working condition. By old I mean antique, and as you'll read elsewhere in this issue ("Oldies But Goodies," page 82), antique radio collecting is big-time business.

If you don't have an old-time radio of your own to enjoy, you can get the feeling free, courtesy of the Antique Wireless Assn., one of our sources on the subject. The association operates a remarkably eclectic museum in East Bloomfield, New York, about a half-hour's drive from Rochester in the beautiful Finger Lakes district. Regular hours run from May through October, but the association will provide guided tours by special appointment at other times.

For more information, call the AWA's Electronic Communication Museum at (716) 657-6260 or 657-7489. **PM**

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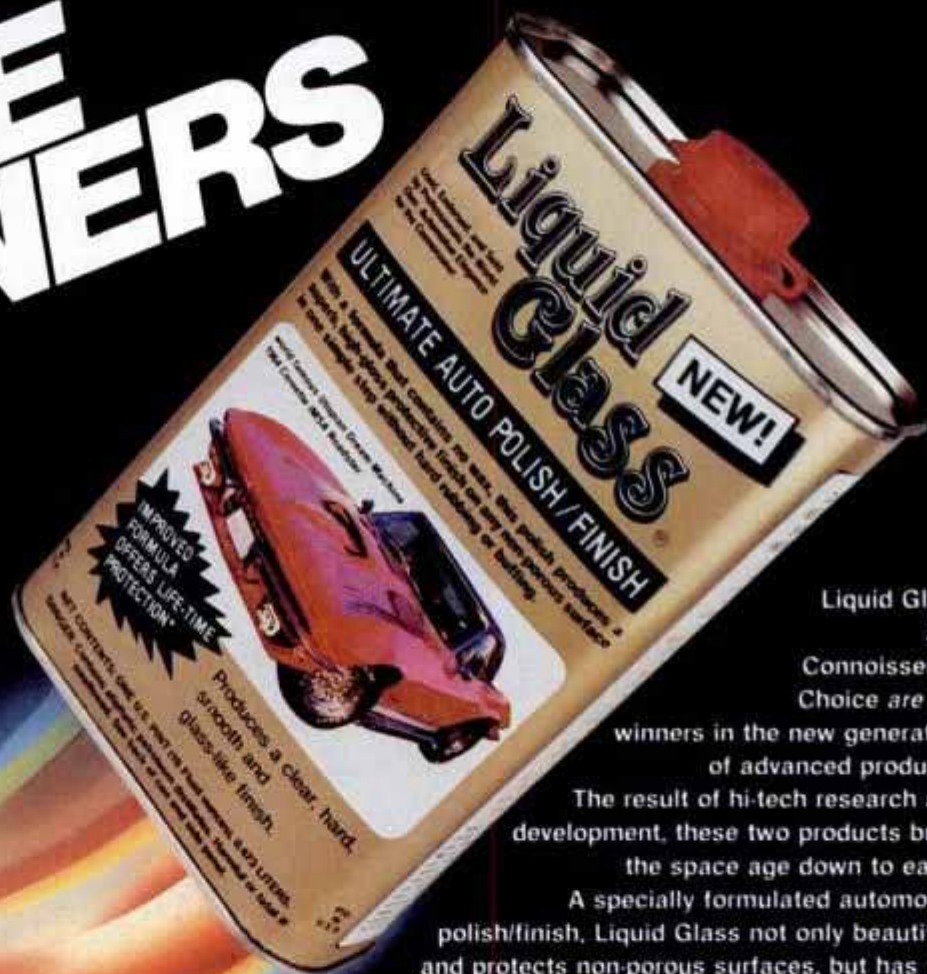


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Video For The Constantly Mobile

BY FRANK VIZARD, Contributing Editor

EVERY morning and evening, thousands of people board commuter trains and buses that take them to and from their jobs. Most of these people have something to read—be it a newspaper, magazine, book, or even an interoffice memo—that makes the travel time go by more quickly. On weekends the scene is repeated as people go off to parks and beaches with something to read. The great thing about printed matter, of course, is that it's portable. Reading for business or pleasure can be done virtually anywhere.

Although printed material is in no danger of extinction, you might see some people opting for video products instead of paper products as an information source. The age of personal video is dawning.

Personal video really means portable video. Pocket-size televisions have been with us for some time, appearing with regularity at stadiums, beaches, parks and other locations. But viewing material is limited to off-air broadcasts, and reception, to be understated about the matter, isn't too good when you're inside a moving vehicle.

Sony, the company that introduced the Walkman personal audio cassette player, is now unveiling a personal video machine that is both a television receiver and an 8mm videocassette recorder.

The Video Walkman (\$1300) is roughly the size of a hardcover book, measuring

5 × 8 × 2½ in. and weighing 2½ pounds. The VCR portion of



Sony's Video Walkman houses an 8mm VCR and a 3-in. color TV in booksize package.

the Video Walkman performs all the basic functions you'd want from such a machine. Recording VHF or UHF broadcasts can be done on the spot, or by using the 1-Day/1-Event timer.

Up to 4 hours of material can be recorded using the Extended Play mode, and High-Speed Picture Search enables you to scan through a recording quickly.

The TV portion of the Video Walkman is a 3-in. LCD screen that presents an excellent color picture. Its quality owes largely to an active-matrix drive system that enhances sharpness, contrast and color purity.

The LCD screen is also backlit, a technique that improves the brightness level so that the picture doesn't wash out in sunlight.

The Video Walkman operates on both AC and DC power for indoor and outdoor use. Outdoors, the Video Walkman uses a

Sony Video Walkman. The screen is slightly larger at 3.3 in. List price is \$1300, identical to that of Sony.

How small a VHS TV/VCR can be made is restricted by the size of the VHS cassette, of course. Still, many manufacturers may follow Casio's lead in downsized TV/VCRs. Casio uses smaller video heads than those normally used but wraps the videotape three-quarters of the way around the head drum rather than customary halfway around. By doing so, the same amount of videotape comes into contact with the video head as in larger VHS machines. Further design changes along these lines may make VHS models even smaller.

Given the existence of personal video products, it might not be long before a fellow traveler opens his briefcase for his Video Watchman instead of his favorite magazine. He might surprise you even more by watching a magazine. Several video suppliers are poised to cash in on the personal video trend by offering what are essentially video magazines.

One of the pioneers in the video magazine field is *Videofashion Monthly*. Each 8mm cassette is 30 minutes long, available by subscription through Sony's Cinema 8 movie club at \$9.95 plus shipping and handling.

"Videodicals" are also available from the Home Broadcast Network for the same \$9.95 list price.

(Please turn to page 52)



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— Chuck Yeager

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HOME VIDEO

(Continued from page 50)

Among the titles subscribers receive are *Golfer*, *Driver*, *Inside Moves* (for 17 to 27 year olds), *Rage* (for fashion buffs), and *Hunting & Fishing*.

Random House, travel specialist International Video Network, and the video divisions of *Golf Digest* and *Tennis* magazines are also committed to supplying 8mm video material for the personal video user. The usefulness of existing software should also be enhanced. A cooking video now can be brought right into the kitchen or a car-repair video can be brought right into the garage. The Sony Video Walkman has audio/video inputs and outputs so that material can be easily transferred from one video format to another if necessary.

Sony also hopes that the Video Walkman will be a message carrier for the desktop revolution in the business world. The company is offering a palm-size video camera, the CCD-G1 (\$750), that can be used with a larger TV/VCR, the EV-DT1 (\$1700), to make video memos.

The EV-DT1 sports a 5-in. monitor, suitable for office use, but Sony hopes business people will use the Video Walkman to view interoffice memos and



Electronic image-stabilization lens in camcorders eliminates jitters from home movies.

instructional material outside the office or workplace.

A Stable Image

Bob and weave is generally the kind of advice that cornermen give to boxers. Unfortunately, bobbing and weaving is too often associated with homemade video movies shot with camcorders.

The plain truth is that the jitters can affect any video. You might think you're holding the camcorder rock steady but even inhaling and exhaling can impart

movement to the picture. Holding your breath only works for short takes. A tripod introduces additional gear into the equation—a step backward for many people.

A technological solution to the problem comes from Magnavox, Panasonic and other camcorder makers in the form of a new feature called EIS—for Electronic Image Stabilization. What it does is to compensate for camcorder motion electronically.

EIS camcorders are instantly recognizable because the lens is encased in what looks like a small box. Inside this little box are sensors and motors that compensate for both horizontal and vertical movement. Angle the camcorder slightly downward, for example, and the lens moves slightly upward to compensate. Horizontal compensation works the same way.

EIS generally reduces jitter to about 25 percent of the original motion. The benefit of EIS becomes most obvious in difficult shooting situations, such as recording from a moving car, but it also offers a steadier picture even if you're shooting from a standing position. If you've ever watched a video that made you seasick, then EIS will make you feel

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as though you've returned to solid ground. EIS is available on more expensive camcorders but its obvious benefits surely make it destined for lower-price models in the future.

Televideo

At some point early in the day I generally consult the television listings to see if there is anything worth taping for late viewing. If there is, I make a mental note to program the video cassette recorder's timer before leaving the house.

Sometimes, though, some interruption will sidetrack me before I can get to the timer. And long after I've left the house, I remember that there was a program I wanted to tape.

Now, thanks to Panasonic, if you leave the house without programming the VCR all you have to do is call home. The company's PV-4826 can be programmed from any touch-tone phone.

The PV-4826 (\$550) has a modular telephone jack on its rear panel. You plug in your phone directly. When you call, the PV-4826 responds after 10 rings.

Once the VCR picks up, you enter a 2-

digit identification code using the phone's keypad. The VCR responds with a beep indicating that it is ready to accept commands.

Communicating with the PV-4826 is simple. You might, for instance, want to check that there's a tape in the machine. All you do is press T, A, P, E and then the numbers (#) symbol on the phone keypad. If there is no tape in the VCR, you'll hear four beeps. If a tape is in



New Panasonic camcorder can be programmed remotely by phone—but insert a tape first!

place, the machine responds with a single beep. All programming is done in a similar manner. When you're finished, you simply sign off by pressing the asterisk (*) symbol on the phone.

The RV-4826 can also share a line with a telephone answering machine. The 2-digit identification code turns off the telephone answering machine temporarily until you've completed your programming.

New And Noteworthy

Toshiba has joined forces with Carver, a well-known high-end audio manufacturer, to develop a line of stereo televisions. The MTS sets utilize what Carver describes as its Sonic Holography audio technology. The basic idea is to replicate the audio experience provided by surround-sound systems. Instead of using four speakers, however, the Toshiba/Carver system uses only two speakers.

Carver creates the sensation of surround-sound systems by processing the audio signal to eliminate virtually all interaural crosstalk. By doing so, Carver claims to restore the depth and ambience in the image that is masked during normal playback.

Toshiba will make the Carver audio system a feature in four screen sizes: 27, 30, 46 and 52 in. The company also plans to offer the system on two projection TVs as well. The 27- and 30-in. models will incorporate a subwoofer for added bass response.

Whether the Toshiba/Carver duplicates the effect of a surround system is a subjective opinion that depends on your ears and listening environment. In any event, it's worth comparing the two. **FM**

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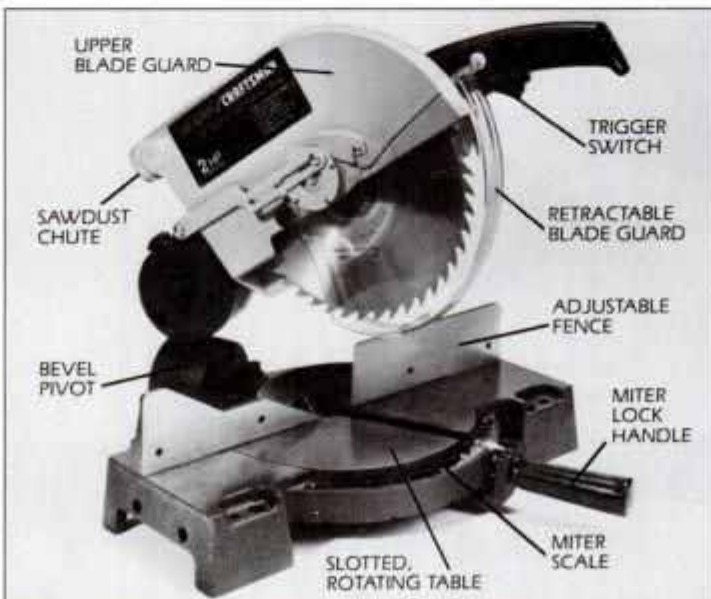


A Do-It-All Miter Saw

BY ROSARIO CAPOTOSTO, Contributing Editor

ORECENTLY tested the new Sears compound miter saw—the first 10-in. power miter saw that can cut bevels and compound angles. The saw (model No. 23461N) features a rotating, slotted worktable for making square crosscuts and left- and right-hand miter cuts up to 45°. And unlike other 10-in. power miter saws, the saw head *tilts* up to 45° for cutting bevels. Set the saw for both bevel and miter cuts to saw compound angles. This is especially helpful when making picture frames and installing crown molding.

The direct-drive motor, rated to develop 2 hp, powers the blade to 5200 rpm. An electric brake stops the blade in about 2 seconds after releasing the trigger switch. The saw is solidly constructed with a cast-iron base, turntable and pivoting mechanism. The adjustable fence and upper blade guard are made of die-cast aluminum. The rotating table has positive stops at 22½° and 45°. The saw weighs in at a hefty 60 pounds. This makes the saw a little cumbersome to



Here's the Sears 10-in. compound miter saw with its parts identified.



A view of the saw's underside reveals heavy-duty cast-iron construction. This provides the tool with strength and stability.

To adjust the rotating table for miter cuts, depress the thumb latch, move table, release latch. To lock table, tighten handle.



Bevel adjustment scale is located in back of saw. Select the bevel angle, up to 45°, and then tighten the bevel lock handle.



This shows the maximum cross-cut capability of the Sears 10-in. miter saw. The timber cut measures 2½ in. thick × 5¼ in. wide.



Here we're making a maximum-capacity miter cut. Note that clear plastic guard retracts automatically as blade is lowered.

tote around, but its weight provides solid, vibration-free operation.

The 10-in. blade affords great cutting capacities. In fact, with this saw you can bevel cut a 2x6 and cut a compound angle on a 2x4. The actual capacities are: 90° crosscut, 2½ × 5¼ in.; 45° miter, 2½ × 4¼ in.; 45° bevel, 1½ × 5¼ in.; 45° compound miter, 1½ × 4¼ in.

A sawdust chute on the upper blade guard accepts a dust bag that collects a fair amount, but not all, of the sawdust.

The clear plastic lower blade guard retracts automatically as the blade is lowered to make a cut—a good safety feature.

Another nice feature is an arbor lock that keeps the arbor from spinning while changing the blade.

All in all, I think that this is a good, multipurpose saw for the home workshop. It's sold at larger Sears stores and in the 1988 Sears annual catalog for about \$220.

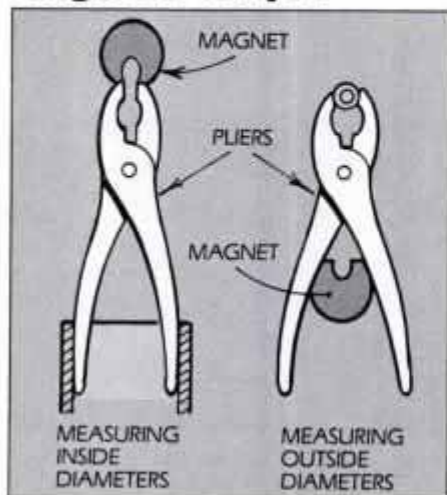
For more information and details, contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684. **PM**



Installing decorative crown molding requires cutting tricky compound angles. Adjust saw for both miter and bevel cuts.

HINTS FROM READERS

Magnetic Caliper



After reading about using an adjustable wrench for a quick caliper ("Hints," page 54, April '87), I thought of this method:

Grip the pipe you need to measure with pliers and slide a magnet between the handles to hold the jaws the correct distance apart.

For inside dimensions, insert the handles into the space and position the magnet at the jaw end.

—F.L. Seager

Using Paste Fillers

The key to a smooth, glass-like surface on open-grain woods is an application of paste wood filler before the final finish.

While paste wood fillers are usually wiped with coarse cloth or similar material before setting, I've found an approach that works better.

Apply the filler normally. But instead of wiping, let it set. Then, use a putty knife or paint scraper with worn rounded edges to remove the excess filler. Work gently across the grain and follow by wiping with paper towels. This leaves the surface with little or no sanding necessary.—Ted Burke

Take A Powder

When working with a dark wood, it's often difficult to make distinct pencil marks. It helps to sprinkle the area with talcum powder and blend it in with a cloth. The talc can be removed later by wiping with a damp cloth.

—Walter Burton

TWIST & SHOUT.

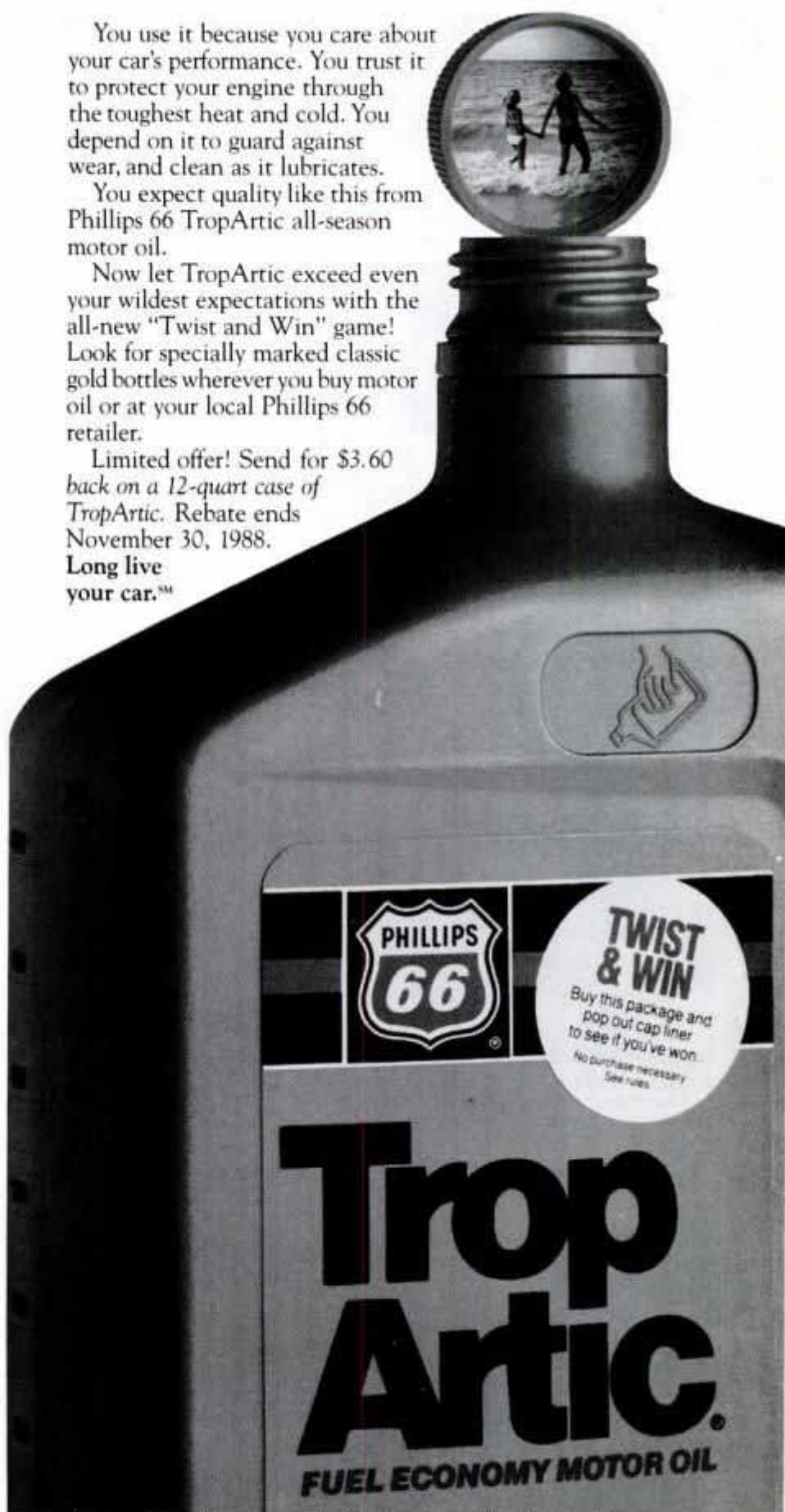
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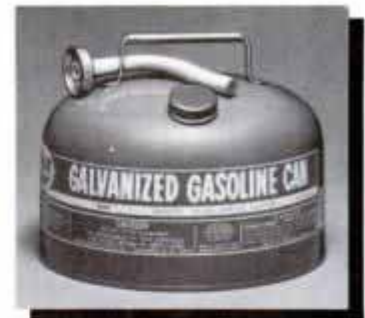
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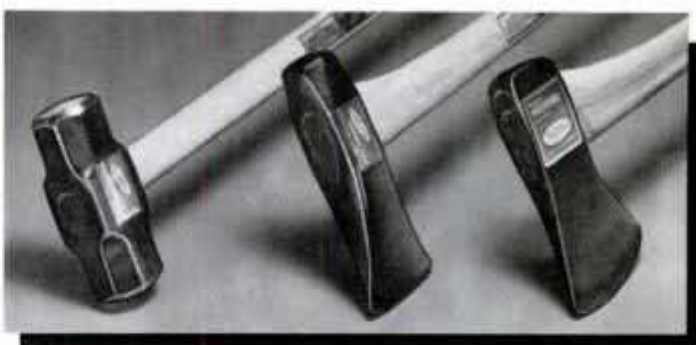
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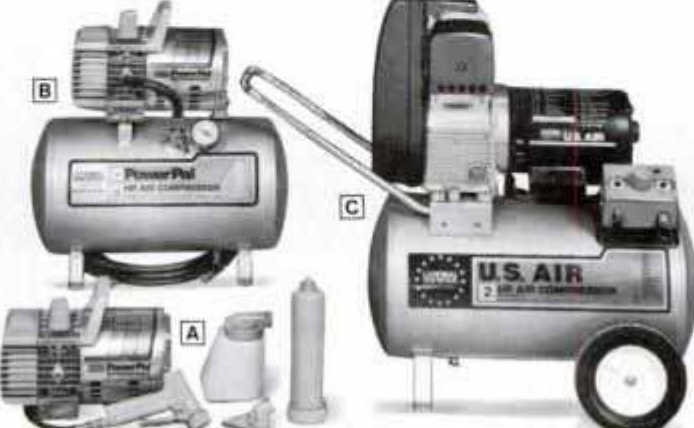
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The Piper Cub Is Back!

BY FRED MACKERODT, Contributing Editor

THE RETURN of the Super Cub is Piper's major effort to bring aviation back to grass roots America. Derived from the original J3 Cub, the airplane that put America in the air after World War II, the Super Cub was first produced in 1949. Known as the "Poor Man's Helicopter" due to its legendary short takeoffs and landings, the tandem 2-seater remained in production until November 1982. Because of its ruggedness, the Super Cub is still the airplane of choice with Alaskan bush pilots and border patrol types. A lot of the 10,000 original Super Cubs are still slogging it out doing some of the toughest jobs in aviation.

And now the Super Cub is back not only as a finished airplane, but in a kit for home assembly. That's right. You'll now be able to build the famous airplane yourself.

The people we watched assembling the first new Super Cub in Hangar 21 of Piper's Vero Beach, Florida, facility were all veteran Piper employees. Four of them had worked at the company when the original Cub was first being built.

One of them, Clyde Smith Jr., left the company in 1984 to become the leading expert on restoring vintage Pipers. His new job is to write the assembly manual for the kit.

"We're trying to make it simple enough for a 16-year-old to assemble," Smith said, "and that's tough. But we're getting there."

The Super Cub is not your



Piper's Stuart Millar at the controls of the reborn Super Cub.

average kit airplane. Piper will supply completed subassemblies which the owner then puts together. No welding is required, and only very simple tools and painting equipment are needed. "About the most unusual tool you have to have is a fish scale to set the tension of the brace wires," Smith says.

While most airplanes are assembled under the experimental amateur-built certification category, the Super Cub will be certified the same as a factory-built airplane. To do this, Piper will send a designated employee to inspect the assembler's work two times during the

construction. On the final trip, the Piper employee will test fly the new airplane.

Smith guesstimates the assembly time to average out at 500 to 700 hours, depending on a lot of factors. The most important of these, he says, is finding a spacious, comfortable work area.

A lot of amateur-built kit airplanes tend to languish during construction and not get completed. But Smith doubts this will happen with the Super Cub. "You're talking about a \$40,000-plus proven fun airplane," he says, "and I doubt anybody will leave one of these out in the garage half finished!"

The price for the factory-assembled Super Cub is \$42,595. The kit goes for \$21,095 without engine or propeller. But Piper will sell you a brand-new 150-hp Lycoming O-320 engine and Sensenich propeller for an additional \$10,300, a package which normally lists for twice that amount.

Jess Krall is the man in charge of Super Cub sales. You can reach him or anybody else at Piper by dialing (800) 72-Piper.

The new Piper

But the return of the Super Cub is only part of the whole Piper revival. Today Piper Aircraft in Vero Beach is a fun place. For a pilot, it's a toy store.

The last time I was here, in February 1987, it was a very different kind of place. Only 748 of Piper's original 8300 workers were left. Some were working on airplane components to be assembled in foreign countries, but most were working on resumes. The place was Gloom City. Piper belonged to conglomerate Lear Siegler which, at the time, was looking for a convenient carpet to sweep it under.

Now there are 1040 people, and 50-year-old Piper is bustling with activity. The assembly lines are running again and airplanes in a wide variety of shapes and configurations stand around in different stages of completion. Across the field, Piper's skunk works, headed by aviation wizard Roy LoPresti, is

at work on new aircraft, including a replacement for Piper's Comanche.

The boss

The man behind the Piper transformation is the new sole owner, Stuart Millar, a 62-year-old former military pilot and self-made multimillionaire, who loves flying more than anything in the world. Case in point: Millar had his office moved from the executive suite at the front of the building to a work area in the back. "Over there I had a view of a parking lot," Millar explains. "Here I can see airplanes. I didn't buy an airplane company to look at a parking lot."

Millar views personal aviation as a great freedom unique to the United States. Nowhere else in the world are there so many private pilots and private airplanes, Millar points out, quoting numbers: "There are maybe 10,000 private pilots in West Germany, 13,000 in France, 4000 in Spain, maybe 5000 in Italy, and 7000 in Japan. Here we have 600,000 registered pilots, two-thirds of whom are private pilots."

But he also sees this freedom in jeopardy. "Of the 600,000 pilots flying today," he says, "400,000 were trained by the government. Although I plan to live to 112, a lot of the other military-trained pilots from the World War II era are dying off. We have to find a way to attract

and train the pilots of the future."

One of the keys Millar sees to this training effort is the availability of training aircraft. The present fleet is just plain wearing out. To remedy this, earlier in the year Piper began offering a stripped-down version of its entry-level Warrior called the Cadet. At \$45,000, the plane admittedly doesn't make much, if any, money for Piper, but it will go a long way toward keeping the basic training fleets around the country in operation. And the young people who learn to fly in the Cadet today, Millar reasons, will be ready to buy new Pipers of their own in 10 years' time. Piper has more than 100 orders for the Cadet and more are coming in every day.

Two tens

While at Piper, I also had the opportunity to fly the Malibu, the most advanced single-engine airplane on the market today. In testimony to the easy-to-fly nature of this complex airplane, Roy Hanan, a 28-year-old demonstration pilot, took the controls only once during the entire 2-hour flight.

We were cruising at 17,500 ft. in pressurized comfort, with the loran indicating 200-knots groundspeed and the fuel flow showing an incredible 16 gallons per hour, when he suggested I try a steep bank. "Bring it over to 60°," he

said. Gingerly, I banked the airplane, watching the long wing dipping toward the vertical, and feeding in backpressure to maintain altitude. Again, just as gingerly, I brought the airplane back to straight and level, feeling pretty satisfied with myself that I had managed to hold altitude within 50 ft. or so.

"Try it this way," Hanan said, and with a flick of the control yoke—Wham!—he laid the airplane on its side. With another flick—Bang! Shades of Chuck Yeager!—the airplane was banked 60° the other way, pointing the other wingtip at the Florida landscape.

After hours of this kind of flying, including a 4500-fpm simulated emergency descent and some supersoft "are we there yet?" landings, I was pretty high on myself and the Malibu. It's an airplane that makes you feel good.

I asked Hanan how he would compare flying the Malibu and the Super Cub, two airplanes separated by 45 years of technology and about \$260,000 in price.

"For fun, on a scale of one to 10," Roy said, "the Malibu is a 10. The Cub is also a 10," he quickly added, "but it's a different kind of 10." He explained that after flying the Malibu all day, he just loved to jump into the Super Cub, leave the windows open and the door down and cruise around low and slow. "There's nothing like it in all the world." **FM**

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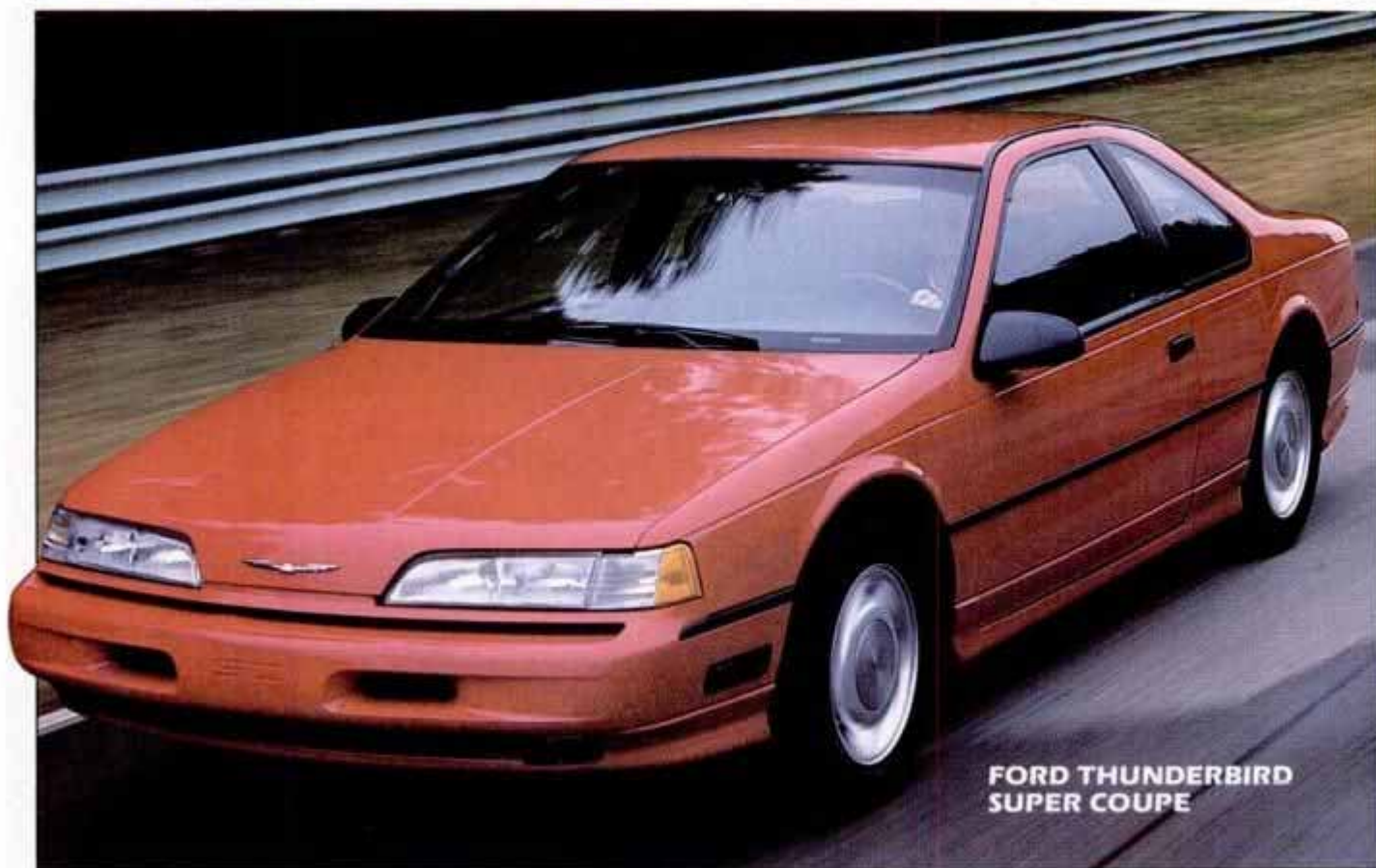
**One more reason
Ford Motor Company
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the highest quality
American cars and trucks
for 8 years running.**



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*Based on an average of owner-reported problems in a series of surveys of '81-'88 models designed and built in North America.
Restrictions and deductible apply. Ask your dealer for a copy of this limited warranty. **Buckle up—Together we can save lives.

FORD THUNDERBIRD
SUPER COUPE

SWEATING THE DETAILS

Powertrains, key models and refinements highlight Motor City's new offerings.

BY TONY SWAN, Auto Editor,
and JIM DUNNE, Detroit Editor
PM Photos by John Lamm

DETROIT automakers will roar into the new model year offering major redesigns in selected cars, with special emphasis on their most critical product features—body styling, engines and suspensions. Changes are

not spread evenly over the complete lineup of 1989. Instead, they pinpoint specific models, improving appearance, performance or handling.

General Motors, stung by its dramatic decline in market share over the past three years, is taking a highly aggressive position throughout its entire 1989 lineup with selective styling and engine revisions from each of its five car divisions.

Ford will counter GM's effort with brilliant new styling for the Thunder-

bird and Cougar, plus several potent new powerplants and a special low-volume Taurus sedan aimed at the premium high-performance market.

On a more modest scale, Chrysler has a new line of midsize sedans—the Plymouth Acclaim and Dodge Spirit—that begins the replacement of the aging K cars.

However, as with Ford and GM, Chrysler engineers have also been busy under the hood.

Here are the highlights:

Dramatically different with new styling, longer wheelbase, independent rear suspension and a powerful supercharged optional engine, Thunderbird is a good bet to take all Car of the Year honors for 1989. Lower hoodline, large glass expanses and smooth, aerodynamic surfaces give the body a completely new look. Shown here is the Super Coupe. New 3.8-liter supercharged V6 develops 210 horsepower and a whopping 315 lb.-ft. of torque.



**MERCURY
COUGAR XR7**



Ford/Lincoln Mercury

Ford has once again stolen the show. Not only are the new Thunderbird and Mercury Cougar the visual sensations two years of spy photography have conditioned us to expect, they also escalate the technology wars with the first domestically produced supercharged (as distinct from turbocharged) cars since the Studebaker Hawks of the mid-'60s.

Ford's pressurized 3.8-liter V6 makes respectable power (210 hp at 4000 rpm) and impressive torque (315 lb.-ft. at 2600), which represent gains of 10 and 25 percent, respectively, over the 2.3-liter turbo Four that powered the 1988 Turbo Coupe. However, neck-snapping acceleration isn't going to be the strongest suit for these two personal luxury entries. Although both cars are actually shorter overall—189.7 in. versus 202.1—an 8.8 stretch in wheelbase, with attendant stiffening in the rear-drive platform, has produced prodigious weight gains. Normally aspirated 'Birds now scale in at 3542 pounds, up some 300 pounds from '88, and the Super Coupe adds another 200+ pounds to that.

Other gains are more positive—more rear-seat leg room, more elbow room, improved seating and availability of ABS braking throughout both model lines.

Base engine for both Cougar and Thunderbird is still the 140-hp normally aspirated 3.8 V6, but the supercharged engine is also available to both, something new for the XR7.

Although the revitalized Thunderbird and XR7 dominate Ford's 1989 headlines, the real performance news belongs to the Taurus. Equipped with an all-new 3.0-liter 24-valve dohc V6 from Yamaha, the SHO (for Super High Output) Taurus sedan suddenly ranks second only to the ever-green Mustang 5.0-liter among Ford's performance cars.

Although the SHO edition is all but indistinguishable from the regular Taurus, its extra muscle (220 hp), fatter tires (215/65 VR-15 versus



Cougar, Thunderbird's twin, is all new for 1989, and has the same supercharged 3.8-liter V6 engine option. Base engine on both cars is a normally aspirated 3.8-liter V6. Real sleeper in Ford's lineup is the SHO (Super High Output) Taurus, powered by a 3.0-liter 24-valve dohc V6 from Yamaha. Ford's Probe is one of the most successful new cars introduced recently. Built by Mazda in the United States, with body design by Ford, this car is watched closely by competitors in Detroit.

205/70R-14 standard), 4-wheel disc brakes and excellent sport seats make it the equal of some very prestigious German machinery.

The arrival of the new joint-venture Probe lends even more muscle to the Ford lineup. Assembled at the new Mazda Motors plant at Flat Rock, Michigan, the 626-based sport coupe arrived as a 1988 mid-year and immediately became one of Ford's hottest sellers.

Power teams include a 2.2-liter 12-valve Four in normally aspirated (110-hp) and intercooled turbo (145-hp) editions, with 4-speed automatic

and 5-speed manual transaxles.

Although the rest of the Ford Motor Co. lineup is largely carryover, there have been a few tweaks here and there. Foremost under this heading is the addition of sequential port fuel injection, roller tappets and magnesium rocker arm covers to the company's corporate 3.8-liter V6 (Lincoln Continental, Ford Taurus, Mercury Sable, T-Bird, Cougar). Continuing its successful Designer Series program, Lincoln is offering a Gucci Town Car for 1989, while Mercury is making a driver-side air bag available as an option on Topaz models.—T.S.



**FORD
PROBE GT**



CHEVROLET
CORVETTE ZR1



You'll have to wait until early next year to get one of these \$52,000 ZR1 Corvettes. Power—385 hp—comes from Lotus-designed 32-valve aluminum V8 (left). Massive rear tires are 11 in. wide. Top speed and 0-60 acceleration are at world-class levels. New engine mates to new 6-speed Getrag manual transmission. Chevrolet forecasts 1989 ZR1 production at 2000 units. Volume will be much higher for hot-selling Corsica, which adds a 5-door hatchback to the lineup for '89.

General Motors

Body style changes are scarce at GM this year, and there aren't any cars in the lineup that can be called all-new. But that doesn't mean there won't be changes you perceive at a glance.

Buick's Riviera gets the most radical restyling, while the Buick Century, Pontiac 6000 and Olds Cutlass Ciera get more modest facelifts. Corsica adds a 5-door hatchback sedan, and Corvette will have an ultraperformance option—the ZR1—to challenge some of the world's fastest and most exotic sports cars. The V6 lineup is different, with a new 3.3-liter V6 (based on the 3800) replacing many 2.8-liter and 3.8-liter engines.

Several models will offer a more powerful High Output (HO) version of the highly successful Quad 4 engine. Olds claims that the HO puts out 180 hp, compared with 150 in the regular Quad 4, through larger valves and a higher 10.0:1 compression ratio. Olds engineers claim 0-to-60 mph times of 7.5 seconds for the HO in a Calais chassis.

Riviera returns to the look of the past, when its flagship personal luxu-

ry models were among the most appealing in the industry. While the basic structure, chassis and even the interior (including the controversial CRT control panel) are unchanged from 1988, the exterior styling is dramatically different. Some 11 in. have been added to the overall length, 9.5 in the rear, 1.5 in front.

Overall the car has a more rounded appearance, making it look heavier, though the added length only amounts to a 75-pound increase. Buick returned to the shape of past Rivieras by angling the profile of the rear quarter panel in a style that

helped make these cars so popular in the 1970s and early 1980s.

The midsize 6000, Century and Cutlass Ciera also get a freshening for 1989. These cars are less angular than in previous editions, creating a look that is more aerodynamic and contemporaneous.

Century has the most extensive revisions with a new front-end look, including grille, fascia, front-end panel and flush headlights. At the rear there are new roof designs for both 2- and 4-door models, as well as new rear quarter panels.



CHEVROLET CORSICA
HATCHBACK



Restyled Cadillac de Ville has a 3-in. wheelbase extension and is almost 9 in. longer. Changes project a larger, more luxurious sedan, and add to rear-seat access and room. Major styling revisions in the Buick Riviera also conjure up the luxurious past. While interior remains the same, outside has a new profile and an 11-in. stretch in overall length. Midsize Olds Cutlass Ciera gets a new roof, backlite, fenders and front end for 1989. Its cousins at Buick and Pontiac have similar changes.



Ride and performance are different for this car, too. Buick made changes in shock-absorber valving as a key part of what is being billed as Dyna-ride suspension.

The optional Century engine is the new 3.3-liter V6, developing 160 horsepower. It replaces the optional 2.8- and 3.8-liter V6s, with more power than the old 3.8, as well as better fuel economy.

Pontiac's version of the Century, the 6000, has a less elaborate freshening with changes only to the rear of the roof, quarter panel and trunklid. The 2.8-liter V6 is still optional on the 6000, but a 3.1-liter V6 becomes the standard engine on Pontiac's limited-production all-wheel-drive STE model.

The Olds Cutlass Ciera, a bread-and-butter car for the division, has similar changes in rear end and roof styling. But its engine lineup is slightly different from those of the Century and 6000. Base engine is still a 2.5-liter Iron Duke Four, but the optional engines are a 2.8-liter and the new 3.3-liter V6.

The Olds Cutlass Calais presents a more aggressive front-end appearance in 1989 that includes new fascia and grille (or, more properly, nongrille), and at the rear, new taillamps and end cap. At the side there are wider moldings. On the International Series, 3-spoke wheels, 16-in. tires, wheel flares and ground-

effects panels have been added. A special Quad 4 appearance package has its own combination of distinctive wheels, tires and black and gold accents.

Excitement is Pontiac's catchword, and what better way to project that image than with a powerful turbocharged engine in the division's sportiest car, Firebird Trans Am GTA. Built only in a white notchback body, the car's turbocharged 3.8-liter V6 is the same engine Buick bolted into its wild Grand National.

Equipped with its standard intercooler, the engine develops horsepower in the 250+ range.

Pontiac believes that 0-to-60 mph times for this package will be about 5.3 seconds. Only 1500 or so will be built in the 1989 model year, lending appeal for collectors. Will this be faster than the Trans Am with a 5.7-liter V8? "Substantially," say insiders from Pontiac. That's not to say the Trans Am's other engines are slouch-

es. You can still order the big 350-cu.-in. V8 (235 hp, 0 to 60 in 6 seconds), though this engine continues to be available only with an automatic transmission.

"If the 5.7 V8 is a Mustang-fighter, what do you call the GTA with turbocharged V6?" a Pontiac executive was asked. "Mustang-killer," came the immediate reply.

Meanwhile, Cadillac is taking care of business in its plush Allante and high-volume de Ville lines. The de Ville coupe is 6 in. longer, while the sedan is stretched 9 in. over a 3-in. longer wheelbase. Those changes, plus a major freshening that takes in grille, front fenders, front bumper, hood and deck, give the luxury sedan a more substantial appearance, something Cadillac owners and dealers have been asking for since the current body style was adopted three years ago. The Fleetwood line, for its part, digs way back into the past to come up with new rear fender skirts in addi-



tion to the rest of the changes given to the de Ville.

Cadillac's determination to make the Allante a strong entry in the super luxury-coupe market is evident by the changes made for 1989. A new 4.5-liter version of Allante's aluminum V8 engine turns out a welcome increase to 200 horsepower. Cadillac claims the engine will propel the Allante over 130 mph, and, more important to most drivers, allow it to accelerate to 60 mph in 8.5 seconds. That's the kind of performance Allante should have had when it was introduced.

Ride is improved with a speed-controlled damping system that shifts between three shock absorber automatic settings that depend on car speed and handling conditions.

Variable-assist steering makes steering light at low speed, firmer at higher speeds. Other improvements include a no-leak convertible roof seal and a simpler system for lowering the convertible top into its well.

"Don't call it the King of the Hill." That's the word from Chevrolet engineering ace Don Runkle, speaking of the ZR1, Corvette's ultimate performance option, Chevy's big news for 1989. "If we say King of the Hill, we automatically put ourselves in a corner. That's kind of a cocky statement. We'd like to take a lower profile and let the car speak for itself."

With 385 hp, wider tires and a special 6-speed Getrag transmission, the ZR1 can and does speak for itself, with 0-to-60 capabilities registering in the sub-5-second range, according to Chevrolet insiders. Top speed should approach 185 mph, putting this car in the same performance category as some of the world's most exotic machinery. The ZR1's brand-new 32-valve, dohc aluminum V8 engine was designed by Lotus in England, while the block will be specially cast here in the United States by Mercury Marine, the outboard motor company.

Chevy plans to build only some 2000 editions of the ZR1 in the 1989 model year, with the new supercars scheduled to start hitting the showrooms early next year.

Less spectacular in terms of nose-flattening performance, but probably more popular with Chevy buyers is a hatchback model in the Corsica lineup. The glass fitted in the rear hatch is the largest single piece of glass used in hatchbacks, but the appearance of the new model is virtually identical to that of the standard 4-door Corsica. The rear seats fold down, creating almost as much cargo room as a station wagon.—J.D.



OLDSMOBILE
CUTLASS CALAIS
QUAD 4 HO



Cutlass Calais International Series moves up a notch in the Oldsmobile performance stable with the addition of the High Output (HO) edition of the dohc 16-valve Quad 4 engine. Ground-effects panels, fog lamps and 16-in. wheels with performance tires help to distinguish this car from milder members of the family. The HO Quad 4 is rated at 180 hp, and will be offered in Pontiac Grand Am as well as the Cutlass Calais. However, HO models are not expected to be available before late 1989.



PONTIAC
FIREBIRD
TRANS AM
TURBO



Pontiac will heat up the 1989 horsepower derby with a turbocharged edition of the Firebird Trans Am GTA. The limited-edition Trans Am is equipped with a 3.8-liter V6 turbo, the same engine that once made Buick's Regal Grand National the quickest car in General Motor's entire lineup. The limited-edition turbo Trans Am is expected to outperform V8 models. Production is expected to be limited to about 2000 of the turbocharged V6 models.



DODGE SPIRIT ES

Chrysler

Although the look isn't exactly new, the cars—Dodge Spirit and Plymouth Acclaim—give Chrysler Corp. two fresh nameplates in the midsize family sedan game. With their conservative formal sedan styling, the two newcomers are unmistakably members of the current Chrysler design idiom, and just as obviously descended from the faithful K-car clan.

However, even though they're destined to replace the cars that helped pull Chrysler back from the brink of ruin at the beginning of the decade, Spirit and Acclaim are positioned slightly upscale from the familiar Plymouth Reliant and Dodge Aries. They're also bigger, inside and out, with room for five or six passengers, depending on seating layout.

And for all their conservatism, the new Chrysler A-bodies present a smoother, more rounded appearance than their no-nonsense predecessors.

"They're family sedans that have a modern, soft shape," explains Bob Lutz, Chrysler president of operations. "While they're not completely aero, the fast windshield gives them an up-to-date look. The wide C-pillar lets us build more headroom for rear-seat passengers, and helps us get an extremely roomy rear seat."

Chrysler executives claim the new models are a departure from the K-body, a basic building block that has been at the center of the company's designs for the past decade. But this doesn't mean the A-bodies represent an entirely clean sheet of paper. Lutz calls the chassis an "evolved K."

Each of the car's drivetrains is used in other Chrysler models, standard operating procedure for the company in the Iacocca era. Base engine is Chrysler's 2.5-liter Four. It's hooked up to a 5-speed manual or 3-speed automatic transmission, driving the front wheels. Two optional engines



Shown here in prototype performance trim, Spirit ES is one of three new 6-passenger intermediates in the Dodge lineup. All-new body, plus chassis and powertrain refinements help make this car different from previous K-car derivatives. Base engine is a 2.5-liter sohc Four. Turbo 2.5 Four and Mitsubishi 3.0-liter V6 are options. New 4-speed electronically controlled transmission is standard with V6 engine. Jeep's Wrangler Islander has new graphics on familiar sheetmetal.

are offered—a new turbo version of the 2.5-liter Four and the smooth 3.0-liter V6 that Chrysler imports from Mitsubishi. The V6 is teamed with Chrysler's slick new electronically controlled 4-speed automatic.

One of Chrysler's marketing plans for the Spirit/Acclaim series, which will sell in the \$9000 to \$16,000 price range, is to offer more standard comfort and convenience features than the competition. The cars' primary competition target is Chevrolet's successful Corsica sedan.

Other Chrysler domestic sedans and coupes are mostly unchanged in styling from the 1988 models. One exception is the Daytona coupe, which has acquired new racing-inspired trim all around the lower part of the body. Also, look for 16-in. cast-alloy

wheels on sporty Daytonas and Chrysler LeBaron coupes.

Chrysler's 2.5-liter turbo engine is the third generation turbo in a Chrysler Four. Horsepower is up 50 percent to 150 from the normally aspirated 2.5-liter. Chrysler claims that a smaller turbine gives the engine reduced response time for more power low in the rpm band, as well as a flatter torque curve than previous Chrysler turbos. The 2.5 turbo is offered as an option on a number of Dodge, Chrysler and Plymouth models.

On the safety front, Chrysler plans to increase availability of driver's air bags after making them standard on the rear-drive Fifth Avenue model for the current model year. For '89, air bags will be standard equipment in all LeBaron coupes and convertibles.



JEEP ISLANDER

Jeep/Eagle

Although Jeep is the obvious focal point of Chrysler's newest marketing division, new products just around the corner could make the Eagle line-up as important as any.

However, with the joint Chrysler-Mitsubishi Diamond Star plant in Illinois still some months away from production startup, the only Eagle-brand passenger car produced in North America continues to be the upscale Premier, flagship of this new division.

Designed by Giorgetto Giugiaro and built in the ultramodern facility in Bramalea, Ontario, the Premier enters 1989 virtually unchanged from its introduction for the current model year. Operating in the same size class as cars like the Audi 5000, the Premier is roomy, understated and elegantly turned out. It's also aerodynamically efficient, with a drag coefficient (C_d) of just 0.31.

Two engines are offered, a 111-hp 2.5-liter Four and 150-hp 3.0-liter V6. Although similar in displacement to the new Mitsubishi V6 used in a number of Chrysler products, the Eagle V6 is supplied by Renault. The powertrain also differs from other Chrysler products in that it is longitudinal, rather than transverse.

Offered in LX and ES trim levels, about the only noteworthy change to the Premier line this fall is the availability of cruise control. However, Eagle divisional executives plan to make a limited edition of the ES model available sometime midway through the model year. The ES Limited, which is shown here, will feature a monochrome paint treatment with body-colored trim.

Other members of the current Eagle passenger car family—Medallion and Summit—currently qualify as imports, although the Mitsubishi-built Summit is due for production in the new Diamond Star facility.

The Medallion is supplied to Chrysler by Renault under the AMC buyout agreement.

On the volume side of the ledger, Chrysler looks forward to its first full year of selling Jeeps.

Biggest news in this department is the availability for 1989 of a new antilock braking system for Jeep Cherokee and Wagoneer models equipped with 4-wheel drive. Designed by Bendix Corp., the system is the first of its



kind for 4wd vehicles, and functions on all four wheels whether the vehicle is in 2- or 4-wheel-drive mode.

The basic Jeep lineup remains the same as 1988, with four sport/utility models—Wrangler, Cherokee, Wagoneer and Grand Wagoneer—plus an intermediate-size pickup truck, the Comanche.

Engine offerings include a 121-hp 2.5-liter Four, a pair of inline Sixes (4.0 and 4.2 liters) and a 5.9-liter V8. Of the 6-cylinder offerings, Jeep's star is the 4.0, rated at 177 hp and 224 lb.-ft. of torque. Available as optional equipment in Comanche and Cherokee models, the 4.0 gives these Jeeps the best hp ratings in their class.

Wagoneer and Wrangler models get the 112-hp Six, the former as standard equipment, the latter as an option. The torque (280 lb.-ft.) old V8 is reserved for the Grand Wagoneer.

One new transmission—a Japanese overdrive 5-speed manual—will join the powerteams during the coming model year.

Aside from a few new colors and trim changes, about the only visible difference in the Jeep family is the addition of the Wrangler Islander graphics package. **PM**

Flagship of the Eagle line is Premier ES Limited model, offered for '89 with body-colored grille and wheels to set it apart. Built in an all-new facility in Bramalea, Ontario, this 5-passenger sedan is based on a Renault design that includes front drive and independent rear suspension. Plymouth's new name in the midsize lineup for 1989 is Acclaim, twin to the Dodge Spirit. Formal roofline is key to generous rear-seat headroom in Chrysler's new bread-and-butter entries.

Made In The USA?

Detroit's traditional automakers, now down to three, still account for the lion's share of car sales in this country. But the advent of hybridized and captive imports poses a problem of identification for us. Which cars are truly imports?

As more and more Japanese manufacturers open plants in the U.S.—particularly joint-venture operations involving Ford, GM or Chrysler—almost any system of classification becomes arbitrary at some level. Is the Michigan-made Ford Probe an import? Is California's Nova?

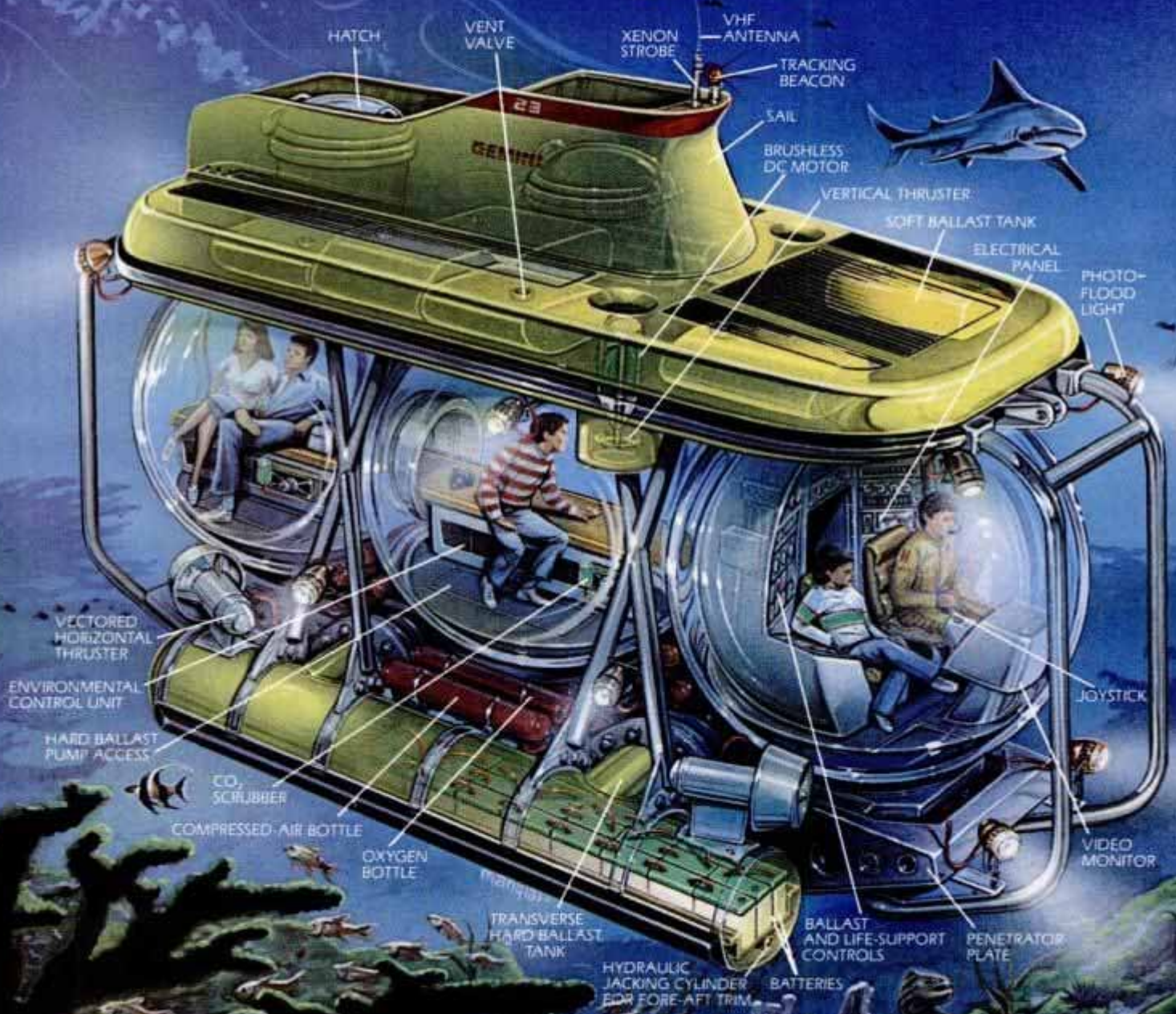
We believe in keeping it simple. In addition to the traditional nameplates, we include the Eagle Premier, the Probe and the Mercury Tracer (built in Ford's new plant in Mexico). In future years that lineup will surely change. But for now, our goal is to keep it simple and sensible.—J.D.

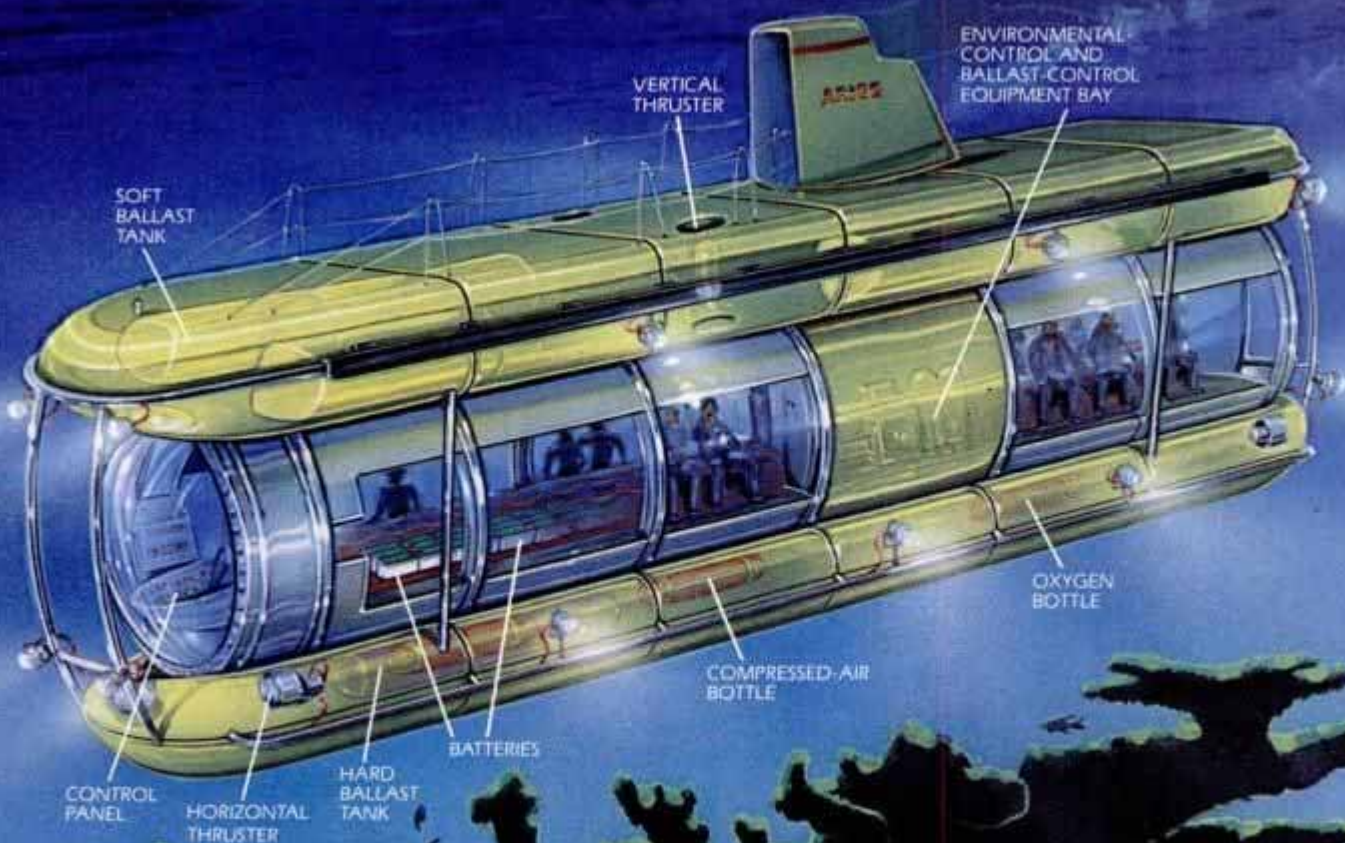


TOURING THE DEEP

Submersibles made of transparent acrylic spheres offer a new way to view the ocean's fascinating riches.

BY GREGORY T. POPE; PM Illustration by Jeff Mangiat





I WATCHED an alien blue world drift slowly past the viewport. Gnarls of limestone, some spindly lifeforms, and the jetsam of civilization—everything looked close enough to touch, thanks to the fisheye effect of our hemispherical window. Sparks flashed as bioluminescent organisms bounced off the transparent acrylic. The scene had the same ghostly hue and limited visibility of a moon-lit landscape.

"PC 1203 to chase, we're at 800 ft., 8-0-0," said pilot Courtney Platt behind me. He waited for the acknowledgment to crackle through the speaker, then flipped an overhead valve. A harsh gurgling sound ensued, as a pump blew water out of a ballast tank to slow our descent.

We were floating down the side of an undersea mountain—a quarter-mile off Grand Cayman, about 200 miles south of Cuba. Our destination lay cradled by two limestone pinnacles on the mountain's shoulder—the *Kirk Pride*, a cargo ship that had sunk six years previously. Our

vessel: a veteran research submersible, pulled out of early retirement to make deep waters accessible to the layman.

A 12-year-old *Perry*-class workhorse, PC 1203 was built to carry oil-seeking oceanographers during the boom years of undersea exploration. These days, put out of work by cheaper remotely operated unmanned subs, she carries tourists.

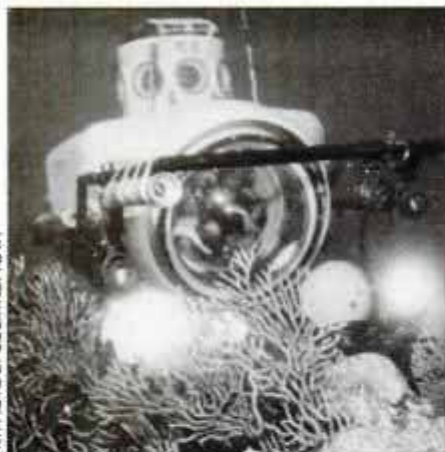
The vista from PC 1203's viewport gave me a foretaste of a new generation of submersibles being built exclusively for tourism. The most innovative of these craft will feature hulls made entirely of transparent acrylic, for panoramic views of ocean depths well below scuba-diving limits.

The see-through submersibles will clearly outclass PC 1203 and her sister subs. Not that PC 1203 isn't reliable, beloved by both her current pilots and the commercial exploration outfits that can't afford her in these oil-glutted '80s. But she's a dinosaur with her sweating 4-in. steel walls, noisy hydraulic systems and scant elbow room. Comfort is the watchword for the new subs—

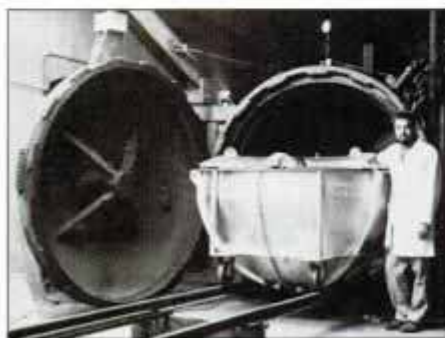
Windows on a watery world: Gemini submersible [opposite] and Aries submersible [above] will transport amateur aquanauts to unprecedented depths. Clear 6-in.-thick acrylic hulls will provide unrestricted views from personnel modules.

TOURING THE DEEP

PHOTO BY COURTNEY PLATT



Molded acrylic also boosts visibility aboard PC-8, sister sub to PC 1203.



BRUCE BEASLEY PHOTOS

Sculptor Bruce Beasley pioneered the use of acrylic in submersible construction, using a high-pressure autoclave (top) with rail-mounted mold to create acrylic hemispheres. Acrylic resin seals the two halves (center) to form the completed sphere (bottom).

they'll feature climate control, public-address systems and other amenities.

Three thousand miles away, in Vancouver, British Columbia, a company called Hyco Technologies has been pioneering acrylic submersible design and has developed two models. *Aries* is a sea-bus that will carry 46 passengers down to 250 ft., and *Gemini*, an 8-person deep diver, will be able to descend as far as 2580 ft. The first transparent tour sub—a *Gemini*—will arrive next year at Grand Cayman, according to Hyco's founder Phillip Janca.

The impact of these clear-walled craft? "They're going to revolutionize the submersible industry," says Janca without hesitation, "and make other submersibles obsolete. They signal the beginning of the acceptance of plastic subs." Bold words from this Texas-born Cayman Islander, considering that neither sub has left the drawing board. And yet, when you listen to Janca, and then taste the tour-sub experience on PC 1203, you find it hard to argue with the attraction of see-through subs.

Clear spheres

Of the two designs, *Gemini* has the more radical look—three acrylic spheres sandwiched in a stainless-steel/fiberglass framework. *Gemini* represents the meeting point of several lines of submersible evolution.

Because a sphere resists collapse under huge pressures, it's the best shape for a deep-sea personnel module. But perfection is crucial—pressures from all directions must push in evenly. Making a perfect sphere large enough for multiple passengers is beyond today's technology. Moreover, a big sphere is impractical because of poor hydrodynamics.

One solution is a multisphere hull, and the U.S. Navy pointed to the future in the '70s with its two Deep Submergence Rescue Vehicles (DSRVs), dubbed *Avalon* and *Mystic*. These vessels can be transported by cargo plane, descend up to 5000 ft., and dock with stricken submarines to save crewmen. Designed by Lockheed Missile and Space Corp., the DSRVs consist of three connected steel pressure spheres sheathed in a torpedo-shaped cowl.

Meanwhile, acrylic engineering was maturing, and the distinction between viewport and hull was blurring. Unlike glass, acrylic is a good thermal insulator and doesn't shatter catastrophically if it fails under pressure. An acrylic layer must be thick, though, to withstand substantial water pressure.

Shrink to fit

The stumbling block: How to cast big, thick hemispheres of acrylic. When acrylic resin solidifies in a casting mold, the molecules lock together into a tight lattice, causing 15- to 20-percent shrinkage. Moreover, the process also releases heat. Since acrylic conducts heat away slowly, bubbles and flaws form easily in a thick layer of hot resin.

In the late 1970s, acrylic sculptor Bruce Beasley developed a special procedure, using a high-pressure autoclave in his Oakland, California, studio/laboratory, to overcome these drawbacks. Beasley created the acrylic hemispheres that, fused with a bond of acrylic resin, became the spherical cockpit of the research submersible *Johnson Sea-Link II*. Identical spheres tested in pressure chambers withstood the equivalent of 12,000 ft. of water.

Beasley later licensed the technology to specialty plastics manufacturer Reynolds & Taylor, which used it to cast the 53-in. sphere for *Deep Rover*, a 1-man submersible. Though Beasley and R&T decline to discuss the process, logic suggests the casting involves variable temperature/pressure control and a flexible mold.

Reynolds & Taylor made *Gemini's* spheres, which are 90 in. in outside diameter and 6 in. thick. Connecting each sphere are transfer tunnels, fitted with beveled stainless-steel retaining rings. Other penetrations accommodate hatches and penetrator plates that anchor the spheres to the frame. According to Hyco's managing director Chris Metcalfe, engineering these penetrations and passageways to be leak-free was a key step in bringing *Gemini* to life. Because acrylic contracts more than steel under pressure, the penetrations are designed with rings of specialized nylon to allow for movement.

Acrylic contraction brings another problem—buoyancy control. Like any submersible *Gemini* relies on its hard ballast tanks, filled with water at the surface, to compensate for the sub's natural buoyancy. (The so-called soft ballast tanks in the upper fairing—filled with air to provide freeboard and surface stability—are also flooded before descent.) But deep underwater, as the acrylic spheres shrink, the sub displaces less water and hence loses some buoyancy. A pilot must compensate by pumping water out of the ballast tanks. On *Gemini*, an on-board microcomputer, fed with data from a depth gauge, will automate this function.

(Please turn to page 102)

TOMORROW'S CAR TODAY



PM PHOTO BY CLIFF GROMER

Navigation, diagnostics, security and communications—our concept car has them all, with hi-fi and video to go.

BY FRANK VIZARD, Contributing Editor, and CLIFF GROMER

IF YOU THINK the talking car ("A door is ajar") is a tough act to follow, wait 'til you see what the engineers are cooking up for the automobiles of tomorrow. Trading current novelty gimmicks for serious electronics, cars five to 10 years down the road will feature on-board satellite navigation systems, video camera rear vision, advanced audio and video entertainment systems, and new dimensions in voice and data communications. You'll see new concepts in driver-information displays that diagnose and indicate the status of the car's various operating systems. Comfort and convenience controls, such as seating and climate, also will show innovation.

The interesting thing is that the technology and hardware for these high-tech electronics systems are available today. Install some of this equipment into one of today's more advanced vehicles and you'd come up with something very close to what you'll find in showrooms in the mid-'90s.

We did just that to a Buick Riviera. With its unique CRT display and touch-screen operation of radio, climate, diagnostics and other functions, the Riv is one of the more electronically sophisticated vehicles on the road today.

The hardware we added to the Riviera can

be categorized into five basic areas: navigation, communications, entertainment, diagnostics and security. Some of the equipment added is more visible than other gear, depending on its function. Wherever possible, we wanted our options to blend cosmetically with the car.

Navigation

Let's assume that the Riviera is parked in your driveway. As you approach, flick the tiny remote-control on your keychain to unlock the doors and disarm the security system.

You start the engine, put the car in Reverse and proceed to back out onto the street. To help you see where you are going, there's a Sony Watchcam video camera attached to the roof liner above the rear window. The camera is centered and angled slightly downward to peer where your eyes and rearview mirror can't see—below the line of the trunk—in case there is a small child or object immediately behind the vehicle.

While the video camera looks behind the vehicle, your eyes focus on the black-and-white image that appears on a flat, 4-in. Sony Watchman monitor mounted into the roof liner just above the rearview mirror. You can easily

TOMORROW'S CAR TODAY



Clockwise from the right: Sony's Watchman monitor supplements rearview mirror by displaying extended area of view from video camera in rear. For mobile computing, NEC Multispeed laptop slides out from dashboard. Color TV keeps backseat drivers occupied with videos from in-dash player. If there's radar around, indicators near steering column will alert you.





Beginning at the top of the dashboard, above the gearshift console, is PM's red-illuminated custom control panel for activating other high-tech electronics. Below this is Riviera's touch-screen display for gauges, radio, car diagnostics. Remote-control for trunk-mounted Sony CD changer follows, with Alpine graphic equalizer just to its left and Delco cassette player below. Red light between gearstick and Alpine cellular telephone indicates status of remote-controlled security system. Arrayed left to right across dashboard on passenger side is Valentine Research G-Analyst, display for Etak navigation system, and Sony 8mm video cassette player. NEC Multispeed laptop computer is installed on slideout shelf below.

is an Alpine 9510 mobile cellular radiotelephone that lets you make calls as easily as if you were at home or in the office. Then, we added another function—the ability to transmit data from a computer. The computer is NEC's Multispeed laptop model, one of the most versatile portables on the market.

Like other laptops, the Multispeed features a pop-up liquid-crystal display screen. But this is one baby you won't have to balance on your lap. It's installed underdash on a sliding tray in front of the passenger seat. When needed, the NEC computer glides out within easy reach of the user.

Data for the computer can be transmitted or received over the Alpine cellular phone. Making the connection between the Multispeed and the cellular phone with its Hirschmann antenna is a specially designed modem called The Bridge, manufactured by Spectrum Cellular. Why special? Because cellular phones experience a brief break in transmission as you cross from one cell to another. You can't hear the glitch in voice communications, but fast-moving data would be lost. The Spectrum Cellular Bridge prevents this by buffering the data—essentially, storing it during the cell-to-cell skip.

Entertainment

The Buick Riviera comes factory-equipped with a Delco Electronics AM/FM/cassette system, whose front and rear stereo loudspeakers are driven by 80 watts of amplifier power. There's also a 5-band graphic equalizer. This, along with the POWER, VOLUME, BALANCE, FADER, RADIO-TUNING and CASSETTE controls, is operated via the Riv's touch-sensitive CRT screen (which also displays the car's diagnostics, gauges and climate controls). The transport mechanism for the cassette itself is housed above the gearshift console.

To expand our autosound options even more, we added a Sony Disc-jockey compact disc changer to the

remove the monitor for maintenance or picture adjustment. The monitor and its camera operate only when the transmission is in Reverse gear—automatically.

Before you hit the street, you'll use the Etak Navigator to plot your destination. Once you've punched in your destination, the electronic processor in the trunk calculates the best route to take.

The map used in the system is actually contained on a cassette tape inserted in a console-mounted player between the front seats. One tape contains all the data required for a single metropolitan area. The map is displayed on an in-dash monitor, and map scale can be adjusted from a 40-mile overview down to one-eighth of a mile to show an exact street address. Your location on the map is indicated by an arrow that moves as the car does. As the car travels, sensors mounted on the wheel rims, and oper-

ating in conjunction with an electronic compass, relay the data to the electronic processor. A star on the map display indicates your destination.

In getting to your destination, you're subject to local speed laws. We installed a B.E.L.-Tronics Micro-Eye Express remote radar detector so that you'll know when Smokey is around. The remote section of this radar detector is concealed in conventional fashion, behind the grille and under the hood. Meanwhile, the control module was taken apart for stealth deployment. The ON/OFF, HIGHWAY and CITY controls are installed in-dash as toggle switches to the left of the steering wheel, along with the alarm and illuminated status indicators.

Communications

Riviera's doors do not seal you off from the outside world. The central element of our communication system

TOMORROW'S CAR TODAY

hi-fi system. Sony's changer holds 10 CDs and is mounted in the Riv's trunk. You operate the CD changer by a remote-control module mounted on the dashboard just above the cassette player. A coaxial cable connects the command module to the trunk-mounted changer. Though the CD changer is stationary, the remote control can be lifted off the dash and passed to rear-seat passengers for their use. You can program the changer to play tunes in any order.

Although the factory autostand system already has built-in amplification for the cassette/receiver, we added a Nakamichi PA-150 amplifier and Alpine 3318 equalizer/spectrum analyzer for the CD changer. The trunk-mounted PA-150 sends 14 watts of power to each of the four speakers at an extremely low distortion level. A custom switching device installed underdash automatically cuts out radio or cassette and puts the audio system into the CD mode as soon as the Sony Discjockey is turned on.

We've also equipped the Riviera with an 8mm video system made by Sony. The tiny size of the 8mm video cassette makes it the obvious format of choice for mobile use. The small EVX-S8 video cassette player and controller fit comfortably into the dash.

The driver, of course, shouldn't watch TV while driving. We envisioned the video system as an electronic babysitter and so installed Sony's 8-in. XVM-8 color monitor below the armrest between the two front seats and facing the rear seats. For sound, an amplifier in the monitor drives a pair of 4-in. MEI speakers concealed in the rear package shelf.

Diagnostics

To complement the instrument gauges and diagnostic readouts displayed on the Riviera's CRT touch-screen, we added two pieces of equipment that can be described as diagnostic in nature.

One is an electronic dipstick called Oil Check, Model 150, made by TMM, Inc. With this product, the standard dipstick is replaced by an electronic probe connected to a small dash-mounted indicator. The oil level is checked with the en-

gine off and by pressing the OIL CHECK button for a minimum of 5 seconds. A green light indicates the oil level is acceptable while a flashing green light followed by a red light indicates the level is low.

The other diagnostic aid is the G-Analyst by Valentine Research. It's designed to quantify how a car handles, and is a useful device for those interested in high-performance driving. The G-Analyst mathematically quantifies a car's handling characteristics as it relates to acceleration, turning and braking. The results are displayed graphically on the unit's screen, and stored in its computer memory.

The G-Analyst can be removed from the dash, to study the results at home. Long-term analysis of the G-Analyst data should help hone your

driving skills while also measuring the response of your car under a variety of conditions.

Security

With all this added equipment in the Riviera, we wanted to make sure it stays there. Of all the security systems available, the Super-III system by Clifford Electronics incorporated all of the most desirable features.

This alarm system utilizes both motion and impact detectors. If the car is jolted severely, if metal makes contact with the locks, glass, or if the windows shatter, an ear-splitting 125-decibel air horn begins to howl. Disconnecting the battery under the hood won't stop the alarm—we've got a hidden backup battery just for that eventuality. The system also includes an ignition-kill function that prevents the car from being driven away unless the system is disarmed.

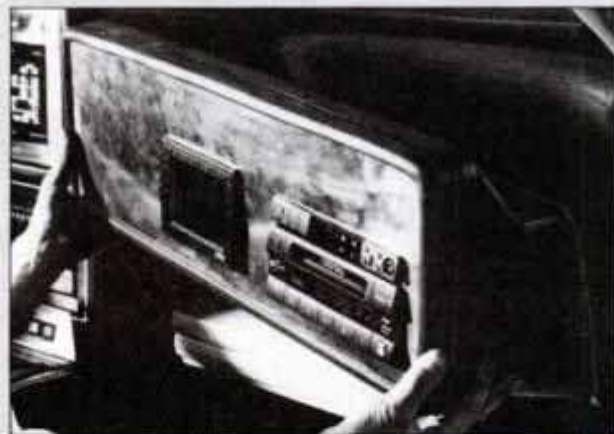
A flashing red light mounted on the gearshift console indicates that the system is armed. The ARM/DISARM switch is located under the armrest between the front seats. The system can be armed or disarmed from up to 75 ft. away with a small remote control that fits on a key-chain. A set of Microscience Twindows automatically locks the doors and rolls up the windows once the security system has been remotely activated. Additionally, a panic button on the remote lets you activate the siren if, for example, you find yourself being followed in a lonely parking lot. You can also make the headlights flash via remote control, in case you can't remember where you parked.

Putting it together

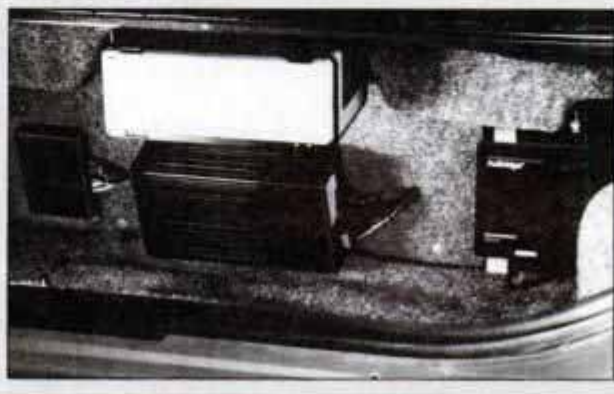
Whenever the tomorrow car hits the production line for sale today, you can bet that you won't have to stretch left and right to activate and operate its many electronic features. Most likely, there will be a central control panel that integrates the various devices. But why wait for tomorrow?

An integrated switching panel such as this was not beyond the talent and expertise of Galaxy Sound in Ridgefield, New Jersey—the automotive-electronics specialty installer that turned our imagination into reality. Galaxy's custom-designed controller for the

(Please turn to page 112)



Riv's modifications include sweepback sailfins (top) and matching dash for extra gear (above). In trunk are Sony CD changer and Nakamichi amp (below). Spectrum Cellular's Bridge modem, for data communications, is seen on right.



BEYOND THE BLADE



LASERONICS PHOTO

Advancing at the speed of light, lasers are changing the way doctors operate.

BY CHRIS DAVIS

THE PATIENT has a large cyst on his right larynx. Surgery, it has been decided, is the only answer. The very word conjures up visions of blades and blood, sutures and stitches, pentathol and pain. Going

under the knife. But things have changed.

The surgeon, wearing scrub greens, rubber gloves and ruby-red goggles, approaches the operating table holding only a spindly strand of fiberoptic cable. He snakes

the coil down the patient's throat until it's resting on the cyst. He signals his assistant, who hits the power switch on a refrigerator-size device sitting across the room. A pulse of 532-nanometer light courses through

The future is now for a new breed of laser surgeon (above). Using a carbon dioxide device equipped with a helium neon aiming beam, the doctor relies on CO₂'s ability to turn the body's water content into steam, cooking tissue instead of cutting it.

the cable. The monitor crackles with green lightning. But not enough.

Again, the surgeon orders. There's a pause while the machine—as if building up steam—winds up to spit out another dose. Suddenly the screen lights up a second time. The surgeon shifts his weight, adjusts the aim of the fiber cable and asks his assistant for more power.

The third try strikes. The desired microexplosion occurs. What a moment before was a white swollen growth is now a faint cloud of smoke. The cyst is simply gone, vaporized. There has been no bleeding in a completely sterile procedure with damage to the underlying vocal chord minimal.

It's not exactly ET's finger that simply touches a wound and makes it better, but, as Dr. Bernard R. Marsh, chairman of Johns Hopkins Laser Committee, puts it: "Lasers have already revolutionized medicine in just the past five years . . . and we're not standing still. I don't like to excite optimism before it's justified," he adds, "but there is a lot of interest and research. Things are moving fast."

The laser spectrum

Used in eye surgery since the early 1960s, lasers are being put to the test in the full spectrum of operating room chores. From clearing the plaque out of clogged arteries to erasing freckles, resculpting corneas, welding torn tissue, removing tonsils and hemorrhoids, even replacing the needles of acupuncture. This tool of reined-in energy is lighting the way to a future of health care that sci-fi writers could once only dream about. Says Dr. Walter G. Wolfe of Duke University: "Perhaps only your imagination will be the limiting factor with the use of lasers."

Dr. Wolfe's prediction is already coming true. Imagine—if you can—a smart laser, confronting a group of suspect cells and asking, with a probe beam, if they are cancerous and zapping them if they answer yes. Or

so-called Trojan Horse drugs that are absorbed only by malignant cells and, when hit with the kind of fine-tuned light lasers produce, turn to poison, killing the unsuspecting cells that house them.

Albert Einstein envisioned the possibility of a laser beam back in 1917. If a pure substance is stimulated with an electrical charge, he reasoned, its electrons will jump up to a specific energy level, and, when dropping

back down to where they prefer to be, give off an emission of very specific wavelengths of light. Enclose the process with mirrors, let the energy ricochet around and collide with more electrons (or amplify), poke a pin hole in the chamber, and out will come a beam of very pure, intense electromagnetic radiation. Thus we get Light Amplification by Stimulated Emission of Radiation, or LASER.

The idea of using light as a weapon goes back to Zeus' belligerent bolts and persists today in the so-called Star Wars scenario. The fact is that the peaceful use of lasers has already changed the world of arts and entertainment and dozens of industries dependent on precision. Lasers identify fingerprints, read cartons on the grocer's checkout counter, and cut diamonds. But no application has been more dramatic than the lineup of laser weapons that have joined the medical armamentarium in the past few years.

Lasers at work

Various lasers take their names from the different host or lasing substances that produce the beams.

Carbon dioxide produces a beam that is absorbed by water in body tissue. Heat from the laser turns the water into steam, searing the adjacent tissue.

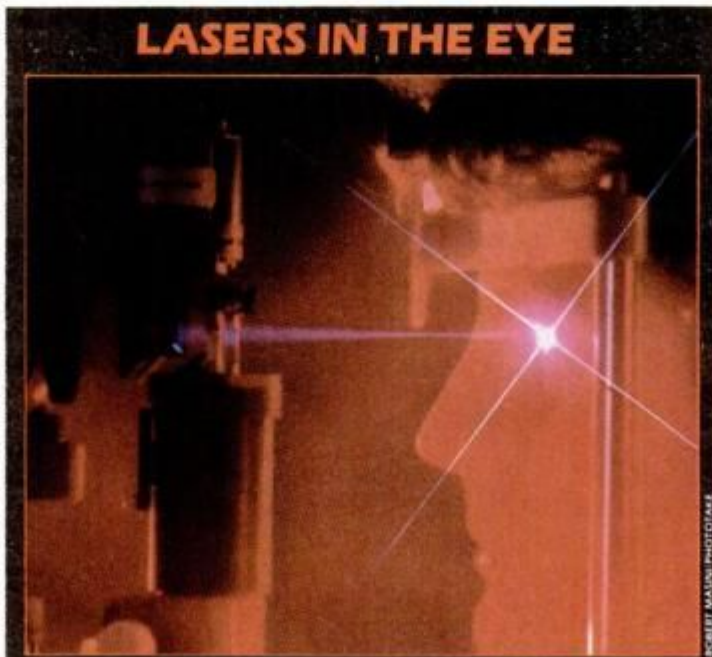
The argon laser, on the other hand, reacts to the color red, so it will penetrate the skin until it runs into blood, making it good for dermatological procedures.

The YAG laser, the most invasive laser surgical device, can penetrate 4 to 5 millimeters, cooking rather than cutting, and can turn a tumor into a coagulated mass of easily removed debris.

Dye lasers can be tuned to different wavelengths just by adding or diluting tint from the laser medium.

Also tunable, the free-electron laser is now being harnessed for medicine. This powerhouse uses magnets to stimulate pulsed laser light from a stream of electrons.

Dr. Stephen Goldstone, director of Laser Surgery Care in New York City, uses a carbon dioxide laser for a variety of procedures. "If I cut a tissue sample with a knife and with a laser and look at a cross section under a microscope, the lasered sample has far less surrounding damage—less inflammation, swelling and edema. Less damage, less pain." Aside from sterilizing as it cuts, he says, the laser seals blood vessels,



LASERS IN THE EYE

Argon laser is used to close blood vessels before eye surgery.



Above left: Cyclytic membrane, an abnormal growth over pupil. Above right: Pupil after YAG laser surgery. Cornea tissue micrographs (below) show rough surface after scalpel cuts (left), smoother surface after excimer laser surgery (right).



nerve endings and lymphatics—characteristics that make it ideal for treatment of conditions like hemorrhoids.

The danger with using a knife in such a procedure, says Goldstone, is that all of a hemorrhoid cannot be removed without risking extensive, debilitating scarring. With a knife, the procedure usually means a 5- to 7-day hospital stay and a week or more out of work. Using the carbon dioxide

laser, Goldstone treats patients on an ambulatory basis—they are on their feet within 2 hours of the procedure, back to work within three days to a week.

It's the precision of the tool that makes the difference, Goldstone says, precision and delicacy that allows him to write his name on the yolk of an egg without breaking the yolk. It makes it possible for him to remove tattoos, sloughing away skin,

layer by microscopic layer, until it's just enough—and not a fraction more—to remove the tattoo's pigment.

Late in 1986, the FDA approved procedures using lasers to remove other unwanted collections of pigment beneath the skin—problems such as port-wine stains, spider veins on the face, and birthmarks. Dr. David Apfelberg of Palo Alto

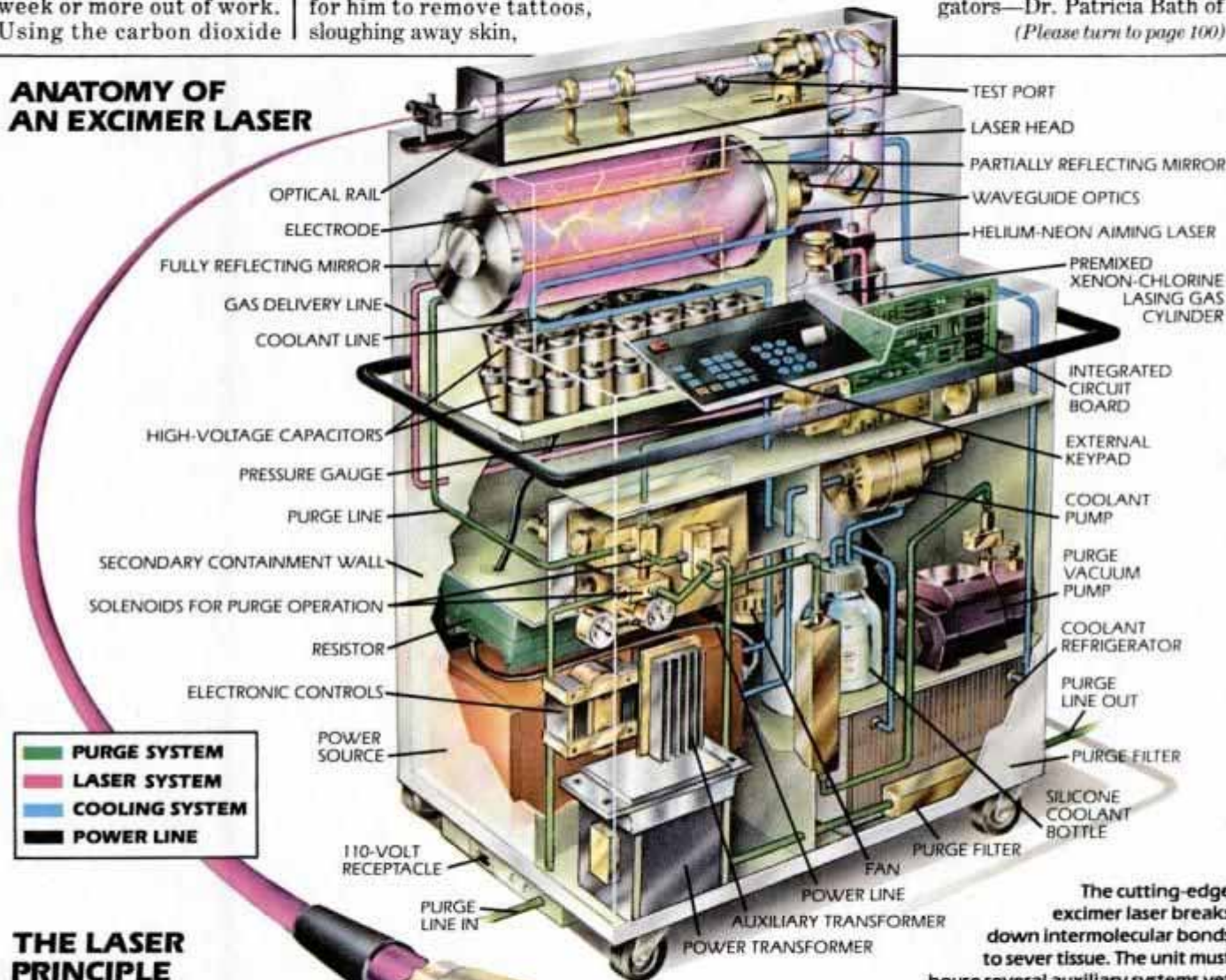
says that children with the disfiguring port-wine stains may not have to wait until adulthood to be treated.

Enter the excimer

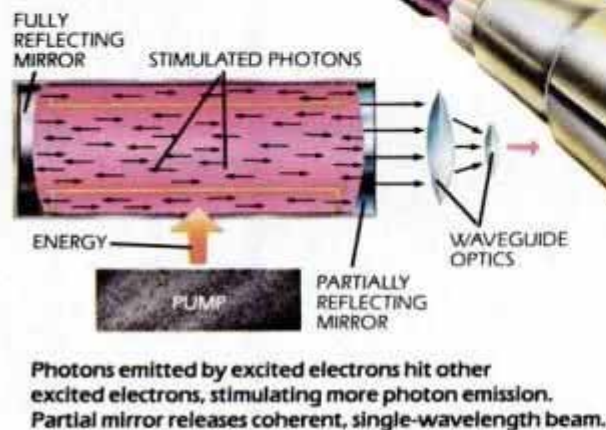
The world of laser medicine has great hope for a newcomer. It's called the excimer. Where the carbon dioxide cuts and the YAG cooks, the excimer, in the words of one of its most prominent investigators—Dr. Patricia Bath of

(Please turn to page 100)

ANATOMY OF AN EXCIMER LASER



THE LASER PRINCIPLE



The cutting-edge excimer laser breaks down intermolecular bonds to sever tissue. The unit must house several auxiliary systems yet remain self-contained and compact. This Summit Technology excimer has built-in power source, cooling system, premixed xenon-chlorine gas supply and plumbing to let inert-gas mixture purge laser head for maintenance.

HANDPIECE

LASER BEAM



BIG-LAKE WARRIORS

We tackle wind-whipped, freshwater rollers in a 6-way shootout to find the ultimate small-boat fishing rig.

BY JOE SKORUPA, Boating/Outdoors Editor; PM Photos by Skip Gandy

A CANADIAN STORM front whistles across the border into Wisconsin and lashes placid Lake Winnebago into punishing 4-ft. waves. The temperature drops 40°. The gray sky is thick with heavy, churning clouds.

There's only one thing to do on a day like this—put on rain gear, take out your boat, and go fishing.

Big-water, northern fishermen are a breed apart. Storm or no storm, they tackle immense, freshwater bays and lakes in rigs no bigger than a runabout in search of the reigning king of the region, the sweet-tasting walleye.

We decided to take a look at these specialized rigs, especially the cutting-edge models used by pros on the booming walleye



PM
COMPARISON
TEST



Reverse chines throw water away from skipper as he blasts across storm-lashed Lake Winnebago in a Lund Pro V 1700 Deluxe (above). On a calmer day (left), fishermen maneuver their boats in the tall reeds (left to right): Yar Craft 1781 GPS, Starcraft Pikemaster 180, Lund Pro V 1700 Deluxe and Crestliner V170 Viking Deluxe.

BIG-LAKE WARRIORS



Choose your walleye weapon (left to right): Grumman G5C 164 DLX, Starcraft Pikemaster 180, Tuffy Pike Rampage, Lund Pro V 1700 Deluxe, Crestliner V170 Viking Deluxe, and Yar Craft 1781 GPS.

tournament circuit. We brought six of them to Mercury Marine's test center in Oshkosh, Wisconsin, and ran them through a battery of tests. All were equipped with the new, oil-injected 100-hp Mariner outboard and run with an 8-hp Mariner kicker. Here's what we found.

Yar Craft 1781 GPS

The boat the test team would most like to enter in a big-money walleye tournament is the Yar Craft 1781

GPS, which finished first in fishability, rough-water handling and fit and finish. It was second in total stowage space and third in all three performance categories.

The main strength of the winner is a deep-V fiberglass hull, which has a double-flared bow and spray-deflecting chines that give a smooth, dry ride. A level, evenly balanced water profile makes it easy to control at slow trolling speeds in high winds.

The test team especially liked the

boat's unique, double-cut transom, which has dedicated cutouts for auxiliary motors. Other features we liked were high stern splash wall, deep cockpit, wraparound side decking and sealed livewell and baitwell.

The Yar Craft was the only test boat cutting-edge rigged—loran-C, chart recorder, kicker, bow and stern trolling motors, and bow and stern fishfinders. This equipment, which can double the cost of the boat, fit easily into a well-planned layout.



| 1. YAR CRAFT 1781 GPS | 2. CRESTLINER V170 VIKING DELUXE | 3. LUND PRO V 1700 DELUXE |
|---|---|---|
| LOA: 17'6"/Beam: 81"/Wt.: 840 lb./Fuel: 18 gal. | LOA: 17'6"/Beam: 78"/Wt.: 810 lb./Fuel: 22 gal. | LOA: 16'6"/Beam: 83"/Wt.: 950 lb./Fuel: 27 gal. |
| Deck/Cockpit Area: 60.65 sq. ft./Ranking: 5 | Deck/Cockpit Area: 69.38 sq. ft./Ranking: 2 | Deck/Cockpit Area: 60.03 sq. ft./Ranking: 6 |
| Top End: 42.88 mph/Ranking: 3 | Top End: 43.38 mph/Ranking: 2 | Top End: 43.50 mph/Ranking: 1 |
| Hole Shot 0-35 mph: 9.47 sec./Ranking: 3 | Hole Shot 0-35 mph: 10.50 sec./Ranking: 6 | Hole Shot 0-35 mph: 9.40 sec./Ranking: 2 |
| Performance Course: 26.70 sec./Ranking: 3 | Performance Course: 25.36 sec./Ranking: 1 | Performance Course: 27.75 sec./Ranking: 5 |
| Fishability/Ranking: Superior trolling and layout/1 | Fishability/Ranking: Level water profile a plus/3 | Fishability/Ranking: Fine transom cutout/2 |
| Rough-Water Ranking: 1, smoothest, driest ride | Rough-Water Ranking: 3, soft mod-V hull | Rough-Water Ranking: 2, forgiving in 4-footers |
| Fit & Finish/Ranking: Craftsmanlike detailing/1 | Fit & Finish/Ranking: Rivet-free hull/2 | Fit & Finish/Ranking: Minimalist approach/4 |
| Stowage/Ranking: 28.15 cu. ft., superb/2 | Stowage/Ranking: 27.92 cu. ft., huge livewell/3 | Stowage/Ranking: 23.27 cu. ft., adequate/5 |
| Price as Tested: \$5995 | Price as Tested: \$5582 | Price: \$5965 |
| Address: Yar Craft, 1213 20th Ave., Menominee, MI 49858, (906) 863-4495 | Address: Crestliner, 609 13th Ave. NE, Little Falls, MN 56345, (612) 632-6686 | Address: Lund Boats, P.O. Box 248, New York Mills, MN 56567, (218) 385-2235 |

V170 Viking Deluxe

Despite not being tournament rigged, the rivet-free, aluminum-hulled Crestliner was a strong contender and a driver's favorite. It finished first on the performance course and second in top-end speed.

It was also the most consistent finisher, ranking no lower than third in any category except hole-shot speed, where a smaller-pitch prop would probably have helped.

Fit and finish was another strength, although some detailing we saw wouldn't appear on walleye boats, such as pop-up aft table, jump seats and transom-extender bracket.

The V170 ranked third in fishability, even though the optional transom bracket created a long reach to stern auxiliary motors. Low, evenly balanced water profile, generous stowage and large deck area tipped the scales in its favor. Rough-water performance was equally strong due to a deep cockpit, high splash wall, reverse chines and mod-V hull.

Although we didn't run this boat with true tournament rigging, we're sure it would be a superb competitor.

Pro V 1700 Deluxe

Nothing beats the Lund Pro V 1700 Deluxe for straightahead performance. It whipped the fleet in top-end speed and finished a close second in acceleration.

Sophisticated aft layout and transom design make using stern auxiliary motors among the easiest in the



fleet. Rough-water performance was also tops, with the aluminum hull displaying a soft, smooth ride through rollers. Dryness was preserved by riveted-on reverse chines.

Due to its evenly balanced profile and superb backtrolling ability, the Lund ranked second in fishability.

The biggest problem we discovered was how the boat handled on the performance course, a quarter-mile run with two short sprints and a hard left, hard right and 180° turns. The boat finished well off the pace and had a tendency to slide and skitter.

Fit and finish was spartan, too, with pop rivets showing, but nice touches include an O-ring sealed livewell, wraparound side decks and sturdy double-plated hull.

Pikemaster 180

There's a lot to like about the aluminum Starcraft Pikemaster 180. Its riveted hull handled like a dream on the performance course, overcoming slower top-end and acceleration speeds to finish a strong second. It bested the fleet in total stowage space and ranked third in fit and finish.

All of its other rankings, however, were in the bottom half of the fleet, though not by much. The most noticeable problems were a hard, wet ride in rough water, unusual positioning of switches/circuit breakers behind driver's seat, and a bow-in-the-air profile that makes high-wind maneuverability difficult.

Smaller problems include a poorly
(Please turn to page 99)



4. STARCRAFT PIKEMASTER 180

LOA: 18'3"/Beam: 79"/Wt.: 935 lb./Fuel: 19 gal.

Deck/Cockpit Area: 65.15 sq. ft./Ranking: 4

Top End: 42.75 mph/Ranking: 4

Hole Shot 0-35 mph: 9.73 sec./Ranking: 4

Performance Course: 25.94 sec./Ranking: 2

Fishability/Ranking: Weak trolling profile/4

Rough-Water Ranking: 4, a bit hard and wet

Fit & Finish/Ranking: Good, but a few glitches/3

Stowage/Ranking: 36.04 cu. ft., outstanding/1

Price: \$5824

Address: Starcraft, 536 Michigan St., Topeka, IN 46571, (219) 533-1105

5. GRUMMAN GSC 164 DLX

LOA: 16'4"/Beam: 84"/Wt.: 840 lb./Fuel: 18 gal.

Deck/Cockpit Area: 68.26 sq. ft./Ranking: 3

Top End: 38.0 mph/Ranking: 6

Hole Shot 0-35 mph: 9.31 sec./Ranking: 1

Performance Course: 26.89 sec./Ranking: 4

Fishability/Ranking: Kicker doesn't fit on transom/5

Rough-Water Ranking: 5 (tied), bone-jarring, wet

Fit & Finish/Ranking: Has a spartan feel/5 (tied)

Stowage/Ranking: 9.87 cu. ft., inadequate/6

Price: \$4639

Address: Grumman Boats, P.O. Box 549, 7 South St., Marathon, NY 13803, (607) 849-3211

6. TUFFY PIKE RAMPAGE

LOA: 18'1"/Beam: 75"/Wt.: 900 lb./Fuel: 19 gal.

Deck/Cockpit Area: 75.79 sq. ft./Ranking: 1

Top End: 41.50 mph/Ranking: 5

Hole Shot 0-35 mph: 9.89 sec./Ranking: 5

Performance Course: 31.07 sec./Ranking: 6

Fishability/Ranking: Poor trolling characteristics/6

Rough-Water Ranking: 5 (tied), hard ride, aft heavy

Fit & Finish/Ranking: Fasteners show, spare/5 (tied)

Stowage/Ranking: 25.72 cu. ft., acceptable/4

Price: \$5250

Address: Tuffy Boats, 865 E. Stony Rd., P.O. Box 759, Lake Mills, WI 53551, (414) 648-2348

OLDIES BUT GOODIES

Mystique makes vintage radios collectible. But condition, rarity and styling make them valuable.

BY MARY CELESTE UMANS; PM Photo By Spencer Jones



Collectible radios span time and styles. From left: chromed tube casings, outboard speaker and stripped-down look of 1940 Scott is hot stuff—while gaudy, plastic '56 Motorola portable is cool once again. Circa-1931 Atwater-Kent cathedral from the golden age of wireless remains a classic.

THOMAS ALVA EDISON didn't think much of radio. In 1921, he lent a record player and some discs to WJZ, which billed itself as "the radio telephone broadcasting station located at Newark, New Jersey." A few days later, the phonograph's inventor asked WJZ to stop playing the records on the air. "If the phonograph sounded like that in any room," Edison complained, "nobody would ever buy it."

The inventor genius underestimated radio. It became big business. And old receivers have become a source of fun and profit for collectors across the country.

If there's an early radio in your basement or attic, it could mean money in your pocket. How much depends primarily on the age and condition of the set. Brand and cabinetry also influence a radio's value.

The vintage radios most in demand are models built between 1900 and just before World War II, says Bruce Mager, proprietor of WAVES, a major outlet for antique radios and TVs located in New York City.

According to Mager, the period from 1900 to World War I was the era of radio experimentation. Young scientists were making their own receivers, inspired by Italy's Guglielmo Marconi, who patented the wireless in 1897.

This was the period of Morse code, and these sets were for commercial or military ship-to-shore communications.

But the development of the audion or radio tube by Lee De Forest in 1906 would make voice transmission a reality by 1918. Among the manufacturers building radios before 1920 were Connecticut Telephone and Telegraph, Westinghouse, Marconi and De Forest.

The earliest voice-receiving sets are among the most rare and valuable. If you think you might have one, a radio expert can identify the configuration of tubes and circuitry that characterize a pre-1920 receiver. A radio club or dealer can put you in touch with such an expert.

The birth of commercial radio occurred in 1921, when station KDKA went on the air in Pittsburgh. Soon, radio broadcast stations were springing up all over.

Most of the radios of this period were battery-operated. Many, too, have headphones instead of a loudspeaker, or the speaker might be separate from the receiver. These sets also tend to have a lot of knobs, since this was the era before gang tuning. Moreover, the earliest sets were made with only one or two tubes.

Voice radios made from 1920 to 1922 are among the most valuable. Shortly thereafter, around 1925, the market was glutted by almost 1000 companies manufacturing radios. Popular brands of the early to mid-'20s included RCA, Grebe, Crosley and Stromberg-Carlson.

In 1927, radios powered from household wiring first



appeared. By this time, heavy competition among manufacturers was reflected in the variety of styling and cabinetry. In the beginning, there were floor-standing console models that were elaborate furniture. Then, reflecting the economy, "Depression" sets came into vogue around 1931. These—ironically—are the less expensive cathedral and compact units so prized today. Around the same time, radios with cabinets made from synthetic or plastic materials began to appear. The big names of this pre-World War II period are Atwater-Kent and Philco.

Though age tends to translate into value, the condition of a radio can drastically affect its price. A collector looks at a set in terms of how much time it will take to restore.

A vintage radio doesn't necessarily have to work to be valuable. What's important is that the cabinet is in good condition, and that the parts are intact. Minor defects such as scratches often can be remedied with corrective chemicals available at antique and hardware stores. Restoring the old finish is always preferable to stripping and refinishing. Modernizing a set decreases its value. Whenever possible, old parts rather than new should be used as replacement pieces. Many buffs collect tubes and knobs in hope of finding that special set in need of repair.

A word of warning: If you're not sure of what you're doing, it's best to go to a professional for restoration work.

Many of today's commonly used household cleansers can destroy an old finish. And, plugging in an old electric set that hasn't been checked out might result in burning out the power transformer.

Another factor that might determine the value of that old radio is the specialization of an individual collector. If the set's in demand, the price will probably be higher. Some collectors prize specific generations. Others seek certain manufacturers, and others may look for styling—wooden cathedrals or plastic compacts, for example.

Occasionally, certain models are especially in vogue. Art-Deco and 1950s' styling, for instance, have enjoyed a renewed popularity in the past few years.

If you have a potential collectible, you might anticipate making anywhere from \$5 to \$500. Radio clubs put out publications that contain classified ads of interest to people hoping to buy, sell or trade. The clubs also sponsor swap meets where collectors exchange equipment.

For information, write the Antique Wireless Assn., 17 Sheridan St., Auburn, NY 13021, or the Antique Radio Club of America, 81 Steeplechase Rd., Devon, PA 19333. Another source for estimating the value of your radio and finding a buyer is Bruce Mager at WAVES, 32 East 13th St., New York, NY 10003. A photo and self-addressed, stamped envelope will speed your reply. **FM**



Bath Grooming

Accent your bathroom with our easy-to-build clothes hamper and circular mirror.

BY THOMAS KLENCK, Associate Home And Shop Editor

BATHROOM improvements usually take the form of updated fixtures, new floor covering or built-in storage cabinets. There are ways, however, to enhance your bathroom's appearance without going through a major renovation. A fresh approach to those areas of the bathroom that aren't nailed down can give new life to an otherwise mundane space.

We've designed our bathroom hamper and circular mirror to fill just such a requirement. The hamper features frame construction with cane panels for ventilation and good looks. And, our large round mirror is just the thing to liven up an empty wall and create the illusion of space.

Starting the hamper

Begin by ripping the stock for the stiles and rails about $\frac{1}{8}$ in. greater than their finished width. Use your circular saw and ripping guide for this operation. Crosscut each piece roughly to length and plane the sawn edges to finished width. Then, cut the pieces squarely to exact length.

Lay out the joint positions as shown in the drawing and use a doweling jig to aid in boring the $\frac{3}{8}$ -in.-dia., $\frac{3}{8}$ -in.-deep dowel holes (Fig. 1). Apply glue sparingly to the dowels and holes and assemble the frames. Use pipe clamps to draw the joints tight.

Hamper details

Shape the rounded edge on the top frame by first planing bevels along both corners of each edge of the frame. Then, sand the beveled edges to a smooth curve. It's best to plane the short edges where end grain is encountered first. Plane in from each end to avoid splitting the corners.

Next, install a $\frac{3}{8}$ -in.-dia. straight bit in your router and set the bit depth to $\frac{1}{4}$ in. for cutting the groove that holds the plywood floor. Measure the distance from the cutting edge of the bit to the router base edge and clamp a straightedge cutting guide squarely to a side frame so the groove will be spaced 2 in. from the frame leg bottoms (Fig. 2). Note that the grooves in the front and back frames stop $\frac{1}{4}$ in. short of the edges.

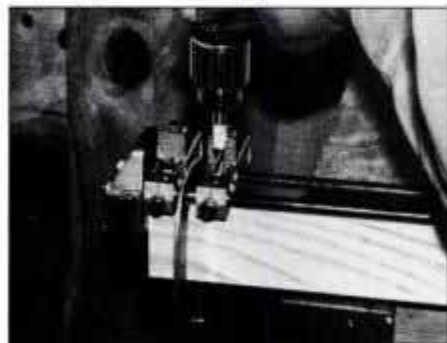
Use a compass to lay out the round cutouts that form the hamper legs. Then, saw to the line with a sabre saw (Fig. 3). Sand the curve with a drum sander or use cutaway scrap as a sanding block. The cane is installed in shallow, $\frac{1}{16}$ -in.-deep \times $\frac{3}{8}$ -in.-wide rabbets routed around the inside perimeter of each frame. Use a $\frac{3}{8}$ -in. rabbeting bit and square the rabbet corners with a sharp chisel (Fig. 4).

Installing the cane

We used prewoven paper cane which is available in rolls. Lay a section of the cane sheet on a frame and mark it for cutting to size. Use a sharp utility knife and steel rule to cut the cane. Try to follow the lines in the cane pattern so the pattern will be in line with the frame when installed.

With the first piece cut, secure one corner of the cane to one corner of the rabbet with two $\frac{3}{8}$ -in. staples. Drive each about 1 in. in from the corner

Color photo: J.R. Rost
Black-and-white photos: Thomas Klenck
Technical artist: Eugene Thompson
Photo stylist: Gabe Henck



1 Use a doweling jig to bore $\frac{3}{8}$ -in.-dia. holes $\frac{3}{8}$ in. deep. Be sure to reference the jig on the same working face of each piece.



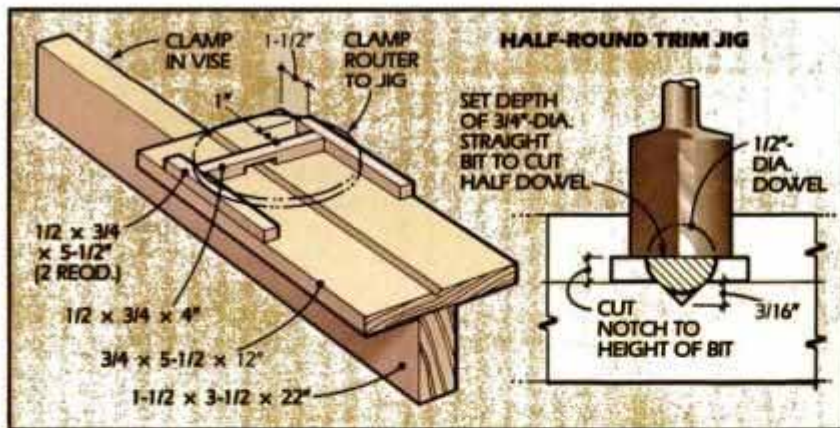
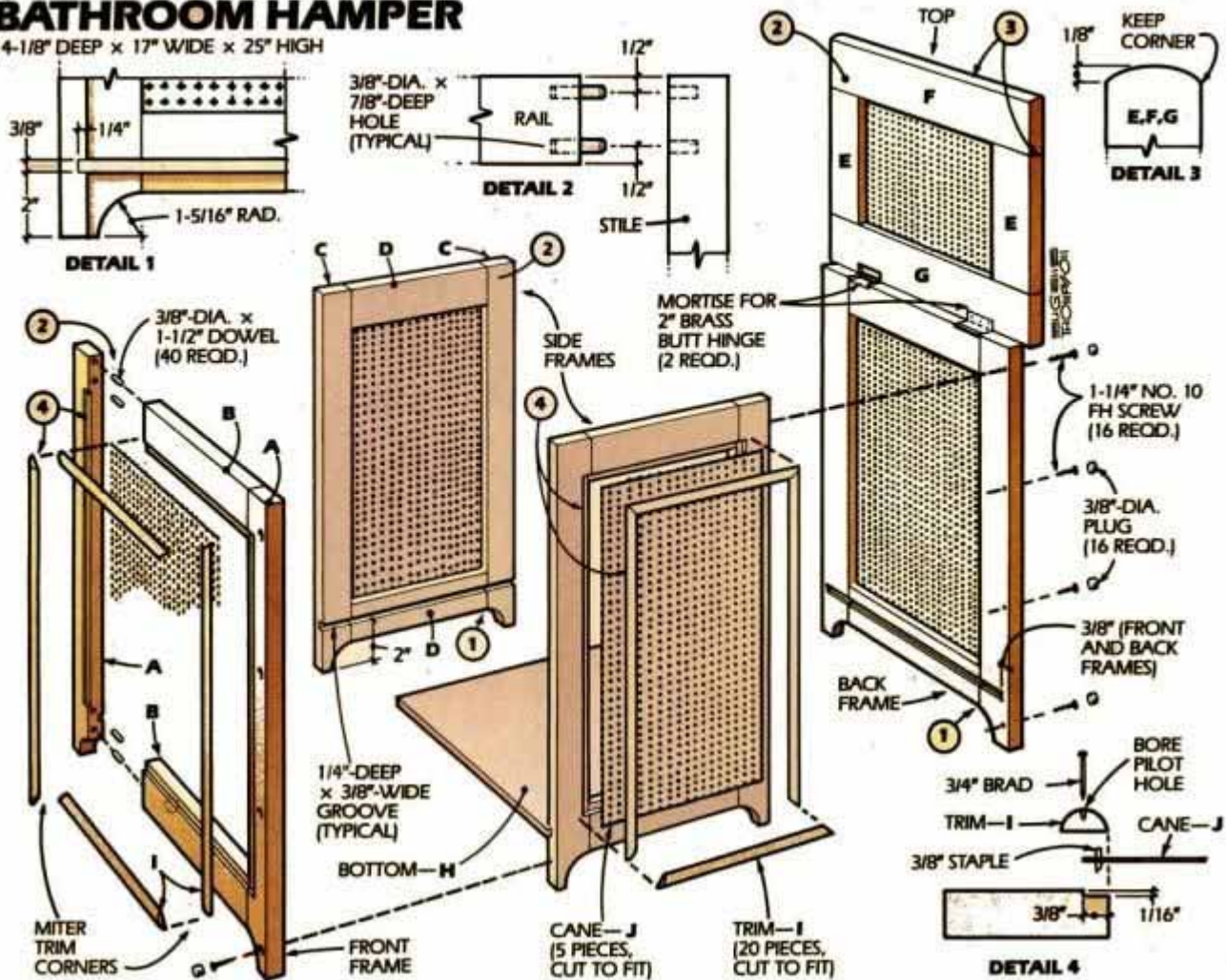
2 After assembling frames, rout a $\frac{1}{4}$ -in.-deep groove 2 in. up from the bottom of each frame. Use a $\frac{3}{8}$ -in.-dia. straight bit.



3 Lay out the $1\frac{1}{16}$ -in.-rad. arcs for the legs and cut with a sabre saw. Work from inside of frames and use a fine cutting blade.

BATHROOM HAMPER

14-1/8" DEEP x 17" WIDE x 25" HIGH



- MATERIALS LIST — HAMPER**
- | Key | No. | Size and description (use) |
|--------|-----|---|
| A | 4 | 1/4 x 2 1/2 x 24" pine (stile) |
| B | 4 | 1/4 x 2 1/2 x 11" pine (rail) |
| C | 4 | 1/4 x 1 1/4 x 24" pine (stile) |
| D | 4 | 1/4 x 2 1/2 x 8 1/2" pine (rail) |
| E | 2 | 1/4 x 3 x 8 1/2" pine (top rail) |
| F | 1 | 1/4 x 3 x 17" pine (top stile) |
| G | 1 | 1/4 x 2 1/2 x 17" pine (top stile) |
| H | 1 | 1/4 x 12 7/16 x 15 7/16" plywood (bottom) |
| I | | 1/2"-dia. half-round trim, approx. 25 ft. reqd. |
| J* | | paper cane, approx. 48" reqd. |
| Misc.: | | 1 1/4" No. 10 fh screws, 3/8"-dia. plugs, 3/8" staples, 3/4" wire brads, 1 pair 2" brass butt hinges. * Paper cane (No. H1705) available in 24-in.-wide rolls from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374-9514. |

(Fig. 5). Then, while pulling the cane taut, tack the next corner with two staples. Drive staples between the two secured corners about 1 in. apart. Next, secure the third corner while pulling the cane taut and attach the last corner in the same way. Staple the cane along the rabbet while making sure that the pattern is kept square and straight.

Making the trim

Prepare to make the half-round trim by building the jig shown in the drawing. First rout a V-groove in a roughly

5 1/2 x 12-in. scrap piece of 3/4-in. stock. Then, screw the two side router support pieces in place as shown in the drawing. Cut a third piece to fit in between the side strips and span the V-groove. Cut a notch in the center of the third piece so that one half of a 1/2-in.-dia. dowel resting in the V-groove is visible under the notch.

Secure the notched piece to the jig and attach the 2x4 rail so the jig can be easily clamped in your vise. Clamp your router—equipped with a 3/4-in.-dia. straight bit—to the jig so the bit is centered over the V-groove. Adjust

the depth of cut to be in line with the top of the notch.

Turn on the router and slowly advance a length of 1/2-in. dowel along the V-groove (Fig. 6). As the cut nears completion, simply move to the outfeed side of the jig and carefully pull the stock through.

Miter each piece of trim to fit and install with 3/4-in. wire brads. It's best to bore a starter hole with a small bit held in a pin vise. Lay the trim next to its position when boring the starter holes to avoid placing a brad where there's a staple (Fig. 7).

Bath Grooming

Before assembling the hamper, lay out the hinge mortises in the rear frame and top, and cut them with a sharp chisel.

Assembly and finish

Clamp the two side frames to the back frame with pipe clamps and mark the screw positions. If possible, bore the pilot holes with a combination bit that will also bore the $\frac{3}{8}$ -in.-dia. counterbore for the plugs that cover the screws. Otherwise, first bore $\frac{3}{8}$ -in.-dia. \times $\frac{1}{4}$ -in.-deep holes for the plugs. Then, bore the screw pilot holes for the $1\frac{1}{2}$ -in. No. 10 fh screws. After installing the screws, slide the plywood floor in place (Fig. 8), and secure the front frame to the sides the same way.

Use a $\frac{3}{8}$ -in.-dia. plug cutter to make the plugs and glue each in place. After the glue has set, carefully trim the plugs flush with a sharp chisel (Fig. 9). Mark the screw locations for the hinges and install the top. Finally, sand the hamper with 120- followed by 220-grit paper.

We finished our hamper with three coats of Minwax satin polyurethane varnish. Sand lightly between coats with 220-grit paper.

The circular mirror

Before starting this project, order a 22-in.-dia. \times $\frac{1}{8}$ -in.-thick mirror from a firm that specializes in glass and mirrors. Crosscut the $\frac{3}{4}$ -in.-thick

frame stock slightly longer than specified and rip each piece to exact size.

Construct a jig to hold the stock and guide your circular saw when cutting the miters (Fig. 10). Secure two pieces of straight 48-in.-long, 1x3 stock to a $10\frac{3}{4}$ \times 48-in. plywood base. Space the 1x3s $5\frac{3}{4}$ in. apart so the frame stock fits in between. Then, lay out the cutting lines for the miters and secure straightedge cutting guides to the jig for cutting both miters on each frame piece at the exact length.

After mitering the four frame pieces, lay them together and double check that the joints are tight. If necessary, trim the miters with a sharp, finely set plane.

Laying out the frame

Temporarily nail the frame pieces in position to the worktable and tack a small $\frac{3}{4}$ -in.-thick block in the center. Mark the exact center of the frame by laying out the frame diagonals on the center block. Construct a shopmade compass by first driving a finishing nail near the end of a 16-in.-long piece of 1x3 stock. Then measure from the nail and mark the inside and outside mirror frame radii. Bore a $\frac{9}{32}$ -in.-dia. hole at each mark for holding a pencil and lay out the circles (Fig. 11).

Lay out the clamp access notches and dowel pin positions and label the pieces so they won't be mixed up during assembly. After cutting the clamp

notches with a sabre saw, use a doweling jig to bore the $\frac{3}{8}$ -in.-dia. dowel holes (Fig. 12).

Frame assembly

Insert slip-fit dowels into the frame pieces and dry-assemble the frame. Check all joints for tightness and alignment, and disassemble. Apply glue to the dowel holes and fluted dowel pins, reassemble and clamp. Allow the glue to dry overnight.

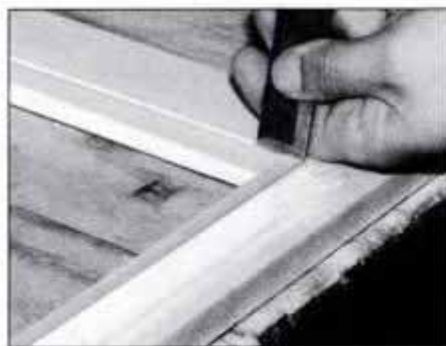
Use your sabre saw for cutting to the inside and outside circle lines (Fig. 13). Staple a strip cut from a sanding belt to an inside waste section and smooth the inside of the frame (Fig. 14). Use the compass that you built to lay out a similar sanding block for the outside diameter.

Install a $\frac{1}{4}$ -in.-rad. rounding-over bit in your router and round the two outside edges and top face inside edge. Then, use a $\frac{3}{8}$ -in.-rabbeting bit to rout the rabbet housing the mirror.

Installing the mirror

Before installing the mirror, varnish the frame as described for the hamper. While the varnish is drying, prepare the wedges that hold the mirror in place as shown in the drawing.

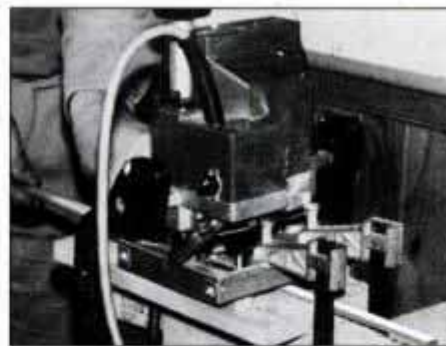
This system secures the mirror in the rabbet without bearing on the back of the mirror which may cause the coating to wear off. Plane a roughly 15° bevel along one edge of a 16-in.-



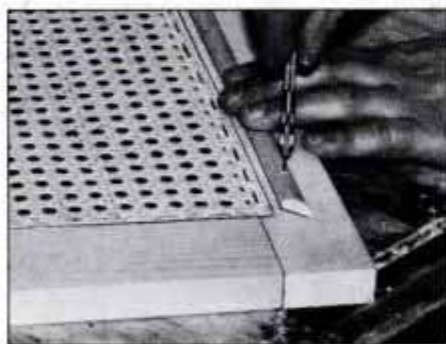
4 After routing the $\frac{1}{8}$ -in.-deep \times $\frac{3}{8}$ -in.-wide rabbet that holds the cane, square the rabbet corners with a sharp chisel.



5 Secure cane by first stapling two corners. Place staples along rabbet 1 in. apart and avoid distorting cane pattern.



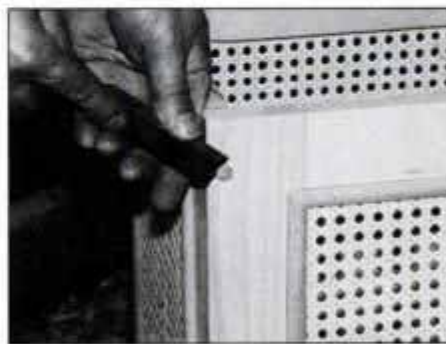
6 Construct half-round trim jig as in drawing. Clamp router in place and adjust bit depth to remove half of $\frac{1}{2}$ -in.-dia. dowel.



7 Bore pilot holes part way into the trim to avoid splitting the wood. Be sure to place brads so they won't hit the staples.



8 After assembling two sides to the back frame, slide $\frac{3}{8}$ -in.-thick plywood bottom panel in place. Then, secure front frame.



9 Install $\frac{3}{8}$ -in.-dia. plugs over the screws with glue. After glue has set for an hour, use a sharp chisel to cut plugs flush.

Bath Grooming

long piece of scrap stock. Lay out a ripping line along the face allowing about $\frac{1}{16}$ in. at the narrow corner of the wedge. Rip the long length of wedge with your sabre saw. Then, cut this strip into 1-in. segments.

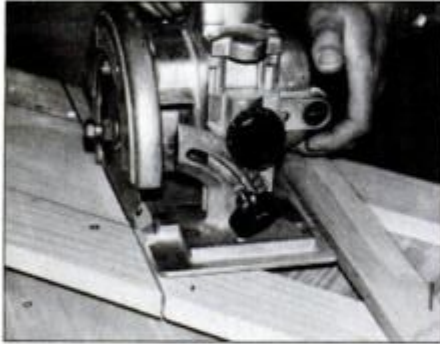
When the finish on the frame has dried, lay the frame facedown on a blanket and lay the mirror in place. Install the wedges between the mir-

ror edge and the side of the rabbet. If necessary, trim the wedges with a sharp chisel so they fit snugly.

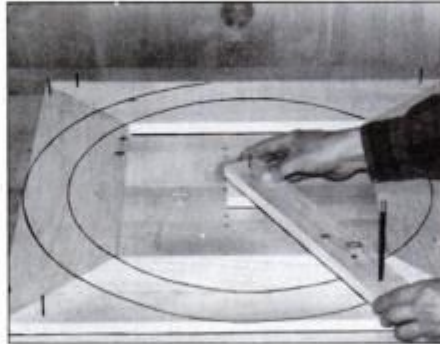
Secure the wedges permanently by pressing a $\frac{5}{8}$ -in. wire brad through each wedge and into the frame. Be sure to protect the back of the mirror with a piece of thin cardboard for this operation (Fig. 15).

Carefully pare each wedge flush

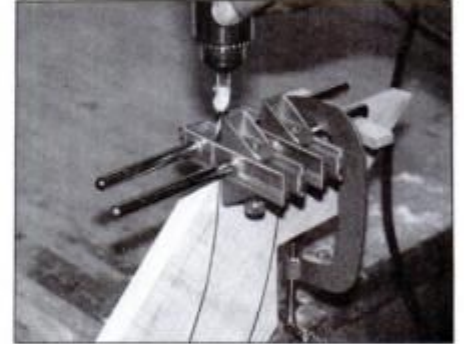
with the frame back with a sharp chisel. To protect the back of the mirror, secure a $23\frac{5}{8}$ -in.-dia., $\frac{1}{8}$ -in.-thick hardboard disc to the frame back with eight evenly spaced, $\frac{1}{2}$ -in., No. 6 fh screws. The hangers (No. D3007) are available from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374-9514. Secure picture-hanging wire to the hangers. **PM**



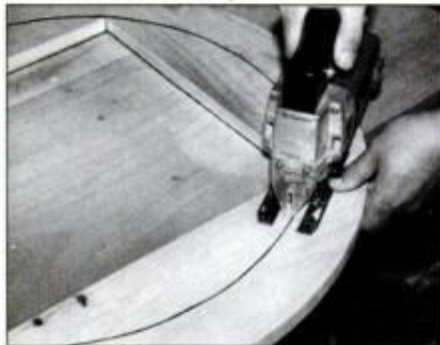
10 Hold the mirror frame stock in a jig with circular saw guide strips set at 45° . Space guide strips to cut stock exactly.



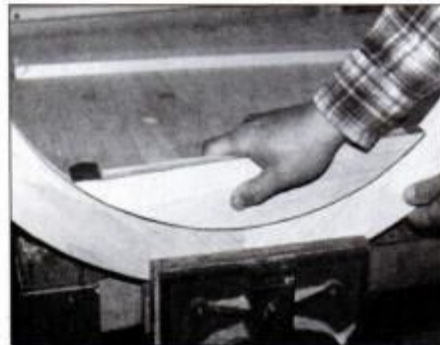
11 Tack frame pieces to worktable and lay out inner and outer circles. Lay out dowel positions and clamp notches.



12 Line up doweling jig with dowel positions and bore $\frac{1}{8}$ -in.-dia. \times $\frac{3}{8}$ -in.-deep holes. Tape on bit indicates hole depth.



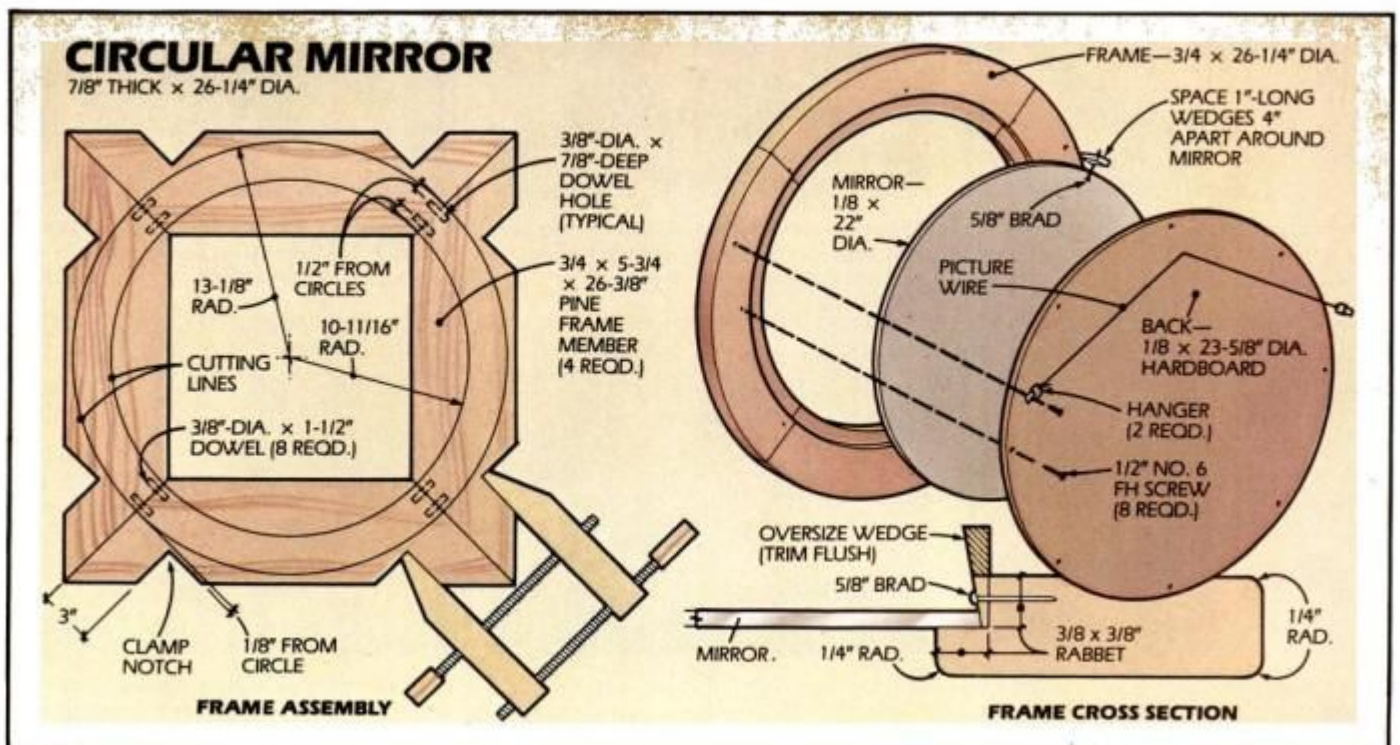
13 Use a sabre saw with fine, sharp blade to cut the circular frame shape. Save an inside cutoff to use as a sanding block.



14 Attach a strip of sanding belt or sandpaper to inside waste section and sand frame. Cut a similar block for the outside.



15 When installing wedges, protect the mirror back with a piece of thin cardboard. Press $\frac{5}{8}$ -in. wire brads in place with pliers.



Workshop Winners

We run five new tools ragged to find out what works and what doesn't.



TEXT AND PHOTOS
BY ROSARIO CAPOTOSTO
Contributing Editor

Benchtop Shop Sander

DELTA recently introduced a new benchtop belt and disc sander that's a miniature version of its large stationary finishing machine. However, don't be fooled by its compact size—this is no toy.

The 42-pound tool has a 4-in.-wide belt and a 6-in.-dia. disc that are powered simultaneously by a 1/2-hp, 4-amp motor. The 4 x 36-in. belt operates at 2000 surface ft. per minute, the disc at 3100 rpm. The sanding belt can be positioned horizontally, vertically or at any angle between zero and 90°. A 6 x 9-in. tilting cast-aluminum worktable can be used with the disc or belt. The worktable comes with an adjustable miter gauge for sanding square and mitered pieces accurately.

One of the many things that I like about the sander is that there are very few plastic parts. A heavy cast-



Position sanding-belt arm vertically to sand square ends. Check belt-to-table alignment with a square to ensure that it's exactly 90°.

iron base accounts for the smooth, vibration-free operation. I also like the belt-tensioning lever that makes it easy to change sanding belts. A



Sanding contours freehand is easy with the belt locked at an angle—about 45°. Work the piece over the rounded end of the arm.

turn-to-adjust belt-tracking knob keeps the belt running true.

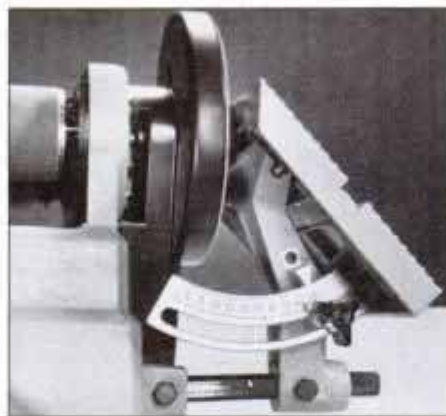
Other convenient features include a backstop fixture that bolts in place for

TOOL TESTS

horizontal belt sanding, removable ON/OFF switch that prevents unauthorized use, and a sawdust chute that accepts a shop vacuum. (An adapter fitting may be required to connect your vacuum hose to the sander.)

The one complaint that I have is that it's difficult to tighten the bolts that lock the sanding-belt arm in an angled position. One of the bolts is hidden behind the disc and to reach it with a wrench is not easy. However, the good points far outweigh the bad and for around \$173 this is a must-have item for the home workshop.

For information, contact Delta, 246 Alpha Dr., Pittsburgh, PA 15238. Or, call toll-free (800) 438-2486.



Tilting aluminum worktable is supported by heavy cast-iron arm and steel rod. Easy-to-read bevel scale has 1° increments to 45°.



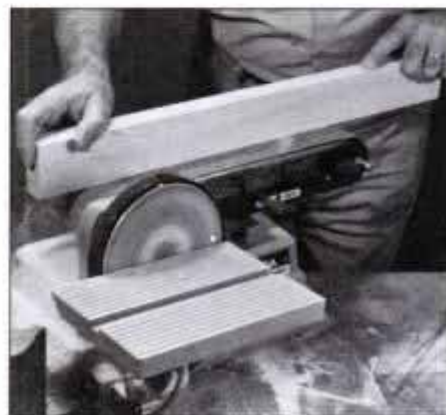
Convenient tension-release lever makes changing sanding belts quick and easy. Sander accepts 4-in.-wide × 36-in. belts.



Worktable comes with a miter gauge for sanding precise angles. Worktable can be used with disc, as shown, or with the belt.



Install backstop (arrow) when sanding with belt in the horizontal position. It supports workpiece and offers much greater control.



To sand stock that's longer than the belt's platen, remove backstop and sawdust chute shroud to permit unobstructed sanding.



Router-bit set features four cutters that are used in different combinations to produce a wide variety of crown-molding shapes. End-cape and core-box router bits are carbide-tipped.

Craftsman's Crown Kit

Crown molding is expensive and often difficult to find, especially when you're looking for a specific shape or size. But now you can mill your own custom crown moldings, with Sears 7-piece router-bit kit. The convenient kit consists of a V-groove bit, 1/2-in. carbide-tipped core-box bit, 1-in. carbide-tipped end-cape bit, 1/4-in. bead-and-chamfer cutter, and an arbor with two interchangeable pilots.

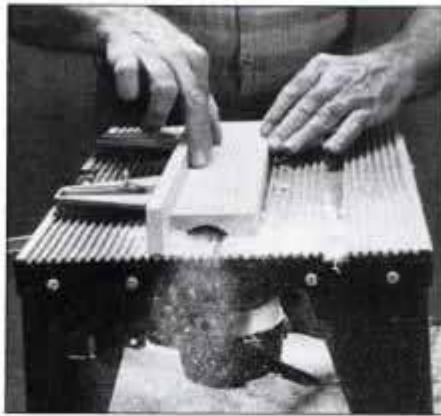
The bits are designed for use in a router table. There are various router tables on the market today, like the one shown, or you can easily make one yourself without much effort or expense (see "Easy-To-Build Router Table," page 148, April '85).

The photos show how to produce a popular-style crown molding in five steps. First, use the end-cape bit as shown in Photo 1. Make the cut in several passes. Raise the router slightly with each pass until the desired depth is reached. Then, install the core-box bit and reposition the table's fence for the second cut (Photo 2).

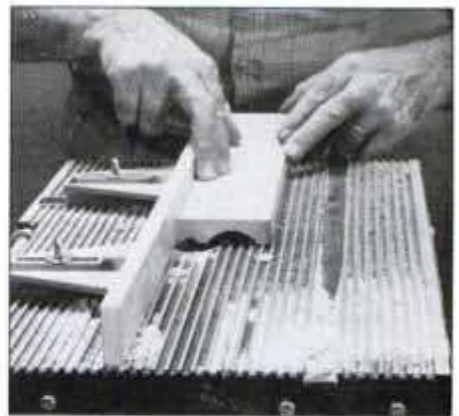
TOOL TESTS

Next, install the bead-and-chamfer bit. Adjust the bit's height so that when the board is on edge, it will rout between the two cuts made previously (Photo 3). Lower the bit, flip the board end for end, and pass the board through on its opposite edge, as shown in Photo 4. Finally, move to a table saw, set the blade to 45° and rip off the board's back corners to complete the crown molding (Photo 5).

The set costs about \$40 and is handy for producing small amounts of molding. However, this system would be very time-consuming if you needed a lot of molding. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.



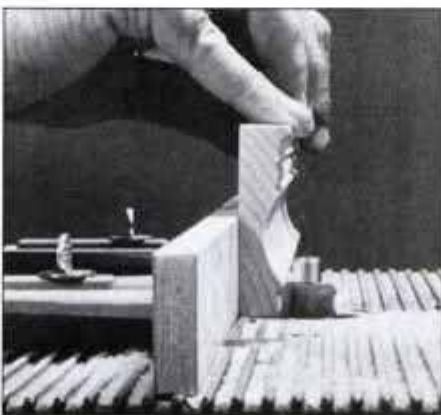
1 Using a router table, start with the 1-in. end-cope bit. Make the cut in several passes. Increase the depth of cut with each pass.



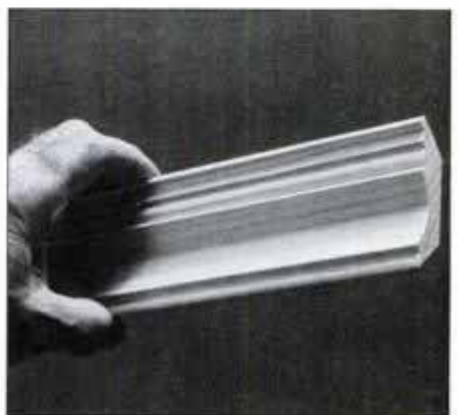
2 Reposition table's fence and install core-box bit for second cut. Increase the depth of cut gradually to form the half-round cope.



3 For the third cut, install the bead-and-chamfer bit and adjust the cutting height to a midway point between the first two cuts.



4 To rout the final shape, lower the bead-and-chamfer bit, flip the board over end for end, and rout a small bead along the edge.



5 Rip off back corners to 45° and crown molding is finished. Install it on top of a cabinet or wall for a classic finishing touch.

Go-Anywhere Soldering Gun

I recently tested the latest in cordless technology—the Ungar model 1200 rechargeable soldering gun. The unit is designed for quick soldering jobs at the workbench and wherever dragging an extension cord is inconvenient, unsafe or impossible.

The take-anywhere gun is equipped with nickel-cadmium batteries to provide the equivalent of 20 watts of power when used with the standard tip. According to the manufacturer, the gun can solder 250 typical joints on a single charge. When you install the heavy-duty tip, the gun delivers 60 watts of power to solder about 85 joints per charge. It takes about 12 hours to recharge the gun.

The kit—gun, plug-in charger and standard tip—costs about \$55. A 7-piece kit costs about \$65 and includes the gun, charger, standard tip, heavy-duty tip, flux brush/pick tool, a coil of 60/40 solder, and a plastic storage case. Contact Ungar, 100 W. Manville St., Compton, CA 90220.



Cordless soldering gun includes plug-in charger, two tips, solder and a flux brush/pick tool.



A screwdriver is all that's needed to change tips. Use the standard tip for most electrical work and do-it-yourself hobby/crafts kits.



The heavy-duty, 60-watt tip worked well on repairing this brass lantern. Use this large tip for metal repair and stained-glass work.

TOOL TESTS

Precise-Handling Saw



Benchtop scroll saw has a 16-in.-deep throat. The 5-in.-long blade is shielded by a clear plastic guard. Steel leg stand is optional.

When testing a scroll saw, I always look for three important features: ample blade-tensioning capability, perfectly aligned blade strokes, and minimal vibration of the saw's worktable. I was pleasantly surprised to find all three of these in the new Sears 16-in. scroll saw—surprised because the saw costs only \$115.

The saw is powered by a direct-drive, $\frac{1}{10}$ -hp motor that delivers 1700 strokes per minute. The saw accepts 5-in. pin-type blades; blade stroke is $\frac{3}{4}$ in. Quality construction includes a cast-iron base and cast-aluminum worktable that tilts 45° for cutting bevels. The saw can cut stock up to 2 in. thick at 90° and 1 in. at 45°. The throat capacity is 16 in., but the blade holders can be turned so that work can be fed from the side. This permits

sawing work of virtually any length.

I tried the saw for a variety of scroll cuts in stock ranging from $\frac{1}{8}$ in. to 2 in. thick and obtained good results in each case. By keeping the blade tensioned tightly and feeding the work slowly, I had no trouble keeping precisely on the line of cut. The saw doesn't have a built-in sawdust blower, which would be a convenient addition. Also, I found that the blade-tensioning knob was much too small. A larger knob would make it easier, quicker and more comfortable to adjust the tension.

The saw (model No. 23611) is sold at larger Sears stores and through the Sears tool catalog. An optional steel leg stand costs about \$22. Contact Sears, Sears Tower, Dept. 703-PM, Chicago, IL 60684.



Direct-drive, ball-bearing motor powers the saw blade at 1700 spm to produce smooth cuts even in 2-in.-thick stock, as shown.



The 8 x 14-in. aluminum worktable tilts 45° for cutting bevels. Removable LOCK-OFF button on switch prevents unauthorized use.



Blade tension is adjusted by turning knob located on top of the saw arm. A larger knob would provide a more comfortable grip.

New Breed Of Sawhorse

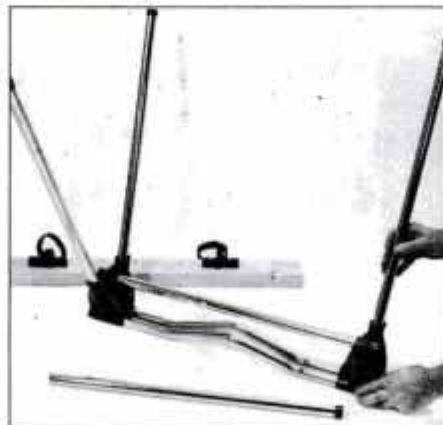
Every do-it-yourselfer knows how valuable a pair of sawhorses can be for home and shop maintenance and repair chores. Well, now there's Buckhorse—a workshop sawhorse that also serves as a scaffold support and sawbuck for cutting logs.



Buckhorse comes complete with 2x4 work surface. Entire unit can be disassembled (unit on floor) for easy transport or storage.

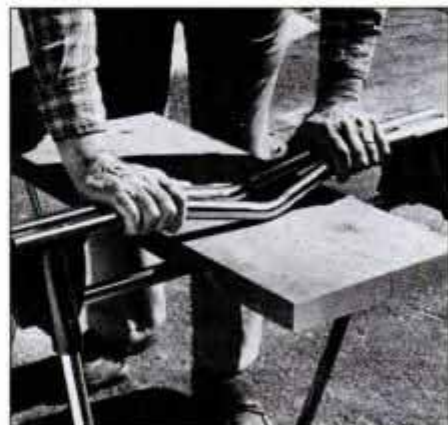
Buckhorse features chrome-plated, tubular steel legs and crossbars, plastic connector fittings with Velcro straps, and a 36-in.-long, replaceable 2x4.

The lightweight, knockdown units come two per box. Each Buckhorse is very easy to assemble and will support up to 500 pounds, according to the manufacturer.



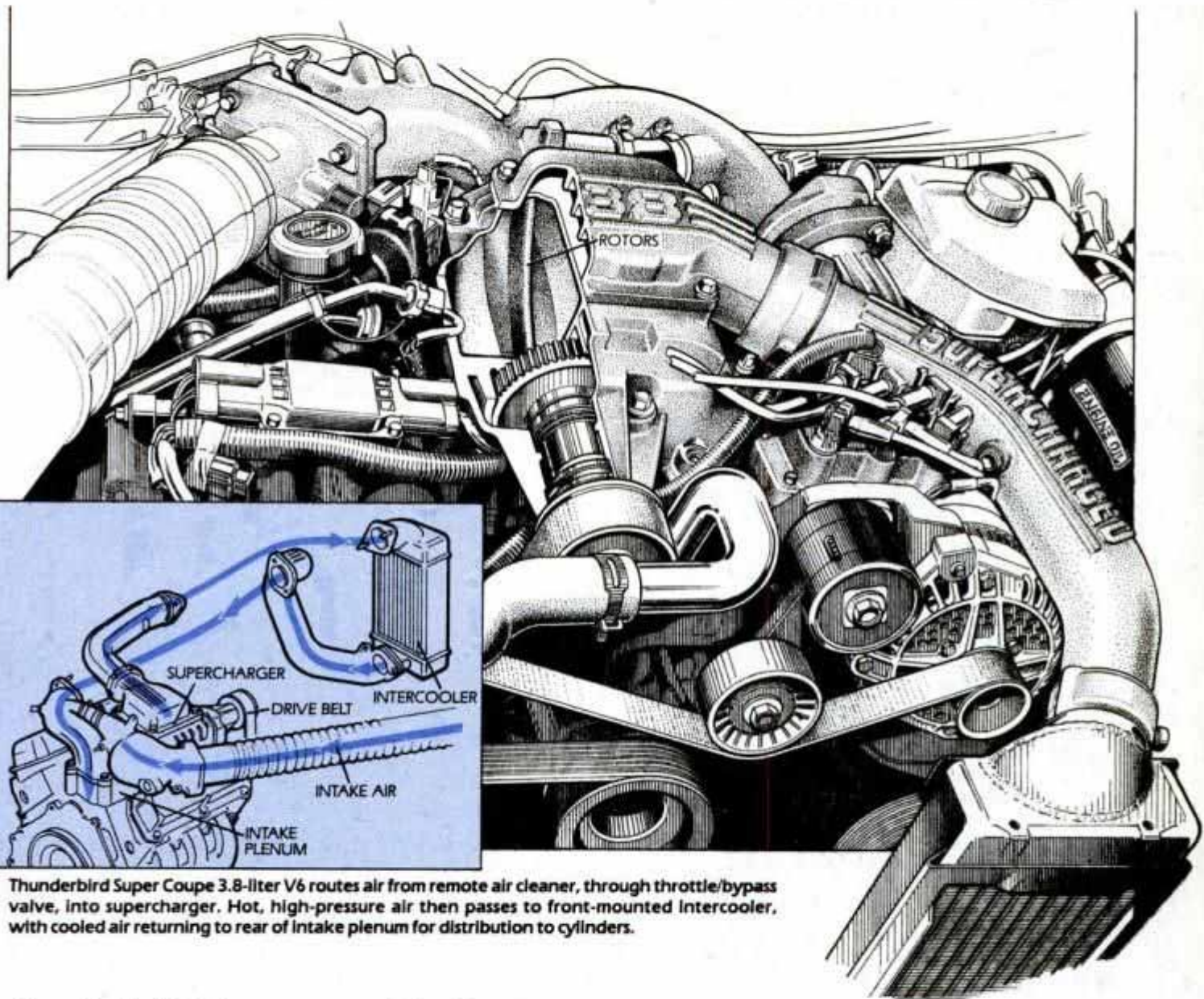
Easy-to-assemble units go together quickly. Chrome-plated steel legs fit into tough plastic fittings. Each sawhorse is 30 in. high.

With the 2x4s removed, the bent crossbars serve as a cradle for logs. To use them as a scaffold, slide a 2x12 plank under the bent crossbars and then rotate them down to hold the plank securely. A pair of Buckhorses cost about \$40 at home centers and lumberyards. For more information, contact Cosco, 2525 State St., Columbus, IN 47201. **FM**



Scaffold plank fits under the bent crossbars. Rotate the bars down to hold the plank. Each sawhorse supports up to 500 pounds.

EMPHASIS ON ENGINEERING



Thunderbird Super Coupe 3.8-liter V6 routes air from remote air cleaner, through throttle/bypass valve, into supercharger. Hot, high-pressure air then passes to front-mounted intercooler, with cooled air returning to rear of intake plenum for distribution to cylinders.

America's 1989 new-car story goes well beyond skin deep.

NOW THAT you've seen how the designers have shaped Detroit's '89 lineup, take a look at the new parts, pieces, systems and powerplants that the Motor City engineers have installed under the sleek new sheetmetal.

Ford

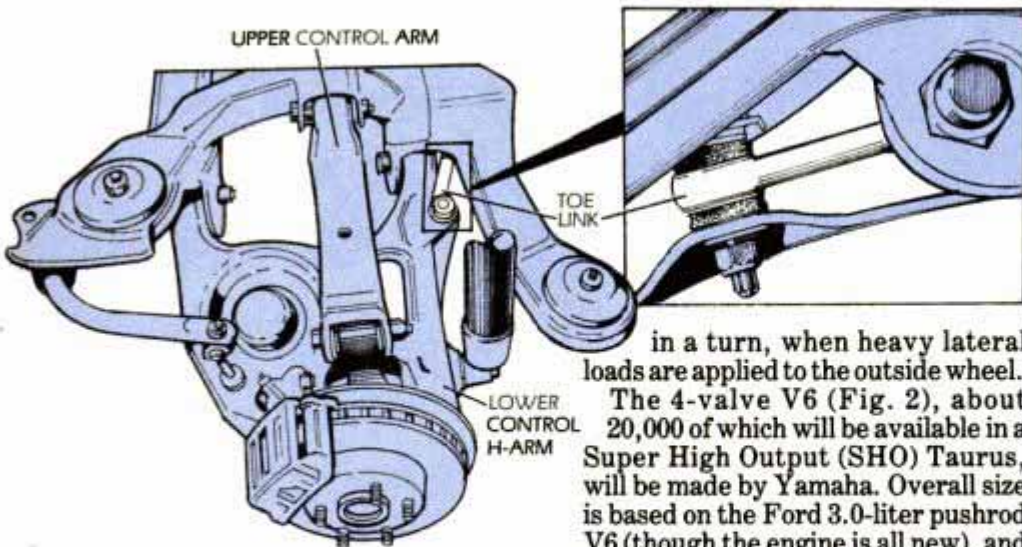
The horsepower race between Ford and General Motors (and some imports) is on again, with a high-tech touch. For '89, Ford will be offering superchargers, 4-valve V6s and dual-sparkplug Fours.

The 3.8-liter V6 in the new Thunderbird and Cougar gets the optional supercharger, a Roots type (counter-rotating rotors instead of a spinning wheel). It boosts horsepower by 35 percent and torque by about 20.

The 3-lobe rotors are helical instead of straight, for quiet operation. They compress the air and push it through an intercooler to lower the temperature of the air, making it denser.

Unlike a turbo, the supercharger provides instant throttle response. In fact, there's so much boost that, at the low end, a fair bit has to be bled off. Peak boost is 12 psi at about 4000 rpm.

The 3.8 super is beefed up with deeper main bearing caps and larger



1 Rigid mounting of T-Bird/Cougar toe link preserves ride and prevents oversteer.

bolts to a stronger bulkhead in the block. The cylinder head is thicker and the crank is made of a higher-strength iron. The pistons use a hypereutectic aluminum-silicon alloy that can take more punishment.

A king-size, 400-watt, 2-speed electric fan is at the heart of the cooling package. An 84-amp battery and 110-amp alternator are standard on the super package.

The engine is missing a couple of items that have been part of the normally aspirated 3.8: The distributor (replaced by a solid-state system) and the balance shaft (rear-drive cars don't have a shake problem and leaving out the shaft saves weight).

The supercharger draws up to 60 horsepower at peak boost, so the power isn't free as on exhaust-driven turbos. However, it more than makes up for the draw, which drops to nearly zero in normal cruising.

To keep the Thunderbird/Cougar rear end from oversteering at high speed when backing off the throttle or jamming on the brakes in a turn, Ford is using a toe link in the independent rear suspension (Fig. 1). The toe link attaches to the lower control-arm joint on the rear subframe and an outboard section of the arm. When a load is applied to the rear suspension, this design prevents the rear wheels from toeing out against the bushings in the control arms. In fact, it forces the wheels to toe-in slightly, providing a mild rear-wheel-steering effect.

Ford could have accomplished the same thing with stiff bushings in the rear, but the result would have been a harsh ride.

The benefit to handling is felt only

in a turn, when heavy lateral loads are applied to the outside wheel.

The 4-valve V6 (Fig. 2), about 20,000 of which will be available in a Super High Output (SHO) Taurus, will be made by Yamaha. Overall size is based on the Ford 3.0-liter pushrod V6 (though the engine is all new), and it has a cast-iron block and aluminum heads. There are twin-overhead camshafts—one for intake valves, one for exhaust—operating directly on solid lifters for the valves. This engine, which also provides 0-to-60 times of 7.5 seconds, produces more peak horsepower—220 at 6000 rpm—than the supercharged 3.8, but much less torque (200 lb.-ft. at 4800 rpm).

The intake manifold has two tuned runners to each cylinder: one for low speed, a second—with a secondary throttle valve—for high speed. At

3950 rpm, the engine computer signals a solenoid, the secondary throttles pop open and the car takes off.

Like the supercharged 3.8, the SHO 3.0 has distributorless ignition.

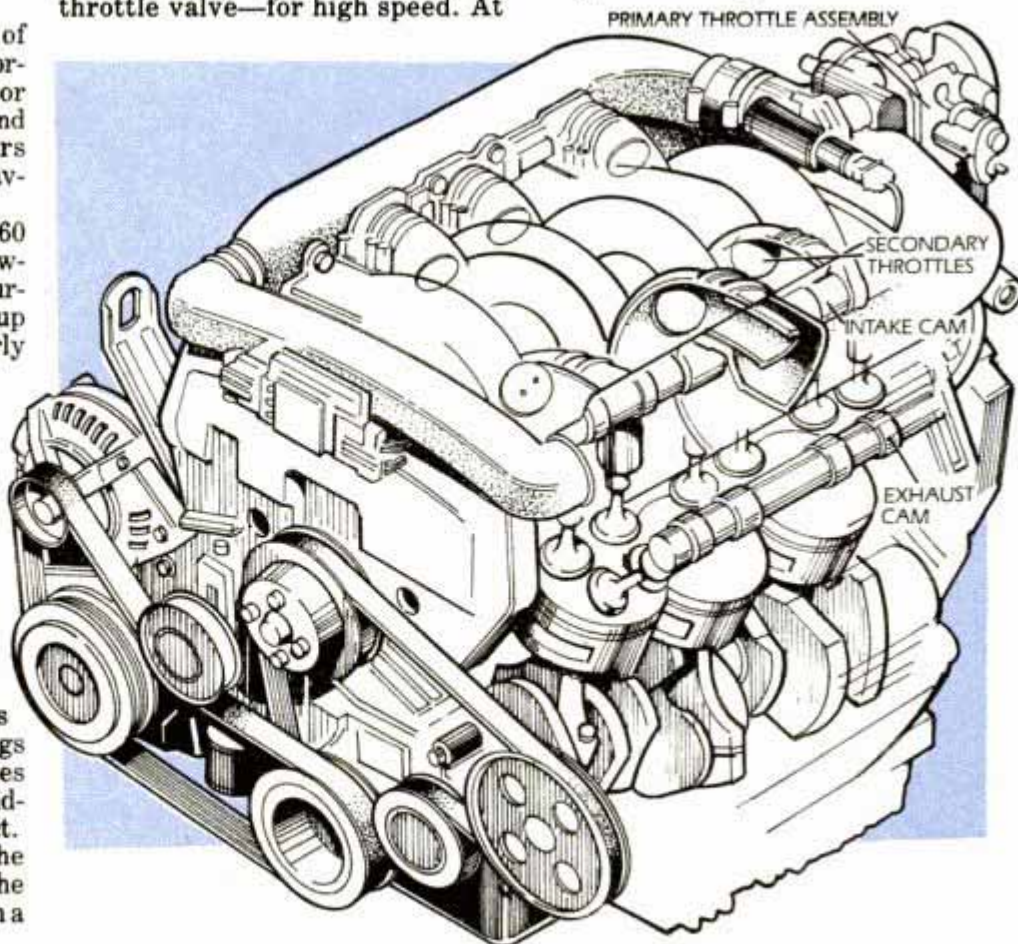
The 1989 Ranger dual-plug 2.3-liter 4-cylinder boosts horsepower by 6 percent (from 90 to 96) and torque by 8 percent (130 to 140 lb.-ft.).

There's more to this than four extra sparkplugs. The shrouds were removed from the intake valves, which eliminates them as a factor in mixture swirl (they were overly restrictive) and the intake runners for cylinders 1 and 4 were straightened to even out the swirl from the manifold, for an even burn rate in all cylinders.

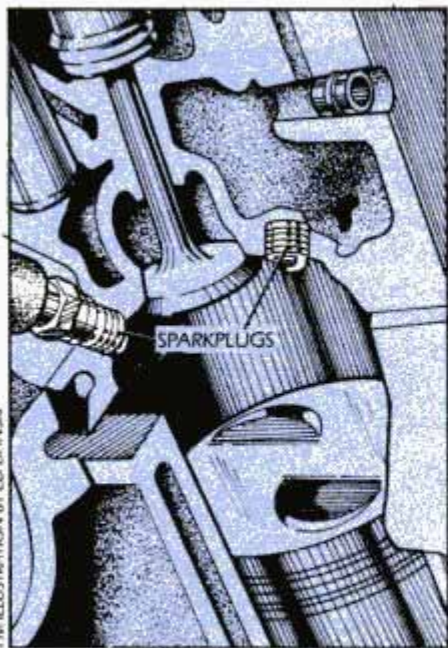
However, straightening the No. 1 runner meant the distributor wouldn't fit, so Ford made an early switch on this engine to distributorless ignition.

The original four plugs are on the exhaust side of the chamber, the new ones are on the intake. They fire simultaneously (Fig. 3).

Ford converted its C-6 3-speed automatic to an electronically controlled 4-speed overdrive, for F-trucks, Econolines and some Club Wagons with large V8 and diesel en-



2 Taurus SHO engine has computer-operated secondary throttles for extra top-end power.



PM ILLUSTRATION BY ED LIPINSKI

3 Twin sparkplugs mean better fuel burn, more horsepower on Ford's 2.3-liter engine.

gines. The transmission uses a bank of four solenoids located in the valve body and wired to the engine computer, to apply signal pressure to the valves. Two of the four signal upshift and downshift, a third applies and releases the torque converter clutch and a fourth activates a coast clutch.

The transmission was a good choice for the precision of electronics, as it's a synchronous design (no need to precisely apply clutches and/or bands simultaneously for shifts, which can lead to shift roughness). The electronic sophistication eliminates a modulator or throttle linkage (the vehicle speed, throttle position and other engine sensors are used by the computer). And the converter clutch operation can be more precisely tailored to the shift patterns, such as being kept on during a light downshift.

Chrysler

Chrysler may not be in the horsepower race, but it has a clear lead in the application of electronics to front-drive transaxles. A new design, mated to the Mitsubishi 3.0-liter V6, is the first application of complex, high-speed digital computers to automatic transmission shifting.

The powerful computer (32k ROM, 384k RAM) monitors lever position, speed and pressure sensors in the transaxle, plus a host of engine sensors, and operates a bank of four solenoid valves to give shift quality the long-term consistency of electronics (Fig. 4). Unlike others, this one can kiss a tough shift so you hardly feel it,

including the always-problematic torque converter clutch.

Early models will diagnose about 30 failures, but as soon as Chrysler engineers get some experience with the software, everything is in place to allow the system to also check the condition of the mechanical components, such as the pump and clutches.

The four solenoids with shift valves control five clutch packs in the two planetary gearsets (there are no bands in this transaxle) and the lock-up clutch in the torque converter. Because the solenoids act directly on shift valves, they are heavy-duty units that can make the simple on/off move and also flutter to modulate the application of a clutch. The solenoid valves are hardened steel designed to digest dirt and still keep going.

Unlike other gearboxes (including those with shift solenoids), shift quality is determined by a few solenoid-valve assemblies and the electronics. Compare that with the fit of dozens of valves in a standard valve body. The initial Chrysler effort has been for smooth shifts, but the electronics can also provide crispness.

Although two solenoid valves are normally open and must be applied by

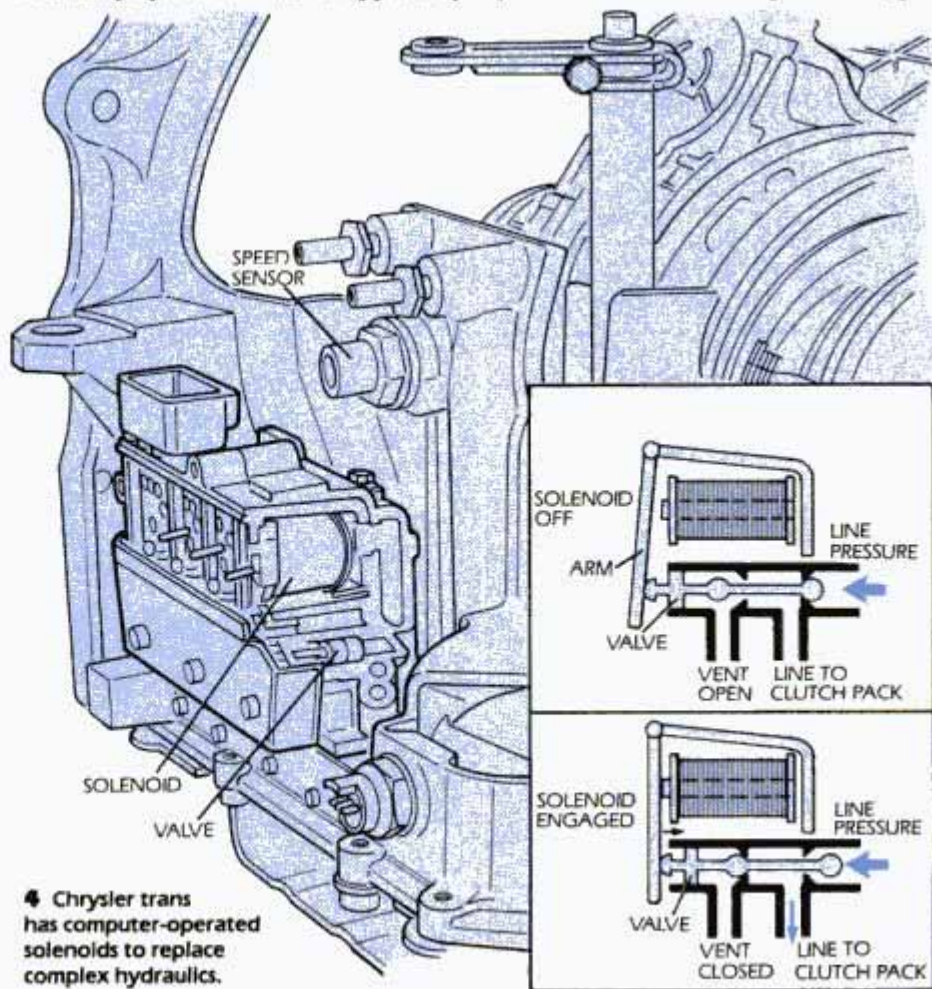
the solenoids, the other two are normally applied. These solenoids must be energized to disengage the clutches, so if there's an electronics failure, the transmission defaults to Second gear for a "limp home" mode.

■ Chrysler is trying to quiet the idle of its 2.2/2.5-liter Fours with sound-damping plastic layers in metal sandwiches of the oil pan and nonturbo cam cover (Figs. 5 and 6). The turbo cover is already a quiet design.

General Motors

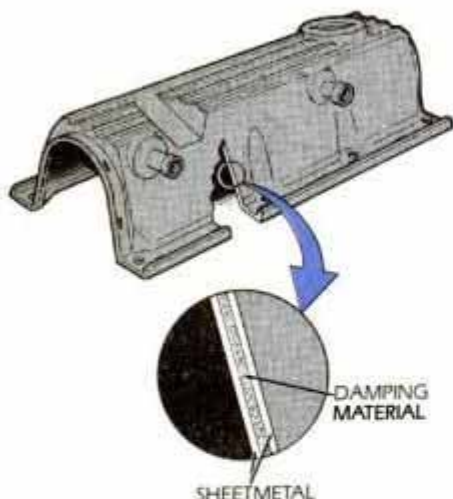
GM intends to win the '89 horsepower race, and it has a 385-horse 32-valve V8 for Corvette to lead the way. The Lotus-designed engine, to be built here by Mercury Marine, meets all fuel economy, noise and emissions standards, yet provides a 0-to-60 time of just 4.2 seconds.

There are two intake and two exhaust valves per cylinder, but one of the intakes (designated as the secondary) is usually along for the ride. The engine features a sophisticated intake system with 11 throttles, three on the throttle body and one each for the ports to the secondary intake valves. The throttle body plates and eight injectors handle normal operation (up to



4 Chrysler trans has computer-operated solenoids to replace complex hydraulics.

PM ILLUSTRATIONS BY HANK IKEN



5 Sandwich of rubbery damping material quiets 4-cylinder Chrysler 2.2/2.5 engines.

about 200 horses), as the engine uses one intake and two exhaust valves per cylinder. At 3950 rpm the computer pulls open the remaining eight throttles and triggers all 16 fuel injectors. A key-operated secondary system lockout on the dashboard restrains parking-lot jockeys.

Virtually all engine castings are aluminum, including the separate cylinder liners, which are of a wear-resistant alloy. Each V8 bank has chain-driven intake and exhaust camshafts. The valve covers are of wear-resistant aluminum and the upper camshaft bearings are part of it.

The eight centrally located spark-plugs—in a cloverleaf-shaped chamber of pentroof design—are fired by a distributorless ignition system with four double-end coils.

The compression ratio is 11.25:1, but the fast-burn chamber prevents detonation even with unleaded regular. Knock is detected by a sensor and canceled by a timing retard.

The crankcase is a 2-piece design, with the lower part actually a saddle for the main bearing caps, which are cast-iron inserts in the aluminum.

The design is surprisingly compact. Even the space between the V8 banks is used—to hold the alternator, a/c compressor and starter.

A German ZF 6-speed manual helps beat the gas-guzzler tax. At low speed and light throttle, a computer ejects a solenoid plunger, which enters a dogbone slot in a shift rail bracket (Fig. 7). When the driver pulls back on the shift lever, the set causes the rail to rotate slightly and the shift lever skips Second and goes down into Fourth, which is direct drive (the engine develops about 300 lb.-ft. of torque at light throttle). The two top gears are Overdrive.

■ Pontiac will offer two V6 turbos, including GM's first transverse job, a water-cooled Garrett on the 3.1-liter V6 in a McLaren Grand Prix SE. It boosts horsepower from 140 to 205, and peak torque (225 lb.-ft.) is developed at 1500 rpm.

Employing an aero turbine wheel for fast pressure buildup, there's almost no lag in this turbocharger and the setup feels like a V8.

The other turbo, by Prototype Automotive Services, is on the 20th anniversary edition of the Trans Am, a 3800 V6 with 245 hp and 340 lb.-ft. of torque.

Other key GM power boosts:

■ Camaro and Firebird V8s pick up 10 hp from a low-restriction dual-catalyst exhaust.

■ GM cars using the 2.5-liter Iron Duke Four will pick up 12 hp, to 110, late in '89. Valve ports will be reshaped and the foundry work was given to John Deere, which does a super job of casting, to prevent airflow-restricting flash inside the ports.

■ A 3.3-liter version of the 3800 3.8-liter V6 goes into the Buick Century and Skylark, Olds Ciera, Calais and wagons. It makes 160 hp and 185 lb.-ft. of torque, versus 125 hp and 165 lb.-ft. for the 3.0-liter V6 it replaces.

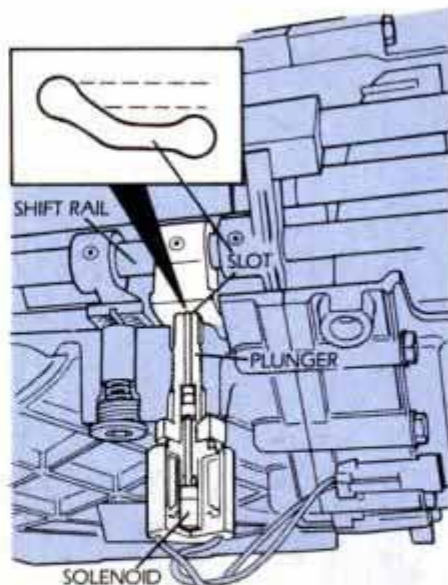
■ The Oldsmobile 2.3-liter Quad 4, which produces 150 hp in standard trim, will be available in a freer-breathing 180-horse version in the Calais, Grand Am and Skylark.

■ The '89 Cadillac Allante gets Mercedes-fighting power with a sequential port fuel-injected version of the 4.5-liter V8, boosting horsepower from 170 (for the old 4.1-liter version V8) to 200 hp. This also means that Allante, at 20.5 mpg slips (by 2 mpg) into the gas-guzzler category. GM okayed this exception to its no-guzzlers rule by calling the Allante an import.

■ To help the gendarmes keep pace,



6 Even the steel oil pan benefits from added sound-deadening material.



7 Vette trans uses solenoid to change shift pattern according to computer's input.

Chevy is working to complete a police pursuit version of the Caprice, using the 454-cu.-in. V8. This, too, is exempt from the gas-guzzler rule.

■ Just as the Corvette driver gets a choice of power levels, he can buy an optional electronic ride control with a choice between Touring (soft), Sport (typical Corvette) and Competition (rock hard). The driver picks the ride with a dash knob, but the computer makes up to six changes in shock valving according to road speed.

■ The Olds Toronado upstages the black/white TV tube of the Riviera with a color Sony. Both tubes are part of computer information systems that even permit the driver to program in personal memos.

■ The Cadillac de Ville/Fleetwood line gets Electri-Clear, GM's first electric de-icing for the windshield. Unlike the glare-ridden golden sheen of the Taurus/Sable, this one has a tint. And there's a special alternator so the battery can be charged while it's operating.

■ Head-Up Display, in which road speed and some other instrument readings are projected into the driver's field of view, will be a late-introduction option on some Olds Cutlass Supremes and Pontiac Trans Ams.

■ Express-down windows will appear on the driver's side of a number of '89 GM cars, and the Allante will have it on both windows. Also an option on some models will be a remote door unlocking system that works from almost anywhere within a 30-ft. range when you press the key fob. The Japanese pioneered bells and whistles, but it's clear that Detroit can provide those neat convenience items that almost everyone likes. ■

PEOPLE WRITE TO PENNZOIL®

Straight answers from the automotive experts.



Worn Out?

Q. I have noticed that after driving around town for a few months, the engine will use a quart of oil after the first few hundred miles of highway driving. Does this mean the piston rings in my 1985 Chevrolet are worn?

B. R., Surry, B.C.

A. Not necessarily. Oil consumption rates depend on several factors. Oil viscosity, engine speed, driving conditions, temperature, fuel dilution and oxidation of the oil. A vehicle that is driven for long periods of time under city driving conditions may consume a normal amount of oil, yet appear to use little. This is because the fuel has diluted the oil from crankcase blow-by gases. Then, after a period of high speed driving, the fuel "boils" out of the oil. The end result is that the engine appears to have consumed an excessive amount of oil in just a few hundred miles.

Diesel Dilemma.

Q. Within 25 miles after an oil change, the motor oil in my passenger car diesel engine turns black. What causes this?

N. S., Rio Rancho, N.M.

A. It is perfectly normal for the crankcase oil in a diesel engine to turn black within a few miles after an oil change. This change of color is due to diesel soot, a product of combustion from diesel fuel which blows past the piston rings in small amounts. Since this is a normal condition, there is nothing for you to be concerned about. You should continue to change your oil at specified intervals.



By Don Johnson

*Vice President, Product Engineering,
Pennzoil Products Company*

Level of Danger.

Q. I would like to know why, when checking the level of transmission fluid, the engine should be hot. Also, why is it dangerous to overfill?

H. B., Hicksville, NY

A. When any fluid is heated, it will expand in volume. Therefore, there must be enough space in the transmission for the hot fluid to expand. If the engine is not hot, there is a greater possibility of overfilling the transmission, since the cold fluid will not expand. Overfilling will result in an over-heated transmission and possible internal transmission problems.

Idling.

Q. When warming up a cold engine, is it better to let it idle for a while, or drive off after a couple of seconds?

T. P., Milwaukee, WI

A. It is far better to drive your automobile at moderate speed to warm it up quickly, rather than allow it to sit and idle.

Can't Handle the Pressure.

Q. After a few miles of driving, the oil pressure in my car suddenly drops. I've checked the main and rod bearings, and they're not worn. I've also checked the hydraulic valve lifters, and they're not noisy. Do you think if I disassembled and cleaned the valve lifters, it would help alleviate the oil pressure drop?

J. H., Conrad, MN

A. A small gradual decrease in oil pressure after the oil warms up is normal. If your valve lifters are not noisy, they must be clean and free of varnish. So it's not necessary to clean them. Oil pressure is registered from the main and rod bearings, so clearance of the lifters would have no effect. Since you have low oil pressure and the bearings are not worn, it could be due to a worn oil pump or a faulty pressure relief valve in the system. We recommend that these areas be checked first. To some extent, a heavier weight of oil could increase oil pressure. You may want to try the next higher SAE viscosity grade oil above the viscosity you are now using, if permitted by the vehicle manufacturer.

WE'RE OPEN TO QUESTIONS

about motor oils, lubricants and engines. But, you can tell us a few things, too. Maybe you've discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Don Johnson, Pennzoil Products Company, P.O. Box 2967, Houston, TX 77252-2967.



World Class Protection™



Firsthand Drive Report

Volkswagen Passat

TEXT AND PHOTOS BY MIKE ALLEN, Assistant Auto Editor

VW's PAST efforts to bring a midsize car into the U.S. have brought us a flock of smaller Audis, disguised in Wolfsburg clothing, and at Audi-level prices, too. That's changed: The new Passat, which unfortunately won't be available until sometime in 1990, is all VW, inside and out, and should come to market with a price tag that's more modest than the new Audi 80/90 series. Pricing for the U.S. versions won't be decided until just before the car is released, thanks to the volatility of currencies nowadays. Bet on it being at least a couple thousand bucks more than a Golf or Jetta.

Passat, previously known in the U.S. as the Quantum, is most easily described as a grown-up Jetta.

The European versions we tested—in Nice, France—came with the 16-valve motor from the GTI 16V and the Golf/Jetta's 8-valve powerplant, both of which are proven, reliable pieces. The suspension uses struts and a beefed-up edition of VW's familiar torsion beam rear axle.

Similarly, the new 5-speed manual transaxle is scaled up from familiar

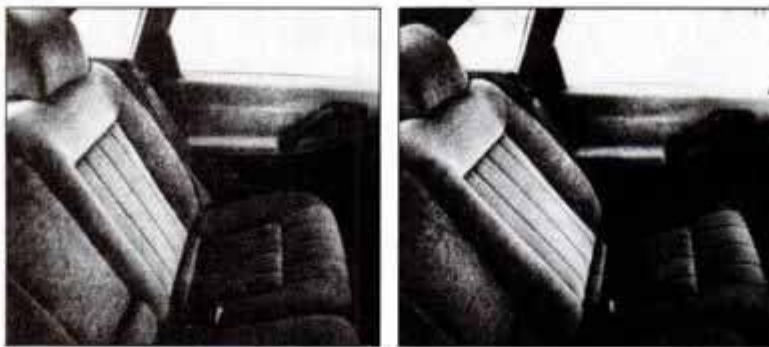
parts, with a cable-operated shifter. It starts out a little less precise in feel than the rod-and-bell-crank style used on the Golf, but hopefully will

hold up better as the miles roll on.

The handling is crisp, with no bad habits, other than a tendency to smoke the inside front tire in First and Second gear under full-throttle cornering. Seat-of-the-pants acceleration feels pretty good even with the conventional 8-valve engine. The 16-valve version trades midrange torque for a brilliant upper register that isn't really necessary most of the time. It is fun all of the time, but you might be better off buying a GTI for fun. What the Passat is good for is hauling

around four full-size adults in adult-level comfort. The rear-seat head and legroom are readily the largest we've ever seen in a car of this class. The rear seat even reclines several inches, by shifting the base of the seat forward, which wouldn't work at all if there weren't knee room to spare.

An automatic transmission will be available, probably, by the time Passats are released here. The new 5-speed is upgraded in capacity from the Golf gearbox, undoubtedly to accommodate VW's narrow-angle V6 that may be ready by the time the car comes here. **PM**



Passat's spacious rear seat reclines by sliding the bottom forward several inches, leaving plenty of legroom, even with a tall driver up front.

VITAL STATISTICS

| | |
|------------------|---|
| ENGINES | SOHC 1.8L4/DOHC 16V 2.0L4 |
| HP/TORQUE | 107 hp, 113 lb.-ft./ 136 hp, 132 lb.-ft. |
| TRANSMISSION | 5 spd. manual |
| SUSPENSION (F/R) | Struts/torsion beam axle |
| BRAKES (F/R) | Discs/drums (1.8L), 4-wheel discs (2.0L) |
| TIRES | 185/65R14 |
| STEERING | Power rack & pinion |
| WHEELBASE | 103.3 in. |
| LENGTH/HEIGHT | 180/56.2 in. |
| WIDTH | 67.0 in. |
| TRACK (F/R) | 58.2/56.0 in. |
| CURB WEIGHT | 2420 pounds |

BIG-LAKE WARRIORS

(Continued from page 81)

supported port-side rod locker that caved in after being stepped on, eight lockable compartments that required a full ring of keys, and a long reach to stern trolling motors.

On the plus side, the Starcraft has seven built-in rod holders, carpeted side decks and a built-in tackle box.

Grumman GSC 164 DLX

This was another boat that arrived without cutting-edge rigging. Missing, for example, was lockable rod storage, which is listed as standard equipment, and, inexplicably, a non-standard wraparound bow rail was installed, even though it gets in the way.

Nevertheless, the Grumman was our hole-shot champ and finished a strong third in usable deck space. It was also our value leader, sporting the fleet's lowest price tag.

The biggest problems we found were in rough water, where the boat gave a bone-jarring ride and threw geysers into the driver's face. Other problems were minuscule stowage and a limiting transom cutout.

On the plus side, the boat has padded vinyl sides, carpeted side decks and bow casting platform.

Tuffy Pike Rampage

Although the Tuffy we tested is a dedicated fishing boat, it's intended for casting rather than trolling. This caused a few problems when compared to true walleye boats.

The fiberglass hull had the fleet's largest usable deck space. Hole shot, which ranked fifth, and stowage, fourth, weren't far from the leaders. All other categories, however, were well off the pace.

The hull is best described as a modified cathedral hull and the result is a flat bottom that gives a jarring ride in rough water, although it's relatively dry due to reverse chines.

The biggest problem was performance-course handling, where extreme cavitation robbed power as the boat skittered through turns. Also, a stern-heavy profile took water over the transom and caught wind.

Tuffy reports that its new 180XT Sportsman is more dedicated to walleye fishing. We've seen the specs and are inclined to agree.

Five years from now, many people predict tournament walleye fishing will be as big and exciting as bass fishing is today, with a wide range of equipment designed specifically for the sport. The boats in our test are the current walleye leaders and are likely to set standards that future designs will be measured against. **FM**



This photo was taken in front of Warehouse #2 in the summer of 1955 at Jack Daniel's Distillery.

IN 1955, a young Jack Bateman learned about how to make Jack Daniel's Tennessee Whiskey at Lant Wood's knee.



Then, he applied what he learned from Mr. Wood for the next 33 years at our old time distillery. Today, as an elder himself in the Hollow, Mr. Bateman does the talking and teaching. Younger men (like Bob Hobbs here) listen and learn. And old time traditions are allowed to continue—deep in the Tennessee hills—where change occurs but continuity prevails.

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TENNESSEE WHISKEY

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ing together tears in the intestine and colon. Dr. Douglas Dew of the Orlando Regional Medical Center's Laser Research and Demonstration Center got an IBM PC AT to help him figure out the fine line between tissue fusion and tissue charring. His program catalogs 80 different tissue types, taking the guesswork out of what wavelength to use and for how long. Human experimentation with the technique is expected to be approved within the year.

■ Investigators at Massachusetts General Hospital have developed a treatment that uses short bursts of light from a dye laser to break up kidney stones. The procedure is a step beyond the so-called kidney stone bath, or lithotripsy, that breaks up the obstructions with ultrasound shock waves, say researchers. Stones below the waist are not susceptible to the bath technique because they're shielded by the pelvis. The beam is passed through a fiber threaded through the ureter. Fragments of the stone are removed in a tiny basket or passed through the urine.

■ In Japanese clinics, doctors have already begun using photoradiation therapy (PRT) in early-stage lung cancer. A dye is injected into the blood, and excreted by all but the cancerous tissue. When irradiated by a dye laser, the chemical changes configuration into a substance highly toxic to malignant cells but harmless to normal tissue. The same technique was tested on 14 patients with skin cancer at the National Cancer Institute of Milan, Italy, with complete remission of the tumor reported in 11 of the 14 cases. The FDA has approved human experimentation in the United States on cancers of the bladder, skin and lung.

"The bottom line," says laser advocate Stephen Fry, Ph.D., "is that lasers save costs. They cause less patient trauma, thus less hospital stay. It allows us to do noninvasively—or less invasively—something that required opening up before. Laser allows us to do things we couldn't do before."

PM

BEYOND THE BLADE

(Continued from page 77)

UCLA Medical School—"breaks up the intermolecular bonds, decomposing matter, allowing exquisitely precise surgery through holes so small they don't need stitches."

Summit Technology, a pioneer in medical laser devices, has produced ExciMed UV 300, an intriguing new entry in the excimer field. Xenon and chlorine in ExciMed's lasing medium are stimulated and combine to produce an excited dimer, or excimer. When the gases return to a disassociated state, their electrons emit photons of light in ultraviolet wavelengths. A helium-neon pre-laser is used to aim the nonvisible UV light.

With an excimer, patients undergoing eye surgery to repair errors of corneal refraction needn't fear the thermal effects or shock waves associated with conventional lasers. The excimer doesn't even touch the cornea. It merely vaporizes the molecular links that bond the tissue using cool UV light. Twelve seconds of laser exposure cuts tissue that once required 30 minutes of careful alignment using a diamond/sapphire scalpel.

Beyond ophthalmology

The ultimate seems to be within reach in many other areas.

■ Research in the United States, Japan, Denmark and Italy shows that low-power lasers are effective in treating arthritis pain and stiffness. The procedure is known as biostimulation. A study at the Neurological Institute of Nevada at Reno found that of 272 patients treated with a YAG laser for chronic pain from rheumatoid arthritis, 80 percent had less pain, better mobility and some even reduced the use of painkillers.

■ The laser is also being used as a welding device, solder-

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BEL TECHNOLOGY DETECTS NEW Ka BAND (PHOTO RADAR)

Don't Be Left Defenseless. Drive With BEL VECTOR 3 Radar Detector.

 Ka Band is the new police radar frequency now in use. And only the new BEL radar detectors are able to detect Ka Band.

Facts You Should Know

The Federal Communications Commission has approved Ka Band for police radar use. And now, many localities in the U.S. and Canada are using Ka Band Photo Radar. But the use of Ka Band isn't limited to picture-taking radar equipment. Standard police radar units can also utilize Ka Band. And as more states quietly introduce Ka Band radar, drivers with only X and K Band radar detectors are left defenseless. Unless they're driving with the new VECTOR 3.



VECTOR 3 comes with everything you see here.

No Quick Fix

Your existing X/K Band radar detector can't be adapted to receive Ka Band signals. For the level of protection VECTOR 3 offers you have to look to the technology leader. The first in the industry with 3 Band technology: BEL-TRONICS.



VECTOR 3 measures only 4.66" L x 3.19" W x 1.095" H.

Greater Detection Range

VECTOR 3 detects X, K, and Ka Band radar. And that's significant. But there's more, it's called Image Rejection Technology (IRT[®]). BEL engineers have incorporated this technology into VECTOR 3. The result is incredible performance and greater detection range of all police radar.

VECTOR 3 Knows

VECTOR 3 is a "smart" travel companion. It warns you when X, K, or Ka Band radar is present with separate audible and visual alerts. It also provides a special audio alert when the radar signal transmitted is Pulsed or Instant On. And for added protection, VECTOR 3 is programmed to advise


VECTOR 3 Remote

The advanced technology and performance advantage of the VECTOR 3 is also available in a remote design for only \$299.95. VECTOR 3 Remote utilizes a compact antenna for easy "under-the-hood" installation. And a very small control panel for discreet positioning in any vehicle.

you should its radar detection circuits ever require adjustment. With VECTOR 3, you'll never question whether radar is present.

At Your Service

VECTOR 3 was designed to make early detection of police radar easy and convenient. You can own the new VECTOR 3 today for only \$279.95. Just call toll-free to order. UPS delivery is FREE. Or ask about our Federal Express overnight service. If not completely satisfied, simply return the unit within 30 days for a full refund (factory direct only). VECTOR 3 comes with a full 1 year warranty on parts and service.

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1-800-268-3994 Canada



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Loctite Corporation
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Cleveland, Ohio 44123

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TOURING THE DEEP

(Continued from page 70)

Inside tech

Beyond innovations necessitated by acrylic construction, *Gemini* is a state-of-the-art submersible, with these modern features:

■ Reversible vertical thrusters mounted in the upper fairing. *Gemini* has strong positive buoyancy, and vertical thrusters are another way, beyond pumping water ballast, to maintain station in the vertical column just like a hovering helicopter.

■ Brushless DC motors powering the thruster propellers. Metcalfe considers these as important as the acrylic spheres. "A major headache in the past," he explains, "was that after a day of diving you'd be guaranteed to spend 3 hours servicing the thrusters, because the brush material breaks down." Submersible motors reside in oil-immersed chambers, with a flexible diaphragm on one side to equalize internal and external pressure.

■ Batteries housed in pressurized—rather than oil-immersed—pods. *Gemini*, like most submersibles, runs on lead-acid batteries linked serially in cylindrical pods.

■ A frame made of stainless steel instead of aluminum, allowing operators to leave the sub in the water for weeks without worrying about the deleterious effect of corrosion.

■ Digital control panels, including navigation and communication instrumentation.

Aries will share most of these features with *Gemini*—except for the battery pods, which will fit beneath the seats. Since a cylinder can't buttress itself against pressure as well as a sphere, *Aries'* hull is reinforced with steel ribs. Despite the 250-ft. depth limitation, the craft has drawn more interest from potential tour operators because of the 46-passenger payoff.

"*Aries* is a shotgun approach to the tourist market," says Janca. "But also not everyone has 1000 ft. of water in his backyard like we have in Cayman. *Aries* would be ideal for a site in the Mediterranean, while *Gemini* would be good for the Galapagos Islands or deep-water basins in the Pacific."

Who's buying?

While *Aries* is strictly a tourist vehicle, Hyco hopes *Gemini* will lure commercial, scientific and military purchasers. The acrylic spheres allow 360° visibility, ideal for exploring unknown deep-sea locales. According to Metcalfe, several navies have expressed interest in adapting *Gemini* as a deep-water rescue vehicle. And because her acrylic hull would present

(Please turn to page 108)

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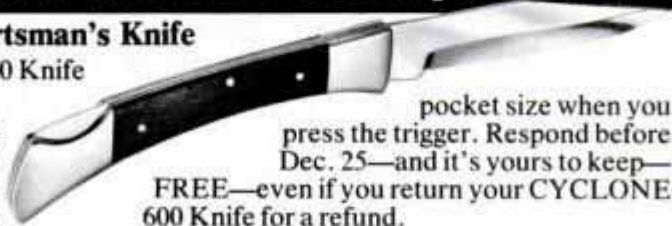


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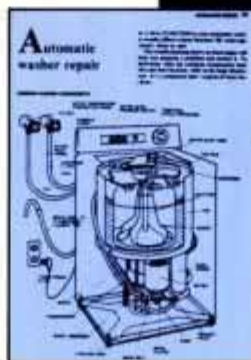
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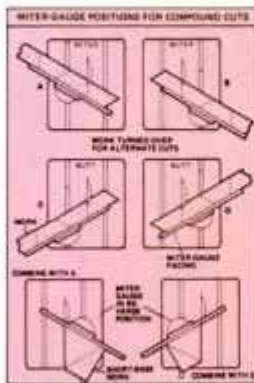
Build This Old-Time "Icebox" Party Bar

Turn-of-the-century iceboxes are now expensive collector's items. This solid oak model has the same frame-&-panel construction, brass hardware and casters featured in Sears' 1902 catalog — plus a hinged lid that opens to reveal a mixing compartment lined with plastic laminate.

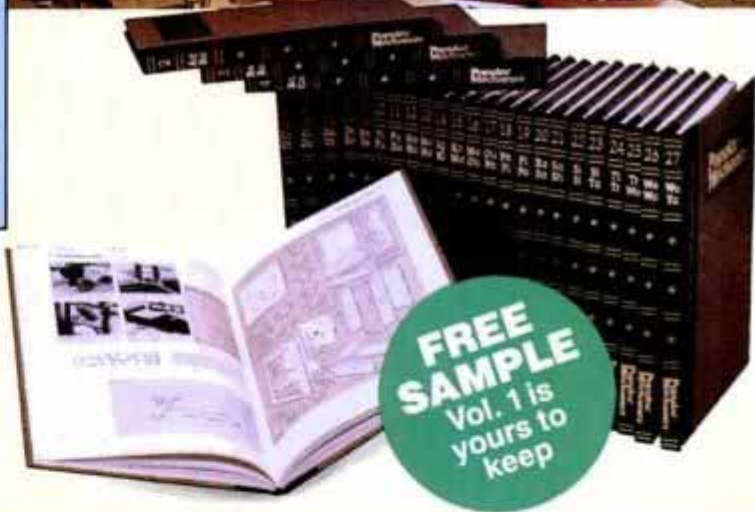


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TOURING THE DEEP

(Continued from page 102)

a reduced magnetic signature, *Gemini* has potential applications for the defense community as an underwater stealth vehicle.

Whether *Gemini* will service these other markets is impossible to predict, but one thing in Hyco's favor is absence of competition.

"Right now, outside of tourist vehicles," says industry consultant Frank Busby, "I don't see any activity in manned submersibles." The reason, he surmises, is that soft oil prices and an unpredictable defense market have deterred manufacturers from building submersibles without buyers. "It's not hard to attract interest in submersibles," says Busby. "They're so sexy. But getting someone to come up with a million or two to have one built is another story." A relative bargain, *Gemini* will run \$870,000 apiece. Each *Aries* will have a \$2 million price tag.

What's the next step in underwater acrylic? Personal submersibles? Janca doesn't think so. For one thing, private owners would be hard-pressed to handle the costs of complying with tough regulations imposed by the American Bureau of Shipping. The subs have to meet rigorous design criteria, including redundant safety and backup features. For example, the subs must supply 80 hours of life support per person in case of some disabling mishap. More important, they must undergo periodic checkups to maintain certification.

So, like PC 1203, the acrylic subs of the future will stay in the hands of tour outfits. But will *Gemini* muscle PC 1203 out of the tourist trade the way robot subs pushed her out of the oil business?

Not right away, admits Janca. Here in Grand Cayman, a scuba mecca, he's witnessed a surge of interest in deep-water sightseeing, both among divers and "dry" tourists. Demand for sub rides will sustain a variety of vehicles to cruise through waters teeming with eye-catching wildlife. And Hyco's not the only fish in the ocean—manufacturers in Britain, Finland and Canada are putting conventional steel-hulled tourist submersibles into the water. For example the British-made *Looking Glass* is currently serving up to 25 sightseers at a time from its base in St. Thomas, U.S. Virgin Islands.

But eventually, in Janca's view, the picture-window appeal of *Gemini* and *Aries* will win over tomorrow's tourists. And if his vision proves correct, you'll soon be able to see the sea like never before.

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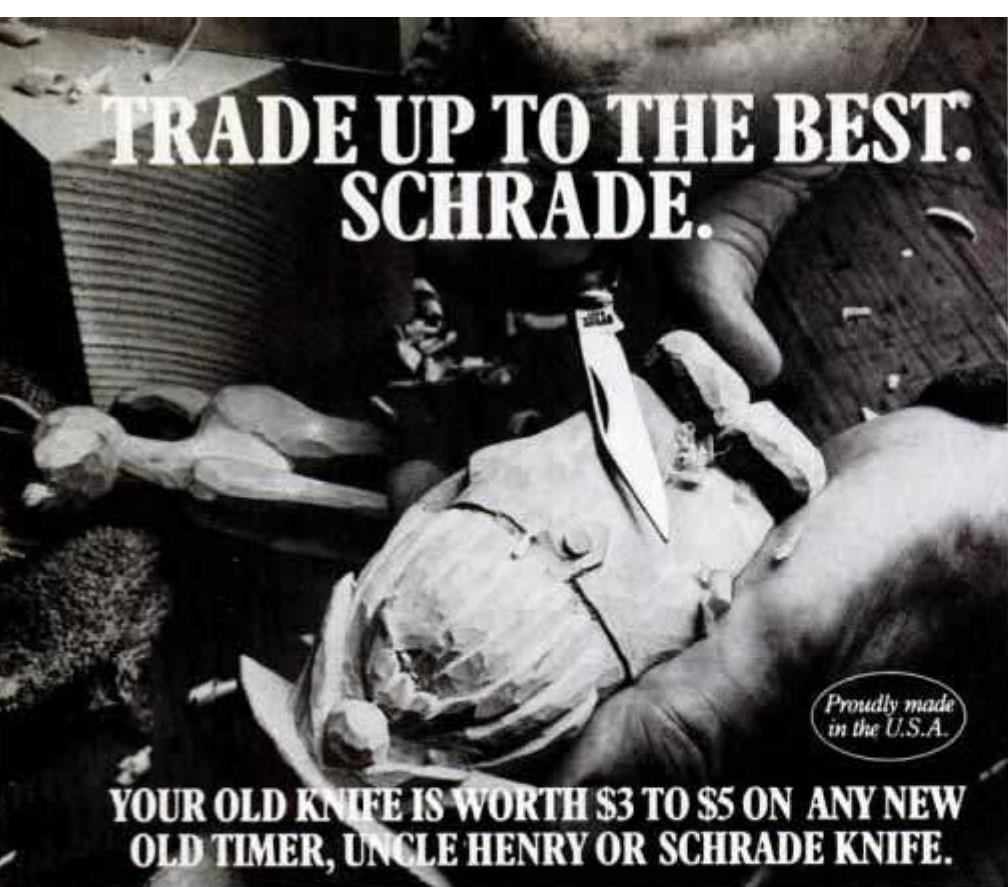
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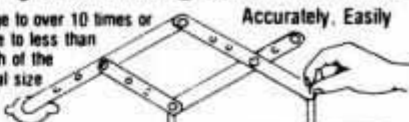
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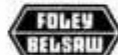
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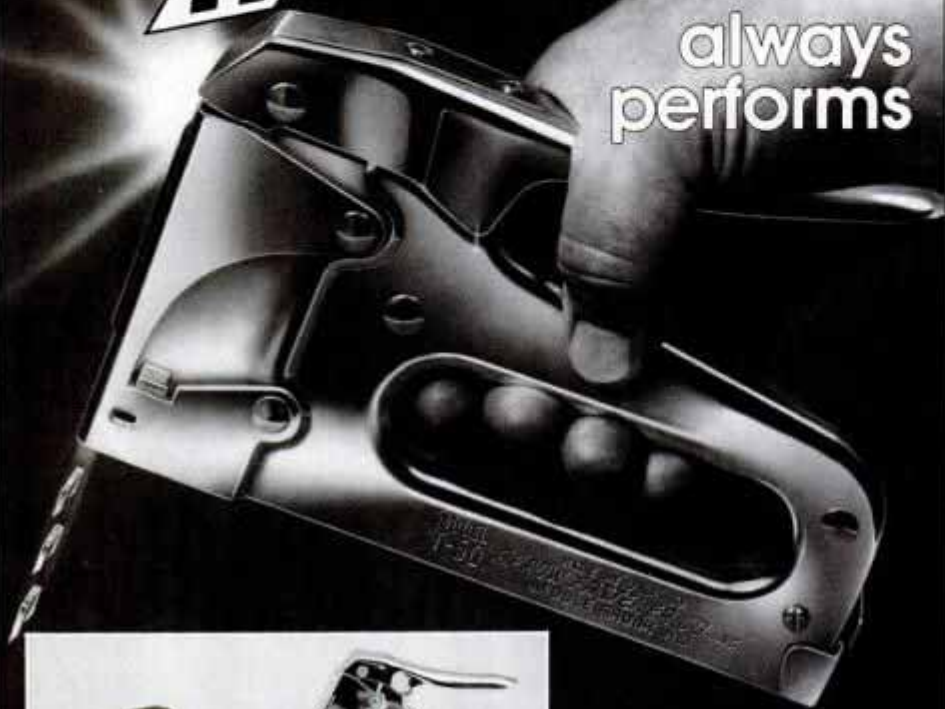
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TOMORROW'S CAR TODAY

(Continued from page 74)

Riviera's electronics consists of a row of illuminated toggle switches that sits above the Riv's touch-screen. For example, you needn't reach right to activate the G-Analyst: Just poke a finger at its switch on the control panel.

The equipment installed in the Riviera would retail today for about \$10,000. Installation and the custom control panel added another \$4000 to the tab, owing to the intricate wiring necessary and our desire to make the add-on gear blend cosmetically with the Riv's interior design. To integrate the extra equipment, Galaxy's artisans had to craft a passenger-side dashboard to match the one on the driver's side. Their clone is actually a modified version of a futuristic dashboard supplied to us by Buick.

Facelift

But high-tech electronics is only part of the story. Our Riviera not only had to perform like a car of the future, it also had to look the part. We weren't trying to guess what a 1995 Buick would look like, but we did want a unique showcase for all our nifty electronics—a real head-turner, something that wouldn't be readily identified as a current production car.

Exterior modifications were handled by Kolb Design in Blauvelt, New York, a subsidiary of Cars & Concepts, using basically the same procedures as the Detroit styling studios to create a new look. Restyling included removing emblems, sandblasting and painting chrome trim, adding composite headlights up front and changing GM's square roofline at the rear. The latter was accomplished by sweeping it back and adding sail panels—louvered for better visibility and style—then a rear decklid wing. The whole shebang is topped off in a Ferrari Testarossa Red monochrome.

Body building

The first step in the process was to sketch the proposed design, then the car was "clayed up." Special automotive styling clay was molded to shape on the car—a first step in transforming a sketch into something physical.

Styling clay differs from ordinary modeling or ceramic clay. It holds a fine line and can be worked to precise tolerances. The clay never hardens fully, allowing changes and modifications to the design at any stage. Working the clay to its final shape takes the skill of a fine-arts sculptor.

To go from the final clay design to finished steel, small cardboard templates are made based on the clay

(Please turn to page 124)

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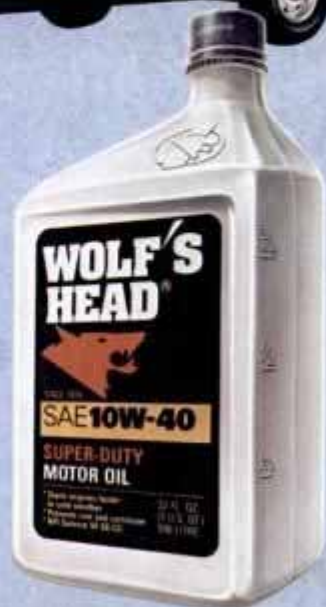
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BUCKLE UP FOR SAFETY

How To RegROUT CERAMIC TILE

BY STEVEN WILLSON, Home And Shop Editor; PM Illustrations by George Retseck

CERAMIC tile, whether on a bathroom wall or kitchen countertop, is a wonderful building material. It's durable, easy to clean and comes in so many different styles and colors that it's a decorator's dream. It does, however, have one major drawback, namely the grout between the tiles.

Sooner or later these grout joints will deteriorate, becoming stained or cracked. This is particularly true on tub and shower walls where the heavy exposure to water speeds the degradation process.

Fortunately, replacing the grout is a pretty easy job and all the tools and materials required are available at most hardware stores and lumber yards. You'll need a bag of dry grout, a grout removal tool, and a rubber-faced trowel for applying the grout, plus a bucket for mixing the grout, a large sponge and a few clean burlap or terry cloth rags. For this story, we regouted tub and shower walls, but the same basic techniques apply to regrouting any ceramic tile joints.

Where to begin

Start by turning off the Shut-Off valves below the floor that supply water to your tub or shower. Strictly speaking, you should be able to complete the job without shutting off these valves because there is no need to ever turn on the tub or shower faucet. But, if a faucet is accidentally turned on when you are working, you could have quite a mess on your hands.

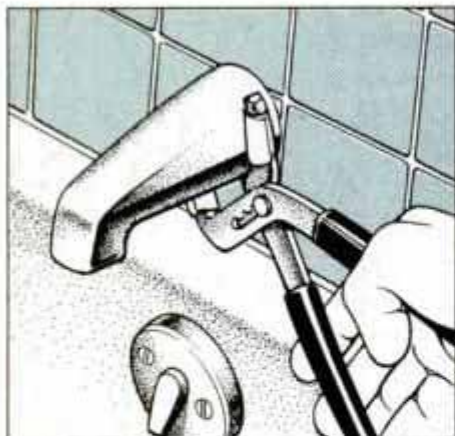
Next, remove the tub spout from the wall. Turn the spout counterclockwise using either slotted pliers or a pipe wrench. Be sure to cover the jaws with masking tape to prevent damaging the chrome on the spout. Then remove the faucet handles, sleeves and escutcheons as shown in drawings 2 and 3. Also remove the shower head and the escutcheon behind it that rests on the wall. By removing these fittings, you will have complete access to all the old grout.

Next, start scraping the grout from

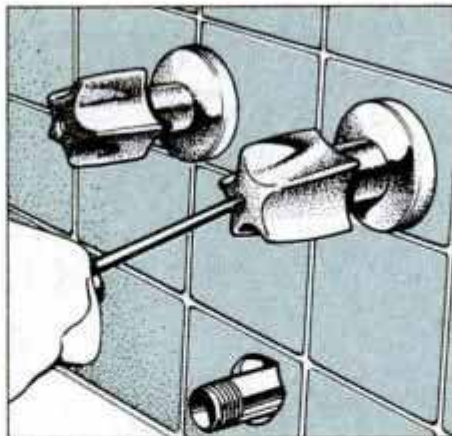


the joints. The grout removal tool shown in drawing 3 is a clever device. It fits comfortably in the hand and its blade is coated with carbide granules that do a great job of cleaning the joints. Remove the grout to a depth of at least $\frac{1}{8}$ in. or until the old grout is no longer cracked or crumbling. This job will take some time—in this case several hours—but it is crucial for obtaining the best results.

Once you are done removing the grout, vacuum all the joints clean and then wash the wall with a wet sponge. Now, mix your dry grout with water according to the directions on the bag. Apply the grout using a rubber-faced trowel as shown in the drawing above. Spread the grout diagonally, across the surface of the tile, forcing it into the joints as you go. Work in sections no larger than 15 to 20 sq. ft. at a



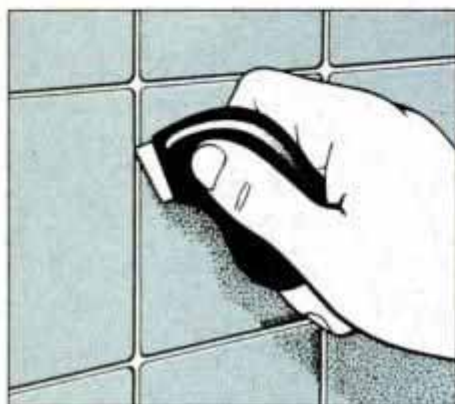
1 Begin by removing the tub spout using slotted pliers or a pipe wrench. Wrap masking tape on the jaws to protect the spout.



2 Remove the faucet handle screws using a screwdriver. Some handles have a covering plate over screw that must be pried off.



3 Remove the faucet escutcheon and sleeve by hand, turning counterclockwise. When stuck, use pliers or a pipe wrench.



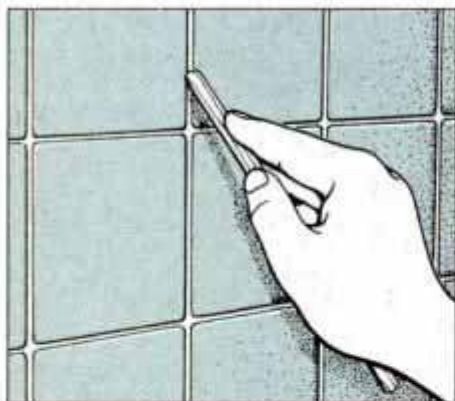
4 Scrape the old grout from each joint using a grout removal tool. The tool has a blade that's coated with carbide granules.



5 Once the grout is removed, be sure to vacuum all dust from the joints. Dust and debris cause new grout to bond poorly.



6 After applying the new grout, wipe off the excess from the surface of the tiles using a wet sponge. Rinse the sponge often.



7 Shape the fresh grout joints with a wet finger or a 1/4-in.-dia. wood dowel. This will yield a uniform joint appearance.



8 As the grout dries, it leaves a chalky film on the tiles. Remove this film by rubbing the surface with burlap or terry cloth.



9 After grout has cured overnight, apply silicone caulk where tiles abut the tub, around spout, faucets and shower head.

time. Otherwise you run the risk of the grout hardening before you remove the excess.

When you have the grout applied use the rubber trowel to remove excess grout. Then wash down the surface with a wet sponge.

Do not rub so hard that you remove the grout from the joints, just clean the surface of the tile.

Next, smooth out all the grout

joints using either your finger or a wood dowel as shown in drawing 7. The finished grout joint should fall just below the surface of the tile, so it forms a very slight depression. After all the joints are shaped, let the grout dry for 15 to 20 minutes, or until a dry haze forms on the surface. Then buff the surface with burlap or terry cloth rags and you are done with the grouting. To finish up the job, just replace

the fittings you removed earlier and apply a generous bead of silicone caulk to the joint between the tile and the tub, and around the spout, faucets and shower-head escutcheons.

Finally, it's a good idea to damp-cure your new grout job. All this means is thoroughly wetting down the wall every 8 hours for two or three days. This step improves the bonding properties of your new grout. **PM**

Homeowners' Clinic

BY NORMAN BECKER, P.E., Contributing Editor

Lightning Damage

I am building a home in a mountainous area of California. Recently, a nearby cabin was struck by lightning and suffered considerable damage. How can I protect my new home from lightning damage?

CHARLES HUPNER
SOMERSET, CA

Although there are about 90 million lightning strikes each year in the United States, most homes don't have lightning protection. Homeowners and builders determine whether a lightning-protection system is necessary by weighing the probability of a strike against the cost of a system.

Because of their location, some homes have a higher risk of lightning damage than others. If your house will be in a high-risk area, then it's wise to install a lightning-protection system. These systems have two objectives. They must provide a direct path for a lightning bolt to follow to ground and they must prevent property damage and personal injury as the bolt travels this path to ground.

It's important that the person or company that installs the lightning-protection system be listed by Underwriters Laboratories (UL). This ensures that the installation will comply with current nationally recognized codes.

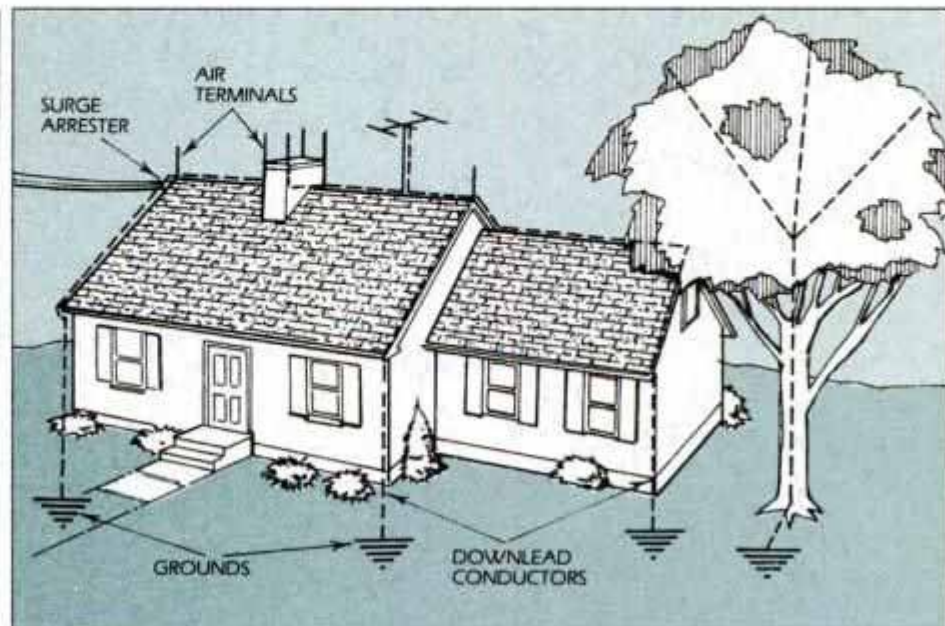
After the system is installed, it should be inspected by UL's Lightning Protection Division. For information on UL-listed installers and more information on lightning protection, call or write to one of the following UL offices:

- 333 Pfingsten Rd., Northbrook, IL 60062, (312) 272-8800
- 1285 Walt Whitman Rd., Melville, NY 11747, (516) 271-6200
- 1655 Scott Blvd., Santa Clara, CA 95050, (408) 985-2400
- 12 Laboratory Dr., Research Triangle Park, NC 27709, (919) 549-1400

Floor Slab Leak

I have water leaking through the concrete-slab floor of my garage. What kind of grout or patching cement will stop the leak?

RAY SVENSEN
EUREKA, CA



A lightning-protection system is comprised of air terminals (rods), surge arresters, downlead conductors and grounds. Installation should be performed by a UL-listed company.

The leakage can be corrected by sealing the cracks and any open joints with a nonshrink hydraulic cement. There are several products which are quite effective, such as Thoro's Waterplug, Tamm's Speed Plug, Five Star Waterproof Plug, and UGL Fast Plug. These products are generally available at hardware stores.

Prior to applying the cement, prepare the cracks or open joints by undercutting or square cutting. Do not use a V cut. Add enough water to the cement to get a putty consistency and then force it into the crack with a trowel or gloved hand. At floor-to-wall joints, form the cement into a cove for increased effectiveness.

If the seepage is heavy, it could be the result of a high water table beneath the slab. Sealing the floor could result in excessive hydrostatic pressure that might cause the slab to heave and crack. In this case, the best solution is to lower the level of the subsurface water by installing perimeter drains below the slab and running them to a sump pit where the water can be pumped away.

Furnace Air Supply

I was recently told that bringing outside air to the base of my gas-fired furnace via a 6-in.-dia. duct would re-

duce negative pressure in the house caused by combustion in the furnace. This would help eliminate drafts and increase the comfort level. What is your opinion regarding this idea?

JOE BORCHARDT
CHESTERFIELD, MO

For a house to develop the negative pressure that will affect the comfort level, it would have to be extremely tight and well sealed. If this were the case, then there would be little or no drafts in your home. Houses do need to breathe to some extent to prevent pollution of the inside air.

Since air is needed for combustion, exposing outside air to the burner area would result in fuel savings.

However, introducing outside air to the recirculating heated air via the return duct is not a good idea. The cost to heat this air would be greater than any savings resulting from a reduction of air infiltration through drafts.

PM

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.

Appliance Clinic

BY STEVE TOTH, Contributing Editor

Frozen Dishwasher

We have a Kenmore dishwasher model No. 587-720511, serial No. 08026540973. Twice now, after leaving the dishwasher unused for several weeks, the unit seemed to freeze up when we tried to start it. The first time it happened, a service technician fixed the problem in a few minutes. Can you tell us how to fix it ourselves?

LOUIS KINNAN
OAKDALEN, NE

What may have happened is that the water in the tank evaporated, which caused the ceramic and carbon water seal to stick. This can prevent the motor from turning.

To fix this problem, first unplug the dishwasher from its power source and take out the lower rack. Then, remove the nut that secures the spray arm and remove the spray arm and sump cover. Underneath is the upper pump housing. Remove the four $\frac{5}{16}$ -in. securing bolts and lift the housing off. This will expose the upper impeller and another bolt that extends down to the motor shaft. Put a wrench on this nut and carefully try to turn it clockwise as if to tighten it. This should free the sticking seal.

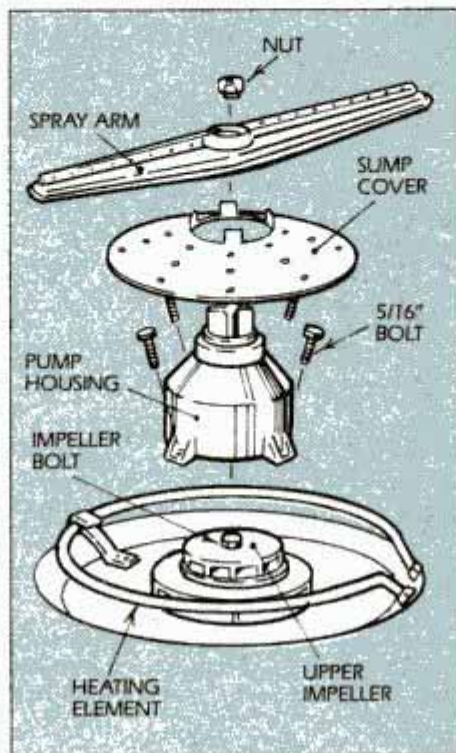
Once the shaft is rotating freely, check the seal by seeing if the machine holds water. Reassemble the dishwasher and move the machine over to the sink and electrical outlet.

Place a paper towel under the machine in the area of the motor and add 2 or 3 cups of water to the tub. Close the door and slide out the paper towel. If there is any water on the paper, then you'll have to install a new shaft seal kit.

If there are no signs of water, slide the paper back under the machine and hook the fill and drain hoses to the sink faucet, but don't turn the water on. Plug in the unit and set the timer to a wash cycle. Let it run for 1 or 2 minutes and then open the door and unplug the machine.

Check the paper for signs of water. If it's wet, you'll need the shaft seal kit. This kit can be purchased from any Sears parts center and includes step-by-step instructions. It's part No. 808042 and costs about \$10.

To prevent the problem from occur-



Free a sticking water seal by first removing the spray arm, sump cover and pump housing. Then, turn impeller bolt clockwise.

ring again, pour about 1 gallon of water into the dishwasher whenever the machine won't be used for a long period of time.

Broken Disposer

I have a model 77 In-Sink-Erator garbage disposer that doesn't work. It runs for about 10 seconds and then shuts off. What could be wrong?

JOHN N. PERIAN SR.
PAULSBORO, NJ

There could be something jammed in the grinding mechanism, a worn motor bearing, or you might have an electrical problem inside the motor.

First turn off the electrical power supply to the disposer. Insert the special $\frac{1}{4}$ -in. Allen wrench supplied with the unit into the lower end of the motor shaft.

You should be able to easily turn the shaft by pushing the wrench with your little finger. If so, then there's a good chance that your problem is within the motor—a shorted winding, bad connection or some other motor problem.

If the shaft is hard to turn, then the

next step is to check the grinding mechanism. Move to the sink, push aside the rubber splash baffle, and look down the disposer with a flashlight. At the bottom of the disposer you'll see the shredder plate. Around the outside edge of the shredder plate is an approximately $\frac{1}{4}$ -in.-high ring that has teeth on the inside. Look carefully between each set of teeth for any foreign object. If you find something, carefully remove it with a pair of needle-nose pliers and recheck the motor shaft for free turning.

If you found nothing and the motor shaft still binds, then there is a good chance that the motor has a worn bearing. If this is the case, or you have an electrical problem, then the disposer will have to be removed and disassembled by a trained technician to determine the cause of the problem.

To locate an authorized In-Sink-Erator service center near you, dial the company's toll-free automated-service information line. The number is (800) 558-5700.

Won't Come Clean

Our Modern Maid range model No. QCU-546B is supposed to have a continuous-cleaning oven. The sides and the top clean okay, but the door and bottom won't clean at all. What's the problem?

MARK A. WILKIE
WESTMINSTER, CO

Your range has a continuous-clean finish on the sides and top of the oven, but not on the door and bottom. These panels have a standard porcelain finish which is colored to look like the continuous-clean panels.

The oven bottom can be removed for cleaning by hand and the door panel is easily accessible. These surfaces can be cleaned with any standard oven cleaner. Note, however, that oven cleaners can ruin the continuous-clean finish. Make sure the cleaners don't come in contact with the top or sides and avoid getting oven cleaner on the door gasket. **PM**

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

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My name is John Wright. Not too long ago I was flat broke. I was \$31,000 in debt. The bank repossessed my car because I couldn't keep up with the payments. And one day the landlord gave me an eviction notice because I hadn't paid the rent for three months. So we had to move out. My family and I stayed at my cousin's place for the rest of that month before I could manage to get another apartment. That was very embarrassing.

Things have changed now. I own four homes in Southern California. The one I'm living in now in Beverly Hills is worth more than one million dollars. I own several cars, among them a brand new Mercedes and a brand new Cadillac. Right now, I have a million dollar line of credit with the banks and have certificates of deposit at \$100,000 each in my bank in Beverly Hills.

Best of all, I have time to have fun. To be me. To do what I want. I work about 4 hours a day, the rest of the day, I do things that please me. Some days I go swimming and sailing — shopping. Other days, I play racquetball or tennis. Sometimes, frankly, I just lie out under the sun with a good book. I love to take long vacations. I just got back from a two week vacation from — Maui, Hawaii.

I'm not really trying to impress you with my wealth. All I'm trying to do here is to prove to you that if it wasn't because of that money secret I was lucky enough to find that day, I still would have been poor or may be even bankrupt. It was only through this amazing money secret that I could pull myself out of debt and become wealthy. Who knows what would have happened to my family and me.

Knowing about this secret changed my life completely. It brought me wealth, happiness, and most important of all — peace of mind. This secret will change your life, too! It will give you everything you need and will solve all your money problems. Of course you don't have to take my word for it. You can try it for yourself. To see that you try this secret, I'm willing to give you \$20.00 in cash. (I'm giving my address at the bottom of this page.) I figure, if I spend \$20.00, I get your attention. And you will prove it to yourself this amazing money secret will work for you, too!

Why, you may ask, am I willing to share this secret with you? To make money? Hardly. First, I already have all the money and possessions I'll ever need. Second, my secret does not involve any sort of competition whatsoever. Third, nothing is more satisfying to me than sharing my secret only with those who realize a golden opportunity and get on it quickly.

This secret is incredibly simple. Anyone can use it. You can get started with practically no money at all and the risk is almost zero. You don't need special training or even a high school education. It doesn't matter how young or old you are and it will work for you at home or even while you are on vacation.

Let me tell you more about this fascinating money making secret:

With this secret the money can roll in fast. In some cases you may be able to cash in literally overnight. If you can follow simple instructions you can get started in a single afternoon and it is possible to have spendable money in your hands the very next morning. In fact, this just might be the fastest legal way to make money that has ever been invented!

This is a very safe way to get extra cash. It is practically risk free. It is not a dangerous gamble. Everything you do has already been tested and you can get started for less money than most people spend for a night on the town.

One of the nicest things about this whole idea is that you can do it at home in your spare time. You don't need equipment or an office. It doesn't matter where you live either. You can use this secret to make money if you live in a big city or on a farm or anywhere in between. A husband and wife team from New York used my secret, worked at home in their spare time, and made \$45,000 in one year.

This secret is simple. It would be hard to make a mistake if you tried. You don't need a college degree or even a high school education. All you need is a little common sense and the ability to follow simple, easy, step-by-step instructions. I personally know a man from New England who used this secret and made \$2 million in just 3 years.

You can use this secret to make money no matter how old or how young you may be. There is no physical labor involved and everything is so easy it can be done

Here's what newspapers and magazines are saying about this incredible secret:

The Washington Times:

The Royal Road to Riches is paved with golden tips.

Los Angeles Herald Examiner:

We've all got to start somewhere... *The Royal Road to Riches* is the first step in the right direction!

National Examiner:

John Wright has an excellent guide for achieving wealth in your spare time.

Income Opportunities:

The Royal Road to Riches is an invaluable guide for finding success in your own back yard.

News Tribune:

Wright's material is a MUST for anyone who contemplates making it as an independent entrepreneur.

Success!

John Wright believes in success, pure and simple.

Money Making Opportunities:

John Wright has a rare gift for helping people with no experience make lots of money. He's made many people wealthy.

Hollywood Trade Press:

We have never heard of an advertiser offering to pay readers \$20 to try its program. Wright's willingness to do this convinces us that his money secret must really work.

California Political Week:

...The politics of high finance made easy.

Hollywood Citizen News:

He does more than give general ideas. He gives people a detailed A to Z plan to make big money.

The Desert Sun:

Wright's *Royal Road to Riches* lives up to its title in offering an uncomplicated path to financial success.

whether you're a teenager or 90 years old. I know one woman who is over 65 and is making all the money she needs with this secret.

When you use this secret to make money you never have to try to convince anybody of anything. This has nothing to do with door-to-door selling, telephone solicitation, real estate or anything else that involves personal contact.

Everything about this idea is perfectly legal and honest. You will be proud of what you are doing and you will be providing a very valuable service.

It will only take you two hours to learn how to use this secret. After that everything is almost automatic. After you get started you can probably do everything that is necessary in three hours per week.

PROOF

I know you are skeptical. That simply shows your good business sense. Well, here is proof from people who have put this amazing secret into use and have gotten all the money they ever desired. Their initials have been used in order to protect their privacy, but I have full information and the actual proof of their success in my files.

'More Money Than I Ever Dreamed'

"All I can say — your plan is great! In just 8 weeks, I took in over \$100,000. More money than I ever dreamed of making. At this rate, I honestly believe, I can make over a million dollars per year." A. F., Providence, R.I.

'\$9,800 In 24 Hours!'

"I didn't believe it when you said the secret could produce money the next morning. Boy, was I wrong, and you were right! I purchased your *Royal Road to Riches*. On the basis of your advice, \$9,800 poured in, in less than 24 hours! John, your secret is incredible!" J. K., Laguna Hills, CA

'Made \$15,000 In 2 Months At 22'

"I was able to earn over \$15,000 with your plan — in just the past two months. As a 22 year old girl, I never thought that I'd ever be able to make as much money, as fast as I've been able to do. I really do wish to thank you, with all of my heart." Ms. E. L., Los Angeles, CA

'Made \$126,000 In 3 Months'

"For years, I passed up all the plans that promised to make me rich. Probably I am lucky I did — but I am even more lucky that I took the time to send for your

material. It changed my whole life. Thanks to you, I made \$126,000 in 3 months." S. W., Plainfield, IN

'Made \$203,000 In 8 Months'

"I never believed those success stories... never believed I would be one of them... using your techniques, in just 8 months, I made over \$203,000... made over \$20,000 more in the last 22 days! Not just well prepared, but simple, easy, fast... John, thank you for your *Royal Road to Riches!*" C. M., Los Angeles, CA

'\$500,000 In Six Months'

"I'm amazed at my success! By using your secret I made \$500,000 in six months. That's more than twenty times what I've made in any single year before! I've never made so much money in such short time with minimum effort. My whole life I was waiting for this amazing miracle! Thank you, John Wright." R. S., Mclean, VA

As you can tell by now I have come across something pretty good. I believe I have discovered the sweetest little money-making secret you could ever imagine. Remember — I guarantee it.

Most of the time, it takes big money to make money. This is an exception. With this secret you can start in your spare time with almost nothing. But of course, you don't have to start small or stay small. You can go as fast and as far as you wish. The size of your profits is totally up to you. I can't guarantee how much you will make with this secret but I can tell you this — so far this amazing money producing secret makes the profits from most other ideas look like peanuts!

Now at last, I've completely explained this remarkable secret in a special money making plan. I call it "The Royal Road to Riches". Some call it a miracle. You'll probably call it "The Secret of Riches". You will learn everything you need to know step-by-step. So you too can put this amazing money making secret to work for you and make all the money you need.

To prove this secret will solve all your money problems, don't send me any money, *instead postdate your check for a month and a half from today. I guarantee not to deposit it for 45 days. I won't cash your check for 45 days before I know for sure that you are completely satisfied with my material.*

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There is no way you can lose. You either solve all your money problems with this secret (in just 30 days) or you get your money back *plus \$20.00 in cash FREE!*

Do you realize what this means? You can put my simple secret into use. Be able to solve all your money problems. And if for any reason whatsoever you are not 100% satisfied after using the secret for 30 days, you may return my material. And then I will not only return your original UNCASHED CHECK, but I will also send you an *extra \$20.00 cashiers check* just for giving the secret an honest try according to the simple instructions.

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"As Mr. John Wright's accountant, I certify that his assets exceed one million dollars."
Mark Davis

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We recently installed special phone numbers (listed below) for all our editors. You can use these special Hotlines to call and talk to us directly. No secretaries. No intermediaries. Just us, answering our own special PM Hotline phone and talking to you.

It's a new service from the POPULAR MECHANICS Editorial Staff to you, the PM reader. However, there are some rules which we ask you to follow in using the PM Hotlines.

1. Please call only between 3 p.m. and 5 p.m. Eastern time, on Wednesdays only.
2. Please keep your calls as short as possible. Remember, other readers are trying to get through.
3. You'll have to pay for the cost of the call. No collect calls, please.
4. Before calling, check the list of editors and their special editorial areas. Please call the most appropriate editor. We won't be able to switch you if you don't reach the correct editor.
5. There will be certain times when an editor is out of the office.

During those times, the phone will ring, but will not be answered. Please call another editor or try again the following week.

6. If the line is busy, please try again.
7. Please don't expect our editors to answer complex technical questions over the phone. Remember, we won't have time to look up information in books or other reference sources while you wait.
8. Remember, we have a Reader Information Bureau that is operational five days a week during regular business hours. Our Reader Service Bureau number is (212) 649-3127. Please call our Reader Service Bureau, not our editors, for information on back issues, reprints of articles, subscription inquiries, plans offers, etc. It will save us all time.

Other than the above guidelines, there are no rules. Call us about anything—what you like in POPULAR MECHANICS, what you don't like, article suggestions, etc. In fact, we'd like you to call and just say hello. We look forward to hearing from you.—Joe Oldham

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TOMORROW'S CAR TODAY

(Continued from page 112)

model and then traced onto sheetmetal. Cut out and welded together, the finished design is substituted for its clay twin. Weld marks are ground down to smoothness, with minor imperfections handled by body filler.

Tail feathers

To fabricate the rear wing, the piece is first constructed out of cardboard sections that are taped together. Fiberglass is then laid up around the cardboard, which is removed once the 'glass sets up. Additional fiberglass mats, applied a layer at a time, create the final shape. Then comes the grinding, sanding, filling and painting.

The finished car looks so correct that it's impossible to detect the extensive body buildup and prep work that went into the project. The sail panels, for example, are not just stuck on the existing body: The roof had to be raised nearly an inch at the rear to accommodate the fastback addition. Because of the intensive heat generated by welding in the roof area, most of the car's interior and all of its glass had to be removed beforehand. Except for the front windshield, we treated all the stock windows to a transparent black tint.

Notice how the rear spoiler flows cleanly into the rear quarter panels. To get the right look, the rear quarters had to be extended upward about 5 in. using square steel tubing. Then the C-pillar area had to be extended away from the car by welding in box-steel spacer sections. The area had to be sculpted in with metal and body filler to get the clearance necessary to open the trunk lid without smashing it into the sail panels. Even so, stoppers were installed to prevent the trunk lid from opening more than 80 percent of its original travel. All this required extensive sculpture work around the C-pillar, side and rear windows.

Red—and hot

Changing the car's color from its original gray to Ferrari red also took some doing. Body sections that were modified had to be taken down to the bare metal, while the rest of the body required sealing with a special primer. The new skin was cured in a special one-million-BTU downdraft oven that changes the air in the spray every 12 seconds to eliminate dust.

After all this esoteric cobbling, we finally had to come back to Earth. The final touch is American Racing Equipment's 15 x 6.5 Pro model wheels, wrapped with Goodyear GT+4 rubber. A head turner for sure, and a preview of things to come.

PM

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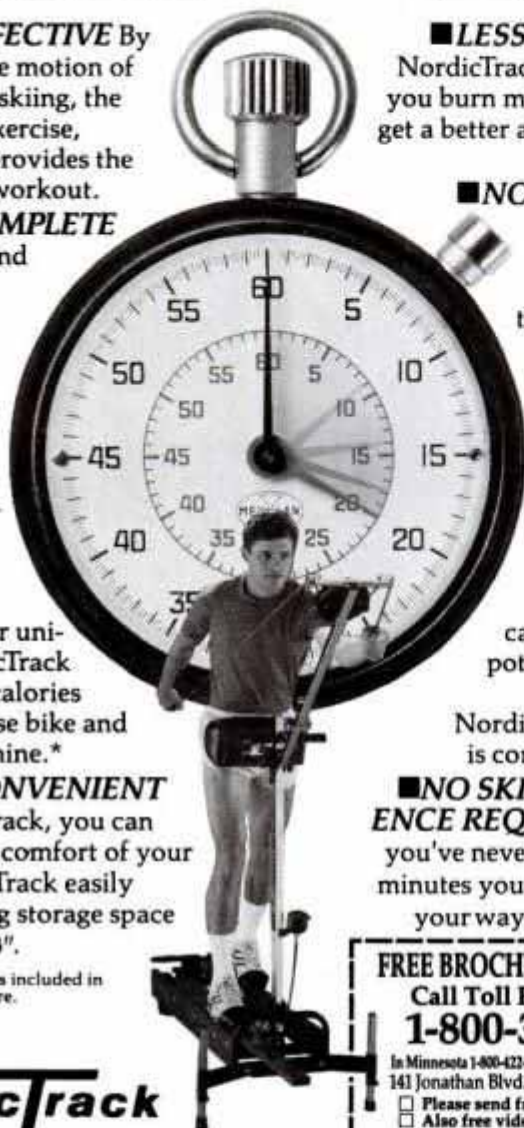
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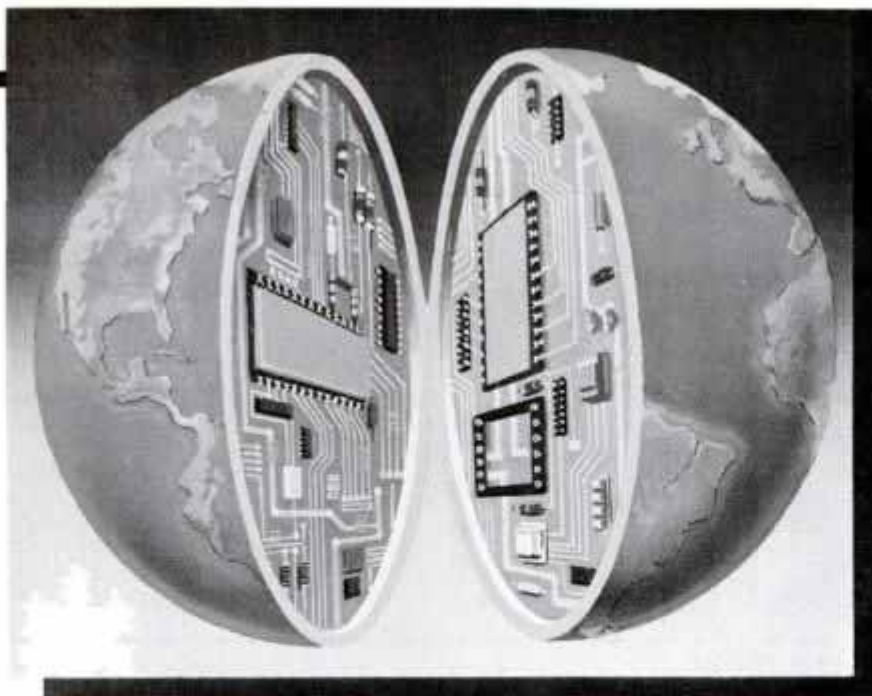
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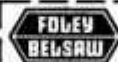
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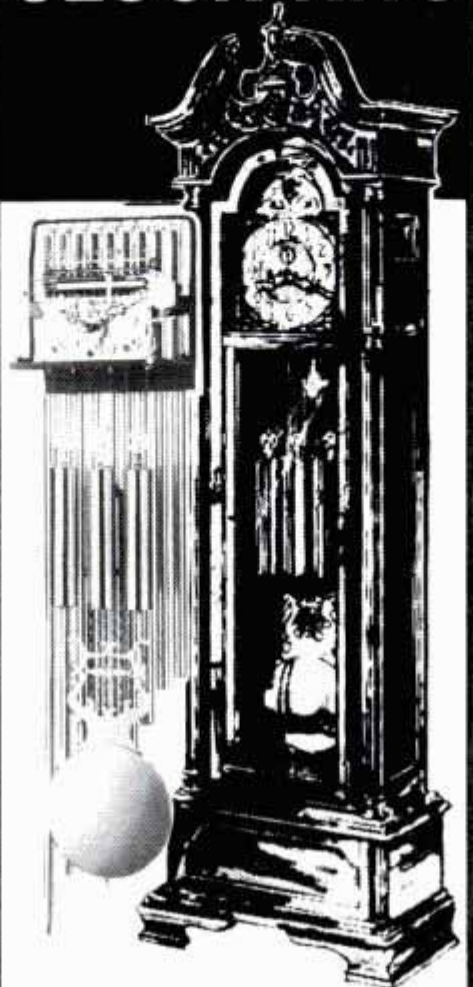


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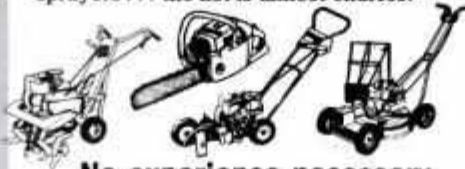
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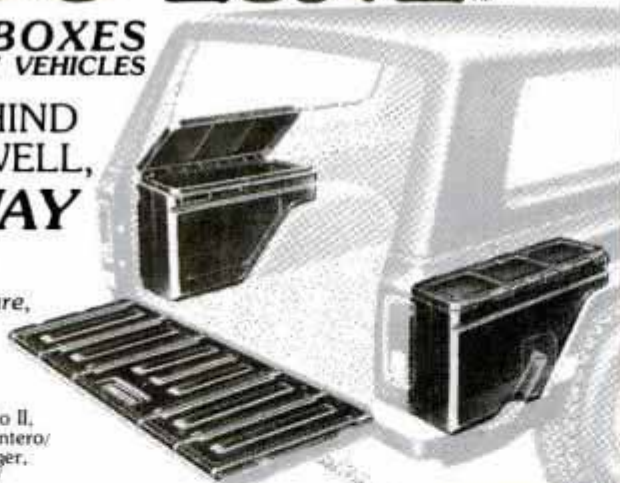
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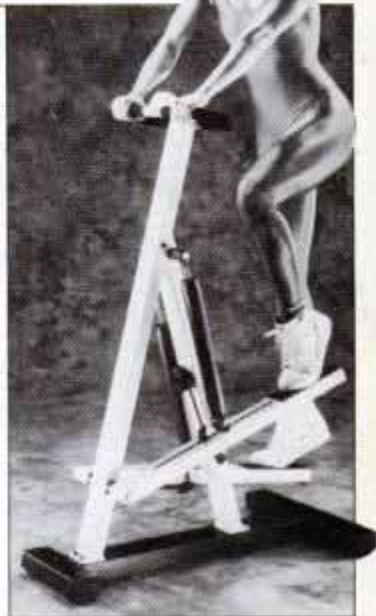
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If you truly appreciate fine machinery, you protect it. With Purolator Filters.

Purolator invented the first oil

and air filters. And you still can't buy better engine protection for your car.

Use Purolator oil and air filters regularly. That way you can rest assured your dream machine won't turn into a mechanical nightmare.



Purolator
FILTERS

Heads you win. Tails you win.

Merit delivers both sides of the coin:
rich, satisfying tobacco taste and even less tar than other leading lights.
In fact, the majority of smokers in a nationwide test agreed that Merit tastes as good
or better than cigarettes that have up to 38% more tar. The secret
is Enriched Flavor.[™] Only Merit has it. Light one up.
Chances are, you'll love it.

Enriched Flavor,[™] low tar. A solution with Merit.



SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.

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Kings: 8 mg "tar," 0.6 mg nicotine av. per cigarette by FTC method.