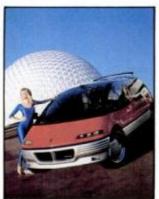




OCTOBER 1986

VOLUME 163 NO. 10



ON THE COVER

Pontiac's Trans Sport minivan is more than just an exotic styling exercise—it's a car you might be driving in the next decade. This year's show cars from Detroit are highly developed test beds for tomorrow's technology. Read about driving the future cars in the exciting story on page 76. It's part of our Special Report on '87 new cars. PM photo by Skip Gandy



80 IBM imitators



87 Future banking



94 Dowel Joints



84 High-tech Miss Budweiser

DEPARTMENTS

- 4 Editor's Notes
- 6 Letters
- 9 Imports
- 12 Science
- 14 Freewheeling
- 16 Audio
- 18 Homeowner's Q/A 60 Aviation
- 21 Minicourse
- 22 Car Clinic
- 27 Appliance Q/A
- 28 Inside Detroit

- 32 Home Video
- 38 Electronics
- 42 Photography
- **48 Tool Tests**
- 50 House Restoration
- 56 Outdoors
- **68 Cycles**
- 128 Hints
- 163 Worth Writing For
- 174 Time Machine

SPECIAL REPORT: '87 NEW CARS

Power To The People

High performance is alive and well and living in Motor City.

76 Driving The Future

Detroit has already built the cars of the future. And we've driven them.

143 Tech Highlights

Power, safety and refinement are the underhood trends for the '87 cars.

COMPUTERS

Target: Big Blue

The IBM Personal Computer has spawned a host of imitators. Here's how the top three fared in our econoclone shootout.

Cashing In On The Future

Computers and lasers will play an important part in the future of banking. Transactions will be easier, and counterfeiting harder.

ELECTRONICS

138 Satellite Receivers

A satellite TV receiver has to pull in more than 100 video channels. Build your satellite system of the future by planning around the right receiver

SHOP AND TOOLS

Console Table

Use our plans to build a graceful maple table to enhance your foyer or hallway.

Dowel Joints

We show how to make a wide variety of strong, dowel-reinforced wood joints.

120 More Power To You

This outdoor power equipment gets the job done and is fun to use.

130 Shipshape Shop

A superorganized workshop offers solutions to combat tool clutter.

HOME

103 The Better Home

Increase the usable space in your home by installing a pocket door.

OUTDOORS

200-mph Bullet Boat

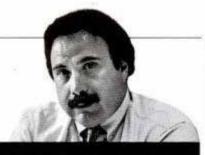
Miss Budweiser speeds into the jet age with lightweight, high-power turbine technology.

TECHNOLOGY

63 PM Technology Update

Read about the latest in robotics, aviation engineering, space, astronomy and the military.

Editor's



very summer, as we prepare our October new car issue, it seems as though cars become our whole world. There are engineering briefings to attend, photographs to be taken and cars to be driven. New York-based Automotive Editor Wade Hoyt coordinates the activity between plane trips. Detroit Editor Jim Dunne and West Coast Editor Steve Parker attend seemingly dozens of press meetings to gather the facts and figures for our report, which begins on page 71. But just next year's cars weren't enough for us. We asked the factories

to roll out their futuristic dream cars and let us drive what might prove to be your 1990 automobile. To drive them, Hoyt traveled to the GM Proving Grounds in Milford, Michigan, to the GM Desert Proving Grounds in Mesa, Arizona, to Chrysler's Proving Grounds in Chelsea, Michigan, to Disney World's Epcot Center in Orlando, Florida, and to Ford's Romeo, Michigan, facility. And he found out several interesting facts. For one thing, none of the prototypes drive as well as they look. They cost well over a million dollars each to build, but there are plenty of rough edges. "Every one I drove



Hoyt and Pappas check the M4S.

broke down in some way," says Hoyt. The Buick Wildcat seemed to be doing fine with easy 70-mph laps, but back at the garage it ran rough and Buick engineer-in-charge Ray Smith figured it had dropped a cylinder. With the Dodge M4S, Hoyt and engineer Joe Pappas had to stop after each lap and reslam the rear bodywork, which kept popping open. Hoyt was told that there was a flat spot programmed into the Pontiac Trans Sport's computer so it would buck at 40 mph, "to prevent the transport guys from going ape with it." Project Manager Joe Dunn told Hoyt to "drive right through it." It went away above 40. But what didn't go away in the Trans Sport was the heat. The vehicle was in the General Motors World of Motion exhibit at Epcot when we wanted to drive it. So Hoyt and entourage had to go to Orlando in 100° heat. "The car's windows don't open," says Hoyt, "there's no air conditioning, and no ventilation system yet. But at least I wasn't wearing a Spandex bodysuit like our model. I had to let her out into the hot sun at each U-turn so she could cool off. It was 20° cooler outside!" Judging by our cover photo, the heat didn't seem to do much damage



Oldham and Corvettes.

to our Miss October, Lynne Austin. . . . I went to Bloomington, Illinois, a couple of weekends ago. Why? Because I'm a Corvette nut, that's why. And if you're a Corvette nut. you have to travel to Corvette mecca once a year on a June weekend where, it seems, every Corvette in the known world gathers in one place at one time. There's a flea market, car shows, an auction, one-off prototypes, restored cars, ratty cars, rareties, buying, selling and lots and lots of looking. By Sunday evening, I was completely satiated and my Corvette fever had gone away. It was back, though, the next day. "Til next time.



Editor-In-Chief Joe Oldham

Managing Editor Bill Hartford

Graphics Director Bryan Canniff

Science/Technology Dennis Eskow, editor

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

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Editorial Production Peter Francesconi, manager

John Bostonian Jr., art Nancy Coggins, Deborah Frank, assistants

John Johanek, art director Alan Andresen, Ann Bennett, Diane DePasque, associate art directors

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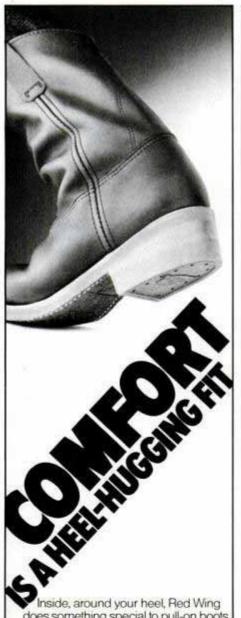
Motorcraft quality parts have been installed as original equipment in more than 35 million Ford, Mercury, Merkur and Lincoln cars and Ford light trucks. But no matter what kind of car or truck you drive, there's only one logical choice. Quality Motorcraft parts from Ford—so you'll know you're getting reliable original-equipment quality replacement parts. Race-proven parts. Trustworthy parts. Motorcraft, of course. Quality parts for all makes of cars and trucks.

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Buckle up-together we can save lives



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Letters



Required Reading

Your July issue which contains *The Building of America* special section ought to be:

 Bound in leather for every coffee table in America,

Required reading for every student in the nation's school system, and

3. Furnished to each and every immigrant who applies for citizenship in these United States! FRANK COGGINS OLD BRIDGE, NJ

I have been a reader and subscriber to POPULAR MECHANICS for more years than I would like to say. Your July issue is the best laid-out issue and most diversified that has ever been published! HOWARD W.

> MORDUE, R.PH. BELFAST, ME

Best issue ever! But I would hate to drive the road that you show accompanying the James A. Michener story on page 108. Of course, I know that the road in Alaska isn't marked as it appears. The photo was obviously "flopped" so the solid and dotted center lines on the road are reversed. The result is

that the passing zone is at the approach of the crest of the hill!

> NORMAN BRYHAN MADISON, WI

We should have had our driving gloves on while checking the layout and the highway photo for the opening of James Michener's story.

This is my first "fan letter" written to a magazine! I have just finished reading your July 1986 special double issue—all 310 pages—and I had to relay my congratulations to the PM staff and the superb writers that have made this issue one that I intend to keep for many years to come. It's constructive and informative and I'm very proud to be a subscriber to one of the best magazines

in the good of U.S.A.! Bravo! CHARLES S. BRENNAAUN PRESCOTT, AZ

Your July issue was outstanding. I do dispute your caption for the 1949 Ford, however (page 180). It wasn't the "first new design since WWII." Being a Hudson buff, I would like to know what you would call the 1948 Stepdown? That really was a new design and was adopted by all car manufacturers. Hudsons are still winning races, especially on dirt tracks.

MERRILL E. REDFIELD TOWNSHEND, VT

In 1946, Studebaker was the first manufacturer after WWII with a completely new line of vehicles—the Champion and Commanders. The only carryover from 1942 were the engines, transmissions and differentials. Thanks for a wonderful magazine.

GORDON W. BISBERG GIG HARBOR, WA

The popularity of the '49 Fords led us to overlook the smaller automakers that moved fast, introducing all-new post-war models. Hudson was one.

Kaiser-Frazer, Tucker and Crosley were others. But the winner was Studebaker, which introduced its 1947 cars in the spring of 1946.

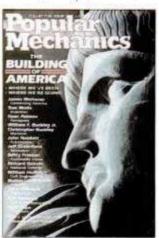
Thank you for "Land Of Wizards" by Tom Wolfe (page 126). His description of apathy and unfairness of the District Courts is accurate. In my own suit against a major car manufacturer, the District Judge became

even more adversarial than the other party, and, on that point, I became the first inventor granted a reversal of summary judgement in the Federal Court of Appeals. ALFRED COOPER SAN LORENZO, CA

I found "Land Of Wizards" very interesting, informative—and depressing. How can I minimize the high chances of having my ideas stolen?

JAMES F. CLEMENTS MARIETTA, GA

One excellent book is Handbook For Inventors by Calvin D. MacCracken (Scribner's, \$14.95). All state bar associations have Patent Law Branches that can help you locate a licensed patent attorney.



Publisher

Daniel J. Coleman

Advertising Director Floyd Sembler

National Sales Manager Bud Gilbert

Advertising Offices

New York

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

Chicago

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

Detroit

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

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

Direct Response Advertising

Al Cohen 224 West 57th St. New York, NY 10019 (212) 262-4279

Business Manager

Agnes P. Maillaro

Marketing Director Edward Vaquero

Production Manager

Lori Ellwood

Advertising Production Patricia Woods

(212) 262-4800

Classified Sales Manager

Sophie Gronowicz (212) 262-4825

Reader Service Department

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

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Frank A. Bennack Jr., President
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Richard E. Deems, Publishing Consultant

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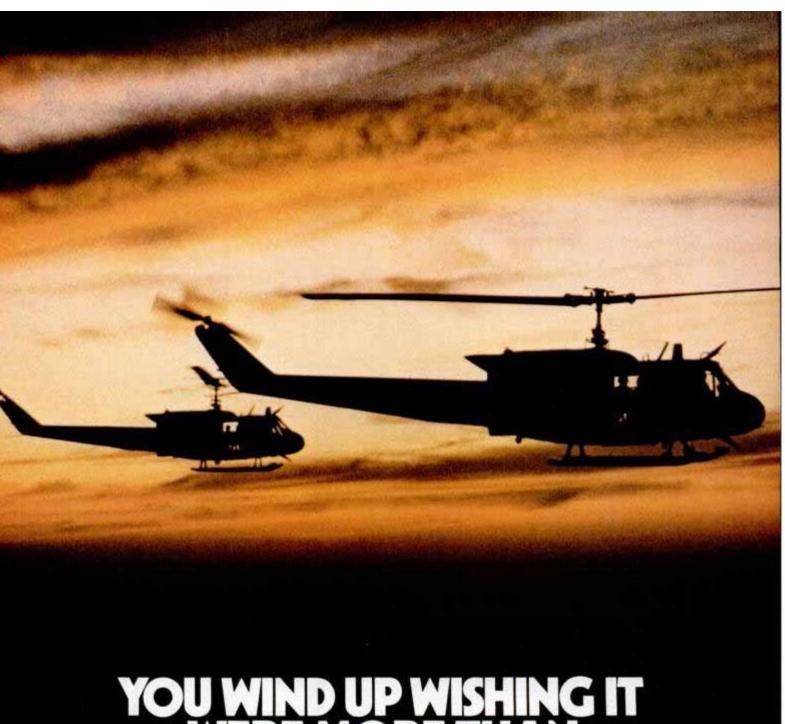
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YOU WIND UP WISHING IT WERE MORE THAN ONE WEEKEND A MONTH.

You might find yourself in a chopper, cruising the treetops at 90 miles per hour. Or doing something more down to earth, like repairing an electronic circuit.

What you won't find yourself doing is getting bored. Because this isn't ordinary part-time work. It's the Army Reserve.

You'll get valuable skill training. Then one weekend a month, and two weeks each summer, you'll put that training to good use, while receiving good pay and benefits.

But maybe most importantly, you'll come away with a feeling deep down that you were challenged and came through. And that doesn't disappear when Monday rolls around.

See your local Army Reserve recruiter about serving near your home. Or call toll free 1-800-USA-ARMY.

ARMY RESERVE. BE ALLYOU CAN BE. **Imports**



BY BILL HARTFORD

Citroen's Petit Four



n Paris, where curbs are no barrier to creative parking, the all-new AX -Citroen's lightweight mini-will soon be staking its spot, squeezed between other interesting European cars. But the streets-and the sidewalks-of New York will be out of bounds: The AX is yet another appealing auto that's in the Cars We Don't Get Here category. Now being shown at the Paris Auto Show, the continental runabout is offered in the



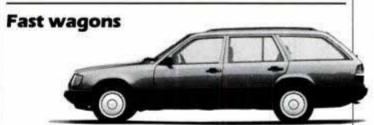
usual quick/quicker/quickest model lineup. Citroen's new TU Four, a light, all-aluminum, ohc design, (block, cylinder head, crankcase) comes in 954-, 1124- and 1350-cc displacements.

They're small all right,



AX's French touch: Relief from run-of-the-mill econobox interiors.

but AX models start at a slight 1400 pounds, so there's more than enough oomph from a liter. And, at speed, a low drag coefficient of 0.31 lets the AX slip along effortlessly. The petite 4wd hatchback also boasts all-independent suspension with MacPherson struts in front and torsion bars at rear. With that type of setup, the AX can handle any kind of road, but how it handles the competition—popular cars like the Opel Corsa, VW Polo and Fiat Uno—remains to be seen.



Mercedes-Benz 300 TD packs 143 hp and 76.8 cu. ft. of gear.

If you're in the market for a classy station wagon, you've got a tough decision to make. Volvo is there with its 740 and 760, and Audi has its super-smooth 5000S. Already, Mercedes has a waiting list for its latest, the 300 TD Turbo. It took a while for M-B to appreciate the appeal that a high-quality wagon would have in the United States, and its first factoryproduction version dates only to 1978. Now, the thoroughly contemporary 300 TD Turbo is turning heads —especially when it flashes by in the passing lane. The 3liter, turbodiesel Six is rated at 143 hp and top speed, like

its 300D sedan counterpart. is in the neighborhood of 125 mph. Aerodynamically better than its predecessor, the 300 TD Turbo also keeps its sure-footed stance when packed to the rack. Its hydropneumatic rear suspension senses added load and keeps the vehicle level. The wagon's volume with seats folded is an impressive 76.8 cu. ft. Antilock braking and driver's-side airbag are standard safety features, and an example of thoughtful engineering is the tailgate wiper that turns on automatically when your windshield wipers are on and you shift into

For 1988? BMW wagon, based on 3-Series, would be a first, since the company's 'Touring' model of over a dozen years ago was really a hatchback.



Pounding the pavement

The bad news is the population of the Earth just hit 5 billion and is heading for 6 billion. The good news is that there are "only" 473 million cars in the world. In Guam, there's one car for every person. In the United States, where there are 168,607,000 automobiles, the number of people per car is 1.8. In China, there's a car for every 10,000 people.

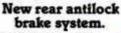
Compiling a world car census must be pretty boring work, but somebody has to do it—and the resulting sta-

tistics are actually pretty fascinating. Automobile International (386 Park Ave. South, New York, NY 10016) has been doing it since 1922. Its World Automotive Market for 1986 is a \$22, 48-page booklet that will make you drool if you're in the car business (worldwide production keeps going up) and intrigue you if you're a car nut. But only up to a point. Normal guys won't buy it, but will read World Automotive Market at the library.

Now, <u>Two</u> Ford Bronco II's ...4-wheel and new 2-wheel drive models.

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

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



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



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

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

Touch and go.

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

Eddie Bauer

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

Free air conditioning.

Free air conditioning is available when you buy any Bronco II Special Value Option Package. The option content varies with your choice of package. The savings are based on the manufacturer's suggested retail price for the Special Value Package compared to traditional suggested pricing for the options purchased separately.

Best-Built American Trucks six years running.

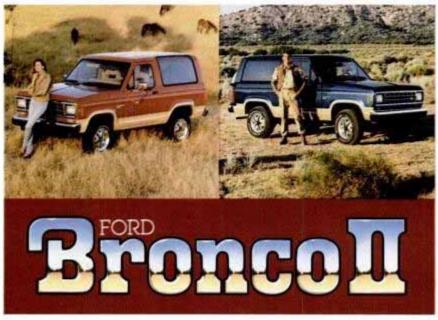
"Quality is Job 1." In fact, for the past six consecutive years, Ford quality has led all other American automotive companies. This is based on an average of ownerreported problems in the first three months of service on '86 models

> and in a six month period on '81-'85 models designed and built in North America.

Buckle uptogether we can save lives.

Based on SAE Standard J1349. Limited warranty. Ask to

see a copy at your dealer.





Science



BY DENNIS ESKOW

Odd Star Gets Cut Up

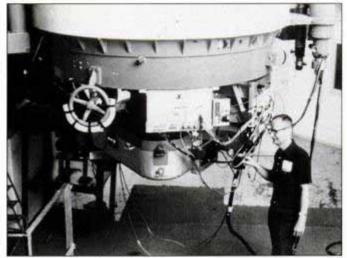


Image Dissecting Scanner is used to identify stellar object.

They call it Star System 433. It sits in the remnant of a supernova. It puts out X-rays like a neutron star, and it sometimes looks like any number of familiar stellar objects. What is it? No one can say what SS433 really is. That's why a team of Ohio State University researchers has gone to work at Lowell Observatory in Arizona with the Image Dissector Scanner shown above. The computerized machine scans 1024 points along the chemical spectrum of images taken by several telescopes. The device then picks up minute discrepancies in the chemical analysis of the source. Later this year, the scanner may be able to tell us the identity of SS433.

Jobs for tomorrow

As I travel around to labs and seminars across the nation, a pattern emerges that I have to share with you. It's all about lasers. Suddenly, they are showing up in places never before imagined. And with them there's an entire new field of work developing. It's exciting and well-paying, and there will be more jobs than there are applicants going into the next century, according to the U.S. Labor Department.

The new profession is called a Laser Electro Optics Technician. To become a LEOT, you need to know basic high school algebra and trig, some physics and chemistry, and have a good pair of hands. One such person is Ron Beck, shown at work with a laser weapons system at Hughes in El Segundo, California. He graduated from high school in 1982 and entered one of the nation's 25 LEOT training programs at Area Vocational Lively Technical Institution in Tallahassee, Florida. There, he spent two years learning basic electronics, optics, laser science and laser equipment fabrication. He graduated in 1984 and went to work for Hughes, one of the major manufacturers of laser-based products.

About 1500 people graduate from such schools each year, and there are about 1800 to 2000 LEOT jobs being offered each year. I recently surveyed 25 companies that hire LEOTs and they reported hiring tech school grads at an average \$20,000 a year and for as much as \$25,000. Top salaries in the field go up into the \$40.000 range.

LEOTs are a whole new breed. Their tools range from clamps and screwdrivers to computers, optical benches and glove boxes. Their work is extremely exacting. They have to read blueprints and work on areas measured in thousandths of an inch. They work in surgically clean conditions and on project teams with engineers and physicists.

If the work sounds interesting and fairly lucrative, consider also the things the laser industry is doing these days. Lasers are being used to harden surfaces of metal and graphite. They are used as experimental dental tools to perform gum surgery. Nuclear physicists at several labs are working on experimental lasers that may power starships in the early 21st century. These space vehicles would carry detectors

and cameras to star systems at near the speed of light.

Lasers are being used in a wide range of printing and industrial processes. This is the technology of the future.

If you know students with an interest in math and science and an ability to work with their hands, you might want to share this information with them. For more information LEOT on schools, send \$1 and a selfaddressed, stamped envelope to: Center for Occupational Research and Development, 601 C Lake Air Dr., Waco, TX 76710. Ask for the pamphlet on LEOT training. It lists schools and gives some background on the field.

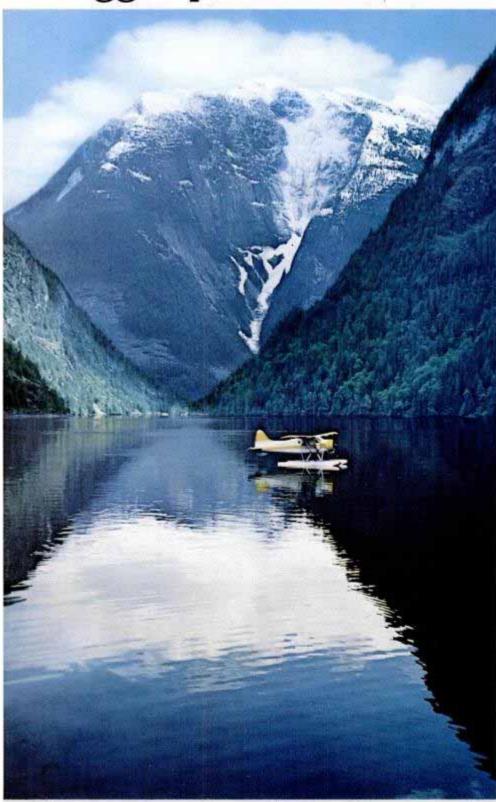
Space inquiry: Part II

I recently attended a NASA briefing on the Challenger Shuttle explosion. It was frustrating because NASA isn't the font of information it was before the tragic explosion. But outside the meeting room, I had a talk with a NASA official whose name will be revealed in a future story. He told me that future versions of the Rogers Commission reports will outline problems with personnel working on the Shuttle flight line. These people were working overtime as much as seven days a week. That was a no-no during the Apollo days. And, my contact says, it will become a nono again after the final publication of the Rogers Commission report.



Ron Beck, testing a laser at Hughes, has an unusual education.

Queens Reach. A rugged place for a smooth taste to start.



WESTERN CANADA—
We found an opening between two peaks, then dropped down fast to the lake. It was the bluest water we'd ever seen, the

smoothest too. So smooth, a ripple would have seemed like a wave.

All around us were walls of deep, green pine and mountains capped with the whitest snow, all reaching for the sky. Pure glacial magic.

They make Windsor Canadian from pure running glacial waters. And from the rich local rye. Even the crackling mountain air plays a part. Nature at her best. That's what makes Windsor, Canada's smoothest whisky.



WINDSOR ANADAS SMOOTHEST WHISKY.

Freewheeling



BY WADE HOYT

Tropical Truckin'



PreRunner lights up your life with up to six extra halogens.

If you want to impress the press with your new line of pickup trucks, introduce the vehicles on- and off-road on a Hawaiian island with a 5500-ft. volcano, a rain forest that registers over 450 in. of the stuff each year, and plunging waterfalls that have carved out a half-scale Grand Canyon.

That's what Mitsubishi decided to do with its first new pickups in eight years on the "garden island" of Kauai.
The '87 Mitsus have all-new

The '87 Mitsus have all-new sheetmetal with a new grille, modestly sloping hood, fend-

Spare is quickly removed for real work.

er flares and bigger windows. For the first time, long (7.4 ft.) and short (6 ft.) beds are available, both 59 in. wide.

Six different 2-wheel-drive models are available, including a One Ton Mighty Max with a payload of over 2100 pounds. Engine choices include 90-hp 2-liter or 109-hp 2.6-liter Fours with a choice of 5-speed manual or 4-speed automatic overdrive transmissions.

The macho-looking fourwheel-drive versions come with the 2.6 engine, 5-speed,

> automatic front hubs and P225/ 75R15 radial tires.

For closet Baja racers, there's a tough-looking Pre-Runner package that has tubular bumpers, a light bar, quick-release in-bed spare tire mount, load-box side braces and a cargo net in place of the tailgate.

Ford's future

Ford recently unveiled a trio of concept cars at the Los Angeles Auto Expo, and at least two of them were a lot closer to production than some observers

may have gathered. One was the Probe V aerodynamic mockup (see page 79). The other two were fully driveable prototypes that have a more definite place in Ford's future.

The Cobra 230 ME is a high-performance 2-seater that will give Ford an entry in the high-priced Cadillac Allante, Chrysler-Maserati, Buick Reatta market. If the finished car is quick enough, it might even slip over into the Porsche-Corvette high-performance market.

Built by the French coachbuilder Chausson, the midengined car features a flush windshield raked back to 65°, engine cooling ducts in the rear quarter panels, and a biplane rear spoiler like the Merkur XR4Ti.



Removable panels convert TSX-6 into a pickup with side glass.

The 2.5-liter 16-valve 4-cylinder produces 230 hp at 6000 rpm, with a redline at a staggering 8000 rpm. It will do 0 to 60 in under 6 seconds with a 130-mph top speed.

On a more practical side is the Ghia Vignale TSX-6 wagon, created by Ford's Ghia Studio in Italy.

Built on a mid-size frontdrive chassis, its rear roof panels can be removed to convert it into a genteel pickup for oversized cargo. The raised roof also lets center and rear passengers sit higher up for a better view of the road. Behind the front bucket seats are folding benches that can hold five more passengers.



The 230 ME is a first look at Ford's 1988 Allante fighter.

Air head

A desmodromic valve train uses cam-operated rocker arms to close the valves as well as open them, eliminating valve springs. The last successful desmodromic system was used on Mercedes Formula One racers in 1954.

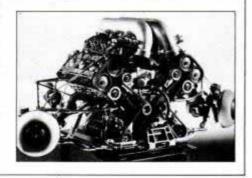
Renault's latest F1 engine uses air pressure acting against small pistons on each valve stem to close its

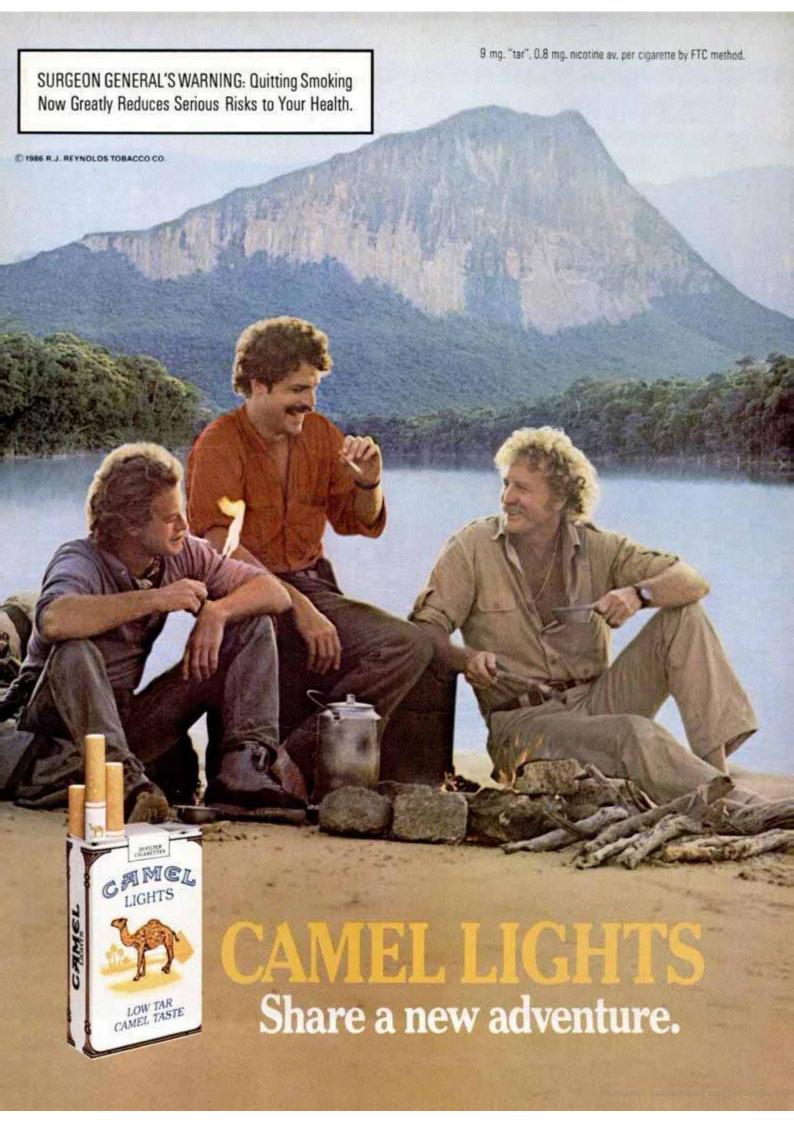
valves. Camshafts open the valves in the usual manner. By eliminating the valve springs, the Renault design reduces stress and wear in the valve

Twin-turbo V6 blows valves shut.

train, raises safe engine speed from 11,000 to 13,000 rpm, cuts weight and provides a wider power band.

A tiny ½-liter canister supplies air at 2000 psi to the valve-closing pistons via a nest of hoses and computer-controlled solenoids. The radical twin-turbo Renault V6s have been impressive in Lotus, Ligier and Tyrell chassis this season.





Audio



BY FRANK VIZARD

Back-Seat Driving

Recreational vehicles, whether they're large motor homes or smaller vans, are regaining popularity as more and more Americans vacation within the United States.

With the whole family along for the ride, there are going to be diverse demands placed on the autosound system. Back-seat drivers are likely to become back-seat conductors as well, and TOWNS OF THE PARTY OF THE PARTY





there's nothing more annoying than people climbing

over your right shoulder to

fiddle with the radio.

One way to keep passengers in their seats is to get one of the new crop of cassette receivers with remote control. While a staple of home audio for years, remote control in car audio is very new. Autosound makers noted the rising popularity of RVs and so developed "front ends" suitable for

those vehicles. Remote-control models are currently available from four manufacturers-Sony, Pioneer and Sharp. Blaupunkt. Sony has the most extensive lineup of remote-control models, eight in all. The top two models, list priced at \$350 and \$450, offer remote-control functions for cassette play, tape direction, fast forward and automatic music search. Remote tuner functions include station seek and AM/FM band selection. The other six models in the Sony line, priced between \$220 and \$300, dispense with the band selection capability.

All the Sony models feature wired remote control. Wires, I find, have a life all their own. They invariably get tangled up and wrap themselves around things. This is why wired remotes no longer come with video cassette recorders.

Far more convenient to operate are wireless infrared remote controls of the type offered by Blaupunkt, Sharp and Pioneer. The Blaupunkt remote control is packaged with the company's Houston SQR 06 cassette receiver (\$700). Remote functions include seek and scan, 18 FM and six AM presets,

AM/FM/tape selection, fast forward and reverse, and volume control.

Less expensive is Sharp's remote control model. The RG-F870 carries a list price of \$400 and includes a built-in 5-band graphic equalizer. The remote control can be wired to the RG-F80 or can be used in a wireless mode. Remote features include volume control, fast forward

The Blaupunkt remote control (right) handles all functions.



and reverse, song-search system, automatic replay, AM/FM/tape selection and

station search.

Remote control in autosound systems is not strictly limited to cassette receivers. It's also a feature of Pioneer's new DEX-77 Compact Disc/radio combination and Sony's 10-disc, trunk-mounted DiscJockey CD changer (\$1000). Also remotely installed and operated is Alpine's 6-cassette changer and tuner (\$1500). Like the DiscJockey, it has wired remote control.

The tube returns

My father used to spend his spare time down at the electronics shop testing tubes—his hobby was fixing old radios and stereos. Tubes disappeared, though, and the new technology didn't seem to lend itself as much to amateur repairmen. My father, in recent years, has spent more time listening than fixing.

It's probably too soon to say that the tube is making a comeback, but Luxman, the home hi-fi division of Alpine Electronics, has introduced two hybrid amplifiers that incorporate a pair of oldfashioned vacuum tubes.

The two triode tubes, clearly visible on the front panel of the LV-105 and LV-103, correct what Luxman engineers say are the nonlinearities introduced to the music reproduction process by the transistors now used in amplifier designs.

Specifically, the inclusion of these tubes is designed to eliminate the coloration of sound caused by low-level distortion, and to prevent the masking of low-level musical passages that Luxman engineers say is common to many of today's amplifiers. Such quiet in an amp means you'll be able to hear those soft passages inscribed on digital Compact Discs.

Tubes were always appreciated by audiophiles because of a certain unmeasurable warmth they seemed to bring to sound reproduction. Interestingly, the tubes themselves have to be kept warm if you expect a quick "turn-on" time.

Each amplifier comes with a preheat switch that should be turned off only when the amplifier is not going to be used for a long time. Without the minute amount of electrical current supplied by the preheat switch, the "Brid" amplifiers, as Luxman calls them, need about 30 seconds to warm up. With preheating, both amplifiers are up and running in about eight

(Please turn to page 17)



Best of both: Luxman-105 Brid amp has tubes and transistors.





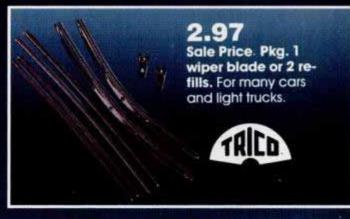
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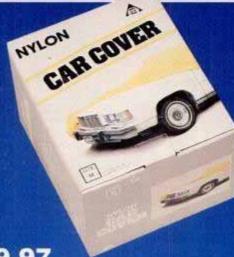
bench seats, Colors, western styling Mit may vary



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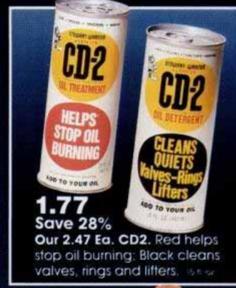




















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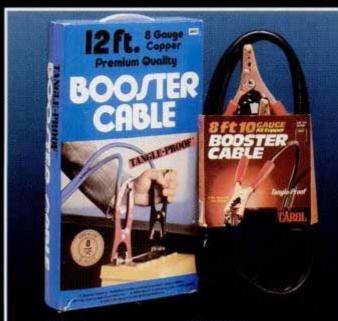








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OUR BEST















AUDIO

(Continued from page 16)

seconds. The sonic properties of vacuum tubes-or the lack of them-have been argued among audiophiles for years. Whatever your opinion on the matter, you'll find both Luxman amplifiers provide solid foundations for any home entertainment system.

At 80 watts per channel, the LV-105 has a little more punch than the LV-103 (50 watts per channel). The LV-105 also has more inputs than the LV-103. The former can accept both audio and video inputs from up to three components, while the LV-103 is limited to two. The LV-105 also incorporates a separate video amplifier and complete video switching capability.

List price for the LV-105 is \$700, while the LV-103 lists for \$600.

Smart tape deck

Compact Disc players might be the new darlings of the audio scene, but cassette decks are reaching new levels of performance and convenience. The latest example of this evolution comes from Bang & Olufsen, a Danish company with a long history of hi-fi innovation.

The Beocord 5500 from B&O is unusual in appearance in that the tape well and most of the controls slide out on a drawer. Control functions on the faceplate are minimal.

Far more significant, however, is the incorporation of circuitry that automatically detects whether a tape has been recorded with Dolby-B or Dolby-C noise reduction, and adjusts itself for proper playback.

I think automatic Dolby selection might be the best convenience feature developed for cassette decks since auto reverse.

The superior Dolby-C is more common on home equipment than it is on car decks. Often, music lovers wind up making two tapes of a recording one with Dolby-C for home use and the other with Dolby-B for the car. Invariably, those car tapes seem to find their way into the home deck. If played at Dolby-C, they'll sound terrible (though Dolby-C tapes played on Dolby-B sound okay, if a little bright). The end result is a lot of time wasted scrutinizing the tape for some clue indicating the correct Dolby format. This is a chore I'd rather leave to the machine.

This convenience will be limited to B&O equipment only for a short time. B&O has made the technology available to Dolby Labs, which in turn will pass it on to all the Dolby licensees-and that includes just about every hi-fi maker there is. Look for Automatic Dolby B-C Selection on a lot of cassette decks in about a year's time.

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Homeowners Clinic

BY NORMAN BECKER, P.E.

Faulty Doorbell Wiring

y front doorbell does not ring the chimes. I removed the pushbutton and crossed the wires, but still no chimes. The rear doorbell works, so I switched the wires on the chime unit, front to rear. When I press the rear bell, it rings the chimes as if it came from the front.

I concluded the chimes are working and the transformer must be okay. Is there something I missed?

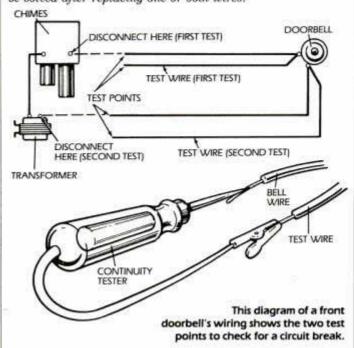
JOHN PERROTTA NORTH PROVIDENCE, RI

Check the continuity of the wire that runs from the doorbell button to the chimes and the continuity of the wire that runs from the button to the transformer.

One of these wires probably developed a crack in the conductor due to a kink or sharp bend in the wire. Consequently, there is no longer a continuous circuit.

Check the integrity of each wire with a continuity tester available at electrical supply and hardware stores.

Disconnect the front doorbell wire from the button. Splice a test wire onto the exposed end and run it back to the chimes. Disconnect the bell button wire from the chimes and touch the probe of the continuity tester to it while clipping the other end to the test wire. The tester's bulb should light. If not, that wire is bad and needs to be replaced. Repeat the test on the wire that runs through to the transformer. Most likely the problem will be solved after replacing one or both wires.



Damp sash

I have wood-sash, doubleglazed windows that have been stained and varnished. In the cooler parts of the house, condensation collects on the panes and drips onto the horizontal parts of the sash. Now the finish is starting to crack.

What is the most waterresistant finish that can be applied to the sash?

> R.W. COOLEY KOKOMO, IN

For the best protection, the wooden sash should be coated with a polyurethane finish. Prior to applying such a finish, you should strip the sashes, sand them thoroughly and then wipe them clean with a tack cloth.

When refinishing, apply the polyurethane so it covers about '\(^{f}_{s2}\)-in, of the glass pane. This seals the joint between the glass and the wood.

Now that you've treated the symptom, it's time to correct the cause—excessive moisture buildup. First, determine from where the problem originates.

There are a number of causes for excessive condensation, such as a crawl space with no vapor barrier on the dirt floor, water seepage into the basement or inadequate ventilation. An improperly operating humidifier or leaking air valves on steam radiators can also introduce excessive moisture into the house.

If you can't eliminate the cause of the high humidity, you can at least control it by ventilating rooms and using a dehumidifier.

Z-Brick removal

I recently purchased a new home with Z-Brick on one of the kitchen walls. I'd like to remove the Z-Brick and wallpaper the entire kitchen. Can you recommend a product that is fast, easy and safe for removing Z-Brick?

> EDWARD E. ANDERSON ROCKFORD, IL

For those of you who are not familiar with it, Z-Brick is a molded ceramic type material measuring about 4x in. thick. It's applied with a mastic to an interior wall, giving it the appearance of a real brick wall.

Removing the Z-Brick without damaging the surface behind it is virtually impossible. Knocking the Z-Brick off the wall with a hammer is somewhat hazardous because pieces of the Z-Brick will fly all over.

If you try to peel off the Z-Brick, you'll end up puncturing, tearing and spalling the surface of the gypsum wall behind it.

The fastest, most economical way to remove the Z-Brick is the most radical. That is, take the wallboard with Z-Brick off the wall, ripping it back to the studs, then recover the wall with new gypsum board.

Be careful not to damage any wires that might be in the wall cavity. Also, be sure to wear eye protection during the job.

Although removing Z-Brick is somewhat messy, the job should go relatively fast. Since there is only one wall with Z-Brick, you should be able to remove the Z-Brick, cover the wall, and remove the mess all within a half a day's work.

Any other removal method will not give the wall the smooth surface necessary for wallpapering.

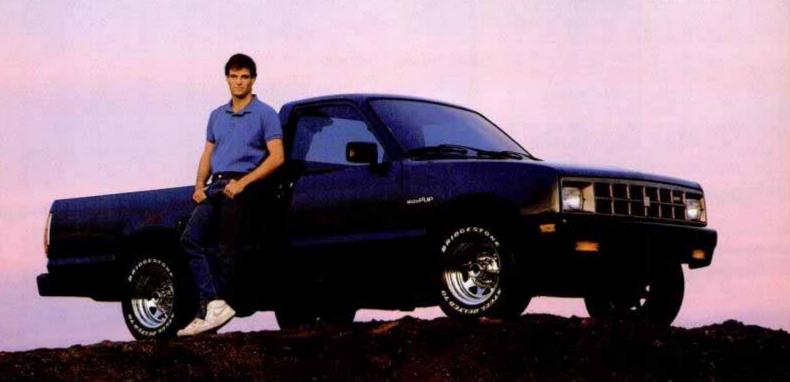
SAFETY TIP

When cleaning your house, it's very important not to mix bleach with ammonia or with any detergents or cleansers containing ammonia. Mixed together, the two can produce harmful fumes similar to mustard gas.

In several instances, people have died from breathing the fumes from such a mixture. Many household cleansers contain ammonia, so be extremely careful of the types of cleaners you mix with bleach.

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, NY 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$2.45 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, NY 10101.





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Or consider the comfort. This Isuzu PUP gives you more leg, head and shoulder room than the front seat of a luxurious subcompact like the Mercedes 190E.

Of course, if you pick our pickup, you will have to give up something. A back seat.

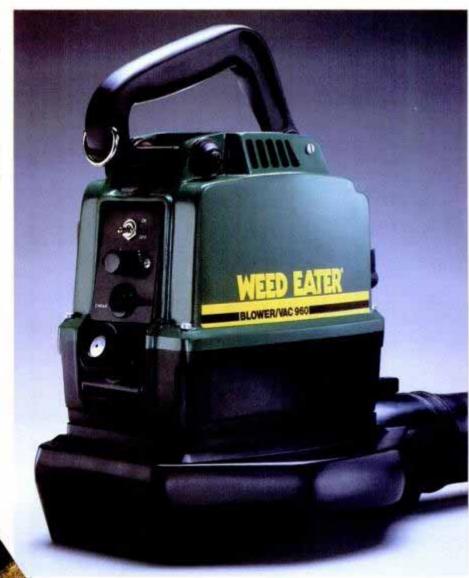
Instead there'll be room for the occasional refrigerator, dirt bike or antique dresser.

As well as room for something far more important. A chance to express your individuality.

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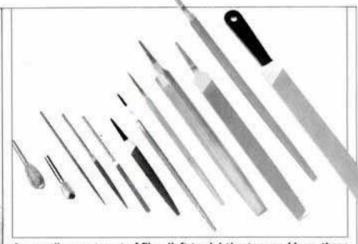
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Workshop Minicourse

BY ROSARIO CAPOTOSTO



A versatile assortment of files: (left to right) rotary and burr, three needle files, warding, round, triangular, half round, mill, square and a combination single- and double-cut file.

Using Files: 1

does require some practice to become skilled at it. Knowing the different files and which is right for the job also will help in their use.

Files differ in the following ways: type of cut, coarseness of teeth, cross-section shape and outline shape. As files get longer, they get thicker in cross section and their teeth become coarser. They can taper from heel to point or change width.

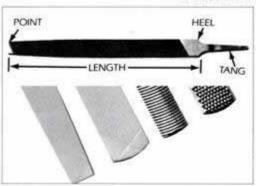
Single-cut files have diagonal rows of teeth that are parallel to each other. Double-cut files have two rows of parallel teeth that diagonally intersect each other.

Single-cut files, also called mill files, are used to smooth a surface or sharpen saws and keen-edge tools. Doublecut files—known as machinist files—cut faster, but not as smoothly.

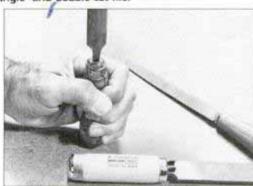
Both are sold in the following categories (in descending order of coarseness); coarse, bastard, second cut, smooth.

Some files have curved rows of teeth and work especially well on soft metal. Rasps remove material even quicker, but do leave a rough surface because of their large, staggered teeth.

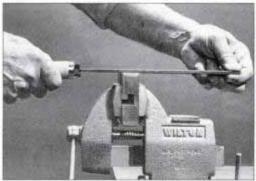
Though there are many different ways of filing, the most basic is shown at right. Grip the file as shown and don't rock it while pushing it across the work. In the next two months, we'll talk about more involved filing techniques.



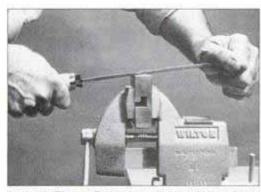
Top, file length is measured from point to heel. Above, a close up view of a single-cut, a double-cut, a curved tooth and a rasp file.



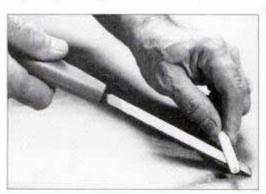
Set a file into its handle by tapping it; never use a file with a bare tang. Handle in the foreground has adjustable jaws to fit various tangs.



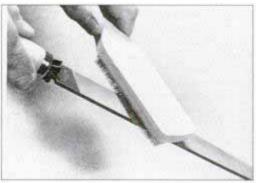
This is the correct grip for a file. Stroke the file with arm pressure only; don't lean on it. Move the file diagonally or straight across the workpiece.



Incorrect file use: Too heavy a grip and upper body movement tend to produce an uneven and rocky motion, instead of smooth, even strokes.



Rubbing a thin coat of chalk into a file helps reduce clogging and makes it easier to clean off filings when finished with the job.



Don't let material clog a file, slowing its cutting action. When done, scrub thoroughly with a file card in the direction of the tooth rows.

Car Clinic



BY MORT SCHULTZ

Legal Beagle

hat is and what isn't covered under the emissions control systems warranty that is supposed to guarantee parts for five years or 50,000 miles? At 24,500 miles, my 1983 Dodge Aries failed the Pennsylvania emissions test because the carburetor couldn't be adjusted to meet test requirements. The dealer, a representative from the zone office, and another from Chrysler headquarters in Detroit told me the carburetor is guaranteed only for 12 months or 12,000 miles and refused to pay for repairs. It's water over the dam, but I'd sure like to have the matter clarified. R.M. BROWN BETHEL PARK, PA

Those who said your carburetor was covered for 12 months or 12,000 miles were off the mark, unless something you did caused the part to fail. According to the Federal Clean Air Act, a carburetor that causes emissions in excess of federal standards is covered under the emissions systems warranty for at least 24 months or 24,000 miles, whichever occurs first, and might even be covered for the full five years or 50,000 miles.

Two different emissions control warranties are involved: a performance warranty and a defect warranty. The performance warranty states that emissions-related parts of all 1981 and later model cars, light trucks and vans which fail a state inspection and maintenance

(I/M) test that's approved by the federal government are covered for the first two years or 24,000 miles, provided failure didn't result from owner misuse or improper maintenance.

The EPA classifies the carburetor as an emissionsrelated part. It doesn't control emissions as does an EGR valve or catalytic converter, for example, but it could cause a rise in emissions level if it fails.

My advice to owners in states having I/M programs is to have their vehicles inspected just shy of two years or 24,000 miles to catch any emissions-related part that has gone bad. By doing this, they should be able to get repairs paid for by the manufacturer.

The defect warranty covers 1972 and later model vehicles. It stipulates that parts specifically designed to control emissions must do their jobs effectively for at least five years or 50,000 miles. The attitude of the EPA is that if any of these fail a state I/M test, it will cause emissions in excess of federal standards and is therefore to be repaired by the manufacturer anytime during a 5-year or 50,000mile period, whichever occurs first. Under the defect warranty, emissions-related parts that fail (your carburetor) are also covered for the 5-year/50,000-mile period if you can prove that the part creates emissions in excess of that allowed by the Federal Test Procedure (FTP). That's a tall order.

The only way Chrysler could have been bound legally to pay for repairs was for you to have had an FTP performed, which would have cost you more than a new carburetor. Was there a less expensive way to prove that Chrysler may have been liable? Possibly.

You could have asked supervisory personnel at the state I/M facility if they were able to tell if the vehicle would have failed the FTP because of the carburetor, then gotten a statement to that effect in writing and called the EPA to determine if there was interest in pursuing the matter and testing your car. The EPA's number is 1-202-382-2640.

Quiet? Quite!

Back in June (Car Clinic, page 22), I told Ken Jonalitis that GM engineers were working on a solution to the noisy fuel pump in his 1985 Pontiac 6000 station wagon. I suggested that owners of '85 GM A-Body wagons watch this column for more information. Well, a new fuellevel sender and pump assembly (part No. 25091799) has just been issued to correct the condition. For '86 wagons, it's part 25092920.

A need to be free

I have a 1984 Plymouth Turismo with the 2.2-liter engine and 5-speed transaxle. From the day I took the car from the showroom, the clutch pedal didn't have any free play. When I asked the dealer about this, he told me not to worry—that the clutch adjustment was automatic. You can guess what happened. Recently, the throwout bearing disinte(Please turn to page 24)

Look For The Cat

Look For The Cat Under The Car

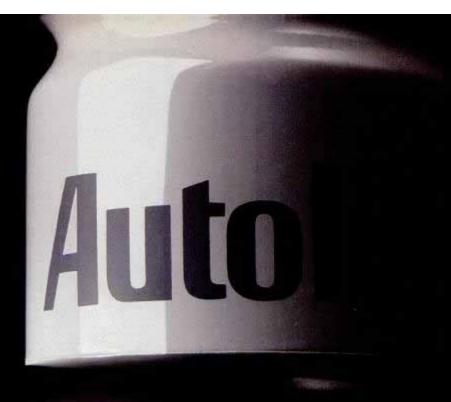
Instant heartache is being told at a state emissions inspection station that your newly-bought second-hand car or pickup truck flunks because it's missing a catalytic converter. That's \$100 to \$350 out of your pocket, all because you didn't take the time to

look under the car or truck before buying it.

Farfetched, you say? Don't tell that to Dr. Fred W. Bowditch, who's vice president of Technical Affairs at the Motor Vehicle Manufacturers Assn. According to Fred, a recent MVMA survey

of 2000 vehicles built from '75-'85 showed that 15 percent of the light trucks and 7 percent of the cars had their converters removed by the previous owners.

If you're planning to buy a used car or truck, you better take a look under the car.



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Allied Aftermarket Division East Providence, Pl 02916



(Continued from page 22)

grated. Flying bearing pieces destroyed the flywheel ring gear and starter solenoid, causing \$635 in damage. The dealer now has the gall to say I caused the damage by riding the clutch. That's not true. I drove my previous car, a 1978 Horizon, 102,000 miles and never had clutch trouble.

I think Chrysler should stand the cost of repair, but the zone rep says no. I'd appreciate any information you can give me—even if it's just to agree with me.

WAYNE L. CHRISTENSEN
WILLIAMS, AZ

I agree with you-something was wrong all along. The dealer just didn't pick up on it. I've never seen a clutchself-adjusting or not-that didn't need some free play. Trying to prove that the damage resulted from a mistake in production could be tough, especially if you have no documentation that you brought the matter to the dealer's attention. But you have nothing to lose. Tell the dealer you want to file a grievance with the Chrysler Customer Arbitration Board. It will help your case if you've got work orders from the dealer's service department showing that you asked them to check free play.



Playing Rough

The guys at Bendix say that if your next set of front-disc brake pads are semimetallic, you have to rough up smooth rotor surfaces a bit to ensure that the pads seat properly. If rotor surfaces are left smooth, pads can develop glazed surfaces. Roughing up can be done with the rotors on the car. Use an electric drill sanding attachment fitted with a No. 160 to 220 medium-grit sanding disc. Move the drill across the rotor instead of using a circular motion

To sand the back surface of the rotor, remove the caliper and stick the sanding disc between the rotor and dust shield in

SAFETY GOGGLES

DUST MASK

ROTOR

DUST SHIELD

the spot that was occupied by the caliper. As you finish treating one section, turn the rotor to move another section into the opening so you can get at it.

Anyone's guess

Perhaps you can give me information concerning a to-do I'm having with Ford Motor Co. over my 1981 Ford Escort 1.6-liter engine (77,000 miles). It has a crack in the aluminum cylinder head. After much arguing, the area zone manager has agreed to pay onequarter of the \$800-estimated bill for repairs. If this was a deficiency to begin



with, shouldn't Ford pay the entire cost? What should I do?

> CHERYL HENLEY RANDLEMAN, NC

Grab the offer. It's the best you'll get. The crack could have been caused by owner neglect or by a weakness in the aluminum head. After 77,000 miles, who's to know? I've had other letters regarding cracks in high mileage 1.6liter Escort engines, but Ford denies that there's a widespread problem.

In any case, your experience should provide a warning for others to make periodic hydrometer checks for ample low-temperature protection and to replace coolant every two years or 24,000 miles, whichever occurs first. Install a name-brand cooling agent that's formulated for aluminum cylinder heads. Also make sure coolant is at the FULL level all the time. Less than FULL can result in air pockets that may lead to cylinder-head hot spots that result in cracking or warping.

IOUs for THMs

I read recently that General Motors has agreed to reimburse the cost for major after-warranty repairs made to THM-200 automatic transmissions. I bought a 1980 Chevrolet Chevette off a used car lot in 1983 and had the transmission fail on me after six months. The odometer showed 46,784 miles when this happened. Repairs cost me \$562. What do I have to do to get my money back?

> STEPHEN INGRAM MILWAUKEE, WI

Disappointing news, Stephen. Under the proposed settlement (which has not yet been approved by a U.S. District Court) second and subsequent owners of vehicles will not be covered if GM's proposal is adopted.

Those who bought new 1976-'80 GM vehicles with THM-200 transmissions (these are the only ones covered by the proposal) and incurred transmission repairs within the first 50,000 miles come under the provisions. If a person can prove there was transmission trouble at or before 24,000 miles, he or she would get back 90 percent of the repair costs; between 24,000 and 36,000 miles, 80 percent; and between 36,000 and 50,000 miles, 60 percent.

To keep abreast of what's going on, call or write the Center for Auto Safety, 2001 S St. N.W., Washington, D.C. 20009 (202-328-7700).

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

- Owners of domestic front-wheel-drive Chrysler Corp. cars with manual transaxles take note if you're getting gear clash, if the clutch isn't releasing or if the clutch spins longer than five seconds when shifting into REVERSE. You may have a damaged drive strap, so replace the clutch pressure plate assembly. Technical service bulletin (TSB) 06-01-86 gives the details.
- Owners of 1986 and previous model GM vehicles having VIN codes F, H, S, W, X and Z may find oil dripping from around the oil pan plug. If so, replace the copper gasket with a new steel gasket (part No. 14090908). Don't over-tighten-12 to 20 ft.-lb. is the range.
- Nissan has issued a new distributor (part No. 22100-18F121) that cures hesitation during light to moderate acceleration in 19861/2 200 SX nonturbo engines. If the description applies, ask your dealer to check TSB 86-085 to determine if the fix applies to your car.
- Eliminate a leak from the power steering gear of a 1986 Ford Aerostar by having your dealer install parts from seal kit E69Z-3E501-B.
- Look under the rear of your 1986½ Toyota Supra to make sure the dealer installed rubber plugs in the hook holes on both sides of the car. If not, the floor side member can start rusting. Go and ask for the plugs (part No. 58707-14010).

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Eda Martin • Niagra Falls, Ontario, Canada

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Frank and Julie Parsons . Summit, Mississippi

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Lee and LaVonne Fliss . Minneapolis, Minnesota

There were many reasons we chose Kent. The stove's appearance was important and we've received many compliments from friends about our Kent. We felt Kent was the best value for the money and we feel the same now as when we purchased. 99

Jos and Leslie Vandervelden • Calgary, Alberta, Canada



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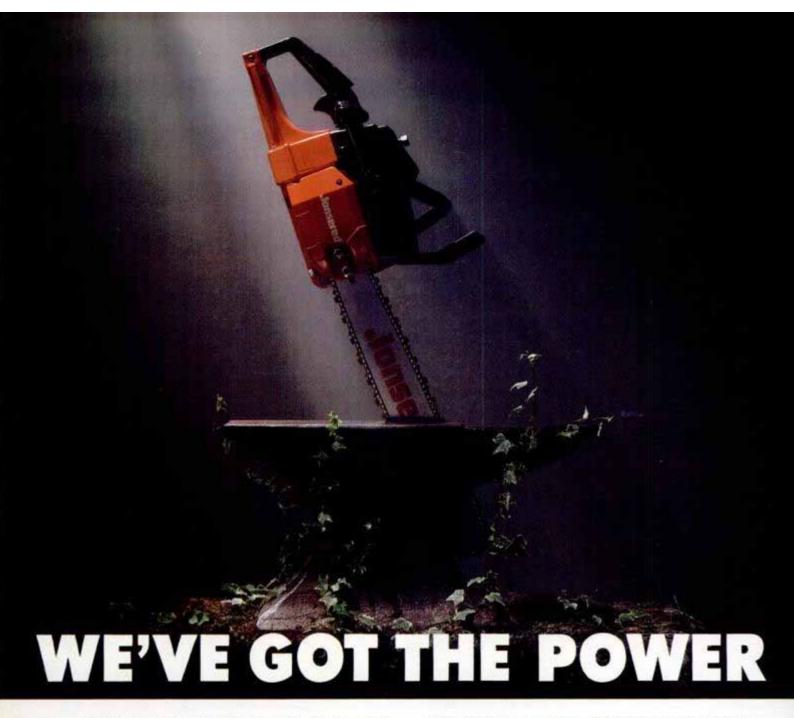
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Appliance Clinic

BY STEVE TOTH

Stop-And-Go Dryer

have a Norge gas dryer, model No. 322-484-ON, serial No. ICS1798. It works fine, sometimes load after load, day after day. But occasionally, unpredictably, everything suddenly stops (the timer, the drum and the heat) in the middle of the cycle. Sometimes minutes or hours later, it will continue the cycle on its own. Can it be that it has to take a rest due to old age?

I don't want to spend a lot of money trying to fix this dryer. However, we're do-it-yourselfers and if the problem is something simple, maybe we'll fix it ourselves.

HANNAH KITAY

From the symptoms you describe, I suspect the dryer's problem is the timer. Your 1962 vintage Norge dryer has a mechanical wind-up timer with a large spring inside. The component is similar to a standard wind-up kitchen timer.

the Apparently, over years, the spring may have lost some of its tension, or the gears or a shaft may be worn, causing the timer to bind and stop by itself. Then, either vibrations may cause it to start again or the spring overcomes the binding and the timer completes its cycle.

I checked with the Norge

LAKEWOOD, NJ Co. and they tell me the tim-LINE SIDE TIMER WIRING DIAGRAM TIMER CONTROL TIMER KNOE COVER CONTROL PANEL When replacing the dryer's timer, you must mark some wires to ensure that they are put back in the correct

er for your dryer is still available. Its part number is 605830 and it costs about \$53. It can be ordered from any authorized Norge service or repair agency or parts distributor.

To install the timer, disconnect the dryer from its power source and pull it out from the wall. Next, pull off the timer knob and remove the six 5/16-in. hexhead screws that hold the control panel cover to the back guard. Once the cover is removed, you'll have access to the back of the timer. Remove and label each unmarked wire as you pull it from the timer contacts.

Remove the two screws holding the timer bracket to the back guard. Pull the timer and bracket out of the control panel.

Remove the two screws holding the timer to the bracket and wire in the new timer. Assemble the parts in the reverse order from which they were removed.

Switch fix

We have an Amana side-byrefrigerator/freezer. model No. SR17WC, serial No. K36550038, mfg. No. P60340-28WC. The light switch in the refrigerator side needs to be replaced since it will only turn on if you pull it out.

I need to know how to remove this switch and where I can find a replacement.

> RONALD MEYER SALT LAKE CITY, UT

The combination light and fan switch is Amana part No. C36586-1 (\$15.25). It can be ordered through any Amana dealer in your area. If you can't find a dealer. contact the people at Amana Refrigerator, West Central 4849 Kingston St., Denver, CO 80239. They should be able to direct you to your nearest supplier.

To replace the switch, unplug the refrigerator, open the doors and remove the kick plate or grille at the bottom. Then reach in behind the switch and pull off the molded gang connector

that's attached to its back. Next, push in the two plastic tabs on the outside of the switch. Push the switch through the hole in the refrigerator's cabinet.

If you have any difficulty removing it, it may be necessary to pry it out with a narrow-blade screwdriver. Insert the screwdriver between the switch and the painted metal surface, Gently pry it out with one hand while pulling on the switch plunger with the other.

Install the new switch by pushing it into the hole and connect the marked gang connector to its back. Note: the switch has four terminals on it, two large and two small. The switch will only fit into the molded gang connector one way, so be sure the terminals fit into the right holes on the connector. Reinstall the kick plate and plug the refrigerator back in.

Stuck agitator

Mr. Dave Crawford of Burlington, North Carolina. sent in a unique suggestion for removing a clothes washer's agitator. Agitators can be tricky to remove. Often they fit tightly or become stuck to the drive block with soap residue.

First, unplug the washer and remove the agitator cap. Then, if there is room between the bottom edge of the agitator and the tub bottom. work a completely deflated bicycle inner tube under it, distributing the tube as uniformly as possible. Leave the valve stem sticking out and attach a hand pump or mini compressor to it.

Gradually pump up the tube. It shouldn't take much pressure because the agitator's surface area is large. The agitator will let go with a pop. The method won't harm the agitator since the force is fairly evenly distributed around it.

If you have a problem with any appliance, send your question, along with the model and serial numbers, to Appliance Clinic, Popular Me-chanics, 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.

order. For the illustration above, only wires 8 and 9 are labeled.

Inside Detroit



BY JIM DUNNE

Big Ford Reprieve



Ford LTD gets spruced up in '88 with revised front end.

They can't kill the Ford LTD Crown Victoria, so look for this rear-drive big car to stay alive at least until 1991, and maybe 1993. Ford planners have made efforts to drop the vintage 1979 model for a couple of years now. But sales remain high, and Ford executives figure there is no need to bring out a front-drive LTD soon. A modest face lift is planned for 1988, with exterior changes showing up in the grille, front bumper and taillights. But old-fashioned 6passenger comfort, V8 power and rwd will be around for at least four more years.

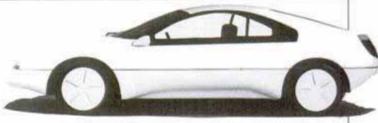
2-faced prototype

Its front end is a 1988 Pontiac Grand Prix, the rear a 1988 Cutlass Supreme. The unusual prototype was spotted at GM's Proving Grounds in Milford, Michigan, undergoing noise and vibration tests. As a moneysaving technique, GM will at times build one prototype with two or more different body features. Since Grand Prix and Cutlass Supreme use the same basic body, it's easy to attach individual parts. This car has a Grand

Prix grille and front clip (fenders, hood), while the roof, trunk and taillights are for the Cutlass Supreme. A third car to be built off this body, the Buick Regal, will soon show up in other mixed prototypes.



This '88 GM prototype has Pontiac front end, Olds rear.



Chrysler's Mojave show car will roll on Cordia chassis.

Chrysler Mustang?

Chrysler's econosport 4seater is scheduled to be one of the first models to come out of the Diamond Star assembly plant now under construction in Illinois.

A tiny front-wheel-drive sportster that Chrysler President Hal Sperlich hopes will duplicate the success of the original Ford Mustang, the car is partially based on the Midas, a mini sportster from Great Britain. The 84-in, wheelbase of the Midas is close to that planned for the production car. But, as one of the first products of the Chrysler-Mitsubishi partnership in Diamond Star, it will use the floor pan of a Mitsubishi Cordia. Body shape will probably follow that of Chrysler's Mojave concept car (above), with emphasis on aerodynamic lines and a 1-color finish for the body panels, wheels and bumpers.

Best quality

At GM, quality reviews show that Corvette and Fiero are the best of anything GM produces. And the Japanese cars in Chevy's lineup—Nova, Spectrum and Sprint-regularly rank in the top 10 for quality. Each month the corporation checks its model lines to count the number of defects and customer complaints. And each month GM's assembly plants are ranked in order of quality based on those checks.

Note that the two top cars, Corvette and Fiero, are 2-seaters and 2-door models with fewer parts to put together. Also, their assembly lines are among the newest in all of GM and handle only one model, not a mix of coupes, sedans and wagons. The quality of Chevy's Japanese cars was expected to be high, based on the history of Japanese products sold in the United States.

Koreans do it differently

At the end of the Hyundai engine assembly line in Ulsan, Korea, is a large sign in English that lists the "Top Ten" suppliers for the current month and for each of the previous 11 months. The Top Ten are ranked according to the quality of the parts supplied to Hyundai.

"So what?" you might ask. After all, that's a common practice in American factories, too. Ah, but there is a difference. The Top Ten here are the worst suppliers, not the best. If you supply crankshaft bearings to Hyundai and make the Top Ten listing for too many months in a row, you could lose your business.

It may be crude, but it is an effective way for a new car company like Hyundai to get top-quality parts.

2-cycle future?

High-speed, 2-stroke engines may be in the works for small GM and Ford cars. New developments in fuel injection and computer controls may make the 2-stroke the design of the future, if current promises of lighter weight, lower height and more power prove out.

Lighter weight and lower height come from the elimination of complicated cylinder heads, while more power may be possible from a more consistent mixing of air and fuel.

Much of the 2-cycle speculation is tied to the Orbital engine design that uses air pressure to inject fuel into the combustion chamber.

The 2-stroke engines are less costly to build because they need fewer parts. Cost savings, more than anything else, makes eyes gleam in Detroit's executive suites.

Steer by wire

It's coming. Electric power-steering systems that do away with the hoses, pumps and pulleys of the hydraulics used on today's cars are a cinch to take over the market by the early 1990s. Allied Corp.—a West German firm—TRW and now General Motors have announced plans for high production of electric steering systems.

Advantages are lighter weight (4 pounds off the 30 pounds of a hydraulic system), better feel of the road, easier adjustment of the pressure needed to turn the steering wheel, smaller size and power assist even when the engine stalls. Cost is said to be higher than hydraulics now, but will change when production of the electrics moves into high gear in two years.

GM will build its electric steer at Saginaw Steering Gear Division, a prime supplier of GM and its competitors. GM officials say that there is some fuel economy savings—perhaps half a mile per gallon—since electric power is used only on demand from the steering wheel, as opposed to the constant pumping of a hydraulic system while the engine is running. The GM system has been in development since 1979, and could show up on production cars as early as next year.

Suburban prestige

Chevrolet officials report that the doeverything Suburban model is bought by the richest and best educated customers of any of its light truck or car lines, including Corvette. "It's become a prestige vehicle in many parts of the country," reports Chevy marketing expert Ed Roggenkamp. "The country club set, especially in Texas for some reason, puts it in the same class as a luxury sedan."

And well they might. The out-thedoor price of a 4-wheel-drive Suburban Diesel starts at \$17,300, but with the usual extras it will easily reach \$22,000.

Age worry you?

Getting older a problem? Think of how Cadillac must feel. The median age of its buyers keeps creeping upward. If it goes much higher, Cadillac buyers will disappear from the market, not to mention the face of the Earth. Youngest of the Cadillac buyers is the group that

chooses Cimarron. But it's pushing 50 years old. Median age of the Fleetwood buyer is 60, and that means many will never buy another new car. DeVille buyers are only a year younger, while Eldorado and Seville are a graying 50 and 54, respectively.

The numbers worry Cadillac officials, who once hoped that the Cimarron would tap a fountain of youth and rejuvinate the whole division.

CJ trivia

Bet you didn't know that the rugged little Jeep, that nothing-can-stop-me 4wheeler, was sold more to city folk than to back-country roamers. Fifty-nine percent of CJ Jeep buyers were from urban areas, according to American Motors figures. Average age: a startlingly low 29 years, but they make good money, about \$29,000 per year. And AMC says that 95 percent of CJs are personal transportation vehicles—replacing cars in the family garage.

The biggest problem in designing the new Wrangler as a replacement for the CJ was in changing the headlights from round to rectangular. Many old-timers were against it. They thought Jeep should stick with the goggle-eyed look.

(Please turn to page 31)

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NAPA parts are as good as, or better than original factory equipment.

be running a little bit foreign, look for the NAPA sign of quality.

We've got all the right parts in all the right places.



All the right parts in all the right places."

Check your Yellow Pages

INSIDE DETROIT

(Continued from page 29)

4-wheel steer

It's not as revolutionary as it seems. The recent flurry of announcements that 4-wheel steering is being developed by a half dozen companies in the U.S., Japan and Germany can be misleading. Actually, two cars now on the road—Mazda's RX-7 and Porsche's 928—have a type of 4-wheel steer. In both, a tiny amount of flex has been built into the the rear suspension. This flex, which changes the position of the rear wheels not more than a millimeter or so, is specifically arranged to make the cars handle better in curves or during braking.

The flex occurs passively, that is, when the suspension twists away from its normal setting. However, the steering that is being developed for a couple of years in the future is an active system. The movement of the rear wheels is powered in the same manner as the front wheels, but with much smaller steering angles.

Another clean sheet please

GM's Saturn car project is changing designs. The car that would be "designed from a clean sheet of paper" will not look like the rounded 4-door that was shown to the public last year when the Saturn Corp. was first announced. GM has taken out another clean sheet to design a more dramatic body for Saturn. This one will follow Ford's lead in emphasizing aerodynamics as well as appealing lines.

In another change, the Saturn will be built in four body styles, not two. In addition to the 2- and 4-door sedans, Saturn will be available in 3-door hatch and 2-seat sporty versions.

So far, prototypes of the new Saturn bodies have not been spotted at GM's proving grounds. But with introduction set for sometime in 1989, prototype testing should begin within the next six months.

Not easy

Buick's Reatta project may seem simple enough, but there are troubles. The front-drive 2-seat sports car is set for introduction a year from now. But Buick engineers are still trying to figure out how to make the windows go up and down! The problem stems from the severe bend in the windows and doors, which causes binding in the guide tracks. One report is that the bind is so bad that "the whole chassis moves a little" when the windows are powered up or down.

Since the Reatta is a completely new car, problems like this are to be expected. But deadlines for moving the car into production are getting shorter, so the window glitch becomes an emergency project that is taking a lot of overtime work to complete.

'Heroes of low tech'

That's the way Yugo executives explain the appeal of their subcompact to American buyers. "We sell basic, nofrills affordability, a meat-and-potatoes product that furnishes solid transportation." True, but the \$3990 price tag helps a lot, too.

Encouraged by the initial sales success of the 2-door, Yugo executives plan to bring out a procession of new models in the next three years, including a convertible, a midship-engine 4wd sports car and a compact 4-door sedan.

Midship Ford

A midship engine sports car is in the works at Ford (see Freewheeling, page 14). But the high-performance model will be smaller and lighter in weight than a Corvette, and fit more with the size of the Fiero or Toyota MR2. Look for this car to show up in auto shows next year, with production coming within a year after that. Price will be in the \$20,000 range.

PRODUCT WARNING AND RECALL

Smith & Wesson 9mm Semiautomatic Pistols

This warning is issued for Smith & Wesson 9mm Semiautomatic Pistols which were shipped from the factory between May 1, 1983 and February 26, 1986. Included are Models 439, 459, 469, 539, 559, 639, 659 and 669 but only with serial numbers in the following ranges:

A745000 through A865000 and TAA0001 through TAL9999.

When the hammer of some of these pistols is in the half-cock notch, the manual safety (decocking lever) cannot be depended on to return the hammer to the "at rest" position. The manual safety may not go fully into the "safe position" and the safety mechanism will therefore not be engaged. If you pull the trigger when the pistol is in this condition, the manual safety may return to the "fire position" and the pistol may fire. If the muzzle is not pointed in a safe direction, this could cause serious injury or death.

THE PISTOLS WITHIN THE SERIAL NUMBER RANGES LISTED ABOVE MUST BE INSPECTED FOR FUNCTION FROM THE HALF-COCK NOTCH. The safety mechanism will function in a perfectly satisfactory manner in many of these pistols, as well as in all pistols with serial numbers outside these ranges and in all pistols shipped from the factory after February 26, 1986.

Every one of these models bearing a serial number within the ranges listed above should be carefully inspected by the owner for this special condition. To determine if your pistol has this condition, do the following:

1. Point the muzzle in a safe direction.

Completely unload the pistol. Check both magazine and chamber to assure they are empty of live rounds.

3. With your finger off the trigger, operate the manual safety with the unloaded pistol fully cocked and fully uncocked so that you can recognize how the manual safety looks and feels when it is fully in the safe position. The hammer will fall from the fully cocked position into the "at rest" position when the manual safety is moved down toward the safe position. When you are thoroughly familiar with placing the manual safety fully in the safe position, place it up in the fire position.

4. With the manual safety in the fire position, place the hammer in the half-cock notch:

For the Model 439, 459, 539, 559, 639 and 659, put the hammer of your pistol in the half-cock notch by pulling the hammer to the rear slowly until you hear the first click and then releasing the hammer so that it catches between the full cock and the "at rest" position.

For the Model 469 and 669, put the hammer of your pistol in the half-cock notch by inserting an empty magazine and slowly pulling the trigger until you hear the first click and then releasing the trigger so

that the hammer catches between the full cock and the "at rest" position.

5. With the hammer in the half-cock notch, push the manual safety down toward the safe position. If you can push the manual safety fully into the safe position and the hammer falls into the "at rest" position, your pistol does not require modification. If you cannot push the manual safety fully into the safe position or the hammer does not fall into the "at rest" position, your pistol is being recalled for modification free of charge.

Recalled pistols should be sent promptly to a Smith & Wesson Warranty Service Center for modification. If you do not have a list of Warranty Service Centers, call 800-633-0164 for the name and location of the one nearest you or for answers to any questions you may have. Law enforcement departments who have pistols which exhibit this condition should contact the Smith & Wesson Service Department (800-633-0164) to arrange for modifying the pistols. Individual law enforcement officers whose pistols have this condition should contact the nearest Warranty Service Center or contact the Smith & Wesson Service Department.





Home Video



BY JAMES B. MEIGS

Tale Of The Tape



Top-grade tapes like Scotch EXG Camera or TDK HD-Pro are for critical applications.

You probably know that high-test gasoline gives better performance than regular. And you've probably discovered that high-grade videotapes provide a better picture than standard grades. But what about all the above-high-grade tapes manufacturers now offer—tapes with names like Hi-Fi, Super High Grade, Pro and Camera Cassette? Are they really necessary? How do you choose the right one?

If you can't tell the difference between many of these top-of-the-line tapes, you're not alone. I've worked with some of the nation's top experts on videotape and, guess what? Often, they can't tell the difference between a Super High Grade

and a Hi-Fi tape, either.

The fact is that in the lab—and in your VCR—most of these tapes perform pretty much alike. In fact, if one company offers a Hi-Fi, a Pro and an SHG, the tape inside the the boxes might be



almost identical. That doesn't mean it's not good: Most of the above-high-grade tapes from well-known manufacturers offer exceptional quality. But given the profusion of names, choosing the right tape can be confusing.

For that you can blame the manufacturers, who use obscure titles such as EXG, HGX and Super HG Master to designate their grades when a simple Good-Better-Best would do.

In fact, some of the names companies use to sell their higher grades of tape are even misleading. To my mind, the most shameful is the bright STEREO label some manufacturers slap on their cassettes. It's not that they're lying, but any tape can record stereo. The question is: How well does it record stereo? There's no reason to think that just because a tape carries a stereo sticker on it, it will record stereo better than a videotape without the sticker.

Only a little less deceptive are the numerous tapes labeled Hi-Fi. Again, any tape can work in Beta or VHS Hi-Fi VCRs. The same attributes that make a tape good for recording pictures—high sensitivity, low dropoutsalso make for a good Hi-Fi audio performer. Generally, though, Hi-Fi tapes have a more durable backing and binder system. So if you plan to play your recording many times-a live concert, for example-a Hi-Fi tape might prove worthwhile.

Another misleading designation is the Pro label some tapes carry. There is such a thing as professional videotape, but it rarely appears in stores and it's not necessarily better than the consumer variety. The Pro label on consumer tape is just another way to convince you the tape offers top quality.

One variety of super-highgrade that does offer you some tangible benefits is the type designed specifically for shooting home movies. Most of these include a top-grade videotape wound inside a tougher-than-usual plastic shell and packed in a hard clamshell carrying case. The most impressive of this type. Scotch's Camera Cassette, even adds an antistatic treatment to the cassette shell to keep it from attracting dust particles (dust is a major cause of picture-disturbing dropouts).

Though it's certainly possible to shoot home movies with any tape, I think it might be worth the extra expense to get a cassette you know will stand up to the rigors of outdoor use. And the super-high-grade tape inside the cassette will act as a top-quality master recording if you're editing and copying your home movies.

Is the extra quality provided by these above-highgrades worth it? Can you see the difference?

A couple of months ago I probably would have said no to both. After all, the picture quality provided by most of today's high-grade tapes—even many standard-grade tapes—is outstanding.

But recently I had an experience that changed my mind. After a technical seminar sponsored by tape-manufacturer TDK, the company gave me a sample of a new above-high-grade tape not yet available here-and not even named. I used it to record a TV broadcast and I'm still astonished by the bright, clear quality of the picture. This proved to me that there's still room for improvement in videotape, and that yes, you can see a difference in tapes.

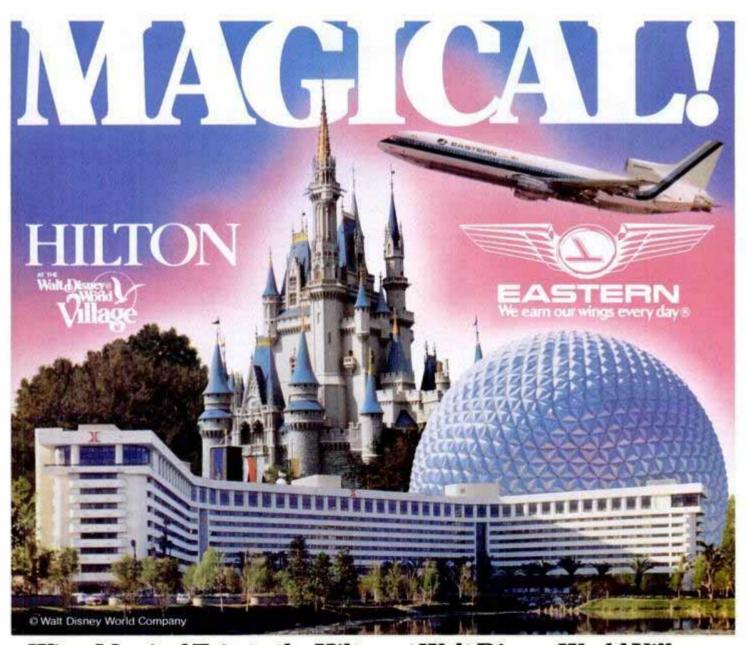
But for the time being, I'd advise you to worry less about the label on the cassette box and pay more attention to how well a tape works in your VCR. Specifically, don't feel you have to use a Hi-Fi tape just because you have a Hi-Fi VCR. For most applications it's not necessary to spend your money on an above-highgrade. But when you do want that extra margin of performance, most of these top-shelf grades from wellknown manufacturers can provide a slight edge.

New TVs for old

Recoton, the company that brought stereo TV to people (Please turn to page 37)



Recoton's FRED III decoder brings stereo sound to older TVs.



Win a Magical Trip to the Hilton at Walt Disney World Village, and Eastern Airlines makes it so easy to get there.

You'll find special offers on famous brands plus big prizes at your local Hardware/Home Center Store. Shop now, save money, and enter the GREAT FALL HARDWARE SALE SWEEPSTAKES. The Grand Prize... a family vacation for four at the glittering, all-new Hilton at Walt Disney World* Village, an official Disney hotel convenient to all Central Florida attractions and transportation! Your family could fly round-trip on Eastern Airlines to Orlando! Hundreds of other prizes, too! See the complete list of prizes and sweepstakes rules at your participating retailer, deposit your entry and enjoy big savings on top brand names during October.

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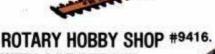
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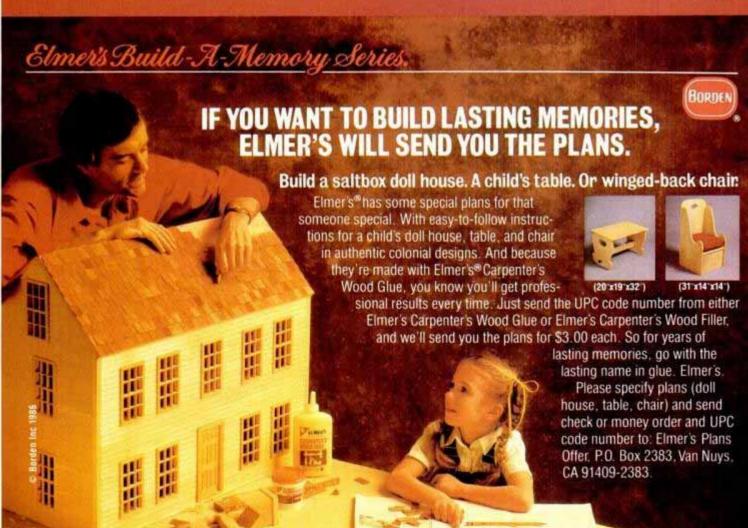


BLACK & DECKER

Take advantage of these super savings today and enter to "Win a Black & Decker Workshop" at participating outlets. Details at store display.







HOME VIDEO

(Continued from page 32)

who don't want to buy a whole new set, has just done itself one better. The company's latest add-on MTS (multichannel TV sound) decoder includes more features and is easier to use than Recoton's original decoder.

Dubbed FRED III (the FRED stands for Friendly Recoton Entertainment Decoder), the new model connects to almost any TV set—even older models—and packs a 12-watt stereo amplifier for driving two separate loud-speakers. It also has audio inputs, so it can accept and amplify the output from a stereo or Hi-Fi VCR. Best of all, the new \$200 model is completely automatic: The only button you have to press is the one labelled POWER.

Scrambling headaches

Movie companies will try just about anything to keep pirates from making illegal video copies of their movies. As I reported in the August Home Video (page 60), MCA Home Video, CBS/Fox and now MGM/UA are using a process called Macrovision to prevent illicit duplication of the prerecorded videocassettes they sell and rent.

The process involves altering the output level of the VCR in a way that confuses any other VCR that tries to record the picture. The result is an unwatchable copy. In theory, tapes encoded with Macrovision should play back normally on any TV set. But unfortunately, it ain't necessarily so.

Scattered reports have begun to filter in from around the country that some people are having trouble viewing Macrovision-encoded cassettes. The problems seem to be pretty rare considering the thousands of Macrovision cassettes that have been sold or rented. Some people report trouble only with a particular TV set/VCR combination. Others say one cassette gives them trouble while another tape doesn't.

Regardless, the bottom line is that the Macrovision system isn't perfect. But it seems to be catching on with video movie companies.

Although I believe movie owners have the right to protect their property from illegal copycats, I feel they're wrong to embrace a system that interferes with the perfectly legitimate watching of a video movie at home. I'd like to see the movie companies hold off on Macrovision until they can work out the bugs in their cassettes.

If you find you have problems with a prerecorded tape and suspect that Macrovision is the cause, see your retailer for a refund or exchange. If those retailers get continued customer complaints, you can be sure the message will get back to the movie producers.



gine industry has grown so quickly, an acute shortage of qualified Small Engine Professionals exists throughout the country. When you see how many small engines are in use today, it's easy to understand why qualified men command such high prices — as much as \$49.95 for a simple tune-up that takes less than an hour.



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Electronics



BY STEPHEN A. BOOTH A

Electronic SOS



Emergency dialer connects between Keepsafer alarm and phone.

ome security systems are practical—up to a point. They'll buzz about a break-in or whoop in case of fire. But, what if no one's around to hear the Mayday?

Some systems on the mar-

offers the Keepsafer home security system reported on earlier (Electronics, page 72, Apr. '86).

The wireless, install-ityourself system (\$180) now does more than just wail

in your home. A \$100 Emergency Phone Dialer will send an SOS to Schlage's Central Dispatch Station, where 24-hour operators in turn will call whomever you've designated.

According to Schlage, whenever one of the wireless sensors in your home transmits an alarm to Keepsafer, the

Emergency Phone Dialer (EPD) instantly calls the dispatch center, whose toll-free number is programmed into the EPD. Depending on the sensor, three types of alarms can be transmitted to the center: break-in, fire or medical (via the optional \$30 "panic button" pendant).

Upon receiving your alarm, a computer at the dispatch center tells the operator which outside parties you

want called for the specific emergency. You can designate five parties for each type of emergency, and Schlage will call them all.

For example, in a medical alert, you might designate calls for an ambulance, neighbor, family doctor, relative and friend, in that order. For fires or break-ins. when you might be away from home, you could designate yourself to be called at another number.

After the dispatch center informs the designated parties, the Schlage operator calls you to confirm the emergency and report what action has been taken. Why call you? It might be comforting if you're hurt. Or if for any reason it's a false alarm, the Maydays can be cancelled. By the way, Keepsafer and its EPD will alert the dispatch center even if your phone is off the hook or busy by "seizing" the line and dialing. The EPD keeps on calling the dispatch center until it gets a response.

Schlage's Central Dispatch Service costs \$15 a month, which includes unlimited emergency calls plus two "test" calls to confirm that your system is working properly. A contract for the service comes packaged with the EPD.

The EPD and dispatch service work only with Keepsafer systems-either the original Keepsafer or the new Keepsafer Plus. What's the difference? The new \$349 package has a master control unit that sounds five different types of alarms, compared to two on the original model. Additionally, you get three remote sensors and transmitters instead of two, plus a wireless remote control. Nearly a dozen optional accessories are available.

More filmless photos

Last month, I reported on Canon's new Still Video System, which makes electronic photographs on a magnetic disk instead of film (Electronics, page 56). At the time, I explained that the electronic prints that ran with the column were freezeframes from a videodisc and a professional video camera. I promised to show you actual images taken with Canon's RC-701 electronic camera and printed on the company's RP-601 printer, and here they are.

The actual $3\frac{1}{2} \times 5$ -in. prints are reduced here, so you might not be able to see

the fine dot-pattern that Canon's ink jet printer lays down to make the pictures. They appear rough and grainy when you scrutinize them closely, but reasonably sharp when you peer from a distance. As for color, Kodachrome it ain't. The printer's tonal range is more limited than that of photofilm, but close to the real thing and about the same as what a videotape reproduces. You can only expect this quality to improve as the digital and laser systems I mentioned last month are adapted for electronic prints.

(Please turn to page 40)





Canon electronic photo prints have adequate sharpness, color.

ket will summon help, by telephone or other means, with a prerecorded message. Trouble is, false alarms strain the resources of police and fire departments. In some communities, these emergency services will respond only to a live caller-

Design your own system with optional sensors for Keepsafer and Keepsafer Plus (shown).

A solution to this problem comes from San Franciscobased Schlage Lock Co. Schlage, you might recall,

not the Memorex version.

POPULAR MECHANICS • OCTOBER 1986

EXCLUSIVE FORMULATION USED BY AIRLINES—NOW AVAILABLE TO CAR OWNERS

Glass Shield™ KEEPS ALL CAR WINDOWS PERFECTLY CLEAR AT ALL TIMES... ABSOLUTELY NOTHING CAN STICK TO THEM...



- NOT SNOW NOT SLEET
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One Application lasts for up to Six Months!

GLASS SHIELD utilizes the formulation now used by most commercial and private planes to insure a perfectly clear windshield regardless of how foul the weather.

WORKS LIKE MAGIC

You'll be amazed as you watch the elements hit your windshield and actually roll and bounce off every area of glass. It's not magic...it's GLASS SHIELD!

IMPROVED FOR CAR & BOAT OWNERS

The plane formulation was enhanced by adding ingredients that not only prevent snow, sleet and ice formation on cars, but also grime, dirt, bugs, tars and salt spray from adhering to your windshield and all glass areas, including side mirrors. You can now drive in the worst of weathers with the assurance that you'll enjoy even clearer visibility at all times without even using your wipers. AND, because GLASS SHIELD protects the entire glass area of your car, you enjoy far greater visibility than merely depending on your windshield wipers. Clearer and wider visibility insures elimination of "blind spots" and provides greater protection against road accidents for you and your family. GLASS SHIELD is made by the manufacturers of famous GLO-SHIELD. America's finest car finish.

AS SEEN ON NBC-TV

David Horowitz' Consumer Report Show

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- FULL WINDSHIELD, SIDE AND REAR WINDOW VISIBILITY PERFECTLY CLEAR AT ALL TIMES (not just wiper area).
- GREATER PROTECTION AGAINST ACCI-DENTS FOR YOU AND YOUR FAMILY.
- ONE APPLICATION LASTS FOR UP TO 6 MONTHS.
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 ELIMINATES CONSTANT WASHING
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ELECTRONICS

(Continued from page 38)

Sleight of hand

First came the transistor radio. Then, the Walkman personal stereo and the LCD pocket TV. But when I first saw handheld copiers in Toyko stores a year ago, I really began to wonder how soon Japan Inc. would shoehorn my office and home into a briefcase.

I'm still waiting for the hip-hung beer cooler, but those palm-size paper copiers have already begun arriving in electronics and department stores. The first, called Copy-Jack from Plus U.S.A. Corp., costs about \$300. So does the somewhat larger Porta Copy from Silver Reed.

Both work on similar principles. You



Run Porta Copy across the surface of a document to make copies 3½ in. wide.



Copy-Jack, about the size and weight of an electric shaver, makes 1%-in.-wide dupes.

run the unit along the surface of the document you wish to copy and presto!-it's duplicated onto heat-sensitive paper stored on a roll inside the copier. The width of Copy-Jack's paper is 11/4 in., Porta Copy's is 31/4 in. Like so many of today's video camcorders, these personal copiers rely on a high-tech CCD (charge-coupled device) chip to pick up the original image. The CCD passes these signals along to a sensor, which converts them to thermal energy and develops them on the heat-sensitive paper. Both Copy-Jack and Porta Copy use rechargeable batteries and come with a recharger and cord.

Canned words

Typical telephone answering machines use audiotape to convey and record messages. But the pocket-size Voice Messenger from Colonial Data Services stores your out-message (up to 16 seconds) digitally on a solid-state voice chip. You can connect the \$55 unit to your phone, home or away, when you're not able to answer but want to convey the same information to many callers. For example, a Little League coach might leave a message that the game is cancelled because of rain.



Pocket-size Voice Messenger answers incoming calls with your 16-second recording.

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

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

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

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

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

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Save Gas, Save Engine with "POLY"

The following introduces one of the most fully tested and proven gas saving, friction-reducing engine treatments ever to reach the market!

The Secret is "Poly"

"Poly" is short for polytetrafluoroethylene (TFE), the slipperiest substance known to man. (1981 Guiness Book of World Records). Petrolon Corporation, makers of Slick 50, invented a way to permanently bind this slippery chemical to your engine with one treatment. Just one quart o Slick 50 can reduce engine friction, inc ease gas mileage and horsepower and reduce engine operating temperature, causing your oil and engine to last longer... plus it reduces metal wear, defraying costly overhauls.

Years of Testing and Use Have Proved it True!

Slick 50 has been thoroughly tested in independent laboratories and out on the road:

The March/April 1982, p. 35 issue of "Consumer Digest" magazine stated, "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon."

One of the country's most respected research institutes reported applying a powerful ultrasonic cleaning process to a Slick 50 treated engine and were surprised at its permanence. "We actually expected the Petrolon Slick 50 TFE Resin coating to also be removed, but later found it was still there."

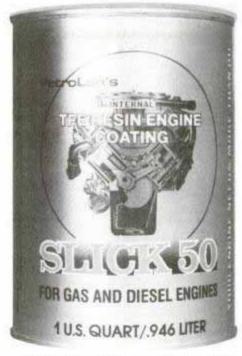
"Dune Buggies & Hot VWs" magazine April 1983 issue records the results of their one year testing of Slick 50. "We can indeed say scientifically that Slick 50 does work, and that it does reduce engine wear! . . . for the price of one treatment when compared to engine rebuild, we feel that you'd be money ahead using Slick 50."

The Federal Aviation Administration has fully accepted a similar product for aircraft—Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). This FAA endurance test simulated 1400 hours of engine use.

The power technology laboratory at a leading southwestern university stated, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university."

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

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



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

It's Easy to Treat Your Engine

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

Only One Treatment Necessary

It's permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4, 6 and 8-cylinder gasoline and diesel engines.

Works with Most Oils

Slick 50 will work with all petroleumbased oils and all synthetics compatible with petroleum-based oils with the exception of graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

4 Ways Slick 50 Saves You Money

Your actual percentages may vary depending on your driving, vehicle condition, weather and geographic location, but no matter what your conditions, Slick 50 can:

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

- Reduce operating temperatures, thus increasing the lubrication and life of the oil and engine
- Minimize or eliminate costly overhauls by reducing engine wear

Up to 90% of the engine wear on a car can be caused by lubrication starvation cars experience when first started before the oil begins to circulate. Slick 50 can eliminate this problem for less than the cost of two tanks of gas.

Slick 50 Will Not Affect Your Warranty

Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, this oil carries an American Petroleum Institute service classification SF-CC-CD.

There's No Risk with Our Money Back Guarantee

Use Slick 50 for 3000 miles. If you don't notice an improvement in engine performance, return your invoice with a short note telling why, for a prompt full refund — no questions asked.

Profit from Selling Slick 50 Yourself

Here's an opportunity to make handsome profits. Having such solid test results from major institutions make Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

For purchase or further information call toll-free 1-800-525-8624, ext. 10 (in California 1-800-233-9559) or send to: Progressive Energy Corporation, 255 South Bent Avenue, #B-1, Dept. PM086, San Marcos, California 92069.

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Photography



Trickle-Down Technology



Infinity uses dual light meters, aspherical lenses (see right).

The new Olympus Infinity provides a textbook example of how technology developed for sophisticated 35mm SLRs is finding its way into compact cameras.

This means that with no more effort than pressing a button, your snapshots can show technical quality comparable to those taken by trained photographers using

PM Photo-Tips Album

Compose your photographs to impart motion and you'll convey emotion to the viewer.





When framing moving cars, boats or bikes in your viewfinder, leave more room in front to create a sense of speed and direction. This will guide the viewer's eye in the direction of anticipated action such as a finish line. Keep the horizon above or below the center of the frame, so the direction is not ambiguous.

In the top picture, the raceboat seems to have run into the edge of the frame. It appears static. But the bottom picture sets up the boats to travel diagonally across the frame, toward the viewer. There's lots of motion.

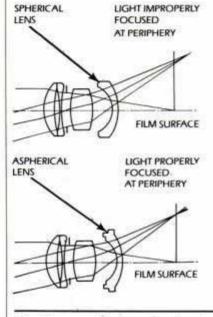
Intelligent framing will improve your portraits, too. A subject looking into a spacious frame conveys a more positive feeling than one facing the edge.

--- Armand Ensanian

complex gear. Specifically noteworthy on the Infinity (\$240) is its light-metering system and various lenses. For example, Infinity uses the ESP (Electro-Selective Pattern) light-metering system introduced two years ago in the sophisticated Olympus OM-PC. Instead of taking only an average light reading of the entire image, Infinity's ESP also takes a spot reading of the subject the infrared autofocus beam has locked on.

If there's a lighting difference of one f/stop or more between the subject and

IMAGING LENSES



background, Infinity automatically fires fill-flash. This prevents a backlit subject from becoming a silhouette. It also softens harsh shadows caused by strong front or side lighting. My test pictures taken under these difficult conditions showed the Infinity delivers what it promises. The flash also fires automatically in low light.

To achieve pinpoint spot metering, precisely measured infrared autofocus, and sharp resolution even into the corners of your pictures, Infinity employs hightech aspheric lenses.

Traditional spherical lenses lose sharpness at their edges. SLR cameras correct this by adding lens elements, but there's no room for these in a compact camera. Aspherical lenses fit the bill. They're sharper at the edges than spherical lenses because their curvature is more extreme. This makes them more difficult to grind from glass, so Olympus molds them from optical plastic.

With so much going for it under the hood, it's easy to forget that Infinity's body and lens are dirt- and moistureresistant, too. Someday, perhaps, more SLRs will claim the same.

Fuji ups the ante in color

No sooner had Kodak taken the wraps off its VR-G color print films (*Photography*, page 49, June '86) than Fuji announced a new-and-improved line of its own.

It's called Fujicolor Super HR and comes in ASA 100 and 400 (seen here) speeds. Like the new Kodacolors,

the claims for Fujicolor Super HR include punchier colors, more consistent color tone even when overor underexposed, and better sharpness than the HR it replaces.

To test Fuji's claims, I used Canon's T90 as a reference camera—the same one used for Kodak's films. Subject matter and lighting were similar, processing was done by the same walk-in 1hour lab.

As with Kodak's VR-G, Super HR does give deep, saturated colors that remain

(Please turn to page 46)



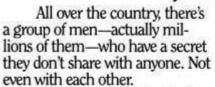


16

15



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

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

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

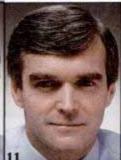
The important thing is that time. The return of your own natural looking color each day over They do it with a clear liquid, a period of weeks is so imperceptible, not even your friends can tell you're using Grecian. Unless, of course, you tell them yourself.

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TRUCKS

(Continued from page 42)

consistent even with as much as two stops over- or underexposure. Super HR is certainly sharp, though Kodak's grain structure appears to have the edge here. But Fuji is less contrasty than Kodak. This means your flash photos will seem more natural, without the washed-out surfaces and stark shadows that sometimes result.

Switch-hitting compacts

Back in February, I noted that autoeverything 35mm compacts give you most of the benefits of SLRs except for a big one-the ability to change lenses (Photography, page 40, Feb. '86). At the time, only two autofocus 35s came with built-in dual lenses.

What was then an innovation is now a trend. Joining Canon's normal/macro Sprint and Minolta's normal/telephoto AF-Tele are switch-hitting models from Fuji, Konica, Nikon and Vivitar.

Other brands are sure to follow suit.

Canon's Sprint (\$160) lets you take closeups only 18 in. from the lens. To do so, the normal 35mm f/3.5 autofocus lens converts to a fixed-focus f/12 for sharp pictures 18 to 43 in. away.

66 CHANNELLOCK, INC. Mc



Fuji TW-300: Twist lens to change focus.

Minolta's autofocus AF-Tele (\$263) goes the other way. At the press of a button, the normal 38mm lens zooms out to capture distant subjects by becoming a 60mm telephoto.

Fuji's TW-300 (\$290) is another normal/telephoto hybrid. Its 38mm f/3.5 optic becomes a 65mm f/6 telephoto when you twist the lens barrel. The autofocus, auto-exposure and flash parameters change simultaneously to the new mode.

At 38mm f/3.2 for normal shooting, and 70mm f/5.8 for telephoto, Konica's \$305 MR.70 clocks in with about the



Konica's MR.70: Fastest macro/tele lenses.

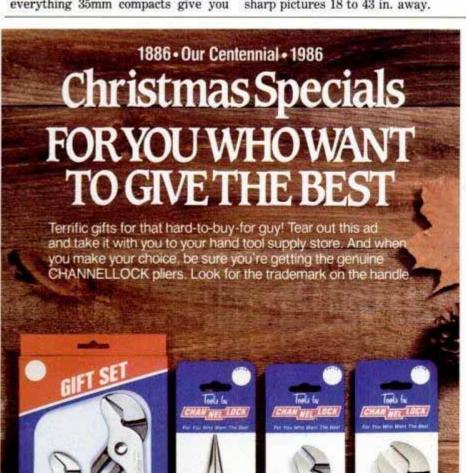
"fastest" lenses among this group of autofocus dual-lens compacts. Fast means the ability to focus more light on the film. The smaller the f/stop number, the faster the lens.

Nikon's Tele-Touch is nearly as fast, with a normal 38mm f/3.5 lens and 65mm f/5.6 telephoto. The normal lens can focus on subjects as nearby as 16 in. for closeup macro shots.

Among this autofocus-35 group, Vivitar's TW 35 (\$210) boasts the longest focal length—an 80mm telephoto. At f/ 8, it's also slower than the rest. So is the fixed-focus 35mm f/5.6 normal lens. PM



Nikon Tele-Touch focuses to within 16 in. POPULAR MECHANICS . OCTOBER 1986



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

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Your subconscious is powerful. Put it to work to bring you success fast. Thousands of men already are.

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

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Listen while you work around the house or while relaxing, watching TV or even while jogging, working out, or driving your car. The sounds of the waves make a smooth background while alone or with your family or friends.

Subliminal stimulation is so effective it's being featured in scientific and technical journals. Just wait until you try it! It's a totally new, yet natural, experience. You'll feel at home with it fast. A to-the-point briefing on each tape gives you the exact wording of the subliminal messages coming up. It's really fascinating and worry-free.

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Here's your opportunity to discover a surefire way to achieve all your goals-no matter what they are-in record-breaking time. You'll feel more alive, more virile and see success after success come your way. Taking advantage of new scientific discoveries puts you one step ahead of the crowd.

Professionals nationwide are finding Subliminal Stimulation Tapes to be one of the biggest scientific breakthroughs of the 80's. Each side actually wakes up your inner mind. Result? You'll see yourself becoming sharper, more "in charge" than ever. You'll get more done faster. And the great part is, each side is so relaxing you'll want to listen time and time again.

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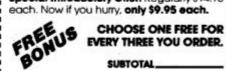
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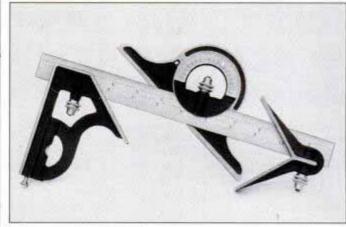
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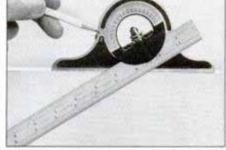
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Tool Tests

Versatile Combination



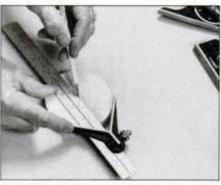
The versatile combination square set features a steel rule and three separate heads—a combination square, bevel protractor mounted in a 180° revolving turret and an easy-to-use center finder.



Adjustable protractor head has doublegraduated, direct-reading scale for measuring and marking angles from 0 and 180°.

or precision and versatility in a mea-suring and marking tool, it's hard to beat the Starrett combination square set (model No. 9-12-4R). This top-quality tool consists of a 12-in.-long tempered steel rule fitted with three heads—a combination square, bevel protractor and center finder.

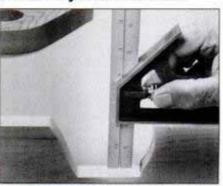
The precision-ground square head



Mark center of round stock quickly, easily with the center-finder head. Secure head to rule by tightening knurled lock bolt.

has a 90° face and a 45° miter face. The protractor head rotates on a revolving turret to read and mark angles from 0 to 180°. It features a double-graduated protractor scale and a spirit level vial. The Y-shaped center head finds the center of round stock quickly and accu-

Use this tool as a try square, miter



Here, the combination square is used as a depth gauge. Tempered steel rule has inch graduations in 8ths, 16ths, 32nds and 64ths.

gauge, level, height gauge, plumb, center finder, scriber, straightedge rule or bevel protractor.

Eighteen- and 24-in.-long rules are also available. The Starrett combination square set is available at hardware stores for about \$72. For details, contact Starrett Tools, Athol, MA 01331.

-Rosario Capotosto

Antiquing and wood grain kit

Create an antique or woodgrain finish easily with Red Devil's do-it-yourself antiquing and graining kit (\$10). The kit contains a pint of base coat, a 1/2 pint of

Kit contains base coat, glaze coat, sandpaper and wiping cloth. Comes in various colors.

glaze, sandpaper and a wiping cloth. Total coverage is about 50 sq. ft.

To create a wood-grain finish, brush on the base coat and allow it to dry for two hours. Then apply the glaze coat. While the glaze is still



Apply the base coat in the direction of the wood grain. Allow it to dry for about two hours.

wet, use a dry brush to make light, long strokes to create wood grain.

For antiquing, apply the base and glaze coats as described above. Then use a clean cloth to wipe off the excess glaze. For more infor-



After applying the glaze, use a dry brush to stroke the woodgrain pattern into the finish.

mation contact Red Devil Paints, 30 North West St., Mount Vernon, NY 10550.

-Rosario Capotosto



Ordinary pine clock shows off new wood-grain finish caused by wavering brush strokes.

One more thing to consider before you buy any compact tractor

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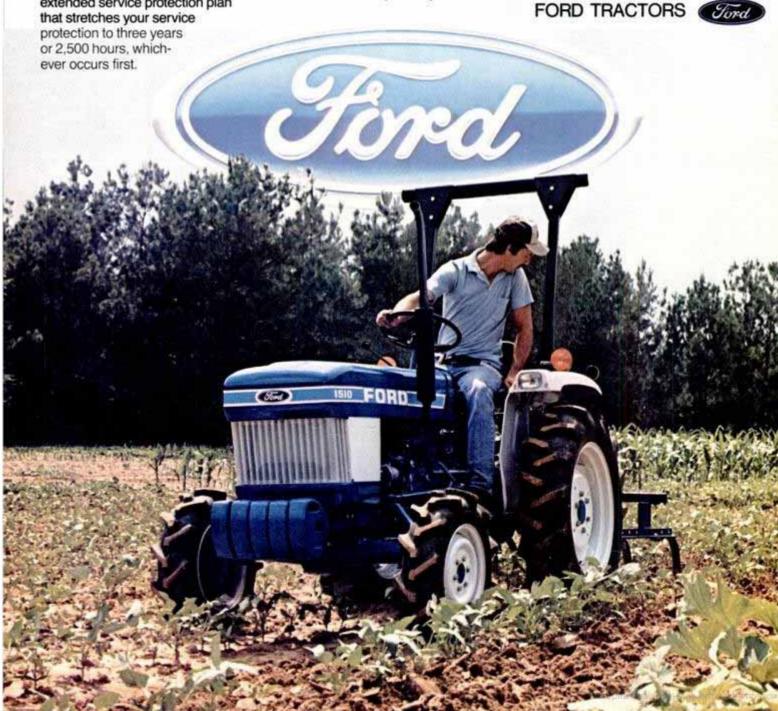
you. A full-time tractor dealer, experienced in meeting the needs of serious gardeners, farmers and contractors.

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Old House Restoration

BY BOB VILA

Ceiling Repair

ne of the most common trouble spots in older homes is unquestionably the ceiling. Perhaps your existing plaster or wallboard is bulged, cracked or riddled with holes. Or maybe you've been living in an older house for a while and have finally decided to finish decorating that basement or attic by adding a new ceiling.

If you've been putting off ceiling repair or replacement because you think it's going to be a difficult chore, you may be in for a pleasant surprise: Ceiling maintenance and repair is easily within the grasp of the average doit-yourself homeowner.

Let's examine the materials used in ceilings and some widespread ceiling problems. Then we'll look at the various repair and replacement options available.

Probably the most common type of ceiling today is one in which gypsum wallboard (also known as drywall) is nailed over the house's ceiling joists. The most commonly used form of gypsum wallboard is % or ½-in.-thick panels, measuring 4 ft. x 8, 10, 12 or 14 ft. Each face of the panel is covered with paper. The edges and corners where these panels meet are covered by paper tape and tape compound,

Contributing Editor Bob Vila is host of public television's "This Old House," funded by Owens-Corning Fiberglas. also called joint cement.

Plaster is an older building material that is not as widely used today as it was years ago. Basically, one of the four types of lath-wood, metal, metal and paper or gypsum-is nailed (or fastened by other means) to the ceiling joists. Then, one to three coats of plaster are troweled onto it. In the process, the first coat of plaster is pushed through holes or slots in the lath and is bonded to the lath when it dries. The subsequent coats bond to the base coat.

Two more recent entries are tile and suspended ceilings. These will be discussed in greater length later. For now, let's look at how to fix a damaged ceiling.

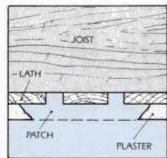
There should be three main products in your ceiling repair kit: patching plaster, spackling compound and joint compound. Patching plaster is used for repairing large sections of ceiling. It comes as a powder and forms a fast-drying paste when mixed with water. Spackling compound is used for filling small holes, cracks and surface gouges. It comes either as a powder for mixing with water or premixed. The spreadable consistency of joint compound makes it an excellent crack filler and finish coat on repairs involving patching plaster. It comes as a powder to be mixed with water or ready-mixed. Apply joint compound in thin layers because thick layers

have a tendency to crack as they dry and harden.

Among the tools you'll need for ceiling repair are: ladder, hammer, nails or drywall screws, pliers, putty knife, trowel, level, chisel, tin snips, chalk line, staple gun and screw hooks.

Fill small holes and cracks in a plaster ceiling with spackling compound. First, use a chisel or knife to undercut the opening. Remove any deteriorating plaster around the hole or crack and make it wider at the bottom than at the top. This inverted opening assures a good bond between the patch and the old plaster. Brush out dust and loose particles and use a paintbrush dipped in water to thoroughly wet the cavity. If there is gypsum lath under the plaster, wet only the edges of the hole; water will weaken such lath. Apply the compound or plaster with a putty knife. Scrape off the excess from around the hole before it dries.

For larger holes or cracks more than ¼ in. wide, use the same process with two additional techniques. You can trowel in plaster in thin

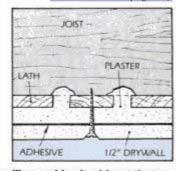


layers or you can cut a piece of wallboard to fill the opening. Apply the patching plaster over the patch.

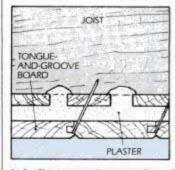
Often, plaster cracks keep opening no matter how many times you repair them. This problem may be due to faulty plastering, bad house construction or the periodic changes in temperature and humidity that cause the frame of your house to shrink and swell. The plaster on your ceiling also swells and contracts, but not at the same rate as the lumber beneath it. This may cause it to develop chronic fissures, and spackling compound or plaster will not patch it permanently because it is not elastic enough to accommodate the movement.

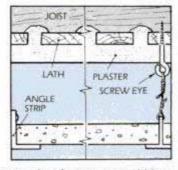
A special tape and compound system is available that forms a semiflexible patch to bridge the crack, rather than fill it in. Krack-Kote (Tuff-Kote Co., 210 Seminary Ave., Woodstock, IL 60098) and Tuff Patch (Synkoloid Co., 2325 Hollins Ferry Rd., Baltimore, MD 21230) are available at paint and hardware stores.

(Please turn to page 52)



Left: Undercut a crack in a plaster ceiling, making it wider at the top. Then patch. The inverted opening helps hold the patch in place. Right: Screw or nall wallboard over a decrepit plaster ceiling. Mastic between plaster and wallboard is optional.



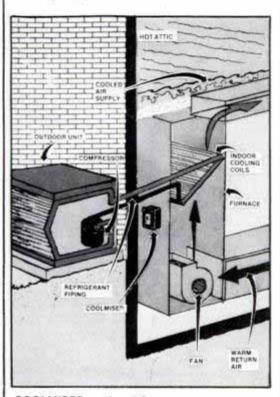


Left: Tongue-and-groove boards are a handsome way to hide a damaged ceiling. Right: A suspended ceiling can be used in the same way to hide ugly plumbing or wiring, or to convert an unfinished attic or basement into finished living space.

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Ever notice how your furnace keeps running even after you turn it off? It's scavenging the last expensive air that you just paid to heat. Good idea, but the same thing doesn't happen with air conditioning. National rules require the furnace to keep running but, guess what? - no rules for air conditioning. When the thermostat says "turn off", the air conditioning fan turns off. Result? That cold air you just paid for sits in the furnace cooling the furnace -not you (for proof, perform the simple test in the box below).

COOLMISER to the rescue! Quantrol Instruments Corp. has invented a clever solution. COOLMISER works by using solid state computer electronics which sense when your air conditioner turns off then tell the fan to run for approximately 2 minutes until all cool air is inside your home.

Really saves money. If your air conditioner runs 20 minutes per hour, up to 10% of your air conditioning dollars are wasted! (Air conditioning bill of \$150? - you waste up to \$15 per month -up to \$150 per year!) How do you get back those dollars? You could sit in the same room as your thermostat and turn the fan on for two minutes each time the air conditioner goes off

(hard to sleep and maybe not much fun). Or, you could leave the fan on all the time (of course you'd be wasting electricity to run the fan when it's not needed - actually RAISING your electric bill). Or, you could install COOLMISER and simply count your savings each month.

You can install COOLMISER yourself. Just mount on the furnace and make only 4 connections - all safe, low voltage. A screwdriver is all you'll need. (If you prefer, a contractor can install COOLMISER for the same labor cost as a thermostat - it's that easy!)

Pays for itself! The only "cost" is the first few month's savings -COOLMISER is only \$39.95 plus tax, shipping and handling. Our full page ads in Popular Mechanics and other national magazines sold COOLMISER for \$49.95 this summer. Because the air conditioning season will be over in a few months, we're offering COOLMISER for only \$39.95. Save twice - save on the purchase cost and save the rest of this year on utility bills. You can charge it with VISA or MasterCard, and start saving money! Or don't call and keep spending money to keep your furnace nice and cool and comfortable!

TEST

- 1. Set your thermostat fan switch to "AUTO".
- 2. Switch your thermostat to "COOL"
- 3. Set the thermostat at 60 degrees.
- 4. Wait for the fan to come on.
- 5. Let run for 5 minutes.
- 6. Raise the thermostat to 80 degrees. The fan will turn off.
- 7. Move your thermostat fan switch to "ON".
- Notice that cold air is still blowing! (even two minutes later.)

Need more proof? Buy COOLMISER, install, and repeat the test. The only difference will be that the fan AUTOMATIC-ALLY runs for approximately two minutes until the cold air is all inside your home!

COOLMISER is available directly from the manufacturer and is not sold in any stores.

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OLD HOUSE RESTORATION

(Continued from page 50)

These systems use a taping compound that resembles hard rubber. It appears dry on the surface, but remains flexible underneath. A fiberglass tape applied over the compound reinforces it and lets the wall expand and contract without breaking the bond or causing the paint over it to crack and peel.

Although wallboard ceilings are less prone to cracks than plaster ceilings, they too have problems.

For instance, such ceilings may develop cracks along the panels' seams. Fill these cracks with spackling compound or joint compound. Holes in wallboard can be filled with wire mesh and then patched with plaster.

The most common problem with gypsum ceilings is when the nails holding the panels to the joists pop out, lifting the compound applied over them. You can redrive the nails just below the surface and patch them over, or you can pull out the old nails and drive a pair of serrated wallboard nails a few inches away. Apply three coats of taping compound over the nailheads, sanding lightly between coats. Prime the patches before painting or papering. If cracks and holes are too numerous to count and previous repairs didn't hold up, or if you're interested in refinishing an underused space, you may want to install a new ceiling.

An effective and inexpensive way to hide a dilapidated ceiling is to cover it with gypsum wallboard. If your present ceiling is fairly flat and solid, nail or screw new wallboard over the surface. Use nails long enough to go through the new wallboard, plaster and lath beneath it, and at least 1 in. into the joists. Wallboard screws of comparable length can also be used.

If your ceiling has bulges or sags, then you may have to apply 1 x 2-in. furring strips to the old ceiling and then attach the wallboard to the strips.

Another alternative is to apply tongue-and-groove boards to the ceiling. In most cases, these can be nailed at right angles to the joists, or parallel to them if nailed to furring strips.

Acoustical ceiling tiles are a popular and attractive way to remodel an old ceiling or create a new one when finishing a basement or attic. Acoustical ceiling tiles and panels may be made of wood, mineral or glass fiber. Most come factory finished in a variety of patterns and don't require painting.

Wood fiber tiles are attractive and inexpensive. They come in 12 x 12-in, pieces and are ideal for rooms with no headroom to spare because they can be stapled to the ceiling.

Mineral fiber tiles and panels come in various sizes and are made to resemble oak, pine, cork and marble. They are excellent sound buffers and have smooth surfaces for easy cleaning.

Glass fiber panels are lightweight, cut easily with a utility knife, and won't chip, break or crumble if accidentally dropped. In many instances, they also carry a 10-year warranty against sagging and warping.

To staple ceiling tiles to furring strips, use a heavy-duty staple gun that takes staples at least 9/16 in. long. Each tile should have flanges or grooved edges that interlock to other tiles. Drive the staple through the flange into the furring strip. The next overlapping tile should hide the staple. Plan the installation so you end up with tiles the same width at the border of the ceiling.

Suspended ceilings consist of two parts: 1. an aluminum grid suspended by heavy wires fastened to the joists or an existing ceiling, and 2. decorative acoustical panels of 2 x 2 ft. or 2 x 4 ft. that drop directly into the grid.

The advantages to this system are many. It can hide a damaged ceiling or finish a basement or attic ceiling while hiding ugly plumbing, furnace runs or wiring. The panels slide in place and allow access above them.





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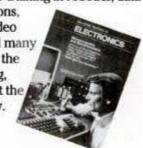
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Outdoors



BY TIM COLE

The Latest In Turbine Tech

Pegasus-class hydrofoil during shakedown on Puget Sound.

n 200-mph Bullet Boat (page 84), PM explores the high-speed potential of turbine power in a demanding marine environment. Our in-depth look under the skin of the new Miss Budweiser reveals that a turbine's light weight and high power can prove unbeatable on the racecourse. But we also had an opportunity lately to learn what turbine power can achieve in an even more demanding settingwith a test spin on the high seas aboard the U.S. Navy's Pegasus currently on coastal patrol from its base in Key West, Florida. Pegasus is the flagship of a squadron of Navy hydrofoils that defend the nation's southern perimeter. Quick response, high speed and a significant punch with eight Harpoon cruise missiles make Pegasus a credible-and by some

standards inexpensivecombatant.

And like the 200-mph Miss Budweiser, Pegasus relies on a shaft turbine engine—in this case a mammoth General Electric LM2500. The Pegasus's 16,000-hp powerplant turns a "propul-

sor," or impeller, made by the Aerojet Liquid Rocket Co. The propulsor brings sea water into the vessel's engine spaces aft via after hydrofoil struts. The propulsor then fires the water through the Aerojet nozzle on the transom. The effect is swift and exhilarating—propelling 131 ft. of surface assault craft displacing nearly 231 tons at a speed well past 40 knots.

From the bridge deck, it seems like blasting over the water in a 3-story building. You're so high off the sur-



PM's outdoors editor inspects the after strut while foilborne.

face—and Pegasus's foils create such a sturdy platform-that the real sensation of speed is somehow replaced by a feeling of grace and power. Prowl around the deck while "foilborne," however, and the customary feeling of going fast-very fast-on the water reappears. We donned safety harnesses and ventured topside with one of Pegasus's crewmen. The apparent wind of such a huge ship traveling at close to 50 mph can blow you over the side.

The flight of the Pegasus is made possible of course by retractable foils fore and aft. Like an aircraft wing, the foils are equipped with computer-actuated hydraulic control surfaces on the trailing edge. Lt. Cmdr. Robert Holt gives the order to "go foilborne" once the throttle has advanced the turbine to 100 percent of its designed output. A lever on the dash of the bridge deck is pushed upward, which raises the ship exactly 1.4 meters above the water-a distance maintained by radar and

sonic sensors in the bow.

Pegasus and her five Boeingbuilt sisters usually "fly" foilborne on an automatic pilot that's called ACS-or Automatic Control System. A quadruple-redundancy bank of computers, gyros and accelerometers is coupled to the helm. Dial in the desired course

heading, engage the auto pilot, and *Pegasus* steers herself over the ocean under the vigilant gaze of the deck officer, self-correcting for minor changes in surface conditions. The Sperry High Speed Collision Avoidance and Tracking System can keep an eye on 44 surface targets.

Maneuverability is essential to *Pegasus*'s defense. Theoretically, the ship should be able to turn tighter than an incoming heat-seek-

ing missile, and Pegasus delights in blasting around curves, as I discovered under Capt. Holt's watchful eye. First you disengage ACS and try to get the feel of the ship. The tiny aircraft-style helm has a hair-trigger, though, and it's far easier for the computer to maintain a steady course than a mere human.

Soon, you begin to understand that *Pegasus* only needs very subtle helm inputs. The helm is really sending "turning rates" to *Pegasus*'s computers, which move the ship's control surfaces. A call for a turning rate of 2° per second to port brings a gentle sketch in the water to the left.

Pegasus banks into the turn automatically, which keeps the ship's centrifugal G-forces on the centerline instead of spinning wildly out of control away from the new heading. It becomes obvious that banked turns are crucial in a vessel capable of such incredible speed. Although this creates a comfortable ride for the entire crew, the



Driving Pegasus demands concentration.

chief beneficiary is *Pegasus*'s talented cook, who manages to keep dinner in the pot and not on the deck during radical maneuvers.

How radical? Try 8° per second on the glassy cobalt calm of the Atlantic. The ship responds like an anxious street bike, leaning deep into a turn and carving a neat slice out of the sea. But it's just kid's stuff for Pegasus, whose stated mission is to "sail in harm's way."

(Please turn to page 58)

WHY GMC TRUCK IS SAYING...

"IT'S NOT JUST A TRUCK ANYMORE."

The key word here is "just."
"Just a truck" implies mere
adequacy. Functionality and
nothing more. That's the
way trucks were.
That's not the way
GMC trucks are
today. At all.

WE'RE CIVILIZED.

Time was when trucks had to hide out in the alleys and byways of the country making pickups and deliveries. You just couldn't take them anywhere.

That's not the case today. A GMC truck is bred for better things. It will still pridefully perform the work of our nation. But it will do so with a lot more style.

Light-duty GMC trucks come with the well-mannered niceties of a car. They offer air conditioning and stereo and plush seating and power this and power that. What's more, there's something about the lively "lemme at it" look of a truck that hints of an active and probably interesting lifestyle.



So, today, you will see GMC trucks perched proudly in the darndest places. Like the front of Restaurant Chez Posh. And the driveway of the rather impressive split-level at the end of your block.

Trucks are the hottestselling vehicles in the



LET'S GET IT TOGETHER . . . BUCKLE UP

country today. And at GMC Truck, business has never been better. GMC trucks are preferred by tasteful buyers seeking quality and integrity.

WE'RE PROUD.

There was a time not so long ago, when a job putting together trucks was probably pretty unexciting. That's when trucks were just trucks.

Today, as the vehicles of preference for so many interesting buyers, trucks border on the glamorous. We

> can sense that feeling filtering from the showroom to the assembly line.

From the design engineers to the people who assemble to the

final inspection teams, there's an infectious new sense of pride and purpose. Everyone knows they're producing something important: trucks that more and more people want today.

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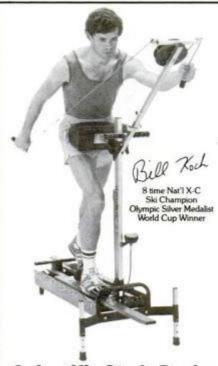
GMC Truck today is a beehive of

activity. We bring you heavy-duty Generals and medium-duty Top Kicks and buses for schools. We offer Jimmys and Safari Vans and small space-age pickups. All crafted with such enthusiasm, we're saying they're "not just trucks anymore."

Since we're not just trucks, we feel most comfortable associating with other vehicles that are not run-ofthe-mill. So in addition to our GMC Truck dealers, our trucks are sold by selected Buick, Cadillac, Oldsmobile and Pontiac dealers. Four fine names indeed. Not "just" cars. Or... maybe their cars are sold by our fine GMC Truck dealers. Depends on how you look at it. However you choose to, just look in the Yellow Pages under "Truck." Or under "Automobile." We're listed under both. For increasingly obvious reasons.



IT'S NOT JUST A TRUCK ANYMORE.



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OUTDOORS

(Continued from page 56)

Search for original VW Camper

Some people argue that its pushed-in nose and crackerbox body panels ushered in the great post-war age of RV travel. Accordingly, a copy of the Volkswagen Westfalia Camper, or Series One-Type II for you insiders, will be placed on permanent exhibit at the Henry Ford Museum in Dearborn, Michigan. Volkswagen of America is conducting a nationwide search for a proper candidate to be so enshrined.

"Authenticity is most important in this display," according to Don Adams, director of public affairs for the Henry Ford Museum. "The VW camper that is placed on display must not only be in excellent condition, it must be as close to original as possible."



VW's original Westfalia Camper: RV classic.

Volkswagen estimates that more than 15,000 of the Westfalia campers were imported to the U.S., beginning with 200 in 1956. Westfalia-Werke in West Germany has agreed to help with any restoration, if need be, and have original kitchen/counter units, seat/bed units and door panels on hand.

VW is asking interested owners of early Series One-Type II campers to send the following information: year their vehicle was manufactured, vehicle identification number, estimated value and, if possible, a color picture. Write to PR Services Manager, Volkswagen of America Inc., 888 West Big Beaver, P.O. Box 3951, Troy, MI 48007-3951.

Merc's new 'turnkey' outboard

Electronic fuel injection perfected on the racecourse is at the heart of Mercury Marine's new 220-hp V6 XRi designed for the recreational mariner. It has no choke and only requires priming after prolonged layup, which means it may be one of the most foolproof outboards yet, as well as one of the quickest. I had a chance to test drive the XRi on Lake Winnebago recently and was impressed with throttle-response from a standing start, top-end speed and noise abatement. But Mercury is particularly proud of the XRi's electronic control system, which precisely deliv-



Mercury's XRi: Hightech simplicity.

ers fuel to the engine based on input from sensors that monitor such functions as rpm, throttle position, manifold pressure and manifold temp. The system corrects for engine temperature, which eliminates hassles associated with cold starting. Add electronic fuel injection to automatic oil in-

jection currently in vogue and you get an outboard that makes precious few demands on the operator.

Reinventing the sleeve

It takes guts to fiddle with a proven design like a jacket sleeve. But the Columbia Sportswear Co. (6600 North Baltimore, Portland, OR 97203) had the temerity to give it a try. Its "Radial Sleeve" design incorporated in its hunting coat line increases freedom of movement for shooters and other outdoorsmen while reducing bulk. The secret is a keyhole-shaped insert under the arm of both shell and liner. It allows shooters to swing through shots and to lift their arms for high overhead shots. This type of innovation isn't new for

Columbia. Its "Interchange System" combines reversible shells and synthetic liners for skiers and hunters. The Widgeon parka uses the same system, but it's cut short for waterfowlers. PM

Columbia Sportswear's "Radial Sleeve" allows increased freedom of movement for shooters.

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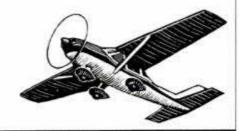


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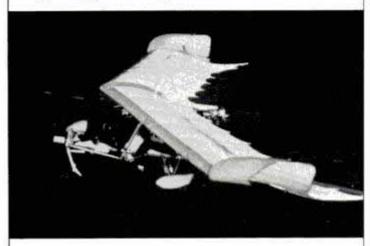
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Aviation



Flying Wing Built For Two



Ilying wings have never been known for gentle handling or stability, but my experience with the Kasperwing 2-place craft indicates the tide is turning. Control pressures are heavy, yet the handling is responsive. Stability is very impressive and the bird is just plain fun to fly. Control is provided by a series of tip rudders, spoilers and elevons, while 52 hp is generated by a Rotax 503 engine. Cascade Ultralights of Arlington, Washington, has already given us lots of fun hours in the 1-seaters they build. The 2-place Cascade Kasperwing 180-KII is even better. It provides 80-mph cruising speed and goes 240 miles on 10 gallons. I've landed one in as little as 50 ft. of runway space. This latest ultralight should be popular for touring and soaring.

Mooney's trend

The trend line for single-engine piston aircraft is pointing straight down, if you look at sales figures from Wichita and Vero Beach. But somebody up there still likes the 1-prop art form, building their hearts out just a hop, skip and flare away from downtown Kerriville, Texas. That's where Mooney builds its popular 201 Lean Machine and 252 TSE. The Lean Machine is \$98,000 fully instrumented and ready to fly at over 200 mph. The nonpressurized, turbocharged TSE, can get you over 250 mph. It's in a similar price range.

Drag reduction is a religion with the Mooney people. Each aircraft exhibits the kind of craftsmanship that seems to have gone out of style elsewhere. And the prices, although seemingly high to a newcomer, are actually very reasonable for aircraft that can transport you around like a commuter airliner. The rest of the industry has been complaining about dropping sales, but Mooney still flies high.

Video VFR

Move over, Jane Fonda, video has come to the flight line. Several aviation training firms have prepared a series of videotaped flight training programs to take the bite and difficulty out of preparing for FAA written examinations. There's no rock music dubbed in, but the flying public may gobble up the new-wave instruction anyway. The Aviation Training Center of Golden, Colorado, was one of the first to offer Private, Commercial and Instrument Rating test preparation videos. Now Hayes and Nolly of Vacaville, California, and King Accelerated Ground Schools of San Diego are getting physical with entry-level, high-quality ground school classes. The newest entries also have advanced videos for Flight Engineer and Air Transport ratings. If you start shop-ping around for video courses, keep in mind that the FAA has recently updated the tests, so you should purchase the latest video pilot workout tapes.

If you're just getting started with basic airmanship, consider the series produced by ASA of Seattle. It is more of a ground school than a preparation for written exams. But it is very complete for novices.

Prop wash

The FAA is still not saying if or when we might be able to expect a new rule to allow for less expensive and restrictive certification for light aircraft. Such a move could open the door to more affordable personal aircraft. The industry is itching to see something on paper, and the word is we'll have to wait until early next year.

Meanwhile, the Aircraft Owner's and Pilot's Assn. has petitioned the FAA for a 36-month interval on third-class medical certificates. This 12-month increase is supposed to cut hassle time and expense. It would also clear some of the red tape clutter at FAA headquarters. So, what are we waiting for, Washington?

Star is born

The full-scale prototype of the Beech Starship is now flying up a storm during FAA certification testing. Although a smaller scale vehicle flew several years ago, the flight of the full-scale article was awaited with a great deal of anticipation to see if the revolutionary aircraft could meet its stated performance goals.

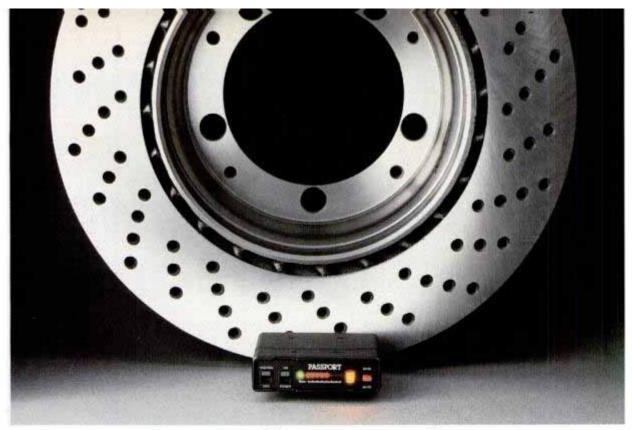
Latest reports indicate the Starship is doing just that. The plane is designed to fly distances of over 3000 statute miles at an astounding 41,000 ft. It is supposed to climb 3250 ft. per minute and fly as fast as 405 mph. This futuristic bird is designed for 2400-ft. takeoffs and it should be able to land (over a 50-ft, obstacle) in less than 2900 ft. We're talking about a prop-driven plane, although the specs have the sweet aroma of a jet.

The Starship is an all-composite twin turboprop that already has shown itself to be a fighter in flight testing. The concept comes from the mind of the greatest small-craft man alive—Burt Rutan. He built the first Starship prototype at his Mojave headquarters and subsequently joined Beechcraft as the proof-of-concept version proved it could do what Rutan said it could do.

No Rutan creation would be authentic without the canard, which Beechcraft has taken to calling the "tandem wing." It is powered by a pair of 1000-hp PT-6A-27 turboprops. The "forward wing" boasts a variablesweep feature to compensate for aerodynamic changes. Winglets, which Beechcraft calls "tipsails," and the two closely mounted pusher engines sitting on the trailing edge of the 54-ft.-long wing structure make the Starship a commuter that can do tricks. That should please evervone.

If all the certification continues on schedule, it looks like we'll be flying a production model early next year. And I can't wait to get my hands on the controls.

—Jim Campbell



Small Wonder

It's here, pocket-size radar protection.

Imagine a superbly crafted electronic instrument, powerful enough to protect against traffic radar, miniaturized enough to slide into a shirt pocket, beautiful enough to win an international design award.

Small means nearly-invisible protection

That could only be PASSPORT. It has exactly what the discerning driver needs, superheterodyne performance in a package the size of a cassette tape.

This miniaturization is possible only with SMDs (Surface Mounted Devices), micro-electronics common in satellites but unprecedented in radar detectors. It's no surprise that such a superlative design should be greeted by superlatives from the experts.

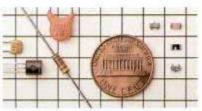
"In a word, the Passport is a winner," said *Car and Driver*.

The experts report excellent performance. Simply switch PASSPORT on and adjust the volume knob. Upon radar contact, the alert lamp glows and the variable-pulse audio

Small means the size of a cassette tape

begins a slow warning: "beep" for X band radar, "brap" for K band. Simultaneously a bar graph of Hewlett-Packard LEDs shows radar proximity.

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In PASSPORT, 102 SMDs (right) do the work of ordinary transistors, resistors and capacitors.

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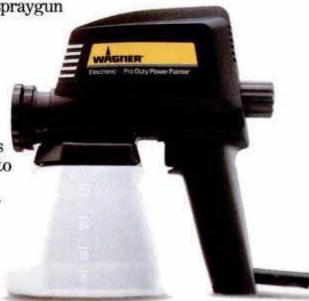
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pump speeds at the touch of a button. To instantly change paint output and spray pattern. Which means you can go from high power to close-up work easily and with almost no overspray or dripping. Which makes the Electronic Pro-Duty ideal

for virtually any job. Whether it takes finesse or force.

Ceramic

spray tip won't ever wear





At the heart of the Electronic Pro-Duty is a powerful 100 watt motor. It atomizes latex or oil based paint so efficiently that thinning is rarely needed. So you get better coverage. While its design reduces vibration so less resting is needed. (Vibration leads to fatigue.)

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The spray tip of the Electronic Pro-Duty is ceramic. It resists wear far better than conventional tips. And you won't ever have to replace it. Guaranteed.

For the pump we've used tungsten carbide for both cylinder and piston.

out. We guarantee it for life. It helps make the Electronic Pro-Duty tremendously tough. Since the Electronic Pro-Duty comes packaged as a

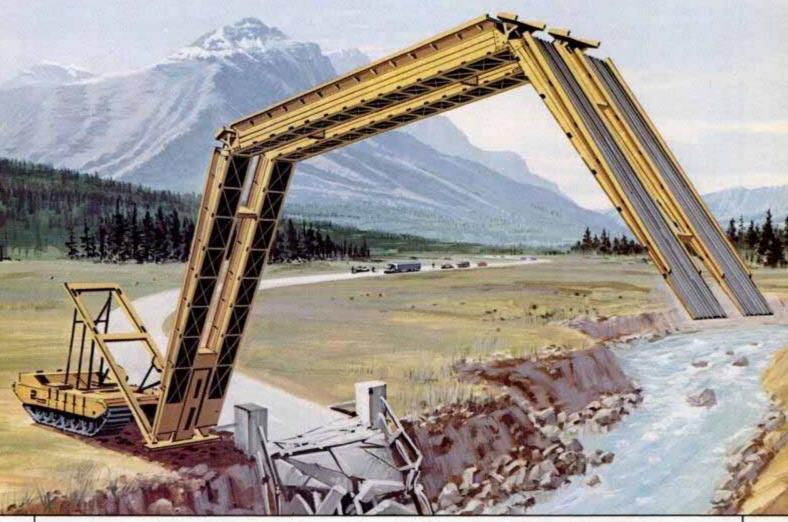
complete outfit, it can immediately help you paint almost anything. With less guess-work and fewer mistakes. There is one thing you have to do yourself, though. Go and see it at your Wagner dealer.



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If you have any questions about this or any Wagner product, just call the Wagner Helpline, 1-800-328-8251.

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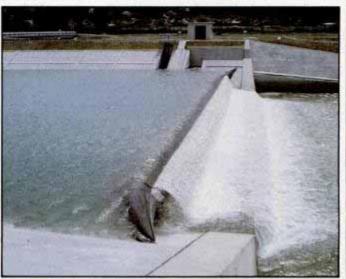
Engineering While You Wait

ade-to-order, on-thedouble engineering is as old as the Roman Army Legion of Engineers. But developments of the past few months have turned the heads of the most blase observers of such construction.

The Army Troop Support Command at Fort Belvoir, Virginia, has come up with a 100-ft., 70-ton capacity bridge that can be driven to any location at 50 mph by a track vehicle. Bowen-McLaughlin-York is building the prototype, and within five years, the Corps of Engineers may be using them for floods and evacuation.

In the private sector, Bridgestone has come up with an inflatable dam to keep streams manageable and navigable. The 1/2-in., nylon-reinforced rubber that lines the dam is coated to resist harmful sunlight. The air-filled "inflatodam" is cheaper to install and easier to service than water-filled rubber dams tried out in Italy. The inflated Bridgestone dam (shown at right) in northern California was installed in two days.

Editor: Dennis Eskow Contributors: Dr. Gary Bennett, Steve Eskow, Jack Hammond, Irena Scott, John Ethridge, Steve Parker



Bridgestone inflatable dam is filled with air. The rubber dam is coated to protect it from sunlight. It sets up in two days.

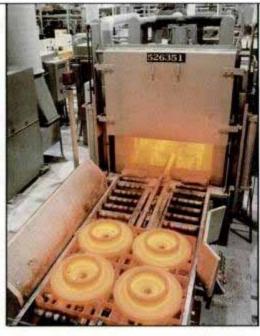
TECHNOLOGY

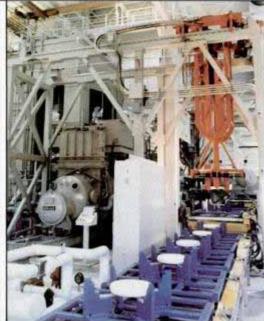
UPDATE 10/86

ROBOTICS

Jet plant on auto pilot

Robotic factories are coming on line in several major industries with uncanny manufacturing capabilities. In Columbus, Georgia, United Technologies/Pratt & Whitney is manufacturing aerospace compression discs for iet engines from kiln almost to final fabrication with machines doing the labor and men controlling management positions. The process shown at the right is a totally automated forging press in which composite blanks are heat-treated in an electric arc furnace and conveyed out into the cool air. The shaped and treated blanks are then built to fine and meticulous specifications by machines working under human supervision.





The kiln loading system shown at the far right moves on a timing device. But sensors placed along the route of manufacture can slow down or speed up delivery if there is a glitch of some kind. The United Technologies operation is being watched as an experiment for future automation of other jet engine manufacturing processes. At a recent robotics seminar held at Princeton University, scientists predicted the construction of aircraft will be entirely automated in 20 years.

ENGINEERING

Deep vision

When the Air Force puts a \$30 million fighter into service there better be no flaws in the airframe. Cracks, corrosion and tiny water deposits under the aircraft skin can lead to disaster. GCA Corp. of St. Paul, Minnesota, working under an \$8.75 million Air Force contract, is building a new device to insure against even tiny flaws going undetected.

The hangar-sized system



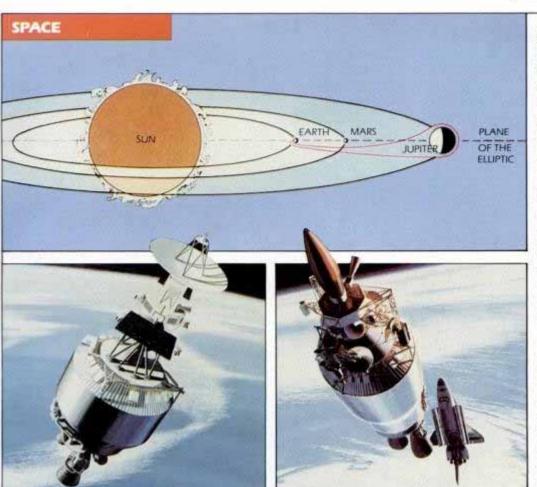
will sweep an airframe with X-rays and neutron radiography. As the plane sits under a rolling canopy, Xray and neutron beam "cameras" move along its surface, stopping at preprogrammed points to take an image. These are fed to a mainframe computer that assembles images of the subskin. It can even "zoom in" on areas just inches across for closeups of what is inside the honeycomb structure of composite airframe skin. The testing device will be operational by the early 1990s.



Sealing sounds

Acoustic microscopes, used mostly for inspecting minute working parts of machines, are now used for bonding silicon chips. Fulmer Research Institute of England developed the process (left) where an acoustic wave, rather than laser or electron heat, does the chip-to-chip annealing. The process will save millions in the electronics industry.





At least we can dream

These are the voyages of the starship Ulysses, whose 5year mission is to travel to Jupiter, swing around the largest planet, then head on a more than 100-million-mile journey around the sun. Ulysses was supposed to be launched last May, but the Challenger explosion put it on hold into the 1990s. NASA still gives the program a high priority. The 815-pound craft is to be inserted into space by the Space Shuttle. Then, a new Centaur G Upper Stage Rocket will put it into orbit. The Centaur G, built by General Dynamics, is still considered the main tool of our near-future space program. It is also slated to carry the orbiter Magellan (far left) on a mapping mission around Venus. That mission, too, has been set aside by the Shuttle disaster. NASAhopes that after renewed Space Shuttle flights in 1988, the plans can be reset.

Spacial comfort

It may never be like home, but NASA hopes that the Space Station, due to be constructed in the 1990s, will have many rooms that remind one of the carefree life down below.

In a recent design compe-NASA tition. officials showed an inclination toward composite materials and wide open spaces for the building of space rooms. The chamber shown at near right contains groups of fold-out desks and tables for comput-



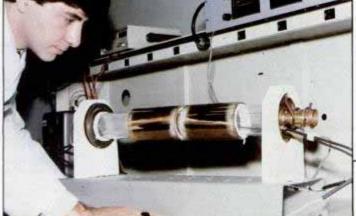
or den-type uses. The other

room shown is a lounge

ers, games and other office

for zero gravity, so footholds are placed around the walls and ceilings.





Crystal clear technology

David Yoel (left) of Boeing Aerospace's Space Experi-ments group and his colleagues have been refining a new crystal-growth furnace for the Space Station. In the photo, the furnace is shown without the cladding and detection equipment it will carry. Within the chamber, crystals of silicon and other materials are grown under 1600° F. Crystals grown in earlier experiments were pure, but not usable for electronics. The Boeing crystals will eventually be used in microprocessors.

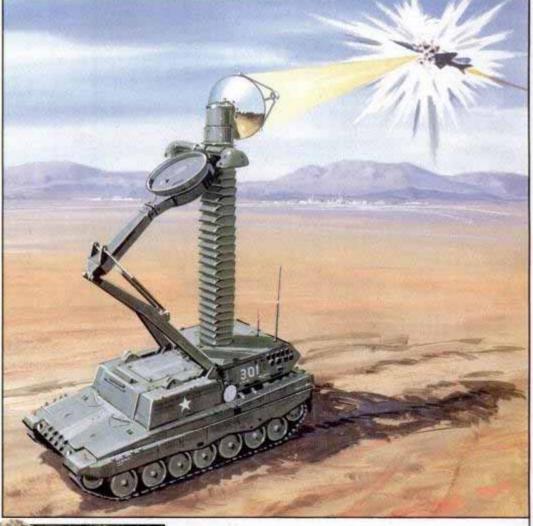
TECHNOLOGY UPDATE 10/86

MILITARY

NATO's tank is really light

Most talk about light tanks refers to the weight of the vehicle, but the latest weapon on the NATO drawing board is a tank that uses light as a weapon. Under development by a West German consortium, the proposed tank (right) carries a high-energy laser (HEL) mounted on an accordion tower that stows in a 2-man Leopard Tank.

The HEL tank's design is mostly for anti-aircraft or missile defense. The laser source is a gas dynamic laser, the most powerful gas laser. Right now, prototypes are being developed in Germany, with the United States theoretically out of the picture. But the Defense Advanced Research Projects Agency last year abandoned a similar project, and it is expected that the German tank will be tested in the U.S. If it works, America probably will buy it rather than build it.





Tomahawk is on target

The missile below has just traveled 500 miles downrange at altitudes as low as 500 ft. It's a Tomahawk Cruise Missile, the newest weapon in the American arsenal, and the Defense De-

Play it again, Sam

Air strikes in Israel have proven that surface-to-air (SAM) missile sites are vulnerable to attack. And the American raid on Libya underscored the ease with which a high-tech jet can destroy a SAM installation. But the British Army has come up with a SAM missile

partment gives it high marks for accuracy and maneuverability. The missile is able to change course even when it's within a few feet of the tarrig that moves as quickly as a soldier can hit the dirt. The "man-portable" SAM, whose guidance system is still secret, has been designed with an extra stinger: It's made to knock out tanks. The rig (left) uses a 2-man crew, one firing and the other sitting. Shells reportedly will move at Mach 5, so fast that no warhead is needed to make these stingers deadly.

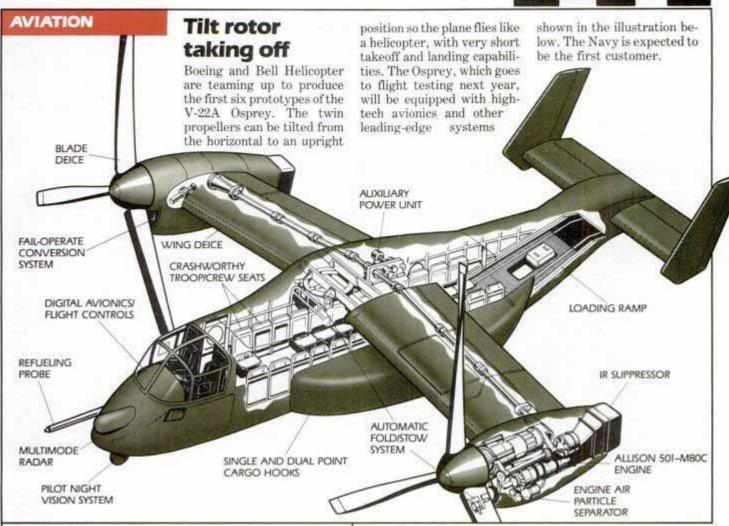
get. That helps it strike with uncanny accuracy after evading enemy radar. The Navy fired the missile from a cruiser in the Gulf of Mexico.













Soviet jet escort service

The growing Soviet Union air arsenal now includes an updated version of the SU-27 Flanker.

Packing air-to-air missiles, this Mach 1 jet (above) has been seen in the Middle East, flying off the decks of Soviet aircraft carriers in support of longer-range fighter-bombers.

Jane's Defence Weekly,

the authoritative British military journal, says the jet's fuel supply has been cut down to make more room for weaponry. That underscores the jet's mission of getting Soviet attack craft into action quickly.

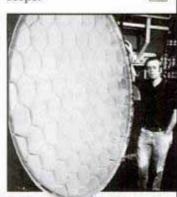
The SU-27 is supposed to defend departing squadrons against low-flying interceptor jets and air-to-air missiles. The jet also is being used for fleet defense.

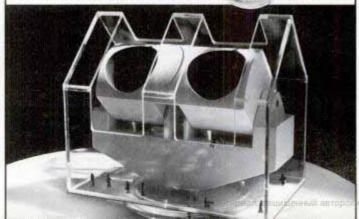
ASTRONOMY

Not so distant stars

With the American space program grounded, astronomers are focusing more attention on the next super Earth-based telescope. The University of Arizona and Ohio State University are building a huge infrared telescope for Mount Graham in Arizona. Final design is still being worked out, but the leading contender is a 2-mirror stand with honeycomb,

315-in. mirrors. When done in the 1990s, it will be the Earth's most powerful telescope.





Cycles

BY NORMAN MAYERSOHN



K75: BMW's Best Buy



Three-cylinder 750 is the smoothest runner yet in BMW's K-series.

Conformity has never been a controlling factor in the designs of engineers at BMW Motorrad.

When the mavens in Munich set out to update their beloved boxer Twin with a modern overhead-cam Four, they designed an inline powerplant with cylinders laid over on their side and the crankshaft running front to back in the bike frame, the better to line up with shaftdrive hardware. And when they saw the need for a 750cc model based on the Kseries layout, they didn't whittle down the bore and stroke to match the smaller displacement. Instead, they chopped off an entire cylinder-and \$1300-to end up with their best effort yet in the new family of liquidcooled Autobahn tourers.

There's certainly nothing radically new about 3-cylinder motorcycles—Triumph, Laverda, Yamaha and Kawasaki have all built thembut all have been cursed by vibration levels intolerable on 1986 equipment.

Where the English, Italians and Japanese had fallen short, the Germans came through. The K75C sampled here proved to be a mighty smooth runner, thanks to the pair of counterbalancing weights fitted to an output shaft already in the engine.

The smaller engine, in this case, doesn't mean lazy performance, either. The 3-cylinder uses the same Bosch LE-Jetronic fuel injection, but makes its 75 hp more efficiently due to a higher compression ratio. But even more important, better than 80 percent of the engine's ample torque is on tap below 2500 rpm.

Riding the K75 will give you the impression of being on a larger-sized machine, and sure enough the 32-in. seat height and 5.5-gallon aluminum fuel tank do give it an imposing air. At 500 pounds fully gassed, it's 24 pounds lighter than the K100 for easier handling.

The K75 line has three choices: The K75C, as shown, with the cockpit fairing and \$311 optional detachable saddlebags, the T with a touring seat and windshield, and the K75S with a framemounted sports fairing.

Not very long ago, BMW's were placed in an elite class of ownership due to their high price tags. At \$4850, though, the K75C we rode is actually less pricey than Honda's top 750.

Honda's longest day

When Honda introduced the super sporting 750 Interceptor model in 1983 it was an instant winner, both as an AMA Superbike champion and as sweetheart of the canyon racer set. But the competition didn't sit still, and Honda found itself one step behind in the Superbike wars—after having fired the opening salvo.

Honda's answer in 1986 is an all-new VFR750F, directly descended from the original and retaining the civilized V4 powerplant that made the package so attractive in the first place. Those similarities could easily mask all the new developments-an aluminum frame. gear-driven overhead cams and the 45-pound weight reduction. So Honda set out to make headlines with the World Motorcycle Endurance Record. That they did, by running 3346 miles in 24 hours at Uniroyal Tires' proving grounds in Laredo, Texas. Average speed, including stops for gas fillups and tire and rider changes, worked out to 143.180 mph! And it wasn't the Interceptor that limited the speeds either—tire-chunking failures caused by heat buildup on the 5-mile circular track made the riders back down for safety's sake.

Though the engine was entirely stock equipment, the bike did get slight modifications—a rear sprocket smaller by two teeth, quick-fill gas tank receptacles, a slightly taller windscreen and Metzeler road-race tires. After the 24-hour torture session, the Interceptor was ridden back to California with no mishaps.

If all these dizzying performance figures send you packing off to the Honda dealer for a price checkup, be prepared for another stunning number—\$5298. Due to the late introduction and exchange rate craziness, the VFR750 comes dearly, but our recent ride up the California coast on this model proved it to be well worth the price of admission.

It has the power for 10second quarter-mile times, the handling prowess to tackle fast sweepers with grace, and only falls short in seat comfort and suspension adjustability.

The good news for those with thinner wallets is that the gorgeous all-white VFR700 model lists for a lot more reasonable \$4498, and at Laredo set a 24-hour pace of 138.9 mph.



New-generation interceptor set 24-hour endurance record: 143 mph.



1987 COMANCHE SPORTRUCK: It's not only the newest 2-wheel drive Comanche pickup, it's also the most affordable vehicle Jeep builds. At just \$6,495, SporTruck has the most powerful standard engine of any truck in its class...delivering an impressive 121 horsepower. Plus, it's the only vehicle in its class with big 15-inch wheels and tires, standard.

POWER: This year, Comanche comes with an all-new optional 4.0 litre Power-Tech Six engine that puts out 173 horsepower and 220 foot-pounds of torque. That makes Comanche by far the most powerful truck of its kind.

A WIDE RANGE OF VEHICLES: Comanche gives you the choice of two-wheel drive or shift-on-the-fly four-wheel drive. And you can choose between the new shortbed model or longbed with the largest optional

kinghed with the largest optional

4-wheel drive payload capacity of any truck in its class.

OTHER OPTIONS: Comanche already has a lot going for it. And there's a long list of available equipment that includes a responsive new 4-speed automatic transmission with overdrive.

Check out the new SporTruck and all the other Comanche pickups. It's the kind of truck just about anybody can afford. But it's also the kind of truck only Jeep can build,

80, DG. Manufacturer's suggested retail price. Title, taxes and destination charges, and options are extract Price may charge without notice.

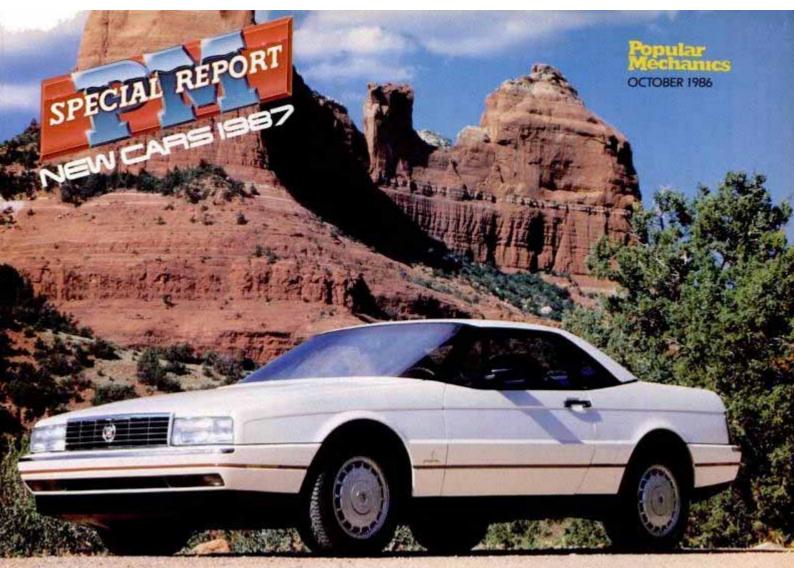
Safety helts save lives.

Jeep Comanche
Available in 2WD and 4WD



Mfr's. suggested pricing based on full-price brands.

Emphysema, And May Complicate Pregnancy.



CADILLAC ALLANTE

POWER TO THE PEOPLE

High performance is alive and well and living in Motor City again.

BY JIM DUNNE Detroit Editor PM photos by Don Green erformance, luxury, styling—three sure-fire features that turn hesitant U.S. auto shoppers into determined buyers—top the new-car offerings from Detroit for 1987.

Something new for everybody? Not quite. Detroit has so many model lines nowadays that the cars have to stand in line to wait for face lifts. But the sprinkling of improvements is spread out in such a way that no matter what type of car you look for, you'll find innovation and freshness. And, as for horsepower, it's bulging hoods across the board.

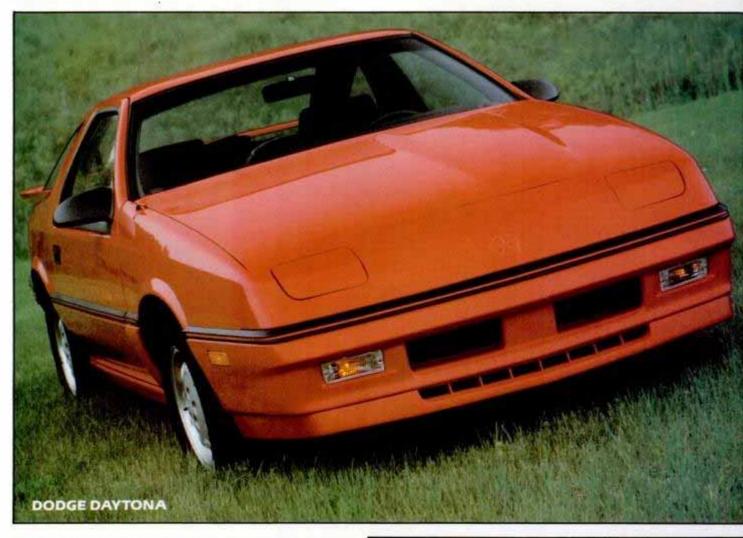
American Motors

A high-performance Renault GTA, completely redesigned Jeep and new, more powerful 6-cylinder engine headline changes in the '87 American Motors lineup.

Similar in concept to the Volkswagen GTI, the Renault GTA comes in 2-door sedan and convertible body styles only. Its chassis is based on the Alliance, but the GTA is equipped with a

new 2-liter engine for performance, special suspension settings for handling, 15-in., 50-aspect-ratio tires for gripping the road, and a 5-speed close-ratio transmission that allows the driver to make full use of the increased engine power at all driving speeds.

Details of the 2-liter include throttle-body fuel injection, aluminum cylinder head, electronic ignition and overhead camshaft. Its larger displacement, 95 hp and the 4.07:1 ratio of the final drive combine to give the GTA excellent performance,



but drive down fuel economy to an estimated average of 25 mpg city, 29 mpg highway.

You won't have any trouble identifying the GTAs on the road. They have a 1-color finish for body, wheel covers and grille, and appropriate aerodynamic flanges along the lower body edges to give a distinctive shape to the Alliance contours.

Wrangler was introduced earlier this year as the replacement for the Jeep CJ. The newest version of the vehicle that traces its ancestry back to the WWII doeverything military utility truck has a number of major changes in chassis and body. But the essence of the original Jeep remains. That includes rugged construction. choice of inline 4- or 6-cylinder engines, and a body that can be fitted with either a soft-top or a rigid cover.

Carryover Jeep lines— Cherokee, Comanche and Wagoneer—take on added muscle with a new optional 4-liter, 242-cu.-in. inline Six. This fuel-injected powerplant replaces the 2.8-liter V6 that AMC used to buy from GM. A gain of 50 percent in horsepower, to 173, and an improvement of 47 percent in torque, to 220 lb,ft. at 2000 rpm, make this the most muscular engine in the compact truck field. AMC claims a 5000-pound trailer pulling ability in its 4liter trucks.

The Cherokee will now accelerate from 0-60 mph in about 10 seconds. Look for this engine to become the new workhorse engine in the AMC lineup, ultimately replacing the anemic old 4.2-liter as the optional powerplant in all Jeeps, including the Wrangler.

Just as much in tune with the latest technology is AMC's new 4-speed overdrive automatic. It has a lockup clutch that prevents the wasteful 6 percent torque-converter slippage that penalizes automatics of older design. You can select two different modes for driv-

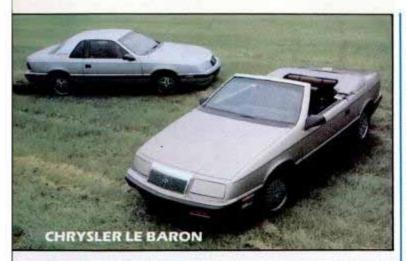


CHRYSLER PHOTO

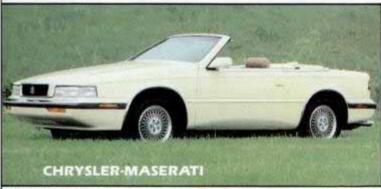
ing this gearbox, POWER or COMFORT. By flipping a switch on the instrument panel, the driver can have either, immediately. I tried the new transmission with the 4-liter Six in a Cherokee prototype and it works just as advertised. My 0-60 mph times—clocked with a stopwatch—all came in below 10 seconds.

In the POWER mode the transmission upshifts at higher rpm during hard acceleration, allowing the engine extra time to run at its most powerful speeds. In POWER, the transmission will also downshift more rapidly. In the COMFORT setting, the transmission will upshift at lower engine speeds, thus conserving fuel and reducing engine noise and vibration.

The new automatic transmission, called the Aisin-Warner 30-40 LE, is a joint development of a Japanese company, Aisin Seiki, and Warner Gear of the U.S.









Chrysler

Two new models in the higher price classes are standouts of the '87 Chrysler lineup, as the shift away from lower priced cars continues.

With the new Chrysler-Maserati super luxury convertible and the LeBaron coupe and convertible, Chrysler once again becomes a full-line company that nearly matches Ford and GM model for model.

In a major change, the company is not adding the same models to the Dodge and Chrysler lineups. A "checkerboard" approach to the allotment of models will mean some moving around of body types so that Dodge and Chrysler dealers will have different cars to sell and will not cover the same part of the market. The Chrysler Laser has been dropped and no longer competes with Dodge Daytona. Convertibles are available only from Chrysler, as the Dodge 600 goes out of production. And the new Chrysler LeBaron coupe has no counterpart in Dodge showrooms.

The latest Chrysler LeBaron is built in 2-door coupe and convertible body styles. Chassis and drivetrain are like those of the discontinued Laserwith 2.5- or 2.2-liter turbo Fours and front-drive.

But the LeBaron is completely different in outside appearance. It features Chrysler's most visible aero styling since the Airflow models of the 1930s. A small grille opening is flanked by covered headlamps. All window glass is flush with the body metal, or nearly so, to cut down wind resistance and noise.

Overall, the body has a rounded shape, a marked contrast from the hard angles seen on other Chrysler products. Look for the coupe to show up at Chrysler showrooms just after the first of the year, with the convertible out next spring. The square-rigged LeBaron sedan and LeBaron GTS sport hatchback continue with minor changes.

New subcompacts are the Plymouth Sundance and Dodge Shadow. They are slightly bigger in size than the Horizon/Omni line, built on a 97-in. wheelbase, and use Chrysler's 97-hp 2.2-liter Four as the standard engine. A 146-hp turbocharged version of this engine is the only power option.

Chrysler originally wanted Sundance/Shadow to replace Horizon/Omni completely, but just last year the decision was made to keep Horizon/Omni in the lineup as entry-level cars and upgrade the Sundance/Shadow with features not found on lower priced lines, including premium seats and a rear hatch. Sundance and Shadow hold five passengers in reasonable comfort, and both can be equipped with the turbo, a handling suspension, 14-in. tires and wheels and a 5-speed manual transmission for a sporty ride that is as much fun to drive as anything in this class.

Introduced earlier this year were the "America" models of the Omni and Horizon lines, cars that carry what Chrysler calls "the lowest sticker price of any American car." For a reasonably equipped base model, the price is \$5499, which includes alloy wheels, a 2.2liter engine, 5-speed transmission and the rear window defogger.

Chrysler is the generally



acknowledged leader in compact van development, but the company is determined to extend that lead, not simply maintain it. That is the planning behind the new, higher powered, stretch version of the Voyager and Caravan. The new models will be available in early 1987 with a base 2.5-liter Four made by Chrysler and an optional 3-liter Mitsubishi V6. The added muscle from these changes will cure one of the minivan's few shortcomings-lack of extra power at highway speeds and when carrying heavy loads.

Chrysler claims an increase of 25 cu. ft. of cargo space (to 150 cu. ft.) in its new stretched minivans. The extra room comes from moving the rear axle 7 in. rearward, to produce a 119-in. wheelbase. Outside, the body is 14.6 in. longer.

Dodge may have been shut out on convertibles, but its hot Daytona line was not forgotten. This year the sporty coupe will have a new nose arrangement that includes pop-up headlights. Chrysler put its new Turbo II engine in the Daytona Shelby Z model. The Turbo II pumps out 174 hp, an increase of 19 percent over the Turbo I. The difference comes from the addition of an intercooler. Look for this engine to show up on other Chrysler high-performance models in the future.

Dodge's midsize Dakota pickup finally makes its

74

showroom appearance this month. Bigger than the compacts but smaller than fullsize pickups, the Dakota offers big pickup features like a 3-passenger cab, 5500pound trailer towing capacity, 61/2- and 8-ft. cargo boxes and a husky 3.9-liter V6 optional engine. Base engine is Chrysler's workhorse 2.2-liter Four. A 4x4 version uses the V6 only. A new 5-speed manual transmission is a mileage-stretcher, but a 3speed automatic is available.

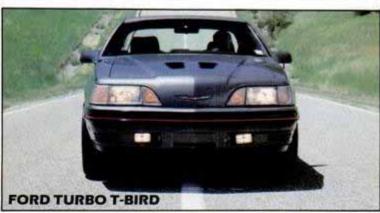
Chrysler's long-anticipated "Built by Maserati" luxury 2-seat convertible will not be ready for sale until a year from now, but details of its chassis and powerplants have been released. Two engines will be used, both based on the Chrysler 2.2liter Four. One is the intercooled Turbo II, the other a 16-valve design made by Maserati. A hardtop roof that takes two people to lift off can be removed if you want the full flair of a softtop convertible. This small car will be assembled by DeTomaso Industries in Italy and shipped to the U.S. as a completed model.

Ford

Ford's sensationally successful Thunderbird and Cougar get new sheetmetal for 1987. Major styling changes refine the shapes of grilles, taillights, roofs, backlights and rear fenders. Still, the two personal coupes carry the basic styling themes that

JEEP









at cruising speeds. Still, with all the changes,

225 lb.-ft. Its 4-wheel disc

brakes are now the antilock

type, while a new automatic ride control alters ride and

handling for better control at

high speed, or smoother ride

the 0- to 60-mph times of the Turbo Coupe are little different from those of the V8powered Thunderbird. Both cars fall in the 10-second range, a level that's a couple of ticks slower than many high-performance other coupes. Ford officials explain that the Turbo Coupe is a road car not designed specially for drag racing, but for high performance at driving speeds. The 220-hp High Output V8 is still restricted to Mustangs.

If you're looking for the major design change in the '87 Fords, look first at the full-size pickup and Bronco

Материал, элимиленный авторожим привом





lines. Styling is new inside and out, but more important is the new braking system. Ford will have ABS brakes on the rear wheels of all its 1987 full-size pickups and Broncos, a first for lightduty trucks.

Because the weight on the rear wheels of pickups varies so much, depending on whether the cargo box is empty or loaded, brake designs are a compromise. They must be strong enough to stop a fully loaded truck, but light enough to avoid lockup when lightly loaded. Brake designers, for the sake of safety, lean toward

brakes that hold up to heavy loads. The result in many cases is that drivers of lightly loaded pickups discover to their dismay that rear wheels will lock up under heavy braking. When that happens, the rear end of the truck tends to skid out to one side, and the truck can actually go into a spin.

ABS brakes are the cure for all that. By automatically pumping the brakes with a light touch, they allow the rear wheels to continue rolling, thus keeping a grip on the roadway and bringing the truck to a straight-line stop. Look for other pickup

builders to follow Ford's lead. GM is next in line with its 1987½ full-size pickups, due next spring.

Mustang GT has the reputation of being one of the top performance street coupes. Its V8 power and rear-drive make the GT quicker than a Camaro, and more fun on the road than the horde of turbocharged front-drive models that match its price. This year, the GT is even more powerful, with 20 more hp thanks to new cylinder heads and a more efficient air intake system. Whether the 350-cu.-in. IROC Camaro can match the 220hp GT will be a challenge worth watching for.

Mustang Other changes include new interiors for all models, heavy decoration on the exterior of the GT, new grilles and new flush-mounted side windows. Mustang's cousin, the Mercury Capri, was dropped from production for '87. Reports out of Detroit indicate that this car may be revived in a different form in 1988 and will feature smaller size, front-drive and a smaller 4cylinder engine.

Ford will join a 4wd sedan trend with a part-time system on a small number of 1987 Tempo sedans. This part-time drive is recommended for snow, mud or ice where traction is slippery. On dry pavement, the driver should switch to 2-wheel (front) drive to avoid drivetrain bindup.

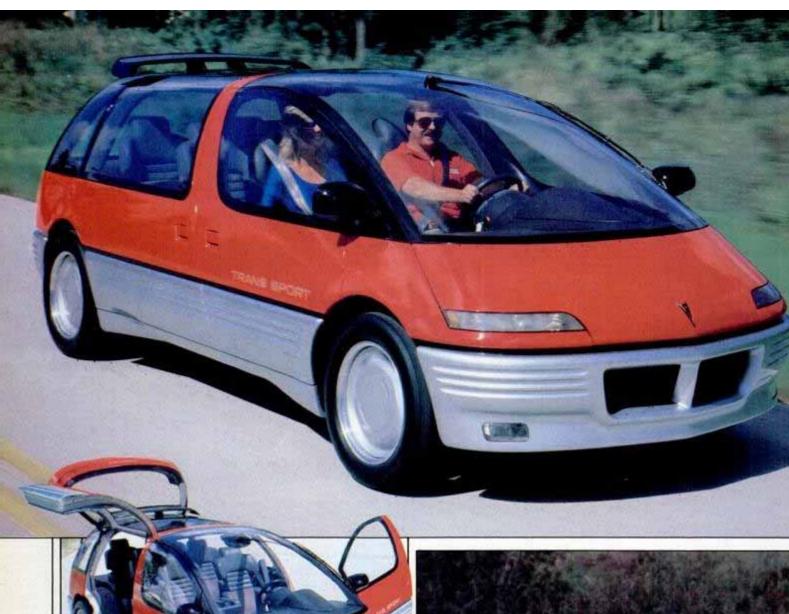
The new Tempo model looks identical to the standard Tempo except for an "All Wheel Drive" badge on the trunk lid. It uses the same 2.3-liter 4-cylinder engine as other Tempos, but is available only with automatic transmission.

General Motors

After 25 years of strong emphasis on small, low-priced cars, GM now swings over to put a brighter face on the luxury end of its lineup. For 1987 GM has only two allnew cars: Allante, a 2-seat sporty model in the pricy \$50,000 class, and Bonneville, a handsome \$16,000 front-drive family sedan.

Cadillac will generate most of the excitement when the Allante makes its appearance. With a body built in Turin, Italy, by Pininfarina, and engine and running gear attached in De-

(Please turn to page 116)







PONTIAC TRANS SPORT

The turbo V6 gives lively performance even to this heavy hand-built prototype. Curb-side gull-wing door and pivoting bucket seats make entry and exit easy. Driver's seat has transmission controls in the armrest. Buttons in the stationary steering wheel hub operate lights, wipers, defrosters, turn signals and cruise control. A windshield that extends well back over the driver and side windows that wrap into the roof make the Trans Sport look like a bubble-top helicopter.





DRIVING THE SPECIAL REPORT

GM, Chrysler and Ford have already built the cars of the future. And we've driven them.

BY WADE A. HOYT Automotive Editor

uto show cars are usually exactly that —just for show. Some don't even have engines, and those with them often don't run. Even the "drivers"—the ones that work—may be so poorly developed that their tires rub, their drivetrains bind and their engines overheat.

This year's crop of Detroit show cars, however, are in a completely different class. They've been highly developed because their engineers are using them as serious test beds for tomorrow's technology, not just as exotic styling exercises.

I've just completed a trek from New York to Detroit, Florida and Arizona to drive three show cars—the Pontiac Trans Sport, Buick Wildcat and Dodge M4S.

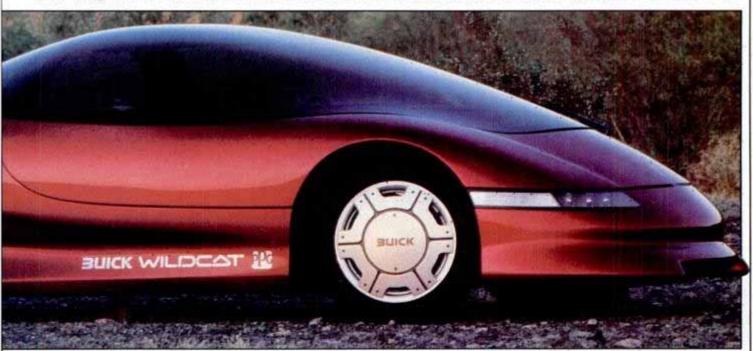
Closest to production is the Pontiac Trans Sport minivan. "We intend to produce a vehicle very much like this one in the next few years," says project manager Joe Dunn. "It won't be quite as far out as the show car, but you'll recognize it as a close relative."

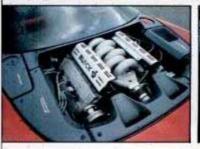
The Trans Sport chassis is a front-drive Pontiac 6000 STE stretched to a 116-in. wheelbase. Its height is only 59.6 in., 5 to 12 in. lower than current minivans. Its 12.5-in. step-in height is 4 to 9 in. lower than the minis, but its interior height of 48 in. is nearly equal to most of them.

The Trans Sport's engine is an experimental turbocharged 2.9-liter aluminum V6 that Pontiac has been developing with an eye toward making the Fiero a Porsche killer. Production Trans Sports will no doubt get standard-issue GM V6s.

If the exterior of the Trans Sport knocks you out, you should see the interior! Six power bucket seats provide not only maximum comfort, but entertainment as well. Center and rear passengers can watch a roof-mounted TV and have easy access to laser disc players in side storage compartments. Each seat has individual radio controls and earphones.

The driver's seat has power adjusters in the left armrest and electric transmission shift controls in the right. This is the vehicle's one weak spot; while getting it off the turntable at Epcot, a GM driver actually rested his arm on the armrest, accidentally shifted the car into gear, and drove it over the









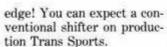
BUICK WILDCAT

The bubble canopy raises hydraulically for entry and exit. The 24-valve V6 is exposed to the elements for a macho motorcycle look. Shifter works like a bike's, too: push down to downshift, pull up to upshift. Wheel hub contains LCD instruments.



PPG/DODGE M4S

Sleek pace car looks like an IMSA sports/racing prototype, and has performance to match. Top speed is 195 mph. Conventional instrument panel is dominated by two red digital readouts for the twin turbo's inlet temperatures. Chrysler 2.2-liter Four is topped by a modified Cosworth 16-valve head.



Buick's Wildcat was developed to do double duty: first to wow them on the show circuit, then to serve as a PPG parade car at CART Indy car races.

"Our philosophy with this Wildcat was, first, to build a driver's car, not just an electronics showcase, not a race car," says Ed Roelle, the car's project engineer. "We developed a list of features we wanted to use to achieve that end—a 24-valve V6 engine, 4-wheel drive, and an instrumentation package that would provide the kind of information that an enthusiast wants."

In its current state of tune, the 3.8-liter V6 develops 250 hp without a turbocharger. It's likely to appear next on Buick's stockblock Indy race engines, but these guys are already talking about 3-liter, 24-valve V6s for front-drive Buick street cars like the upcoming



Reatta 2-seater. The 3.8 version would be too powerful for a front-drive chassis, hence the 4wd exercise.

The transmission is a GM 4-speed THM 700-R4 with a unique manual "shift by wire" arrangement. The shifter lies horizontally between the seats and, just like a motorcycle's, you pull up on it to upshift one gear at a time, and push down to downshift. The shift lever sends signals to a



Delco servo on the transmission, which does the actual shifting. A separate button gives you NEUTRAL at any time. When you stop, the tranny automatically goes into FIRST, unless you select PARK or REVERSE via separate buttons.

Alongside the transmission is a chain-driven transfer case that splits torque front-to-rear 35/65 percent. The suspension uses racing-



type coil-over-shock units the ones at the front of the car are mounted horizontally to lower the hood line and are operated by rocker-type upper control arms.

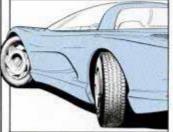
Much of the car's instrumentation is contained on a circular liquid-crystal display in the center of the steering wheel. It includes rpm, oil pressure, fuel level and battery charge.

Speed, odometer and shift quadrant information are











CORVETTE INDY

Chevrolet dream car echoes many styling features of Buick's, including a visible engine, but the Vette's is under glass. The midship powerplant is a modified version of Chevy's 32-valve Indy V8. Unlike the racing engine, the show car's uses two intercooled turbos. Four-wheel steering

(illustration) will be only part of the Total Wheel Control System with 4wd, ABS, traction control and active suspension. Interior features CRT instrumentation, radio and climate controls in each door. Outside mirrors are replaced by a TV monitor and rear-facing camera.

projected onto a small transparent "heads-up" screen just below the driver's line of sight. At first I thought this would be very distracting, but you don't even notice it unless you want to. And then, being 51 in. from your face, it can be read very quickly, with minimal refocusing of the eyes.

The driver can also call up a zillion functions-including oil temperature, horsepower, a spark advance "map" or cornering G-forces-onto a flat dot-matrix vacuum-fluorescent screen in the dash.

Dodge's M4S is an unabashed race car, designed to pace PPG/CART races. Built like an IMSA prototype sports/racer, the M4S is based on a modified Huffaker tubular race chassis with full roll cage. The transverse engine is a 2.2-liter Chrysler Four with a specially adapted Cosworth BDG 16-valve cylinder head.

cooled turbos are used, each with its own Bosch L-Jetronic fuel metering unit. At the maximum boost of 23 psi, this little screamer pumps out 440 hp and was timed at 195 mph on the 71/2-mile oval at the Ohio Transportation Research Center. For pace car duty,

The M4S's 2-disc clutch is

stiff and has two positions: in

the M4S runs 10 psi and about 140 mph.

Two inter-

or out-there's not in between. much The straight-cut gears in the transmission mesh with a slight crunch, and rearward visibility is almost nonexistant. Despite a lot of heat and engine noise, wind noise is minimal due to the long body's slick 0.236 Cd.

The car's main contribution to Chrysler road cars will be in 16-valve technology promised for the upcoming Chrysler-Maserati 2seater. So far, Shelby, Lotus and Maserati have been working on the design, and the Dodge M4S provides experience with a classic Cosworth layout.

Don Runkle, Chevrolet chief engineer, describes the mid-engine Corvette Indy as "a kind of work-in-progress status report" to the public. The finished product—the driver-will feature a Total Wheel Control System that incorporates 4-wheel drive and steering, ABS brakes, traction control and "active'

(Please turn to page 115)

FORD PROBE V

Latest in a series of aerodynamic studies, Probe V is a mid-engined 2+2 sports sedan with temporary slingtype rear seats suitable for small children only. The fabric seats retract like window shades. Doors and engine hatch slide rearward for access. A transverse, overhead-cam Four will power the running prototype, which has such low drag that only 5 hp will be needed to keep it cruising at 50 mphl Tiny headlights allow a low hood line. Flexible skirts cover the front wheels.



POPULAR MECHANICS • OCTOBER 1986

FORD PHOTO

The IBM Personal Computer has spawned a host of lower-priced imitators.

Here's how the top-ranked challengers fared in a face off.

BY RON SCIBILIA; Illustration by Alan Gutierrez

contestants.

t didn't take a soothsayer to forecast that

IBM's Personal Computer, introduced in

August 1981, would establish a new comput-

ing standard. With the basic elements of the

5-year-old IBM PC well accepted today, and

a huge support system of software and hardware in

place, competitors now focus on producing clones

of IBM's PC design at the lowest possible cost. If

you're in the market for a home computer, you'll

find these "econoclones" a real value. Most IBM-

compatible models carry suggested retail prices

\$500 to \$1000 below the PC. And even when a

retailer discounts the IBM PC to match the price of

an econoclone, you'll find the imitators give you

more bang for the buck in terms of expandability,

Edge's Model D, Kaypro's PC and Epson's Equity I

-are only some of the econoclones. We've selected

them for review because each offers a different

combination of features and benefits to satisfy

your specific computing needs. Careful shoppers

will also want to look at machines such as Tandy's

1000 and 1200 models, Zenith's Z-148, and clone-

king Compaq's original and now increasingly price-

competitive Portable, to mention just a few

All three units evaluated here are configured with

The PC imitators evaluated here-Leading

power-supply and support software.



256 kilobytes (KB) of random-access memory (RAM), two 360KB floppy disk drives, and the lowest cost monitor and video display/adapter combination supplied by the manufacturer for that model. All include built-in parallel and serial interfaces for hooking up peripherals (printers, modems) as part of their basic price. Warranties on all three exceed the industry's typical 90-day coverage for parts and labor.

Leading Edge Model D

The Leading Edge Model D is manufactured by South Korean conglomerate Daewoo and distributed by Massachusetts-based Leading Edge Hardware Products. This \$1495 package includes the GW-BASIC programming language, the MS-DOS operating system (version 2.11) required to make the computer work, a diagnostics disk and, last but not least, the Leading Edge Word Processor—a sophisticated and full-featured text-handling program with a \$100 retail value.

What's right about the Model D? For starters, it offers an excellent keyboard with a snappy, positive touch that will more than satisfy experienced typists. The keyboard has raised dots on the f and j keys, so you always know where your fingers should be without looking. Additionally, Leading Edge has moved some keys that proved troublesome on the IBM PC—like the infamous backslash between the z and the left shift key—to locations on the keyboard less likely to cause mistakes.

Significantly—and alone among these three computers—Leading Edge has enlarged several often-used keys: the enter, return, backspace, insert, delete, shift and gray-plus keys.

Leading Edge has cabled the keyboard wisely. The cable plugs into the front not the rear of the main computer unit, permitting more flexible keyboard placement than IBM's PC. A right-angle connector lets you push the keyboard flush against the unit.

Leading Edge also did its homework when it comes to the video display. Recognizing that your first priority is likely to be highly readable text, but that you'd also welcome some ability to run popular graphics packages, the manufacturer endowed the D with both capabilities. Text on the Model D's 12in, monochrome screen is as eye-easy as you'll find on IBM's much-praised monochrome monitor and video adapter. But Leading Edge also built into its video display adapter the capability of emulating the Hercules Graphic Board. This lets you run about 75 major IBM graphics programs with 720 x 348 pixel (dot) high-resolution on the D's screen.

If you'd like to go further afield in graphics than the available roster of Hercules-compatible programs, the



Model D is ready when you are: Flip a switch on the back and you're prepared for any program written for IBM's Color/Graphics Adapter. To get color you'll have to hook up an RGB color monitor to the connector supplied by Leading Edge. Figure on spending \$500 for a high-quality color monitor.

The Model D scores well in two other areas: size and expandability.

With a compact "footprint" that takes up 28 percent less space than the IBM PC, the D is at home on a small, 24-in.-deep desktop without taking over an entire workspace. The D shines in expandability as well: There are four full-size IBM-compatible slots open for use inside, and you can beef up the motherboard with as much as 640KB of RAM without having to occupy these valuable slots with add-on memory.

Leading Edge hasn't stinted on the D's power supply, either: Where IBM gives you 62.5 watts, Leading Edge spots you to a potent 130 watts—plenty for accommodating a wide variety of add-ons without strain.

There's another small but welcome touch which only the Model D, among these three econoclones, offers: You don't have to tie up two wall outlets to operate this system. Just plug the monitor into the main system unit for power. The Model D is a relatively quiet machine, with moderate fan noise and quiet disk drives that make themselves noticed by only emitting an audible click when they first engage.

Kaypro Professional Computer

The PC in Kaypro PC stands for Professional Computer, and Solana, California-based Kaypro targets this model to the budget-minded businessperson with ambitions of becoming a "power user." The machine is an IBM PC-sized performer that continues Kaypro's longtime policy of cramming extra value into a package. This value-oriented philosophy translates into equal parts hardware expandability and bundled software.

The \$1595 Kaypro PC distinguishes itself by offering more potential for expandability than any of its competitors. In all, the unit provides six free slots for add-in boards.

Modular design is yet another asset of this machine. You can install up to 768KB of RAM on the Kaypro PC's Multifunction Board. And because the brain of the unit—the 8088 microprocessor—is also housed on a slot board, you can easily install a more powerful chip to give the unit the same speed (and ability to address extra memory) as IBM's top-of-the-line PC/AT. (Kaypro offers its 286 Card to do just that, priced at \$800.)

Stylistically, the Kaypro PC even resembles IBM's PC/AT—right down to the security lock for the main unit. And befitting the goal of expandability, Kaypro's power is 132 watts strong—as hefty as IBM's mid-line PC/XT—and certainly up to accommodating such add-ons as a hard disk.

Another distinction of the Kaypro PC is what you get for free. The company, long known for its generous software bundles, gives you not only the MS-DOS 2.11 operating system and GW-BASIC language, but six more programs: MicroPro's WordStar word processor and CorrectStar spelling-checker plus four business-oriented programs. This shelf of first-rate soft-



ware, fairly valued between \$500 and \$1000, comprises an excellent beginning for any PC software library.

Like Leading Edge's Model D, Kaypro's Professional Computer is a versatile video display performer. In fact, its graphics capabilities are the best of the three econoclones.

The Kaypro PC arrives with a Multi-Video Board that yields very good text resolution, in addition to displaying monochrome graphics on the 11-in. green phosphor monitor that comes with the system.

Kaypro's graphics adapter can emulate IBM's Color/Graphics Adapter card, giving the Kaypro PC access to the hundreds of graphics programs written for IBM's popular CGA standard. This double-threat display skill enables the Kaypro PC to handle the widest range of IBM software of these three econoclones. As with the Leading Edge Model D, you can also hook up an extra-cost RGB monitor if you want color. All you do is adjust an internal hardware switch, or use software controls to change display modes.

With all these virtues, where does the Kaypro PC slip?

For one thing, its large size—same as the IBM PC—requires a deep, full-size desk, and so might deter some users with limited workspace.

For another, the feel of the keyboard isn't nearly as responsive as that found on either the Leading Edge Model D or the Epson Equity I. Kaypro's keyboard could become a bit tiring during long hours of typing.

Finally, though the unit has very quiet disk drives, it's also endowed with a rather noisy, high-pitched fan that never lets you forget it's there.

These objections noted, there's no arguing Kaypro's package succeeds in offering remarkable bang for the buck. You might decide that the inclusion of its fine software library easily outweighs these negatives.

Epson Equity I

Epson's Equity I captures the prize in this trio for ergonomic and styling merit. It's as compact as the Model D, readily usable on a 2-ft.-deep desk, but even more adaptable to small workspaces. That's because the Torrance, California, company provides small feet on the right side of the machine so that the main computer unit can stand on its side for even greater flexibility of place-

(Please turn to page 114)



The IBM Personal Computer

COMPARISON OF PC AND ECONOCLONE FEATURES

Here's how the Leading Edge, Kaypro and Epson econociones stack up against each other and the IBM PC, pictured at left. List prices refer to the original manufacturer's equipment. Retailers might offer discounts, or substitute monitors of other brands.

	IBM	LEADING EDGE	KAYPRO	EPSON
INTERNAL MEMORY (KB RAM)	256	256	256	256
EXPANDABLE MEMORY (KB RAM)	640	640	768	512
EXPANSION SLOTS	4	4	6	2
POWER SUPPLY (watts)	621/2	130	132	55
GRAPHICS ADAPTER INCLUDED?	Optional	Yes	Yes	Optional
FREE SOFTWARE INCLUDED?	No*	Yes	Yes	No
WARRANTY (months)	3	15	12	12
LIST PRICE	\$1995*	\$1495	\$1595	\$1573

*Even MS-DOS operating software, included by all others, must be purchased separately.

200-MPH BULLET BOAT

Lightweight, high-power turbine technology propels Miss Budweiser into the jet age.

BY TIM COLE, Boating/Outdoors Editor





critical chambers are turning the engine at close to 100 percent of designed optimum. Air- and water-speed indicators-fed by pickups on the deck and on the tip of the rudder-occupy center stage. Thumb switches on the steering wheel operate port and starboard ailerons-critical ground-effect controls that will help prevent the ultimate nightmare, a "blowover," when the boat approaches 200 mph and literally starts to fly.

On this particular point, Kropfeld is philosophical: "There's nothing you can do about it. At around 200, you're just along for the ride."

And what a ride it is-considered unusually brisk even by the hellbent standards found in the world of unlimited hydroplanes.

The Avco-Lycoming T-55 L-7 underneath the cowl changes pitch and screams higher, louder as Kropfeld blazes away from the dock. He wants to get up on plane in a hurry to keep water from entering the air intake, which would interfere with the L-7's 7-stage compressor blades. Reclining underneath the F-16 canopy, Kropfeld keeps one eye roaming over the gauges and sets up for a practice run.

Police and spectator boats clear a path and his foot goes down on the accelerator. There's a slight delay in throttle-response, then Miss Budweiser transmits that satisfying kick in the pants well known to

dragster pilots and fighter jocks.

Kropfeld peers ahead, anticipating trouble, as Miss Budweiser gobbles up Lake Washington. Random wavelets and the sinewy remnants of pleasureboat wake appear in an instant, vanishing underneath Kropfeld's command module. Vibrations are channeled from the lake surface through the hull to his nomex-clad hands and body, demanding helm reactions in a fifth of a second. Miss Budweiser's sponsons port and starboard walk and flutter as Kropfeld countersteers the merest fraction, trying to gain the upper hand on this unholy piece of machinery, now approaching 175 mph, now surpassing it. Gravity is just an afterthought as Miss Budweiser flicks and bobs across the water, feeling lighter-and less manageable-with every tenth of a knot.

She's taking over now. Kropfeld may be Miss Budweiser's mind and muscle, but the hairy fringes of 200 mph beckon, and she charges across the water with self-possessed abandon. She slices into the bottom turn, her skid-fin on the port side gouging into the lake and sending up a mountain of spray. Kropfeld steps on it out of the turn and Miss Budweiser attacks the straightaway, hunting for more speed, hungry for it.

It's a quest unlimited hydroplane drivers understand all too well. But it didn't start with the current age of turbine-powered hydro pilots like Kropfeld, Chip Hanauer (Miller American) or Steve Reynolds (7-Eleven).

The Miss Budweiser team is enter-

GEARBOX

T-55 L-7 HELICOPTER

ENGINE

HEAT DUCT

FUEL CELL

ing its third decade of competition, led by owner Bernie Little of Tampa, Florida. Speed was also the goal when Little entered the game in 1966 aboard a 4seat hydroplane he purchased from the late band leader/sportsman Guy Lombardo. The hull-shape forward was the blunt half-moon typical of the period, presenting so much area to the wind at speed that the threat of a blowover prevented the boat from venturing much past 100 mph.

Little and company buckled down after this casual taste of hydro racing, producing a succession of state-of-theart Miss Budweisers that employed more contemporary hull designs. After relying on the Rolls-Royce Merlin engine, Little purchased a collection of larger interchangeable Rolls-Royce Griffon engines in the early '70s that first saw service in the Shackleton bomber and Spitfire fighter during World War II. Equipped with an awesome nitrous-oxide booster to blast the boat around turns, the 3000-pound, 4000-hp Griffons would become Miss Budweiser's principal form of power through the '70s and into the early '80s.

That left the task of going ever faster to the designers. Two breakthrough boats in the Miss Budweiser camp advanced the leading edge considerably. The seventh Miss Budweiser (ex-Pride of Pay 'N Pak) designed by Ron Jones in 1972 introduced the "pickle-fork" hull design derigueur in 1986. The broad, flat nose of the post-1950 hydro, so prone to blowovers, could now ventilate air away from the bottom of the hull between catamaran-like sponsons. She was wider, flatter, less box-shaped and ran away with the '73-'75 season with a frightening ability to wrap around turns.

The next design advancement in unlimited racing occurred in 1979, (Please turn to page 110). TV CAMERA COCKPIT

F-16 CANOPY

PICKLE FORK

The light weight of Miss Budweiser's new turbine powerplant permits weight savings throughout her 28-ft. 6-in., 5000-pound hull. Driver sits in crash-resistant pod forward between sponsons. Engine and cockpit are offset to the left, which permits snappier cornering. Horizontal stabilizer aft and allerons forward give Miss Bud a semblance of aerodynamic control, but unlimited hydros of the future will carry

computer-activated control surfaces.

RUDDER WITH WATER PICKUPS

COMPRESSED

AIR SYSTEM

86

3-RI ADE RACING PROF

ALUMINUM HONEYCOME

STRUCTURE

ALLERONS



Lasers and computers loom large in the future of banking. Transactions will be easier, and counterfeiting harder.

BY PAUL A. WILLAX

ess than 40 years ago, at the University of Pennsylvania, an assemblage of 18,000 vacuum tubes, 70,000 resistors, 10,000 capacitors and 6000 switches—enough gizmos

to fill a 2-car garage—huffed and puffed at highspeed calculations as ENIAC (Electronic Numerical Integrator and Calculator), the granddaddy of the digital calculator, was born. The revolution that followed touched every corner of society, and has already transformed the banking industry from manually entering transactions on ledger cards to electronically moving funds around the globe in a matter of seconds.

Yet, we've just heard the first rumblings of a revolution that will soon change the face of banking, and money, in ways you may never have imagined. But imagine this: As the Eiffel Tower stands watch over sleepy Paris, an advanced microcomputer I call the Electronic Pal (EP) maintains a silent vigil on a nightstand in an American businessman's hotel room. EP scans the Dow-Jones newswire and other financial reports as its owner sleeps. Half a world away, the New York Stock Exchange is ready to end a day of quiet trading when word hits the floor that IBM stocks are splitting. EP, with a large memory processor etched into its tiny chips, reacts to key words in the report. Using artificial intelligence, the key words "split" and "IBM" set it in motion to take constant updates on the situation. EP is talking to the stock exchange supercom-

Mr. Willax is chairman of the board of Empire of America Federal Savings Bank, the first bank in the nation to install a mobile Ku-Band satellite telecommunications system. puter via a satellite connection. As it monitors those reports, EP automatically switches to another satellite network to talk to the sleeping businessman's home com-

Having been trained by the businessman to follow his portfolio in a set pattern, EP notes the man's IBM holdings and, at 6 a.m., wakes the owner with a buzz. With one flash of numbers, EP tells him what stock is available. With another flash, EP tells him how much cash he has and where. Money has been transferred, and upon the businessman's approval, a deal will be consummated.

All of the various technologies needed to build this

Holograms, expected to

be placed on future money,

and position in varying light

are 3-dimensional, change color

and can't be counterfeited easily.



theoretical device are available today. In fact, the Electronic Pal is already under discussion in electronics circles. Apple computer co-founder Stephen Jobs has described it as "an incredibly powerful helper."

Satellites and computers linked together to allow the traveler to carry all his assets and the marketplace with him are in the future of banking.

Even as high technology moves in to boost the world of finance, similar technological shields against high-crimes are being developed. Counterfeiters of money and credit cards have challenged the ability of the industry to protect its clients, and the challenge is rapidly being met. One interesting challenge, made theoretically only until now, has been in the area of cash. Money counterfeiters have become sophisticated over the years, but a new Defense Department development has set the industry to thinking about how to combat a potential counterfeiting threat of the future.

Three-dimensional

holograms already

appear on some major

credit cards, making coun-

terfeiting almost impossible.

The Quick Response Multicolor Printer, developed by Xerox for Army cartographers, has been judged to have such high resolution in its reproductions that amateur counterfeiters may one day get their hands on such a machine and start printing money. All they would need is the right paper.

Xerox has taken a new lead in the business copying world even with its standard office printer/copiers that use lasers and microprocessor electronics to produce stunningly true copies. Those office machines are not up to the level of the QRMP, but what if a counterfeiter gets his hands on one? The U.S. Treasury Department is concerned about this.

The Bureau of Engraving and Printing is hard at work developing harderto-copy money. By 1988, some redesigned bills will be in the public's pockets. The new bills will feature finer details around the frame surrounding presidential portraits, with transparent plastic threads embedded in the paper. These thin plastic ribbons will display very fine printing when held up to light. These, and possibly watermarks, will be America's first new line of defense against counterfeit bills.

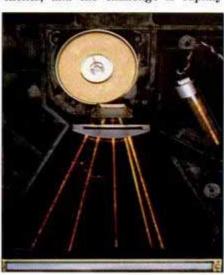
All this is well and good if those who handle the money are willing to take time to examine it carefully for the right watermark or plastic ribbon. But real-life situations don't always allow for that. In the more distant future, American currency is expected to follow the lead of the bank card industry by using holograms to identify money.

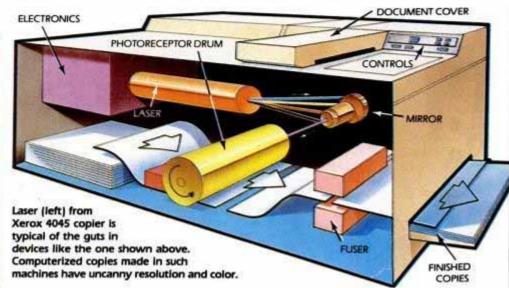


hologram is a 3-dimensional image created by a laser. Imprinting holograms

cards has made them virtually copy proof. A hologram changes position and color as light strikes it from different angles. If you photograph a hologram, you simply capture one position of the holographic image and one color. To copy a hologram, you must create a hologram just like it, and that takes expensive laser and computer equipment most counterfeiters can't touch, much less operate.

The American Banknote Co. already has been experimenting with holographic money, and officials at the





In the future, American currency is expected to follow the lead of the bank card industry by using holograms to identify money.

Treasury Department seem interested.

Meanwhile, the counterfeit trade will have to work with the more standard office laser copiers that can reproduce money, but cannot photograph a plastic ribbon. The laser copier can be linked to a computer using electronics to produce print in a variety of sizes and fonts and excellent images of portraits and other art. The Xerox 4045, for example, has a resolution of 300 dots per inch, making it possible to produce very realistic images. The electronically controlled laser in this machine is directed at a mirror, which shunts the beam to a drum where dry ink is applied and "colored" by a chemical reaction with the laser light. The colors are remarkably true. The ink is heated and bound into place by a fuser device.

This level of copier is still not good enough even for amateur counterfeiters, but the QRMP, if it ever goes beyond the function of military map

making, may be.

n today's world, money is already moving as quickly as the people who need it. More people are using automated tellers, banking by phone and banking at home using personal computers. And banks are installing equipment like videodisc systems that allow customers to summon up detailed information on a wide range of financial topics.

Other developments have great potential for automated banking. Seiko, for example, recently began offering its 3-component Datagraph system linking a specially designed wristwatch to most computers. The system lets you retrieve 2000 characters of data from the watch anywhere and any time.

Epson has recently been showing off a much more powerful device. The RC-20 wrist computer includes 2000 bytes of random access memory and houses a computer chip comparable to those used in many pre-IBM personal computers. With its communications port, the RC-20 can communicate with a desktop computer. Link such hardware to

computer. Link such hardware to emerging software that creates "expert systems" and you have the forerunner of my Electronic Pal advanced microcomputer described earlier.

The coming expert systems will communicate at a rate of millions of bits of information per second on just half a million characters of resident memory. The ability to communicate with other computers is what will give the Electronic Pal and other similar inventions its real power.

Voice synthesis is another area of electronics development that will give such devices—and future souped-up automated teller machines—vocabular-

ies in human languages.

The Air Force is working on a cockpit device right now that will be able to recognize the voice of a specific person—as opposed to some other unauthorized person—sitting in an airplane's cockpit. It can pick up 10 words and understand them. It can tell from the tone of the voice whether the words are spoken calmly or under stress.

The software that goes into the design of such a voice system is getting more sophisticated each year, and we can expect a working vocabulary that permits full banking services by the turn of the century.

With the development of devices like EP and talking Automated Teller Machine stations, security will again become a major concern.

The Electronic Pal and systems simi-

lar to it probably will be activated by a voice "print," the acoustic version of a fingerprint. It also may be able to cross-check the identification with an eye "print." An Oregon-based company, Eye Identify Inc., recently developed a system that scans the retina of a human eye and comes up with a pattern from the grain of the retina. The system makes identifications with a reported 99 percent accuracy.



early 20 years have passed since Arthur C. Clark gave us 2001—A Space Odyssey. The incredibly pow-

erful HAL 9000 computer created in that story was thought incapable of error. But a series of glitches turned it into a killer computer. We understand that the sensitivities of banking and money will always require looking over our shoulders at a criminal element. But the promise of electronic banking is so great, and the possibilities for security so numerous, that future banking with highly intelligent systems is inevitable.



Artist conception of Electronic Pal shows computer keyboard functions and readouts this personal banking device will have. The EP will communicate with distant stock exchanges through satellite linkups and will be able to talk to a home computer by phone line to let you carry your finances worldwide.

PM ILLUSTRATION BY PAT RUGGERO



CONSOLE TABLE

Build this graceful maple console table to enhance your foyer or hallway.

BY NEAL BARRETT

console table is designed to utilize the small, unused areas commonly found in a foyer, hallway and along a wall beneath a painting. The table provides a convenient place to keep your keys, drop off the mail, and display framed photographs. The table shown features the added convenience of two shallow utility drawers. Made primarily of solid maple, it needs less than 6 sq. ft. of floor space. Note that all of the hardwood parts are ¾ in. thick, except the legs, which are cut from 2% × 2%-in. stock.

Starting at the top

Make the tabletop using the following frame-and-panel construction technique. First, edge-join two boards to form the 10-in.-wide top panel (part H in the materials list). Be sure to cut the two boards slightly oversized to permit trimming the assembled panel to its finished dimensions. Join the boards using glue and ¼-in.-dia. × 1½-in. dowel pins spaced about 6 in. apart.

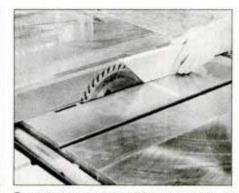
Next, rip four pieces to 31/4 in. wide

1 Mill grooves in inside edges of frame members. The ¼-in.-wide × ½-in.-deep grooves accept the tabletop panel.

for the tabletop frame. Cut a 45° miter on both ends of each of the four frame parts. Then, mill a 1/4- × 1/2-in.-deep groove in the inside edge of each frame member using a shaper (photo 1). The grooves can also be cut on a table saw fitted with a dado blade or with a router. Now cut a 1/8-in,-wide groove in the mitered face of each frame member to accept a hardboard spline (K). Cut the spline grooves on a table saw with the blade set at 234 in. high. To obtain consistent cuts, place a strip of masking tape on the saw table to indicate how far to advance each workpiece into the blade (photo 2). Cut four splines to size, as shown in drawing detail 2, from 1/8in.-thick hardboard.

Remove the clamps from the top panel assembly after the glue has dried. Use a cabinet scraper to smooth both surfaces. Then, rip and crosscut the panel to its finished size: 10 × 48 in.

> Color photo: Paul Sciacca Black-and-white photos: Neal Barrett Technical art: Eugene Thompson Photo stylist: Gabe Herick



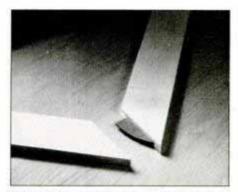
2 Cut spline grooves in frame members on a table saw. Masking tape serves as guide to indicate how far to advance work.

Next, rout a $\frac{1}{4}$ -in.-deep \times $\frac{9}{16}$ -in. rabbet around the four edges of the top panel. Turn over the panel and rout the same size rabbet on this side to form a $\frac{1}{4}$ x $\frac{9}{16}$ -in. tongue (drawing detail 1).

Assemble the tabletop frame, with the panel in place, by gluing the splines to the grooves in the corner joints. Don't glue the panel to the frame. It must be free to adjust to temperature and humidity changes.

Legs

Cut four legs to the sizes given in the materials list. Using heavyweight cardboard, make a full-size template of the tapering leg profile from the grid in drawing detail 7. Trace the template outline on two sides of each leg. Next, lay out the mortise locations on the legs (drawing detail 6). Using a 1/2-in.-dia, bit, bore a series of overlapping holes to 1/2-in. deep (photo 5). Then, use a sharp chisel to square-up the mortises and remove the remaining waste (photo 6). Now move to the band saw and cut the tapered profiles on each leg (photo 7).

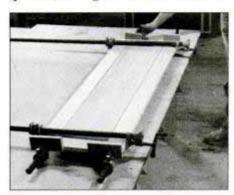


3 Assemble tabletop frame with ½-in. hardboard splines. Cut splines to match the radius of saw blade used to cut grooves.

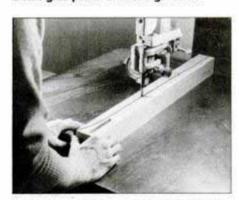
Install a drum sander in the drill press and sand the legs smooth. Rout a $^3/_{16}$ -in. by 45° chamfer on three sides of each leg using a self-piloted chamfering bit. Chamfer the outside corner of each leg with a spokeshave (photo 8).

Aprons

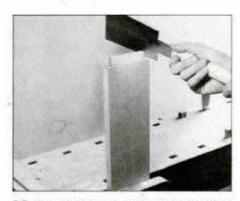
Cut the back apron and two side aprons to size. The front apron assembly (A1-A3) and the drawer faces (A4) are cut from a single board to produce a matching grain pattern across the front of the table. Cut the front apron parts as shown in drawing detail 8. Assemble the front apron with glue and ¼-in.-dia. x 1½-in. dowel pins. Clamp the apron assembly square until the glue dries (photo 9). Using a table saw fitted with



4 Glue and clamp tabletop using four bar clamps. Apply glue to spline joints only. Don't glue panel to frame grooves.



7 Cut tapered leg profiles on a band saw. Each leg tapers on two sides only. Remove blade marks with a drum sander.



10 Cut tenons on both ends of each apron on a table saw. Use dovetail saw or backsaw to trim tenon shoulders to size.

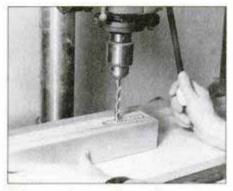
a dado blade, cut a tenon on both ends of the four aprons (drawing detail 6). Cut the tenon shoulders with a dovetail saw or backsaw (photo 10).

Now bore shallow recesses in the top edge of the aprons for installing tabletop fasteners. Bore the 1/4-in.-deep recesses with a 3/4-in.-dia. multispur bit (drawing detail 3).

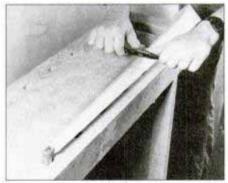
Table assembly

Start by gluing each side apron to a pair of legs (photo 11). Be sure that the legs are square to the aprons. Once the glue dries, glue and clamp the leg assemblies to the front and back aprons. Set the assembly on a flat, level surface to dry.

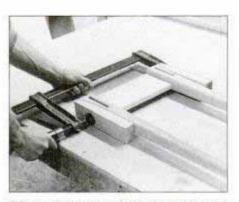
Assemble the drawer slide supports (D-G) and install them as shown. Then,



5 Form the leg mortises by first boring a series of overlapping, %-in,-dia. holes, install a fence to position the work precisely.



8 With leg held securely between two bench dogs, use spokeshave to cut a slight chamfer on the outside, curved corner.



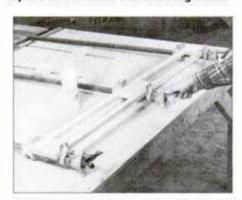
11 Glue and clamp each side apron to a pair of legs. Use two curved clamping blocks positioned against each leg.

build the drawers from ½-in. birch plywood (drawing details 4 and 5). Screw the maple drawer faces to the drawer fronts and bore holes for installing the brass pulls.

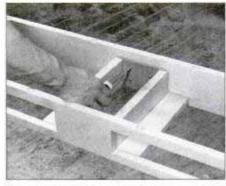
Next, rout a ¼-in. by 45° chamfer around the top edges of the tabletop and a ¾-in. by 45° chamfer around the bottom edges. Finish-sand all parts with 120-and 220-grit sandpaper. Then, remove all sanding dust with a tack cloth and apply a coat of varnish that is thinned 30 percent with mineral spirits. Allow varnish to dry, sand lightly with 320-grit sandpaper, and apply a second full-strength varnish coat. Finally, place tabletop upside-down on a padded surface and attach legs/apron assembly with ¾-in. No. 8 screws.



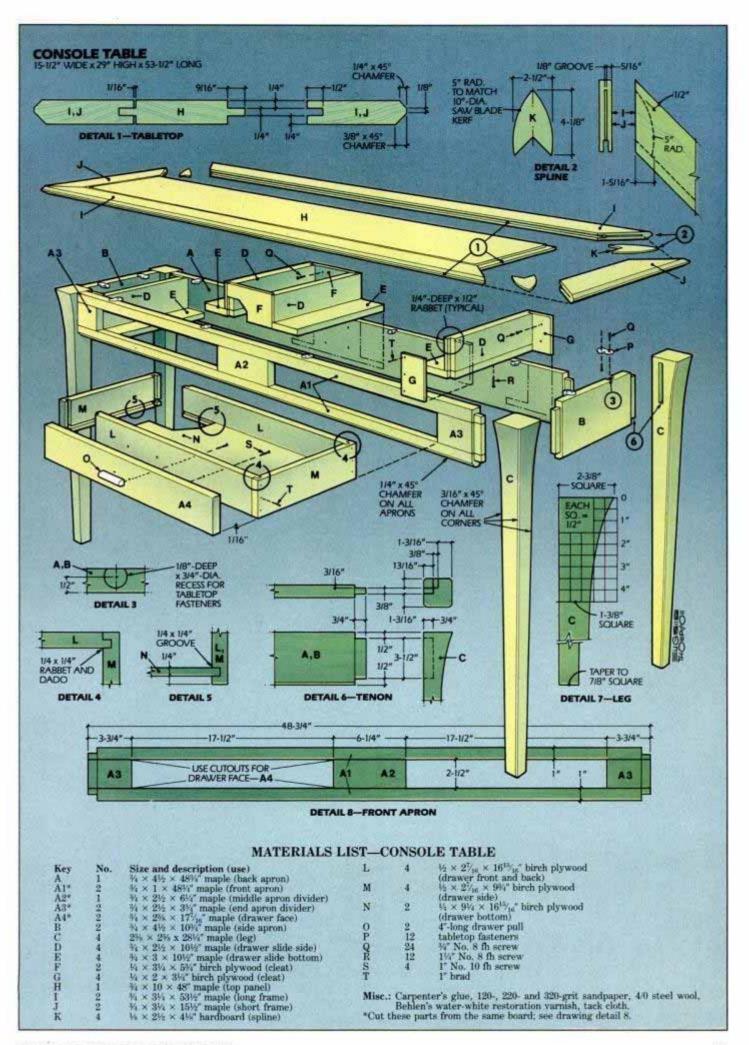
6 After the ¾-in.-deep holes have been bored, use a sharp chisel to cut the mortises square and to clean out remaining waste.



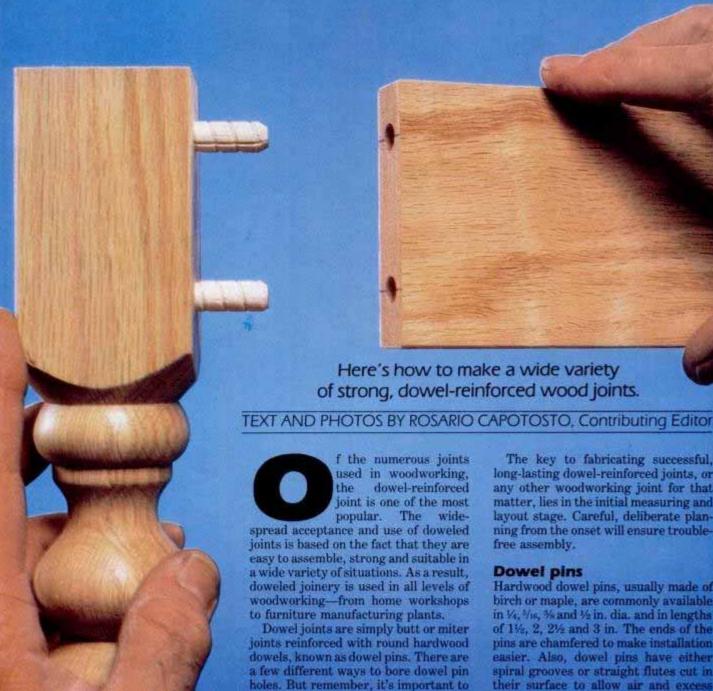
9 Cut the front apron parts and drawer faces from a single board. Then, assemble the front apron using glue and dowel pins.



12 Simple wood tracks support drawers. Attach preassembled drawer slides to front and back aprons with %-in. screws.



DOWEL JONTS



lay out these holes precisely and bore

them perpendicular to the mating surface. Dowel joints are most commonly

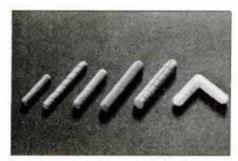
used to join pieces edge-to-edge, end-

to-end, end-to-face, end-to-edge and face-to-face, and to form miter joints

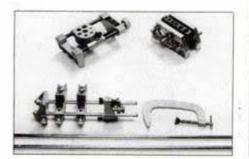
and leg-to-rail assemblies.

The key to fabricating successful, long-lasting dowel-reinforced joints, or any other woodworking joint for that matter, lies in the initial measuring and layout stage. Careful, deliberate planning from the onset will ensure trouble-

Hardwood dowel pins, usually made of birch or maple, are commonly available in 1/4, 1/15, 1/8 and 1/2 in. dia. and in lengths of 11/2, 2, 21/2 and 3 in. The ends of the pins are chamfered to make installation easier. Also, dowel pins have either spiral grooves or straight flutes cut in their surface to allow air and excess glue to escape when clamping pressure is applied. You can also make your own dowel pins from hardwood dowel rods sold at lumberyards and home centers. The rods are commonly available in 3ft. lengths in diameters ranging from 1/8 to 1 in. But, it's necessary to cut flutes



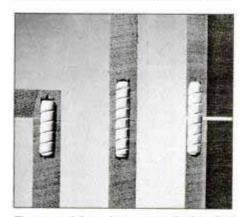
Hardwood dowel pins have either a fluted or spiral-grooved surface. Right-angle plastic dowel (far right) is for miter joints.



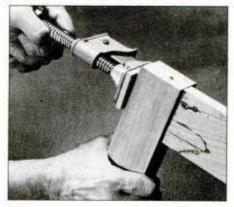
Doweling jigs (clockwise from upper left): Sears Craftsman, Dowl-It 1000 and Record No. 148 with optional 18-in. extension rods.



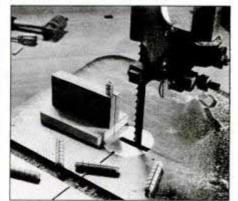
Here's how to make dowel pins from standard dowel rod. Plane two flat areas on each dowel to allow air and excess glue to escape as clamping pressure is applied. Make this simple jig to hold the dowel. Then, spin dowel in drill on sandpaper to form chamfer.



First two joints show properly installed dowel pins. Dowel pin holes in joint on right are too shallow and joint can't close.



This assembly split open when clamp pressure was applied. The reason: Plain dowel rod was used with too much glue.



Cut two-thirds of the way through pins for use in test-fitting parts. These cut pins allow the parts to be disassembled easily.

or grooves in the rod to permit the escape of air and excess glue. Planing two shallow, flat areas on a rod, as shown, will provide escapement, too.

Another dowel worth mentioning is the plastic miter dowel pin. Designed for assembling miter joints, these L-shaped dowels form a 90° angle. To install them, first bore perpendicular holes in the ends of the workpieces before cutting the 45° angles. Then, cut the angles, apply glue, insert the dowels and assemble the joint. The surface of the miter dowel has cup-shaped depressions that hold glue. Plastic miter dowel pins are available in ¼ and ¾ in. dia. from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374. Send \$1 for a catalog.

There are no hard and fast rules concerning dowel pin spacing and location, but here are some general guidelines to follow. Use a minimum of two dowel pins per joint. The diameter of the dowel pins used should be at least one-third, and no more than half, the thickness of the stock being joined. The combined depth of a matching pair of dowel pin holes should be about ½ to ½ in. greater than the length of the dowel pin. Never use dowel pins that are wet—a 5 percent or less moisture content is recommended. Otherwise, as the dowel pins dry out, they will shrink, causing the joint to weaken.

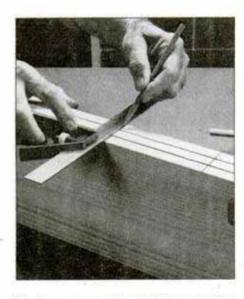
Doweling jigs

To make a successful dowel joint, two critical requirements must be satisfied: The dowel pin holes must be bored perpendicular to the joining faces, and the matching pairs of holes must be in precise alignment with each other. The easiest and most accurate way to meet these two requirements is with the aid of a doweling jig.

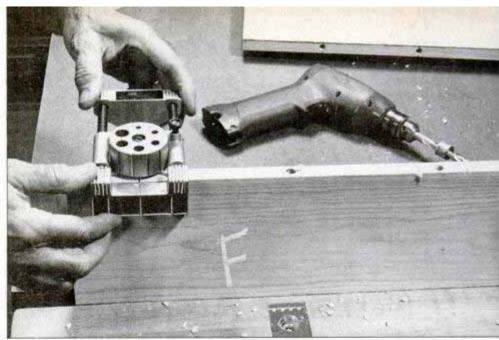
There is a wide variety of doweling jigs available. Prices vary depending on the number of joints and the size of the workpiece that the jig can accommodate. Note that some jigs are selfcentering while other models can be adjusted to bore off-center dowel pin holes. Shown are three jigs that together can handle nearly all doweling jobs.

The Sears Craftsman jig (No. 4186; same as General's No. 840) features a revolving turret that accepts six drill bit sizes: */16, 1/4, 5/16, 3/8, 7/16 and 1/2 in. dia. The jig can be adjusted for boring centered and off-centered holes in stock up to 43/8 in. thick. It's available at larger Sears stores and through the Sears Power And Hand Tools catalog for about \$24.

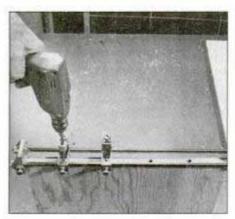
The self-centering Dowl-It 1000 jig has a fixed guide block that accepts five drill sizes: ¼, ½, 6, 16, ¾, 7, 16 and ½ in. dia. Its stock capacity is listed as 2 in., but I've increased that to 2¾ in. by making a few extra turns on the adjustment screw. Although this is a self-centering



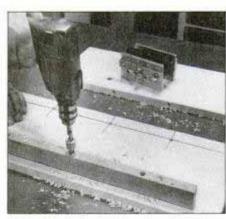
Here's an easy way to mark hole centerlines on edges. Clamp the boards together and use a square to mark them simultaneously.



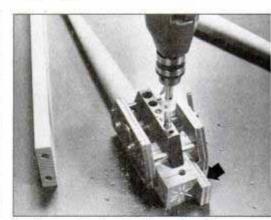
Align doweling jig with the centerline on the board's edge. Then, bore dowel pin hole. Chalk letter on the board's face aids in positioning the jig consistently for all the holes.



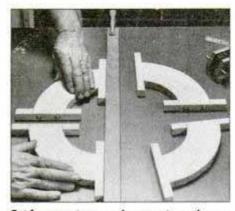
This shows Record doweling jig set up for boring in an edge. Slide the two drill guides on rods and lock them in position.



Make this simple hardwood guide to bore dowel holes beyond your doweling jig's capacity. Use Jig to bore holes in guide strip.



A self-centering doweling jig can be used to bore off-center holes by inserting a spacer block (arrow) alongside the workpiece.



Cut four quarter-round segments, as shown, to gain the best wood grain orientation. Transfer hole locations with dowel centers.

jig, bore off-center holes by inserting a

spacer block alongside the workpiece,

as shown. This jig can also be used on

round stock up to 2% in. dia. It's sold at

hardware stores and through mail-or-

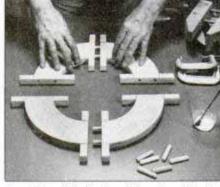
stock up to 6 in. wide with the Record

No. 148 jig. The two drill guides slide

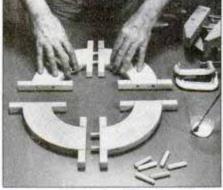
on steel rods and lock in position for

Bore dowel pin holes accurately in

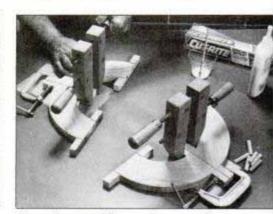
der tool companies for about \$32.



Bore dowel pin holes with a doweling jig, apply glue, insert dowel pins and assemble segments to form two half-circles.



locating the holes as desired. It accepts five drill sizes: 1/4 and 1/8 in. dia. and 6, 8 and 10 mm dia. An optional set of guide rods (\$8.95) is available to increase the jig's capacity to 18 in. Use this jig, as shown, to bore holes in the center of an 18-in.-wide plywood panel. It's available for \$65.95 from Garrett Wade, 161 Avenue of the Americas, New York, NY 10013.



Clamp the assemblies, as shown, until the glue dries. Projecting clamping ears provide a convenient mounting surface for clamps.

Marking centerlines

To obtain precisely aligned dowel pin holes, it is essential to mark the hole centerlines accurately. Remember, always measure and mark centerlines from the same surface or edge on each board. This way, if the marks are just slightly off center, the holes will be aligned nonetheless. When using a doweling jig, just one centerline per

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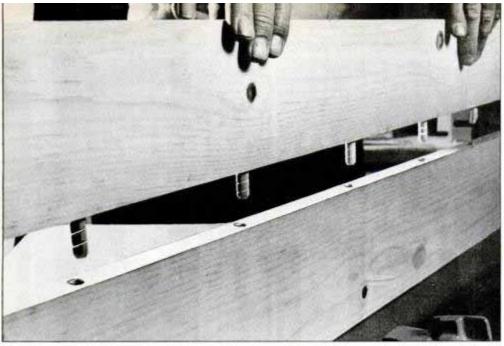
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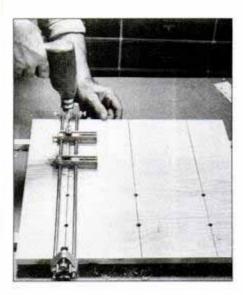
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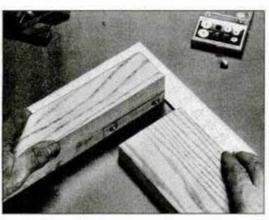
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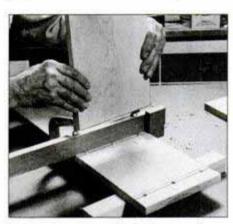
For edge-to-edge joints, space dowel pins 6 to 8 in. apart. The pins' chamfered ends guide them into the holes. Countersink the holes slightly to further ease the assembly.



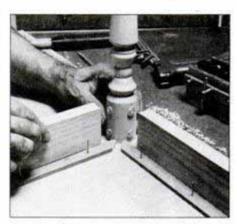
Record jig accepts an optional set of rods to handle oversized workpieces. Here, it's used to bore holes in an 18-in.-wide panel.



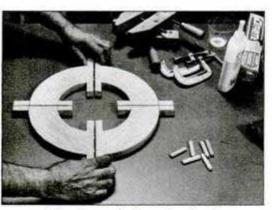
Use a framing square, as shown, to transfer dowel pin holes from a leg to a rail. Dowel centers will mark hole locations on rail end.



Try this setup to transfer hole centers for an end-to-face joint. Position clamp-on fence with stop block to guide the workpiece.

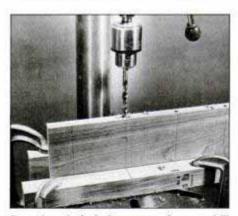


Use dowel centers to mark dowel pin hole locations from round leg to the rails. Tacknail cleats at right angle to guide pieces.



Join the two halves using dowel centers. When completed, saw off the clamping ears and sand the entire assembly smooth.

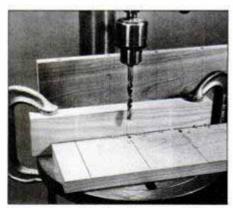
hole is needed. Simply align the jig with the line and bore the hole. The jig will gauge the proper distance from the edge automatically. When boring dowel pin holes with a portable drill fitted with a guide or on a drill press, it's necessary to draw two lines to form a crosshair centermark. To ensure accuracy, scribe the horizontal lines with a marking gauge rather than a square



Bore dowel pin holes accurately on a drill press using this 2-fence setup. Align workpiece centerlines with line on front fence.

and pencil. Then, use an awl to mark the exact center of the holes. These indentations will allow the drill bit to start boring without wandering.

An easy way to transfer dowel pin hole locations from one board to another is with dowel centers. These short steel plugs come in matched pairs—two each of four common dowel pin sizes: ¼, ⅓,, ¾ and ½ in. dia. To use, simply bore



Then, remove the front fence, position the mating workpiece, and use the line on the rear fence to align the hole centerlines.

the dowel pin holes in one board, insert the dowel centers, and position the opposite, mating board. Lightly tap the two boards together. The protruding points of the dowel centers will mark hole centers on the mating board.

Assembly tips

Dowel pins should fit into the holes snugly—not too tight nor too loose.

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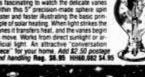
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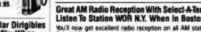
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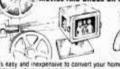
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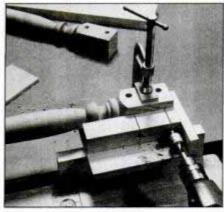


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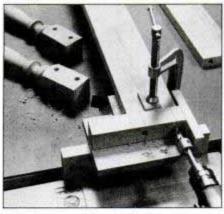
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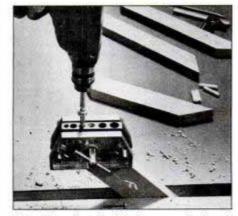
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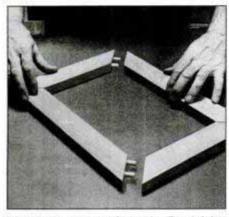
Construct this simple jig for boring dowel pin holes for leg-to-rail joints. First, clamp each leg to the jig and bore the holes.



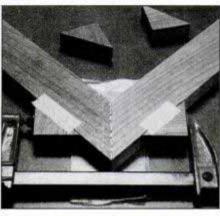
Then, clamp a rail to the jig. Insert a spacer block (arrow) underneath the rail, if needed, to align the holes accordingly.



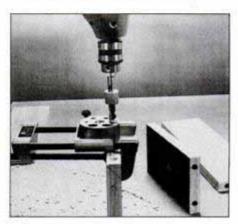
Miter-joint dowel pin holes must be bored perpendicular to the face of the joint. This style jig is excellent for miter work.



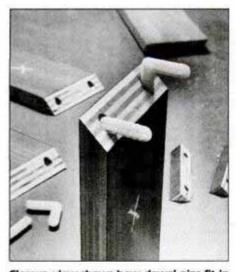
Assemble a mitered frame by first joining the parts into two L-shaped pieces. Then, join these pieces, as shown, to form frame.



Here's a simple way to provide a clamping surface on miter joints: Save the cutoff corners and tape them securely to the work.

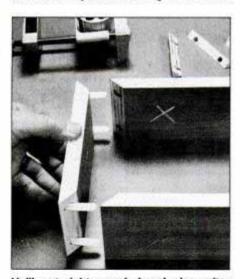


When using plastic miter dowel pins, bore the holes before cutting the miter. Be sure the depth of holes allows for the cutoff.



Closeup view shows how dowel pins fit in the angled cut. Cup-shaped depressions on the dowels hold glue to form a strong joint.

Never force a dowel pin into a too-tight hole or you may split the board. Slight diameter variations do occur among dowel pins of the same size. These minute variations also exist, though somewhat less frequently, among drill bits of the same diameter. Therefore, test-fit the dowel pins in a hole bored in a scrap-wood block. Select the best-fitting dowel pins or, if necessary, switch drill bits to improve the fit.

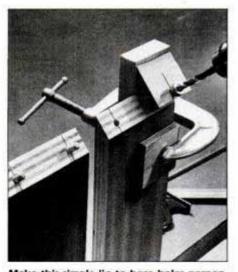


Unlike straight wood dowel pins, miter dowels require straight-on assembly. Plastic miter dowels are excellent for plywood.

Assembling the joint

Always use a depth-stop collar or a masking-tape flag on the drill bit to ensure that the holes are bored to the proper depth consistently.

Any of today's woodworking glues are suitable for use in assembling dowel joints. However, when additional working time is needed to assemble a large project, make certain you use slow-setting hide glue.



Make this simple jig to bore holes perpendicular to a mitered face. Note: Holes are slightly closer to the inside edge of miter.

Apply glue to the workpiece edge before inserting the dowel pins. Also, spread a little glue around the inside of the holes using a narrow brush, thin wood stick or cotton-tipped swab. Apply a light glue coat to the dowel pin and tap it into the hole. Glue-up the mating board and clamp the pieces together. On a wide assembly, position bar clamps above and below the piece to prevent bowing.

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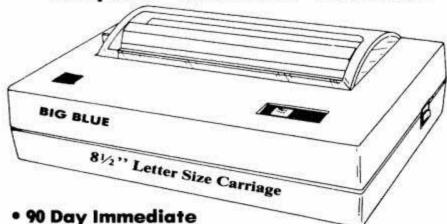
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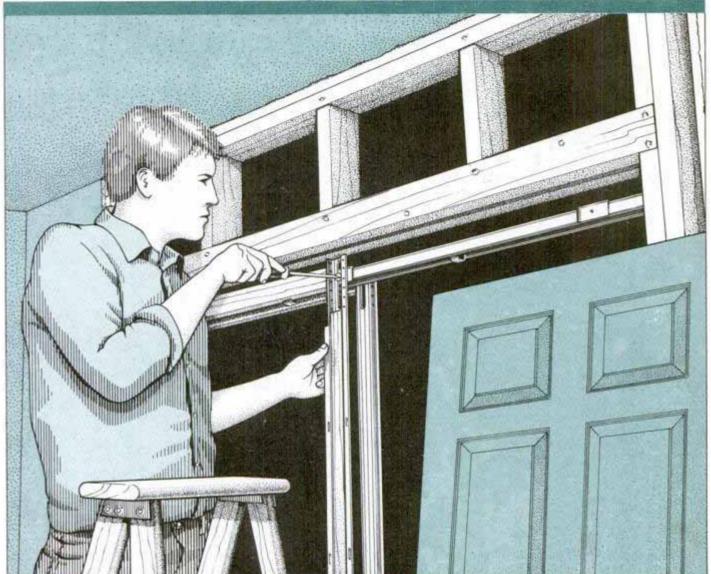
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How To Install A POCKET DOOR

t's always nice to find a way to increase the usable space in your home without expending a great deal of effort or money. Such an increase can be obtained by replacing a swinging door with a pocket door. A standard 2-ft., 8-in. door uses roughly 15 sq. ft. of floor space as it swings to the wall, space that might well be used in more efficient and attractive ways.

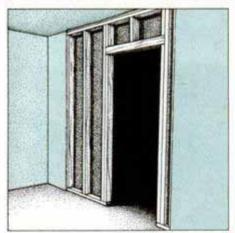
Used extensively in Victorian style

BY NEAL BARRETT AND PAUL BARRETT Illustrations by George Retseck

homes, pocket doors slide on overhead tracks, and when opened, disappear into the wall on which they're hung. They're especially useful for doorways that generally remain open, such as kitchen doors, giving the option of closing off the room without eating up valuable space. The older style pocket doors were set in walls half as thick as the standard walls, in order to accommodate the studding on either side of the door. These days, kits are readily available which make it possible to install a pocket door in a standard 4½-in.-thick wall, making installation much easier for the home craftsman.

There are many types of doors avail-

THE BETTER HEME



¶ Lay out position of rough opening on wall. Remove wall material—from floor to celling—on one side, then other side.

able, and hasically all of them are adaptable for pocket-door use. Flush doors, available in paint or stain grade, and faced with lauan mahogany or birch, can be purchased with hollow or solid cores. Solid-core doors will deaden sound, but are heavier to work with and may require heavier hardware to carry the extra weight. Raised-panel doors are available in pine or molded hardboard, primed for painting or prefinished with a wood-grain appearance. If sound insulation is not important, you might prefer a pine louvered door. The standard height of an interior door is 6 ft., 8 in. Widths vary from 2 ft. to 3 ft., and door thickness ranges from 11/8 in. to 134 in., though you'll want to stay away from the thinnest doors, as they can easily warp, impeding operation.

The hardware kits generally include slim metal studs faced with wood nailing surface and a track from which the door hangs. Some kits come completely assembled, some require assembly as you go. All of the kits we've examined allow installation of doors up to 3 ft. wide, and must be tailored somewhat to fit smaller doors. You can buy extensions for taller doors, and couplings that enable you to hang double pocket doors. You will have to install flush pulls on the door stiles, as well as a flush pull ring on the door's edge.

Although the exact measurements differ according to which hardware you choose, you will need a rough opening measuring slightly more than twice the width of your door. The rough width is measured from the inside of one jack stud on one side of the opening to the inside of the jack stud on the other side of the opening. Since you will be working on the framework inside the wall, it is necessary to open the wall from both



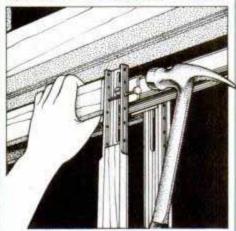
2 Assemble Jack post by nailing Jack stud to common stud at proper height. Toenall post to top and bottom wall plates.

sides, from the floor to the ceiling.

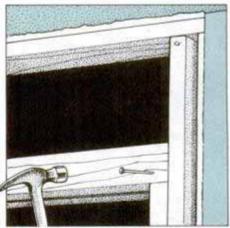
You can have the door recede in either direction so choose the side that will make it easier for you. One important fact to consider is whether you'll have a wall section free of mechanical services. Look for the obvious signs. such as wall switches, electrical sockets, heat registers, cold-air returns and plumbing fixtures on both sides of your wall. If there is nothing visible, you can examine the situation further by removing the baseboard and the wall material behind it. If there are mechanicals present in that area, you will need to reroute them in order to install your pocket door.

Electrical lines often can be changed easily. Gas lines, water lines and ductwork are more involved and, depending on your experience, may require a contractor.

To begin, remove the door and then the casing on both sides of your present doorway. If the headpiece has been



6 Nail top of split jamb to wood nailing strip on door track. Blunt ends of nails before driving to prevent splitting strip.

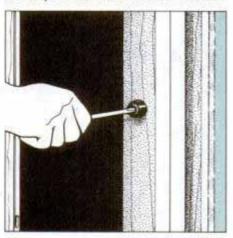


3 Assemble header and toenail to both jack posts. If room permits, also nail through common stud into header ends.

toenailed into the sides, punch the nails through using a small nailset or drift punch. Using a flat pry bar, pry the casing away from the wall and finish jamb, then pull the nails through from the back of the board using locking pliers. This will save the surface of the casing, should you want to reuse it later. Remove the baseboard in a similar manner. Then pry the finish jambs away from the studs and pull the nails through as you did before.

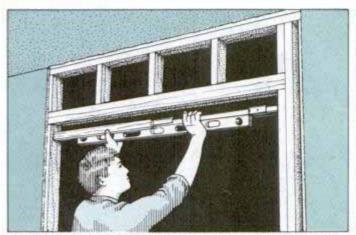
Determine the rough width dimension. This will depend in part on the hardware you've chosen, and will be approximately twice the width of your door, give or take an inch or so.

Using a stud finder, locate the nearest stud beyond the rough width dimension on the side of the wall you want the door to slide into. Drive a nail through the wall surface to determine the exact center of the stud. Then take a 4-ft. level and mark a plumb line from ceiling to floor, and locate and remove the nails



7 Screw rubber bumper to jack post opposite finished jamb. Shim as required so door will close flush to finished trimwork.

THE BETTER



4 Once rough opening is complete, partially drive 8d common nails into both jack posts at specified height. Temporarily hang door track from nails, then check track for level.



5 Snap chalkline between ends of bottom plates, then slide top of split Jamb onto the door track. Center bottom of split Jamb between lines. Check plumb with level and nail to floor.

holding the wallboard along the line. Cut along the line with a utility knife. Remove the rest of the nails holding the wallboard, and cut a line across the top of the wall. Remove all the wallboard in this area. (On a plaster wall, make your cut either by hand or with a circular saw and a masonry blade. Be sure to wear a respirator and goggles, and mask off the area with plastic; this is a very messy operation.)

Next, you'll need to determine if the wall you've chosen is a bearing wall—a wall which supports weight above it. (Note: For more on how to determine if a wall is a bearing wall, see How To Install A Flat Archway, page 117, Feb. '86.) In either case, your work will involve much the same process—replacing the header that is already in place with a longer one to span the entire path of the pocket door.

One way to see if it's a bearing wall is to determine which way the ceiling joists run, even if you have to cut out a

8 Nail finish jamb—below door track—to jack post that door will close against. Keep jamb edges flush with wall surfaces.

square of ceiling material next to the wall. If the joists are parallel to the wall, it's not a bearing wall. If they run perpendicular to the wall, treat it as a bearing wall.

If you do have a bearing wall, you'll need to support the ceiling on both sides of the door opening while you remove the old header and install the new longer header. To do this, build two temporary walls that match the length of the new opening. Nail 2×4 top and bottom plates to 2×4 studs. Cut these studs 1/4 in. shorter than the ceiling and nail them to the plates on 16in. centers. Lay the bottom plate of each wall parallel to the doorway wall, approximately 2 ft. away. Then stand both walls. Carefully slide wedges under the bottom plates on both walls until the top plates touch the ceiling.

Now, take a moment to examine the framework of the wall. There should be two jack studs supporting a header, and several short "cripple" studs between



9 Attach hanger brackets to door with hanger bolt temporarily in place. Make sure the bolt is free to slide out.

the header and top plates of the wall. Also, common or king studs should be nailed to the side of the jacks, from the bottom plate to the top plates. If your wall is not a bearing wall—ours was not—the header may be made of 2×4s. In any case, you must enlarge the existing opening to accommodate the doorway, finish jamb and hardware.

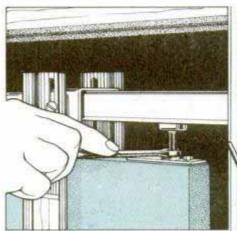
For this installation, we used Stanley's kit #2926, which accommodates 6-ft., 8-in.-high doors from 2 ft. to 3 ft. wide, and up to 1¾ in. thick. The maximum limit on the door weight is 150 pounds. This kit called for a rough width of twice the door width plus 1¼ in. (The rough width is the distance you need between the jack studs when your new framing is complete.)

Begin work by marking the rough width on the floor plate, so you'll know what to remove. Plan to leave one jack stud assembly in place on the side the door will close against. With a hacksaw or a metal-cutting blade in a reciprocating saw, cut the nails holding the bottom of the jack and common studs you need to remove. Pull the nails that hold

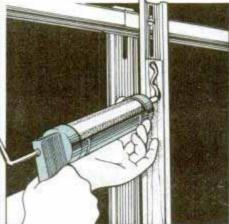
one side of the header and remove the jack and common stud assembly on the side opposite the finish jamb. To loosen the studs, pull them away from the bottom plate and pry the studs from the top plates. Remove the header, then cut off any nails protruding from the remaining framework. Cut the floor plate squarely to rough width dimension, so that the pocket jack stud aligns flush with the end of the plate.

Determine the height of the rough opening and mark it on both jack posts. As mentioned, if the wall is bearing, you may need to use heavier lumber for your new header. Therefore, the jack studs will have to be cut shorter to

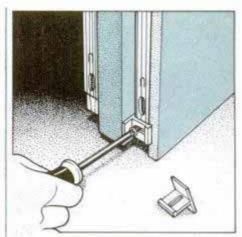
THE BETTER



10 Thread hanger bolts into track rollers, then hang door on bolts and tighten brackets. Turn bolt to adjust door height.



11 Remove door, then apply adhesive to wood nailing strips on both sides of split studs. Attach drywall using short screws.



12 Screw plastic glides to both sides of split jamb at door bottom. Make sure door is centered in opening and slides smoothly.

accommodate a bearing header. Be sure to cut only the jack stud, not the common stud it's nailed to. If it's not bearing, however, you may well be at just the proper height and all you'll have to do is install the new header at the existing jack height.

For bearing walls, plan on using two 2×8s nailed and glued together with a solid ½-in. plywood strip between them. Nail in a 4-in.-square pattern, using 16d common nails. If you wish to install double pocket doors, consult local building codes concerning the proper header material and dimension.

Place the header on the jack studs and nail securely—from the common studs into the header where it's possible (with 16d common nails), and toenailing from the header into the common stud when it's not (with 10d common nails).

For nonbearing walls, use two 2×4s for your header, nailed together with ½-in. plywood between for proper spac-



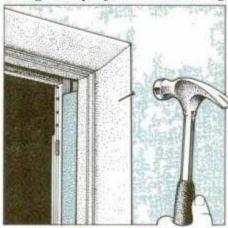
13 Nail door stop to both sides of split jamb and door track. Split jamb flange has slots so nails can reach wood strips behind.

ing. Mark the location of cripple studs on the header and top plate. These should fall on the same 16-in. centers used in the original framing.

Chalk a line on the floor along both sides of the bottom plate across the door opening. Drive one 8d common nail halfway into the center of each jack, at the height specified in your installation manual. This will depend on the floor (finished or rough) as well as the height of the door. Cut the track and wooden nailing strip as specified in the installation manual.

Install the hangers in the track and attach the end cap. Hang the track on the 8d nails so that the nailing strip hangs over the door opening. Check to be sure the track is level. When satisfied, attach with specified nails. Bolt the split jamb to the track against the nailing strip, then plumb and nail the base between the two chalklines.

Next, drive two 8d common nails through the split jamb into the nailing



14 Attach door casing to perimeter of opening. Use short nails so points will not protrude into sliding path of door.

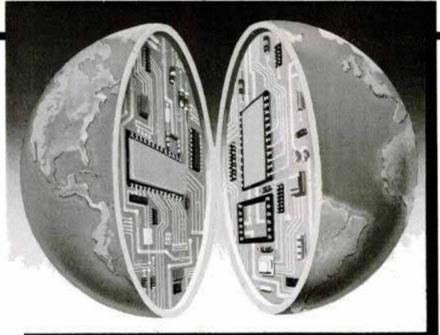
strip. Install the split stud in the same manner, positioning it to halve the distance between the split jamb and the jack stud. Install the rubber bumper, shimming as necessary to ensure that your door will not recede too far into the pocket, or protrude more than % in. outside the pocket. Plumb and install the finished jamb, as shown.

Our installation manual told us to hang the wall material at this point, leaving no recourse but major demolition if we made a mistake hanging the hardware. The safe course—though it does involve hanging the door twice—is to hang the door now, just to be certain everything functions properly. Mount the hanger brackets loosely on the top edge of the door, then attach the hanger bolts to the hardware track. Lift the door into place, slide the brackets onto the bolts, then tighten the brackets.

Check to see if the door clears the floor in its travel from the closed to the open position. Adjust it by turning the hanger bolts with an open-end wrench. Make sure the door meets the finish jamb evenly. If your jamb is straight and plumb, this will be the most accurate gauge, and also the most obvious visual reference point.

To prevent damage to the door, remove it so you can hang the wallboard. Using panel adhesive and short drywall screws, glue and fasten the wallboard to the studs. Finish the drywall. Mortise the door edge for a flush pull ring and the door faces for flush pulls, then install both.

Rehang the door and attach the plastic guides as shown, adjusting them so the door is held evenly between the two halves of the split jamb. Finish up by installing the door stops, casing boards and baseboards.



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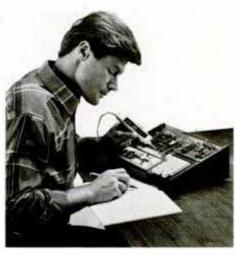
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BULLET BOAT

(Continued from page 86)

when Little again turned to Ron Jones to design a new Miss Budweiser. Jones recognized that all unlimited racing is conducted counterclockwise; the only turn the customary 6-boat fleet is required to make is to the left. Accordingly, he created the first asymmetric hydroplane by placing the cockpit and engine off the centerline to the left. That allowed the starboard sponson to absorb more of the cornering loads, and when the aluminum skid-fin on the boat's port side dug in, it could cut tighter and faster. Controllable speeds in the 130- to 140-mph range were now within reach.

Jones' asymmetric hull is now a standard feature on the unlimited racing circuit. More recent Miss Budweisers have been characterized by subtle improvements in Jones' "pickle-fork" hull design—nuances in angle of attack, for instance, or strake and sponson shape. Driver protection has also been an important design goal. Sparked by the 1982 death of Miss Budweiser ace pilot Dean Chenowith, Miss Budweiser drivers are now fully enclosed inside crashresistant pods ahead of the engine.

Ready for action

Almost as interesting as the boat are the means by which Miss Budweiser's team campaigns during a typical 11race season. It's a show that would make P.T. Barnum swoon with envy, and it begins at Miss Budweiser's Seattle shop, a spotless sanctuary of white lab coats and quiet determination. Crew chief Ron Brown oversees a staff of mechanics as they prepare both the pre-'85 Griffon-powered boat (with driver Scott Pierce) and the new turbine for an unprecedented 2-boat stab at the season championship. A halfdozen T-55 L-7s (costing a million dollars apiece new; \$280,000 rebuilt) are arrayed like soldiers along one wall. Six of the venerable World War II Griffons occupy a correspondingly greater area of the floor plan. Eight engines accompany each boat on the road.

Each boat is transported on a special hydraulic, dual-axle trailer that tilts the vessel upward to within the standard 8-ft. highway width limit. And each *Miss Bud* is towed behind its own semi-tractor trailer "toolbox" that contains hoists, drill presses, parts lockers, and personal computers for performance analyses and inventory control—everything the boats need to win on the road.

Pit crew dressed in the traditional red and white colors of the King of Beers swarm over each boat prior to race time. Fuel-up and test firing is a

(Please turn to page 112)

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BULLET BOAT

(Continued from page 110)

carefully controlled exercise on land, then the boats are deftly placed in the water by crane so the games can begin.

Ron Brown concedes the turbine is a bit more finicky than her Griffonpowered sibling, particularly in a saltwater environment. But a first-place finish at the first race of the season in Miami, where the team concentrated on shielding the intakes from salt spray, convinced Brown that turbine power is the future of unlimited racing, Though the Griffon is able to generate more horsepower (4000 at the prop shaft as opposed to the turbine's APBA-mandated 2700), the extreme lightness of the turbine powerplant results in a whole cascade of weight-saving potential throughout the turbine hull form, which greatly improves acceleration and cornering response—factors that clearly help win races.

A high-tech, aircraft-style composite construction is at the root of Miss Budweiser's newfound performance. Fiberglass sponsons reinforced with Nomex honeycomb are formed over a jig, baked in an autoclave, and attached to a primary load-bearing hull structure

made of aluminum plate and aluminum honeycomb. The turbine is placed in a removable bed made of tubular steel, with the main, or output, shaft extending forward. During the combustion process, atomized fuel is mixed with air that has been compressed seven times atmospheric pressure. Igniters burn the air/fuel mix, which turns a gasproducing wheel, which turns the output shaft. The shaft enters Miss Budweiser's handmade \$60,000 gearbox (just changing one gear costs over \$8000) where more than 15,000 rpm are reduced 10 to 50 percent.

"The objective," according to Brown, "is to create a machine that goes so fast that it starts to fly clear of the drag imposed by the water. Then you have to find a driver who can take it up to

that point—and beyond." That's where Kropfeld of

That's where Kropfeld comes in. But ask him directly how he manages to tame the state-of-the-art Miss Budweiser—part boat, part bird—and he becomes uncharacteristically subdued: "You've just gotta go out there and do it. There are no tips or techniques, really, and there's no place you can go to learn how to drive these boats. It's all on-the-job training, and you either have it, or you don't. Guys who don't have it don't last too long."

Changes in the wind

Turbine power has already added to the complexity of Kropfeld's job up in his comfortable, but compact, front office. There are a couple of more gauges to watch, and increased acceleration around the buoys places more demands on the driver on a crowded course. If designer Ron Jones has his way, though, the future of hydro-racing will become even more complicated—but not for the driver.

"Speed plus control wins races, and there's so much more we can do to improve the aerodynamics on these boats. I mean, we're strictly in the age of Waldo Pepper when it comes down to aerodynamic control. The next great advancement will be in control surfaces actuated by computer."

Still, even the age of silicon and printed circuitry won't diminish the dash, splash and thrill of the mighty unlimited hydro. Check out Jim Kropfeld as he finishes his run with a chinewalk into the bottom turn. The sponsons drift ever so slightly and he's suddenly out of shape. He corrects in an instant and slams down on the throttle. Instead of the clatter and blat associated with piston power, the turbine is eerily quiet. A wraith unleashed, it vanishes in a gusher of water that arcs toward the sun and turns the sky into a thousand tiny rainbows.

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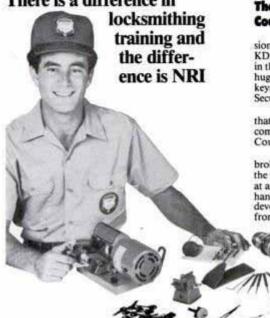


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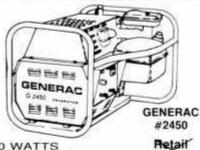
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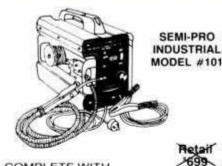
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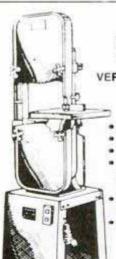
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(Continued from page 83)

ment. That flexibility is enhanced by the unit's keyboard plug, which attaches to the right front of the main unit. The keyboard itself—PC/AT-styled like Kaypro's—runs a close second to the Leading Edge in responsiveness, but lacks the Model D's raised guide dots and enlarged keytops. The Equity I has the quietest fan and disk drives of this threesome.

While it's tagged close to the other units at \$1573 with monochrome video adapter and display, the Epson loses points in this econoclone derby in a few comparative respects.

One weakness is the computer's relative lack of expandability. With its video display card installed, the Equity offers only two open expansion slots, compared to four on the IBM PC and Leading Edge and six on the Kaypro. RAM-hungry users will discover you can install only up to 512KB of RAM without poaching on one of the two available expansion slots.

Another weakness of the Equity I, literally, is its power supply. At 55 watts, it delivers less horsepower than IBM's PC and less than half that offered by the Kaypro PC or Leading Edge Model D. This shortcoming could prove troublesome if you've got plans for extensive add-ons.

On the software side, the Equity I comes with MS-DOS 2.11 and GW-BASIC, plus extra utility software that should make using the MS-DOS operating system easier if you're a computer newcomer. But there's no application software (such as word-processing programs) included with the system. You'll have to buy them separately.

Epson has unfortunately followed IBM's either/or example in video-display technology. You can opt either for high-resolution, easy-to-read monochrome text and give up graphics, or you can get IBM-compatible color graphics with Epson's RGB color monitor and display adapter (this brings the system price to just under \$2000) and settle for less readable, medium-resolution text.

Conclusion

Which machine should you choose? That depends on a careful analysis of your individual needs and preferences in light of the different characters of these three econoclones.

For example, if you'll use the computer for business applications, you might give serious consideration to the all-purpose Kaypro PC. Its hard-to-beat combination of display flexibility, hard-ware expandability and free application software starts you off with a lot more for your money. Despite this, Kaypro isn't the top choice for word-processing chores because of its keyboard.

The Leading Edge Model D is a better choice if you expect to do lots of typing, thanks to its first-rate keyboard and eye-easy monitor. You don't get as much free software as the Kaypro gives, but a word-processing program is included. Meanwhile, the Model D provides nearly as much expandability as the physically larger Kaypro. This efficiently sized package is likely to satisfy a wide range of needs.

The aesthetically elegant Epson Equity I is well-suited to the more casual user who wants to do light word processing, and graphics (with the more expensive color version). The Epson is not intended for so-called power users, who place a premium on expansion capabilities.

The Equity I can be viewed as a 1986 update of the plain vanilla IBM PC design, retaining the PC's virtues while shedding some—though not all—of its vices. You'll find the Equity I an ideal "home" PC—what IBM's ill-fated PCjr should have been, but wasn't. More than enough machine for many PC converts, the space-saving Equity I will accomplish most of your computing jobs admirably—and look great doing it.



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DRIVING THE FUTURE

(Continued from page 79)

suspension that replaces shocks and springs with computer-controlled hydraulic rams.

Although a driveable Corvette Indy won't be ready until later this year, Chevrolet engineers have a pair of running chassis "mules" that demonstrate two of the Indy Vette's features. Active suspension was pioneered by Lotus (now owned by GM) and I drove a Corvette prototype equipped with the system. Unlike a car with conventional springs, this Corvette did not roll toward the outside of a turn, but leaned into it slightly, like a motorcycle. It didn't squat on acceleration or dive on braking, but remained eerily level all of the time. To achieve such stable handling with springs, they'd have to be so stiff that the ride would jar your vision. Yet this Vette rode softer than a Cadillac while cornering at racing speeds.

Another Chevy prototype, this one a Celebrity sedan, demonstrated a 4-wheel steering system GM's been fooling with for 20 years. The rear axle is replaced by an electrically powered rack-and-pinion steering system adapted from the front suspension of the Acar. It's controlled by a computer programmed to turn the rear wheels in the opposite direction from the fronts at speeds under 25 mph and in the same direction at higher speeds. Maximum steering angle of the rear wheels is about half that of the front ones.

At low speeds, the car seems to pivot around the center console and has the same kind of uncanny maneuverability as a fork lift. At high speeds the effect is more subtle, but the experienced driver can feel the car turn into corners with more stability than a normal car. GM hopes to have it on some production cars in a few years.

Right now, Ford's much-touted Probe V prototype is the world's slickest car-shaped object, with a C_d of 0.137. A running model was supposed to be ready by now, but the decision to switch from a hand-formed metal body to one of advanced composite plastics has delayed the program. Among the features that contribute to its low drag are enclosed front and rear wheels, a smooth underbody, eight miniature headlights and engine air intakes behind the doors, with hot air exhausted at the rear bumper.

According to Ford Vice President of Design Don Kopka, the Probe V not only gives engineers a chance to experiment with advanced technologies, but "helps us to educate and condition potential customers to new concepts." So don't scoff at these dream machines... certain features of them are a lot closer to the showroom than you'd guess.

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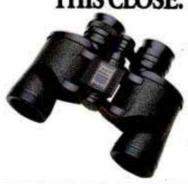
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POWER TO THE PEOPLE

(Continued from page 75)

troit by Cadillac, the Allante is completely different from anything GM has ever tried in the past. Specially outfitted 747 jumbo jets will fly Allante's bodies from Italy to Detroit three times a week. The same planes will ship GM parts such as instrument panels, wiring and steering wheels to Pininfarina for installation there.

Price for the 2-seat hardtop convertible is expected to be just under \$50,000, or on a level with the Mercedes 560SL, the car that Cadillac planners used as a target for the Allante.

Allante's body is mostly steel, but the removable hardtop roof, hood and trunk lid are aluminum. The fabric convertible roof folds completely out of sight, but there is no room aboard to stow the aluminum roof. Its engine is a goosed-up version of the Cadillac 4.1-liter (251-cu.-in.) aluminum V8 that now develops 170 hp. The transmission is an Eldorado 4-speed automatic that's also been beefed up. Roughly speaking, all of the running gear is taken from the Eldorado, but Allantes also have ABS antilock braking standard.

Allante's 3500-pound curb weight is a load for even the beefed-up output of the 4.1-liter V8, and Cadillac officials say they don't expect to match the 560SL in performance. But they do hope to overmatch the German flagship in ride, handling, comfort and luxury.

Other Caddy changes for '87 include a 7-in.-longer deVille model, called the Sixty Special—a mini-limousine that gives luxury car buyers the kind of rear-seat access and room they want.

At Pontiac, excitement this year comes in the sedan class. The new Bonneville seats six and takes the spot as the top sedan in the Pontiac line. The new car replaces both the midsize Bonneville and the full-size Parisienne. Pontiac borrowed the chassis from the Olds 88 and Buick LeSabre. You can still spot the lines of those models in the roof and greenhouse. But the rest of the design is pure Pontiac.

With its own fenders, hood and deck, the Bonneville has a more rounded shape than its sister models. The rounded theme continues inside, where the instrument panel, door pulls and seats have more curves than you've ever seen in a Pontiac. Mechanical details are identical to those of the 88 and LeSabre. The engine is a Buick-developed 3.8-liter V6 that sits crosswise and drives the front wheels through GM's 4speed automatic transaxle. Like its cousins, the Bonneville has independent suspension for all four wheels and sits on a 110.8-in. wheelbase. Overall length is a tidy 198.7 in.; curb weight is just over 3300 pounds.

The '87 Firebird has a bigger, 5.7liter V8 engine option that puts out 210 hp and will zoom from 0 to 60 mph in about 6.5 seconds. The base Fiero gets a new nose and lower rear panel.

Chevrolet is saving its biggest 1987 surprises for early next year when the compact Beretta and Corsica take over the spot in the Chevy lineup previously held by Citation II.

A first for American cars is a low tire pressure warning system in the new Corvette. Each wheel holds a pressure sensor and tiny radio transmitter that sends a signal to an instrument panel warning light when air pressure drops below a safe level.

Chevy claims an ultraquick 6.3 seconds as the 0- to 60-mph time for its 1987 Camaro equipped with the 5.7liter Corvette V8. Chevy rates its engine at 220 hp, 20 more than last year's top-rated 5-liter V8.

Oldsmobile has a new handling suspension for its full-size 98. This model is called the Touring Sedan, and has 15-in. wheels, special shocks, and other heavy-duty suspension refinements. Inside, the Touring Sedan features such luxury items as leather seats, walnut trim and analog instruments. The 2-door sedan was dropped from this line.

Trofeo ("trophy" in Spanish) is the name of a new Toronado model. It too has the sure-handling FE3 suspension and 15-in. wheels. Black trim on the lower parts of the car, a distinctive black grille, plus a black valence panel with clear fog lamps set this car apart from the standard Toronado.

Buick has a new way of selling its eight lines of cars—by packaging. That means you won't be faced with a long list of options to choose from in ordering a new Buick. Instead, you can pick from a number of packages that brings together options that appeal to certain buyers. All car lines will offer a T sports package. That includes oversize aluminum wheels, Level III suspension (for the best handling), oversize sport tires and leather-wrapped steering wheel. Sport packages for exterior finish, interior trim and turbocharged engines are also available.

Buick plans to simplify its basic lineup, and that means model types will be cut. By 1990 the division will reduce the number of models from the present 39 to just 26. The objective: better quality.

An exciting new model for 1987 is the LeSabre T Type coupe. Designed for younger Buick buyers, the LeSabre T Type comes in five monochrome finishes: all-black, red, white, silver or gray. Front fenders are made of plastic, so they resist denting and won't rust. Fast-ratio steering and a more aggressive 2.97 final drive ratio give this LeSabre a sportier feel.

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Would you like to stake a share of the \$25,000,000,000 the government holds for just making a few phone calls and looking in some phone books? That is all you have to do to enjoy thousands of dollars. If you can read English and can speak on the phone, you can make thousands of dollars overnight-and you don't have to do any selling at all.

This ad will explain every detail of an exciting new business that has never been advertised or attempted beforewhat's more, you can enter with ab-

solutely no money.

Life was not always rosy for me. I got involved in a bad business investment a few years ago and lost about \$11,000. Everything I owned was taken away from me. I needed money desperately to feed my family, so I was forced to toil as a waiter at the Sheraton Harbor Island Hotel in San Diego by night, and I was a filing clerk during the day. It was so exhausting, that as soon as I got home, I would sleep for just a few hours, wake up in a stupor, drink four cups of coffee, and then scramble to my next job. I had no choice. It was the only thing I could do to stop disappointing my loved ones. I remember coming home on Mother's Day really eager to call my mother, only to find that my phone had been disconnected. I went through the mail praying for some good news, only to find an envelope with no return address-it contained an eviction notice. At this point I thought we would have to live in our beat-up Fiat. We were fortunate to have relatives that were kind enough to let us stay with them. I never knew life could be so miserable. I sat down on the sidewalk just realizing how much being in debt could hurt. With tears in my eyes, I prayed for a way out.

My friend Gary, who was in the same financial boat as I was told me a story that changed my life forever. He told me very excitedly, "I received a funny-looking letter. When I first saw it, I thought it was another creditor making a claim on me. The letter told me about money that was rightfully mine-it said that if I signed the enclosed form, I would receive \$2,592.59. Things were so bad that I had nothing to lose, so I signed the form neatly and returned it to the

'Ten days later I received a check for \$2,592.59 with an explanation. A distant aunt had died and left \$4,320.98 in her savings account. The company that found me collected \$1,728.39. The firm had no trouble finding out that I was related to her. Just for matching up people with the same last names, that agency was making millions every year.'

It was just then that an amazing idea popped into my mind. I was overcome with excitement; this revolutionary system was so simple, yet I knew it would take me out of my rut. I was compelled to find out more about it. I had lost everything I owned; what else could I lose? I found out everything I could and began to work on a plan. I put it into effect. My prayers were heard. To my relief I started to make more money than I have ever seen in my life for doing practically nothing. In fact, my income for just last month was \$50,076.78.

I had a C-minus average in high school one year, I received an F in English. By no means was I ever considered to have the smarts. But I did it. All you have to do to make large amounts of money is thumb through phone books and make a few phone calls.

Last summer we moved into a gorgeous home. My wife told me it was her life long dream to own a brand new car. You should have seen her tears of joy when I surprised her with her own new \$20,000 car. Later I bought a 1986 Mercedes 560SL that cost me \$56,000.

The amount of money I was making was incredible. Just as a hedge against taxes, I bought two three bedroom houses valued at \$200,000. I asked everyone in my family what they wanted the most and they said they wanted to see all of us together going places. In the past month we have visited three countries. In fact, we take a vacation every month. It's great seeing the joy in everyone's eyes as I spend more time

Twenty-five billion is just sitting there waiting for someone to recover it. One out of ten Americans have forgotten or lost money in bank accounts, stocks, insurance premiums, etc. This is money worth as much as the amount of \$10 bills you could lay end-to-end around the world; \$25 billion. I will disclose a plan to you that will show you how to get your

hands on this money.

Only 10 percent of the rightful owners claim their share of the \$25 billion. The states make no strong effort to contact the rightful owners. Why should they, when unclaimed property is their biggest source of revenue, second only to taxes? The states are required by law to make a list of unclaimed owners. These lists are hard to find but I will show you how to get every one that the states publish. And in some cases, they're free.

Let me give you a random sample list from the state of Wisconsin. (Addresses are included in lists.)

Owner's Name	Property	Amount
Drinka, Teresa, A	Savings	\$10,891,47
Lavelle, Samuel	Stock Proceeds	\$21,529.61
McDonnell, Martha	Savings	\$12,843.78
Meyer, Thusnelda	Savings	\$18,489.18
Patterson, Arthur	Savings	\$14,629.24
Stien, George	Savings	\$57,525.83

This listing is only a minor portion of the \$25 billion in unclaimed property that is waiting for you.

Sworn Testimonials

I've spent at least \$7,000 on moneymaking books and seminars. The difference between them and your method is that yours works! In less than three weeks (part time) I was able to secure \$52,614.21. Thanks for a business that will easily make me \$100,000 this year. If I can ever be of service just call.

Steve S., CO

Having read your book, I have recently launched into the fascinating endeavor of locating people. As a result, I have succeeded in finding an individual with a fairly large sum of money.

Ben S., CA

Thank you so much for the methods outlined in your book. I was able to secure \$24,685 in just six hours of work. I have read just about all the other "get rich" books but yours has to be the best. Terrie, T., MI

To make thousands of dollars, all you need are telephone books and a phone. The proven system in this book can be learned in a half hour. After that, you are all set. If you can read English and can speak on the phone, you're in business. It's as easy as that.

Sample Proof

Bonnie Goldstein, a well-known syndicated newspaper writer who doesn't know anything about finding people, located the owners of \$4,100 in two and a half hours with two telephone directories-she said so in the San Francisco Sunday Examiner & Chronicle.

My Guarantee

Send for my complete guide to recovering unclaimed money. Read the simple formula that has been tailored for each individual state. Sit down and make the required few phone alls and directory searches. After following the simple formula, you must be able to recover \$10,000 in one day or your complete payment will be returned to you.

This opportunity can give you a new home, car and all of the luxuries money has to offer. Think of what \$10,000 today could do for you. Could you use this kind of money? There is a definite flaw in our revenue system, and you can profit from

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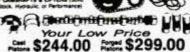
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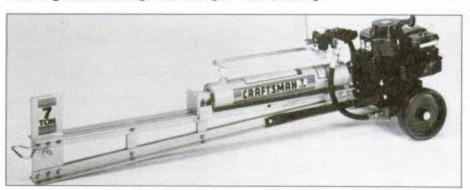
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Chase those garden-chore blues with equipment that's fun to use.

Let's split

Get up and go with this lightweight, portable log splitter from Sears (Sears Tower, Dept. 703-PM, Chicago, IL 60684). The hydraulic splitter is powered by a 3½-hp, 4-cycle gas engine to deliver 7 tons of splitting force. Logs, up to 20 in. long, are driven against a 6-in.-high steel wedge.

The hydraulic arm returns to the starting position automatically after each split. The compact 150-pound unit rolls on two 8-in.dia. wheels and measures 19 x 22 in. high x 69 in. long. The 7-ton log splitter sells for approximately \$620 at larger Sears stores and through the Sears Farm, Ranch and Estate catalog.



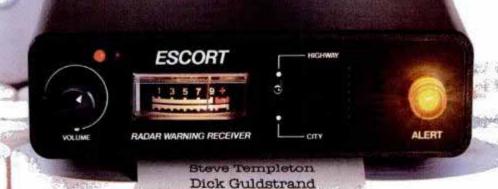
Rear-tine tiller

The Roper Model RT130 tiller (\$700) features counter-rotating rear tines that eliminate annoying tine bounce. The 12-in.dia. tines rotate against the tiller's ground direction to toss soil forward to be tilled again. Powered by a 4-cycle, 3-hp gas engine, the unit tills a 14-in.-wide swath up to 6 in. deep. A 7-position depth stake controls the tilling depth. For details and more information, contact Roper Outdoor Power Equipment, Box 60069, Savannah, GA 31420.

(Please turn to page 122)

POPULAR MECHANICS • OCTOBER 1986

We can't name everyone who owns an ESCORT, but we can tell you why they do.



Because radar is a problem, that's why. And ESCORT is the one detector they trust. Over a million motorists now concentrate on their driving and leave the radar worries to ESCORT.

Unsolicited Testimonial

In a test of all competing brands, the experts at Car and Driver magazine concluded that ESCORT "Is clearly the leader in the field in value, customer service and performance..."

Chances are pretty good you know someone who owns an ESCORT. We've been around since 1978, which is an eternity in this business. So we'll stand on our reputation. Ask around.

Check Our References

We'll bet the first thing our customers will tell you is that ESCORT works. It finds all kinds of radar: X band, K band, over hills, around curves, moving mode, instant-on ambush. Whatever the trap, ESCORT finds it. And this long-range detection is followed up with a full report on the radar's strength. You can read this report on the analog meter. You can hear this report on the audio warning, pulsing slowly when the radar is weak, quicker as it strengthens, then constant as you approach range.

ESCORT even uses a separate warning tone for the two radar frequencies, "beep" for X band, "brap" for K band. The two radars behave differently. Trust ESCORT to keep you informed.

No False Moves

The second thing our customers will tell you is that ESCORT doesn't cry wolf. Our special ST/O/P™ (STatistical Operations Processor) circuitry recognizes and rejects the most common source of false alarms, the ones that set off less-sophisticated detectors up to a mile away.

A Dutch Uncle

The third thing our customers will tell you is that we make shopping easy. We sell direct from the factory only. Just dial toll free. No traffic delays. No parking hassles. No waiting for a salesman. Why wait for him anyway? He won't understand how radar works, so he can't be of much help with your problem.

Our sales staff are trained radar experts. They don't sell cameras and calculators too.

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William Hopkins Don Knowles Herb Adams Just radar detectors. They know the problems you face. And they're only a toll-free call away.

Our sales people won't give you the runaround if you ever need service after the sale either. They're here till 11:00 p.m. on weekdays and 5:30 on Saturday. Just call the same tollfree number.

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Take the first 30 days as a test. If you're not completely satisfied in that time, we'll refund your purchase and your return shipping. There are no hidden charges. We also back ESCORT with a one-year limited warranty on parts and labor.

Let ESCORT solve your radar problem. Judging by the owners we <u>can</u> mention, you'll be in good company.

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ESCORT \$245 (Ohio res. add \$13.48 tax)

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ESCORT. RADAR WARNING RECEIVER

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MORE POWER TO YOU

(Continued from page 120)

Bushwacker

Pull the plug and gain freedom from the extension cord with Stihl's heavy-duty, gas-powered hedge trimmer. The Model HS-60AVE trimmer is powered by a 2stroke, 1.21-cu.-in. engine. The 111/2pound trimmer features a 24-in.-long, dou-

ble-sided cutter bar, electronic ignition. centrifugal clutch and two antivibration handles. According to the manufacturer, noise is reduced greatly due to a large baffled muffler and an air intake silencer. Safety features include a built-in starting lock and a cutter bar guard. It's available at Stihl dealers for about \$270. For more Information, contact Stihl, 536 Viking Dr., Virginia Beach, VA 23452.



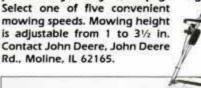
The Mantis 20 tiller (\$288) is designed for use in small- to medium-sized gardens. The compact, 20pound machine is ideal for working in between narrow rows of crops without damaging the plants or their roots. Four 9-tine blades rotate at 240 rpm to till a 9-in.-wide swath up to 8 in. deep. Power is supplied by a 21-cc, 2-cycle Echo engine. Optional add-on accessories allow the tiller to be used as a planter-furrower, edger,

lawn aerator and thatcher. For details, contact Mantis Manufacturing, 1458 County Line Rd., Huntingdon, PA 19006.



John Deere's 21-in. self-propelled mower (\$500) is shown outfitted with an optional spring-steel thatcher (\$60) and a rear bag attachment (\$47). The tines on the frontmounted thatcher rake out dead grass, stems and leaves to prepare the lawn for a clean, uniform cut. Thatching regularly stimulates growth for a healthler lawn, according to Deere. The mower is powered by a 2-cycle, 4-hp gas engine. Select one of five convenient

mowing speeds. Mowing height is adjustable from 1 to 31/2 in. Contact John Deere, John Deere







Turn unsightly piles of brush, leaves and prunings into valuable compost or decorative mulch with the Super Tomahawk shredder/chipper (\$1109). The top-loading shredder has 16 carbon-steel flails that rotate at 3400 rpm to pulverize hay, straw, brush and leaves into compost. Feed branches up to 3 in. in diameter into the side chute to produce decorative wood chips. A hardened steel chipper blade is attached to a heavy-duty flywheel to reduce branches to small chips quickly. The 222-pound Super Tomahawk is powered by a 4-cycle, 8-hp gas engine. It measures 251/2 in. x 35 x 45 in. For more information, you should contact Garden Way, 102 St. and 9th Ave., Troy, NY 12180.



Rake replacement

This gas-powered blower-vacuum (\$285) can replace rakes and brooms for certain jobs. Its fan, driven by a 21.2-cc, 2-cycle engine, produces an airflow of 400 cfm adjustable by a handle trigger. The 11.2pound tool comes with a padded shoulder strap, two 4-in.-dia. plastic vacuum tubes, a 21/2-in.-dia. blower tube with directional nozzle and a zippered 13/4-bushel bag. It's sold at power equipment dealers. For information, write Black & Decker Inc., Power Tools Group, 10 North Park Dr., Box 21030-798, Hunt Valley, MD 21030.

(Please turn to page 124)



Head of the class

At the heart of this Toro self-propelled, 21-In. mower is a powerful overhead-valve, 4cycle, 141-cc engine. The aluminum-block engine has a cast-iron cylinder liner and a 1-piece, forged-steel crankshaft that is supported by ball-bearings. The mower's speed is adjustable while cutting at 11/2, 21/2 or 31/2 mph. Features on this Toro mower include an electronic ignition, key starting, belt-driven gear transmission, a 21/2-bushel clippings bag and a cast-aluminum mower deck. The Model GTS-20624 mower is available at Toro dealers for about \$640. For more information, you should contact Toro Co., 8111 Lyndale Ave. So., Minneapolis, MN 55420.



New Stitch Welder Tames Sheetmetal Distortion



Simplifies Home Bodywork

With a little practice anyone can weld automotive sheetmetal with virtually no distortion or burn-through. The Stitch Welder makes it easy to run a continuous weld bead on quarter panels, body patches, floor boards, etc. If you've ever tried arc welding body panels you know the high amperage output plays havoc on thin gauge metal. Our new Stitch Welder controls amperage to produce professional, uniform welds similar to those made by expensive wire-fed MIG machines.

Special Circuits Control Arc Welding

By directing the arc welder's current through a copper wound solenoid and diode the Stitch Welder creates a unique pulsing action. This pulsed current produces an easy-to-control arc necessary for clean, uniform weld beads on sheetmetal. There are no buttons or triggers — the pulsing action is automatic! All you do is guide the electrode.

Welding with the Stitch Welder is faster and easier than conventional stick welding. The arc's self-starting, so there's less chance of rod sticking. Once you strike an arc lay the rod on the metal and let the machine do the work. After some practice you'll produce welds requiring little grinding or filling. Remember, as with any welding tool the Stitch Welder requires practice to produce good results. We've included complete detailed instructions.

Attaches to Any A.C. Welder

The Stitch Welder's five-foot power cord attaches to the electrode holder on any A.C. arc welder (must run at 80 amps or less). Uses standard arc welding rods up to 3/32" and will weld down to 22 gauge steel and stainless. The tool body is cast aluminum with a vinyl insulated grip for positive control. Electrodes held with a set screw and can be easily replaced. Tool designed for years of trouble-free service. ALWAYS USE PROPER SAFETY PRECAUTIONS WITH ANY WELDING EQUIPMENT.

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Try the Stitch Welder for 30 days in your shop or garage. If you are not completely satisfied, simply return it for a full refund. Order your Stitch Welder now for a head start on body work projects. The Stitch Welder is only \$59.95 plus shipping. Available only through Eastwood.

TO ORDER CALL TOLL FREE: 1-800-345-1178

For fastest service call toll-free 1-800-345-1178 (in PA, 215-644-4412) and charge your Stitch Welder to Visa, MasterCard, or C.O.D. (\$2.75 additional fee on C.O.D.) Mail orders use coupon.

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Electric lightweight

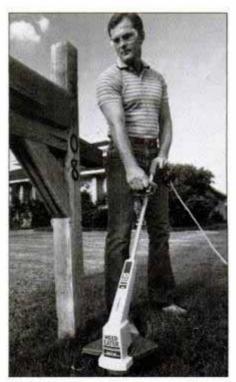
Stihl's Model E-14 electric chain saw (\$225) provides lightweight cutting capability. Its 6.6-pound powerhead will accept a 12-, 14- or 16-in. bar. A cutout mechanism stops power to its 120-volt motor if the saw is overloaded. It runs about 20 minutes on a full tank of chain oil and has a sight glass to

check oil level. The saw's trigger switch activates a gear-driven oiler, lubricating chain, bar and sprocket. To start it, you must press a safety lockout switch. Other safety features include front and rear hand guards and an inertia chain brake. It's sold at Stihl dealers. For Information, write Stihl Inc., 536 Viking Dr., Virginia Beach, VA 23452.



Timber tamer

The Double Eagle 50 chain saw (\$340) is designed for heavy-duty cutting. The 3.1-cu-in., 2-cycle engine has chromed cylinders that are triple-honed to reduce friction. It features an automatic, gear-driven chain oiler, electronic ignition and 6-point antivibration system. A chain brake/hand guard, spark arrestor screen and safety trigger are standard. It weighs 14½ pounds with a 16-in. bar—a 24-in. bar is optional. It's sold at power equipment dealers. For information, write to McCulloch, Box 92180, Los Angeles, CA 90009.



Trim trimmer

Weighing only 4 pounds, this 10-in. electric trimmer (\$36) is designed for easy use. Its 2.8-amp motor spins its single-string, bump-advance spool at 9500 rpm. Its shaft measures 39 in. from handle to line head. Double insulated and UL listed, it has an adjustable front handle and a retainer to stop a power cord from being pulled out accidentally. It's sold at power equipment dealers and hardware stores. Beaird-Poulan/Weed Eater, Division Emerson Electric, Box 9329, Shreveport, LA 71139.



Simplicity itself

Simplicity's Model 1318 electric mower allows you to reverse cutting direction without risk of running over the extension cord. Just flip the mower's handle and push in the opposite direction—the extension cord remains on one side firmly attached with a cord clip. It features an aluminum mower deck and a 3-hp, singlespeed motor that powers twin 9-in.-dia. blades for an 18-in.-wide cut. Cutting height is adjustable to five positions from % to 21/2 in. For convenient storage, the 38-pound mower has a fold-down handle. It costs approximately \$240 at Simplicity dealers. For more information, contact Simplicity Manufacturing, 500 North Spring St., Port Washington, WI 53074.



Heavy-duty diesel

You can till or grade soil, plow snow or cut grass with this diesel garden tractor from Simplicity Manufacturing, 500 North Spring St., Port Washington, WI 53074. It's powered by an 18-hp, 14.8-cu.-in., aircooled, twin-cylinder engine. The 935pound tractor has a hydrostatic transmission and a top forward speed of 7 mph and 4 mph in reverse. Features include a solid-state starter, 12-volt battery, pivoting steel front axle and a cast-iron transaxle. It costs \$5500 at Simplicity dealers, \$6174 with the 42-in. snow thrower, shown. PM

Make your home

That's exactly what your home will be when you fill it with Heathkit electronic products – products that make your life easier and more enjoyable. Within our diverse line are kit and assembled products sure to enhance each room in your home.



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warns you when the inside temperature of your freezer rises too high. Prevent water damage with our Food Alarm that warns you of water that's where it shouldn't be.



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ease and dependability with our Deluxe Garage Door Opener. Easy to install, this opener is durable and includes a handy security light.

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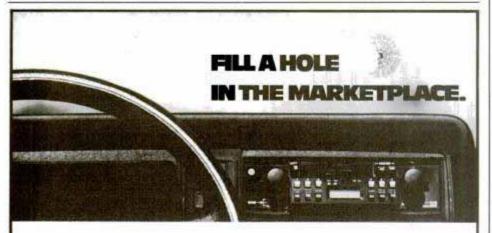
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Trough for a vise



When working on small items in a vise. keep them from dropping to the benchtop or floor when the jaws are loosened. Install a catch-all trough-a strip of cardboard, springy sheetmetal or other pliable material—in the space beneath the jaws. Cut the strip somewhat wider than the space between the jaw arms when the jaws are nearly closed. Position the strip so that closing the jaws on a workpiece bends the strip into a trough.-Walter E. Burton

Sheetmetal thumbscrew

I've devised a way to turn ordinary sheetmetal screws into thumbscrews. They make handy fasteners that you can't buy in a hardware store, and you can turn them easily with a gloved hand. I use a large screw, wedge a penny or a dime into the slot and silversolder it into place. I've also made larger ones-using quarters-for a neighbor who suffers from arthritis.

-John A. Crocker

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A sheet of coarse, 60-grit abrasive is an ideal surface on which to dry freshly varnished items such as wooden blocks or doll furniture. These small items are often coated with varnish on all surfaces at once. One side of the workpiece can easily be ruined when put down to dry. However, the coarse abrasive allows air to circulate around the wet finish and the finish isn't marred by the grains. When the work is dry it can be lifted without sticking to the paper.

-Robert Mosher

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1541	Square	6", 7", 8", 9", 10", 11"	
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High speed trailer wheels & tires. Fits all 4 hole boat & snowmobile trailers.

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1216	480×12	4	780 lbs.	\$32.95	\$24.95

Trailer springs, 1%" wide w/eye center of 25%"

Item#	Capacity	Springs	Leafs	Sale
1250	1000 lbs.	2	2	\$20.00/pr.
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Single 5	pring Set Sh	ackle, Iter	n# 1255	\$9.50/eet

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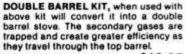
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SHIPSHAPE SHOP

Superorganized workshop offers practical solutions to combat chaotic tool clutter.

or most woodworkers, keeping a shop neat and organized is a formidable task at best. But for Wesley Glewwe, it's simply the right way to keep a shop.

Glewwe (pronounced glev-vee), an amiable Minnesotan with large, gentle hands, has created a clever system of custom-made tool-storage racks. Each of the brightly colored, wall-hung racks is designed to hold a specific tool. And each tool's business end is clearly visible to make tool selection and replacement easy.

Glewwe contends that, "If a tool rack is designed so that replacing the tool is as easy as laying it on the bench, then the tool is more likely to be returned to its proper place." A simple idea, but effective just the same.

Glewwe's love affair with woodworking began more than 60 years ago

BY JOSEPH TRUINI Shop And Tools Editor

when, as a youngster working at his father's grocery store, he would use wooden produce crates to build birdhouses and toys. As the years passed,



Wall-hung storage racks located over the bench keep hand tools readily available.

Glewwe collected tools and continued to practice woodworking as a hobby. Then, after spending 31 years as an FBI agent, he retired and found that his lifelong hobby could now become a full-time interest.

For the last 11 years, Glewwe has (Please turn to page 132)



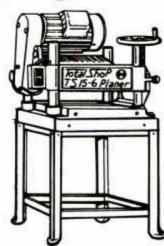
Turning tools storage rack is situated directly over lathe. Note custom-made handles.

Photos: Robert Paulson Technical art: Dyck Fledderus



The Shape of Pride





TS 15-6 Planer

What can compare to the sense of pride you feel when you carefully shape a piece of wood into a timeless treasure? Total Shop understands that feeling because we're proud too, and we have the shape to prove it. Our Total Shop multi-purpose tool and TS 15-6 planer are machines with solid power, versatility and stamina.

Compare Total Shop with Shopsmith® and see for yourself. The Total Shop motor produces nearly 40% more power than the Shopsmith® machine and can be altered by the owner to 220V, this is unavailable with Shopsmith® And in more than 85% of the comparisons, the Shopsmith® machine was priced higher than the Total Shop machine.

Don't overlook the TS 15-6 planer, a rugged machine convertible to 220V by the owner, optional stand and dust collector available, available with 2HP or 5HP motor, and a full 15" x 6' board capacity. A proud addition to any shop.

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Phone _____



One-car garage was remodeled and converted into this L-shaped, backyard woodworking shop. Floor plan drawing (below) shows how stationary tools are arranged.

focused his youthful energy on designing and building antique reproduction wood-gear clocks. To date, he has built 142 clocks. When I saw the clocks, I was awe-struck by the incredible number of parts. It's not unusual to find 60 or 70 wood parts in a single gear.

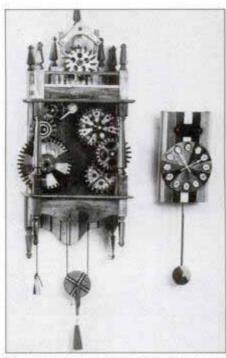
Although the clock's time is actually kept by a battery-operated movement, the exposed gears rotate, the wood weights move slowly up and down, and an escapement lever emits a gentle ticktock sound. Glewwe's clockmaking hobby has blossomed into a small business, and he now offers the clocks for sale in kit form.

Glewwe's practical solutions to improving the performance of a tool is



Wood gears of every imaginable size and wood species are used in the assembly of reproduction wood-gear clocks. Gears are made primarily on lathe and band saw.

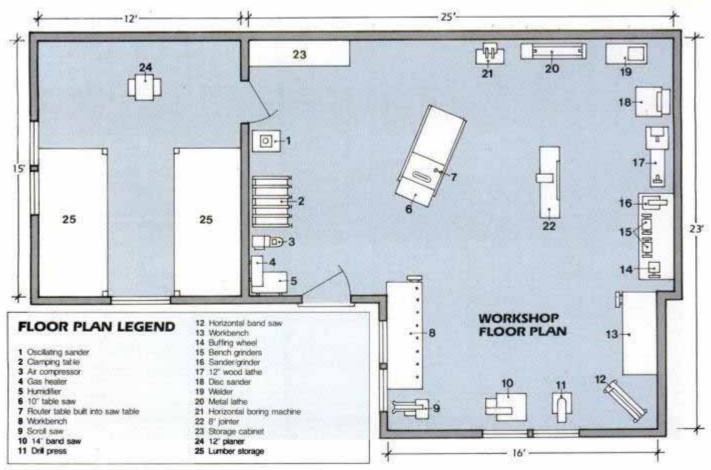
best illustrated with his table saw. First, he installed a Biesemeyer T-square fence and extension table to handle wide panels. Next, Glewwe built and installed a fold-down roller table to support boards on the outfeed side. A handy plywood shelf attached to the front of the saw's base holds a miter



Wood-gear clock, shown with its dial removed, is an elaborate assemblage of various domestic and exotic woods. The gears are powered by an electric motor.

gauge, wrenches and pencils. To make sawdust collection and disposal easier, he bolted a 2×6 frame to the saw's base. A 5-in.-deep drawer slides under the saw to catch the dust.

Another one of Glewwe's clever ideas was to use the saw as a router table. A (Please turn to page 135)



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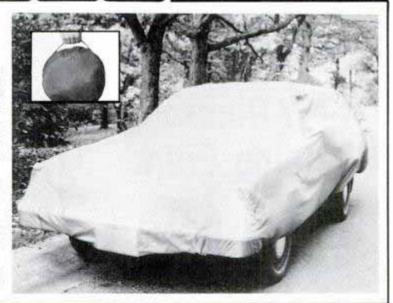
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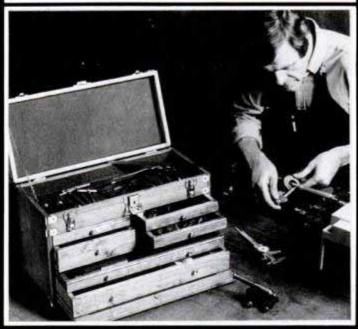
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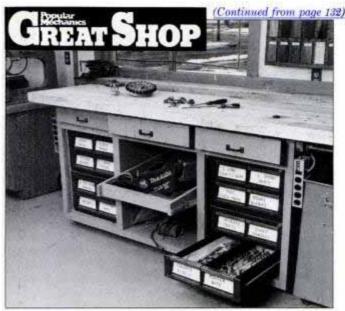
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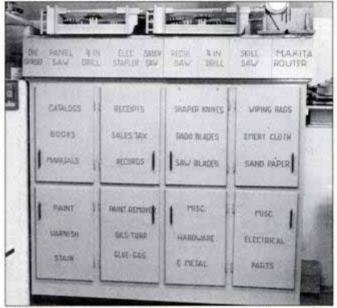




The 8-ft. workbench has 16 lift-out drawers that were salvaged from a metal filing cabinet. Portable power tools are stored in an easy-access tray that is mounted on drawer slides.



Using space wisely is another Great Shop trait. Here, storage cabinets and power tools share a common area. Bench on right holds a sander/grinder, two bench grinders and buffer.



Wall cabinet stores everything from books to finishing supplies. Portable power tools are kept dust-free behind lift-up doors on upper cabinet. Routed door panels divulge contents.



Salvaged from a casket factory's clamping machine, these clamps are used to edge-glue boards and to laminate turning blanks. Long bars have flat metal shoes that apply downward pressure.

2-in.-dia. hole was machined in the saw's cast-iron extension table. Then, he drilled and tapped screw holes in the table for securing the router base. Now, routing and shaping operations can be done on the table saw while using the miter gauge and saw fence.

Glewwe found that the "off" switches on the table saw and jointer were often hard to reach—especially when two hands were needed to hold the work. So, he repositioned the on/off switches

Do you know a shop that we should consider for the Popular Mechanics Great Shop Series? If so, send snapshots plus a description of shop and owner to: Home and Shop Editor, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. If we agree, we'll visit the shop, photograph it and share it with PM readers.

and installed bump switches (see photos with accompanying drawings on page 136). The bump switches are simple wood accessories that hang in front



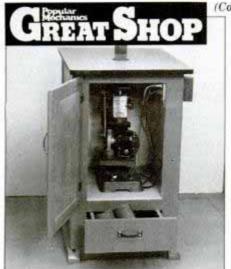
Glewwe (left) shows author the laminated blank he uses for turning chisel handles. Blank is comprised of several different wood species. Author examines a finished handle.

of the on/off switches. When a cut is completed, the tool is shut off by simply bumping the switch with your leg. Note that the switches are designed so that it's impossible for the tools to *start* by hitting the bump switches. *Caution:* Never modify a tool so drastically that it affects the tool's safe operation.

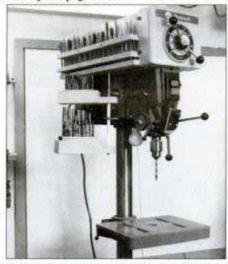
One of the most intriguing tools in Glewwe's shop is the oscillating spindle sander that he built from a benchtop drill press. He inverted the drill press head, added a gear reduction motor and devised a crankshaft arrangement that causes the sander's abrasive drum to rotate and move up and down simultaneously. The sander's smooth, safe operation is a tribute to Glewwe's inventiveness and technical proficiency. In fact, the sander has become so popular

(Please turn to page 136)

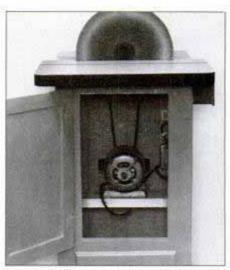
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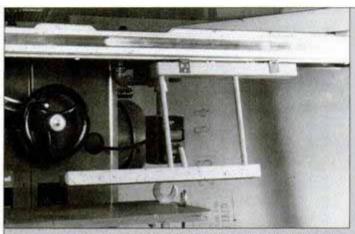
The heart of the oscillating spindle sander is an inverted drill press. The abrasive drum rotates and moves up and down simultaneously. Cabinet has a storage drawer.



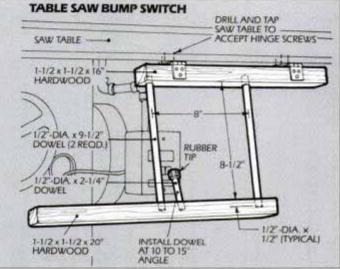
Shopmade storage racks are attached directly to the drill press to keep drill bits handy. Upper rack holds spade bits while twist bits are kept in separate liftout trays.

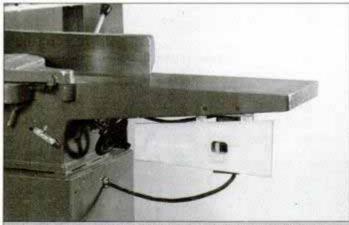


Shopmade 14-in.-dia. disc sander uses a ¾hp motor. Disc was made from countertop sink cutout. Electric blower in cabinet back keeps dust from fouling motor.

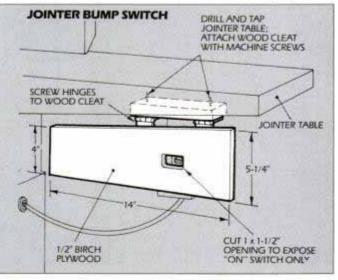


Bump switch allows you to turn off the table saw by simply bumping the lower crossbar with your knee. This is especially helpful when two hands are required to hold a long board or oversized panel.





The Jointer bump switch is simply a hinged ½-in. plywood panel. Cutout opening in the panel clears the "on" button so that bumping the panel with your knee will only shut off the tool.



with area woodworkers that Glewwe now sells a fully assembled oscillating spindle sander for \$175 plus UPS charges. For information, write to Wesley Glewwe, 906 Oakdale Ave., West St. Paul, MN 55118.

Glewwe, a content and generous

man, shares his love of woodworking with everyone. Two or three young woodworkers drop in frequently to learn Glewwe's skills and philosophy concerning wood and tools. The shop is visited regularly by friends, neighbors and curious strangers. Some have heard about his clocks or the shop-built tools, but most are just stopping by to talk shop and to see what Glewwe's got on the bench this week. And, like his smooth-running clocks, Glewwe is keeping a steady pace doing what he loves the most.

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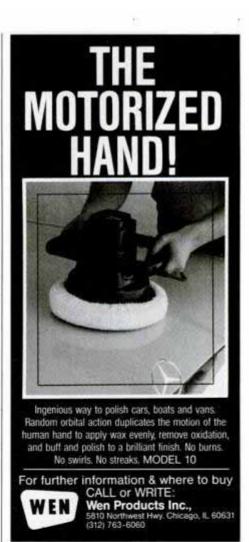
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DOWN TO EARTH

Selecting satellite TV gear makes buying hi-fi look easy.
Plan around the right receiver to build your system for the future.

BY FRANK VIZARD

ou'd probably recognize a home with satellite TV reception by the large, dish-shaped antenna that punctuates the skyscape. Symbolic though that dish has become, it's the satellite receiver concealed indoors that will serve as your command center for tuning in to spaceborne entertainment. This electronics component bears an outward resemblance to a hi-fi receiver, but the functions it must perform are much more demanding.

A satellite receiver has to pull in more than

100 video channels and an even greater number of audio signals, all emanating from points in space some 22,300 miles above the equator. Moreover, the receiver must work compatibly with other electronics equipment, such as antenna positioners and the new signal descramblers just coming on the market.

Operating a satellite receiver still isn't as easy as tuning in a conventional TV broadcast, but judging by the most recent crop of receivers, the difficulty is diminishing. Much of the welcome simplification results from the use of micropro-

(Please turn to page 140)

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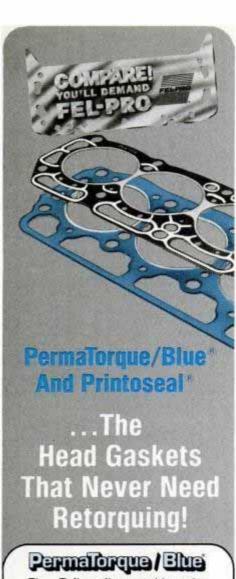
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SATELLITE RECEIVERS (Continued from page 138)

cessor memories that automate many functions you had to perform manually in the past. You still have to choose a receiver, though, and the broad range of models, features and options makes this a tough task.

There are two basic types of receivers: single conversion and block-down-conversion. A single-conversion model conveys only one video signal to your TV from the dish. This means you can select and view only one channel of satellite TV at a time—even though the satellite you've tuned into might transmit two dozen. A second receiver and TV won't solve the problem, either.

If you want to watch the ballgame while the rest of the gang views the news, a block-downconversion receiver is the solution. This type makes every channel (up to 24) coming from the satellite available for simultaneous viewing when additional receivers (called slaves) and TVs are connected to the main receiver. In other words, the block-downconversion receiver acts as a distribution center from the satellite antenna. Slave receivers connected to the block-downconversion unit can tune to different channels independently.

Block-downconversion receivers are beginning to crowd out their older, single-conversion cousins. The reason: lower prices for higher technology. Today, a basic block-downconversion model sells for as little as \$325. A year ago, similar models sold for twice as much.

Whether single or block-downconversion, you still have to train your dish antenna on a specific satellite before the



Budget block-downconversion: Drake's \$325 ESR324S receiver boasts stereo, too.

receiver can tune in channels. You can pivot the dish manually or sight it automatically by remote control with a device called an actuator.

Some of the most recent receivers have an actuator built in. Once you've programmed its memory to locate the satellites, you can switch from Galaxy 1 to Satcom 4 at the press of a button. You needn't buy an actuator right away: It can be added later, as an outboard accessory. These add-on actuators also boast microprocessor memories for satellite positions.

Going back to receivers, those with microprocessor controls perform other useful functions.

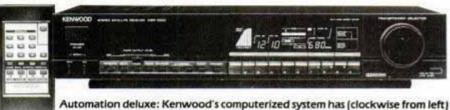
One is polarity selection—an irksome chore in the past. In order to pack 24 channels of TV on a satellite, the transmission pattern (or polarity) of adjacent channels is alternately horizontal and vertical. In everyday language, these translate respectively to even and odd.

In the past, it was up to you to set the proper polarity for the channel you wished to view (the setting is published in satellite TV program guides). The latest receivers set polarity automatically when you punch in the desired channel on your remote control. Skew control, which fine-tunes the polarity, is also done automatically.

Microprocessors even make channel tuning easier. With broadcast TV, the audio accompanies the video when you tune a station. Not so with satellite TV: You have to haul in sight and sound separately. Moreover, if the program's

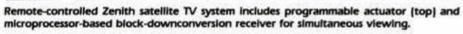
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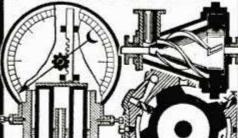
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TECHNICAL HIGHLIGHTS

Power, safety and refinement are the underhood trends for '87.

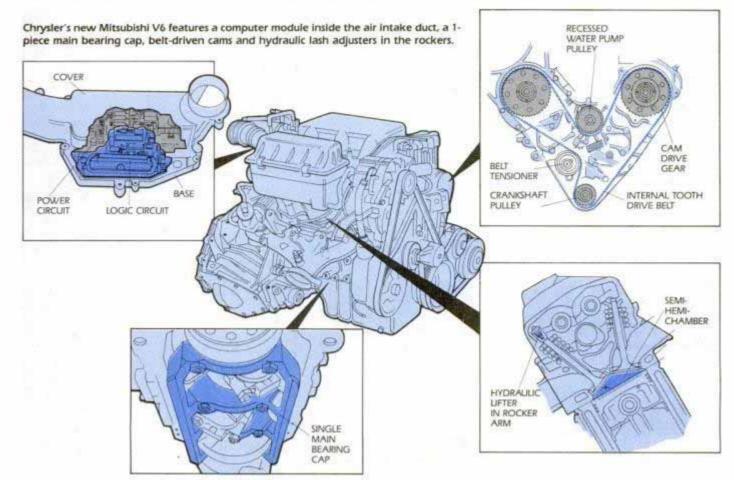
BY PETE WARREN

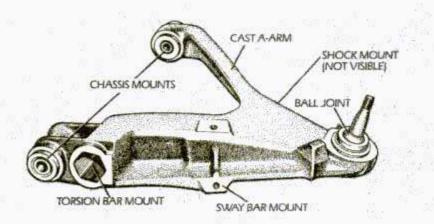
chrysler's high-volume engine lineup is like vanilla ice cream with a choice of syrups. You can get 4-cylinders in 2.2 or 2.5 liters with such toppings as turbo, fuel injection, stroker crank and balance shafts. There's one other choice: 2.6 liters, but still four bores, imported from Japan for vans. For 1987, there's a new flavor—V6 in two varieties, one old and one new. The old one goes into the small Dakota pickup, the new one into the vans and, eventually, into cars.

The new one is a 60° 3-liter V6 with aluminum heads and multipoint fuel injection, and will doubtlessly get the name Semi-Hemi. The V6 is built by Mitsubishi, Chrysler's Japanese partner, and dressed with some Chrysler-supplied parts, accessories and electronics. The combustion chambers of the aluminum heads are basically hemispherical, but there also are narrow appendages on the sides to "squish" the air-fuel mixture, causing it to swirl and

mix better to improve fuel economy, prevent ping and lower emissions. The engine develops a competitive 140 hp at 4800 rpm. Peak torque is 170 lb.-ft. at 2800 rpm, but the tuned intake manifold flattens the torque curve from 2000 to 4000 rpm.

It's the first small V6 for domestic installation with overhead camshafts (GM and Ford V6s are pushrod types), because that's a current Japanese engineering approach. The two cams are driven by a single belt, with slack taken up by a spring-loaded tensioner. Other typically Japanese design features are a rocker arm with the hydraulic lash adjuster built-in and a single cap for all





Chrysler cast-iron A-arm with molded-in mounting points is lighter than stamped steel.

four main bearings, to improve durability and reduce noise.

The distributor is an optical type with light-emitting diodes and photo diodes separated by a thin disc driven by the distributor shaft. The inner part of the disc has six slots in a circle. As a slot aligns with the LED and photo diode, the LED light shines on the photo diode. When the slot passes, the light is interrupted. This light-on, light-off drill produces a signal to the computer, which uses it to trigger the fuel injection and—above 1200 rpm—to control the ignition timing as well.

The outer part of the disc has 346 slots (one every camshaft degree plus a 14° gap at top dead center) and a second LED and photo diode setup. This provides a more rapid stream of data, so spark advance can be set more accurately below 1200 rpm, when normal fluctuations in rpm make it hard to know when to fire the plugs.

The engine's electronic control unit, biggest Chrysler has ever installed, combines both the power and the logic (computer) modules in a single package. It's under the hood, surrounded by the engine's cool-air intake snorkel, so the inrushing air prevents damage from underhood heat. This compares with the industry's standard approach of putting a computer in the relative coolness of the passenger compartment and running a wire harness through the firewall. Chrysler should prevent a lot of the electrical gremlins caused by chafed and kinked wires.

At first, the 3-liter V6 will go only into the minivans, where it's needed for the extra loads sure to be carried by the vans. Later, it should be available for those who want power in their cars, without the expense and trouble of a 4-cylinder turbo. When the V6 arrives, it will replace the Mitsubishi 2.6-liter Four.

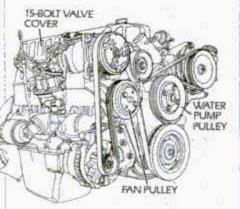
A 3.9-liter V6 for the new Dakota pickup truck is something old, built by "cutting" one cylinder out of each bank of the venerable 5.2-liter (318) V8. No cutting actually is done except on paper, because what was drawn out of the engine picture were the back halves of the front two cylinders and the front halves of the next two cylinders.

The 3.9 V6 is built on much of the same machinery as the 5.2 V8, with many of the same parts. The 3.9 is, of course, a 90° V6 because the V8 is a 90° engine. With the 90° bank angle, the V8 is inherently balanced, but the V6 is not.

Chrysler could have designed an even-firing crankshaft with offset crankpins (firing every 120°) for maximum smoothness, but there are problems with crankshaft strength when this is done. So, instead, the layout is such that the firing alternates between 112° and 128°. This is close enough to reduce unbalance to the point where premium engine mounts will clean up much of the remaining shake.

The 3.9, equipped with a 2-barrel Holley carburetor, produces 125 hp at 4000 rpm and 195 lb.-ft. of torque at 2000 rpm. Yes, the 3.9 V6 is a low-revving engine, but so is the V8 from which it was cloned.

The 3.9 intake manifold has a water passage around the exhaust crossover passage to preheat it, hopefully preventing exhaust gas from coking and plugging the passage. The plugged exhaust crossover, which results in poor cold driveability, has been a long-stand-



AMC 4-liter Six has offset fan to cut length, plus a leak-resistant 15-bolt valve cover.

ing problem on the 5.2 V8, which will get a similarly designed manifold in 1988. The rest of Chrysler's engine lineup undergoes little change. An intercooled version of the turbo will be available on the Shelby Daytona, permitting boost pressures as high as 12 psi (compared with 9 to 10 psi for the nonintercooled), but still well below the 14 to 16 psi used by GM and Ford. The crankshaft, pistons and connecting rod caps were among the parts beefed up to handle the extra power. With 174 hp at 4800 rpm and 200 lb.-ft of torque at 2400 rpm, this is a big jump from the 146 hp at 5200 rpm and 170 lb.-ft. of torque at 3600 rpm of the model without the intercooler.

Why is Chrysler so conservative with its intercooled turbo? So it can live through the 5-50 warranty period,

To keep the intercooled turbo from blowing out the rear of the 5-speed manual transaxle, Chrysler beefed up the case and is installing a coarse-pitch gearset (fewer teeth for greater gear strength) made by Getrag of Germany. The power goes into a stronger differential, with four pinion gears, not two.

Can a hunk of cast-iron be lighter than the same part made in stamped steel. Never, you say? Well, the lower control arms on the 4-wheel-drive Dakota pickup are cast iron and they're more than 10 percent lighter (20.5 vs. 23 pounds) than stamped steel.

One reason is that, if made in stamped steel, the arm would need a lot of welded double-wall area for the strength a 4wd requires. Second, with stamped steel, the mounts for such parts as the sway bar, torsion bar, ball joint, shock absorber and the pivot mounts for the arm itself would have to be separate parts welded in place. With the cast-iron arm, they're just cast into the one piece.

Transmission shifter

Chrysler has had its share of complaints about stiff cable-operated manual transmission shifters on its front-drive cars (as have the other guys).

For 1987, Chrysler takes more steps to try to resolve them. The key ones are a single-pivot, ball-type shift lever end; Teflon-lined conduits; and siliconelubed cables. They go into the 5-speeds on LeBaron coupes and convertibles, plus vans.

Convertible top

When does the electric motor circuit fail on a convertible top? In a pouring rain, of course. And what do you do about it? Get soaked or struggle to raise it manually against the residual pressure in the hydraulic lines. Is there a better answer? Yes, and this one is Chrysler's. On its new LeBaron convertible, you turn a knob in the trunk to open a

hydraulic bypass line, which dissipates the residual pressure. Now raise the top by hand with only minor difficulty.

American Motors

Was AMC ever caught with its performance pants down! Its '86 Jeeps featured the just-adequate 2.5-liter 4-cylinder and two optional Sixes that added little muscle, a 2.8-liter GM V6 and AMC's tired-blood 4.2-liter inline. The problem is solved for 1987 with a new 4-liter, fuel-injected, inline Six that provides 173 hp and 220 lb.-ft. of torque to add punch to the Cherokee/Wagoneer and Comanche pickup.

Those numbers are well above the 117 horses (141 lb.-ft. of torque) of the 2.5, the 115 hp (150 lb.-ft. of torque) of the 2.8 and even the 112 horses (210 lb.-ft. of torque) of the 4.2 Six.

The 4-liter engine is strictly a mutt, but the lineage makes sense. Instead of just trying to wake up the 4.2, AMC added two cylinders to its reasonably up-to-date 4-banger, which was itself originally derived from the 4.2. This gave the new engine a proved combustion chamber, port setup, cam profile and many off-the-shelf parts. Result: a complete engine in only 26 months.

AMC designed a new crank to give a 3.41-in. stroke, half an inch under the 4.2-liter. Along with a remotely mounted air cleaner, this enabled AMC to fit in the engine and still close the hood.

The crank has eight counterweights for stiffness and the block is ribbed for strength. Total weight is 483 pounds, only a pound more than the 4.2, despite many weighty extras.

The front-to-rear installation of the

4-liter engine would have been a pressfit, so AMC shortened the engine a couple of inches by moving the fan from the water pump pulley to its own shaft and using a single ribbed belt for all accessories. A short crossflow radiator, which fits farther forward than the tall downflow model, adds another inch to the engine compartment.

The thick, new cast-aluminum valve cover may set an all-time industry record: It's held by 15 bolts. In case you haven't heard, the 4.2 6-cylinder valve cover brought oil-sealing engineers to tears, and it took many factory fixes (including temporary use of the world's most expensive gasket at \$45) until the problem was solved.

The 4-liter has a silicone paste gasket in a cover groove, and is precured so it won't extrude out. If the cover ever has to come off, you can reach the rear bolts, something nearly impossible on the 4.2 Six.

If you've ever looked at the spaghetti maze of vacuum hoses under most hoods and wondered if they're correctly routed, you had company at AMC engineering. To reduce assembly line goofs, AMC is using a plastic quick-connect fitting with preattached vacuum hoses on the 4 and 2.5 engines. What's more, before the connector halves are joined, each half and its six hoses can be checked for vacuum leaks.

The new Six (and the 2.5 Four) can be mated to a 4-speed overdrive automatic that was cooperatively designed by Borg Warner and a Japanese affiliate. So it reflects some Japanese design, which just happens to coincide with Renault design, namely the use of sole-

noid valves wired to a computer to control shifting. AMC can provide the driver with a dashboard switch to choose between POWER and COMFORT. POWER gives you a computer program that raises the shift points and downshifts the transmission faster on acceleration. Can you believe a Cherokee/Wagoneer or Comanche that will break 10 seconds for 0 to 60 mph? The '87 automatics will. Flip to COMFORT and you get a computer program written for sedate motoring.

Renault GTA

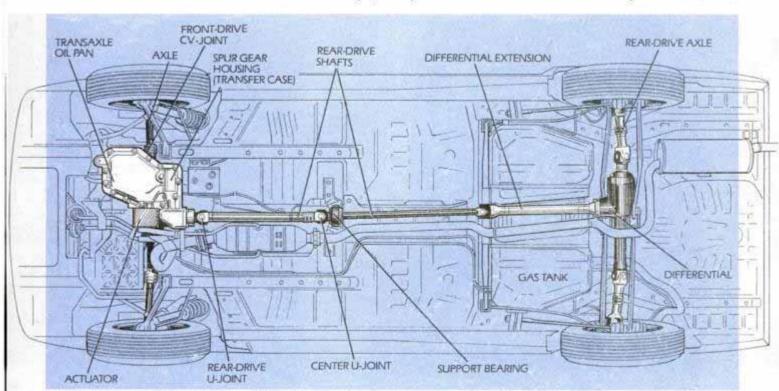
The Alliance/Encore wouldn't get you there in a hurry, either. So for '87, Renault has a pony car, the GTA, with a 95-horse, 2-liter version of the 77-hp, 1.7-liter 4-cylinder in the Alliance. The 2-liter is just 11mm taller than the 1.7, but that's enough to force the use of a remotely mounted air cleaner.

Ford

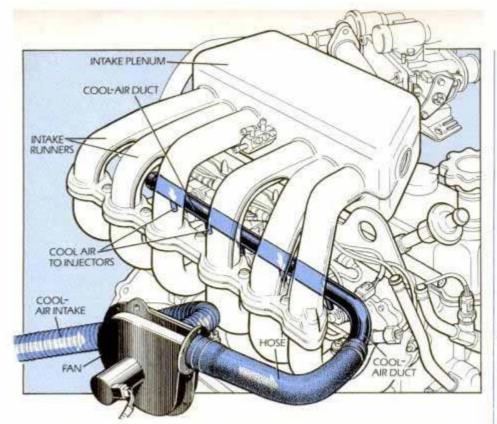
Picture an inline 6-cylinder with a tuned intake manifold and multipoint fuel injection, controlled by a powerful digital computer. Add an air manifold fed by an electric fan to cool the injectors. Combine this with antilock braking as standard equipment and you've got a pretty high-tech package. Sounds like a new BMW, but it's really Ford's 1987 F-series pickup truck.

Trucks are outselling cars at Ford Division these days, so it's not surprising that lots of new engineering goes into the redesigned F-series.

Ford's inline Six was introduced in 1965, and it has been modestly reworked over the years. But the '87



Tempo 4wd has its transfer case built into the transaxle oil pan. Tiny rear differential handles only half the engine's torque.



Forced-air cooling stops fuel from boiling in the injectors of Ford truck inline Six.

modifications really bring it up to date. The 4.9-liter (300-cube) engine now produces 140 hp vs. 120 last year. Fuel injection and other functions are controlled by Ford's EEC IV, a 64K computer. The intake manifold is tuned for maximum torque at the low end, just right for a truck. The exhaust manifold has three dual runners to help the engine breathe deeper.

The cylinder head is not a crossflow design, so there is exhaust heat on the same side as the fuel injectors. Heat shields have been installed and an ultrahigh-pressure (55 psi) fuel-injection system is used. But even at 55 psi, fuel at the injector tips vaporizes at 220° F, which could affect hot restarts.

The fan system is intended to make sure that the injector temperatures never even get close to 220°. When fuel temperature rises to about 190° F with the engine off, it triggers a temperature sensor clamped to the fuel injection rail under the intake manifold. The sensor activates a relay, which turns on an electric fan.

The fan draws cool air from the right side fender well and pushes it into the air manifold, which has outlet necks aimed at the first five injectors from about an inch away. (No 6 is far enough away from the exhaust manifold not to need air cooling.) Because the fan runs with the engine off, a timer limits operation to a maximum of 15 minutes, so the battery doesn't run down.

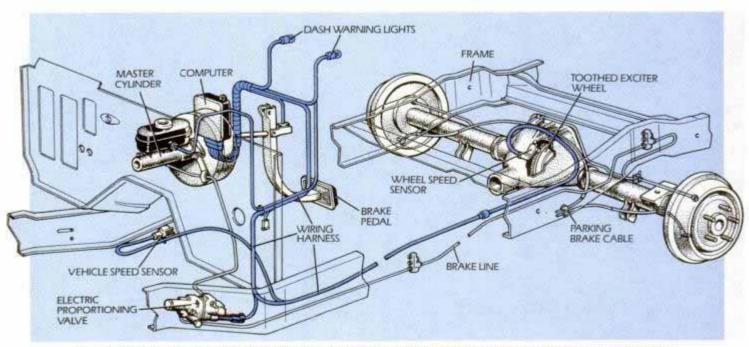
The 4.9 Six is Ford's second truck engine with multipoint fuel injection. Both the car and truck versions of the 302 (5.0-liter) V8 got it last year.

The F-series antilock braking system is on the rear wheels only, but those are the wheels on which it's needed most. A rear-wheel-only system is less expensive, because it has no pump or accumulator, and instead of a toothed trigger wheel and sensor at each wheel, only one set is needed in the differential. And there's a simpler kind of proportioning valve instead of the complex 6-solenoid operating mechanism used on 4-wheel ABS systems.

A conventional proportioning valve mechanically limits rear-brake hydraulic pressure to reduce the chance of lockup, and in normal braking that's all the Ford system does.

However, during a panic stop, when the slowdown rate of the trigger wheel signals impending lockup, a digital computer operates twin-solenoid valves in the proportioning valve. First, it triggers one solenoid valve to isolate the rear brakes from the master cylinder so that no further increase in hydraulic pressure can occur. If the lockup threat remains, the computer pulses open the second solenoid valve to relieve some of the locked-in hydraulic pressure.

If the system doesn't respond, the computer turns on a dashboard trouble light. However, on 4-wheel-drive trucks, the problem could be that the vehicle is in 4wd and it's the front wheels that are locked up. In that case, the lockup is transferred mechanically



First use of ABS brakes on a light truck is on the rear wheels only of full-size Ford pickups and Bronco utility vehicles.

to the rear wheels, but there's nothing the rear-wheel antilock system can do about it. So on 4wd models, there's a switch wired to the computer to tell it when 4wd is engaged. If the computer gets no response to a programmed series of antilockup maneuvers when the vehicle is in 4wd, it concludes the problem may be front-wheel lockup, and so it does not turn on the warning light.

Ford V8

If you wanted to get more horsepower out of a Ford 5-liter passenger car V8, would you put on a truck cylinder head and lower the compression ratio? It doesn't sound like one of Ford's better ideas, particularly when you realize that the '86 car head was a pretty sophisticated design. The intake valves were recessed so the combustion chambers formed masks around them to promote fuel mixture swirl for better combustion.

However, the masked valves primarily served to improve fuel economy—badly needed for Lincoln—but which restricted fuel mixture flow. The economy wasn't required for such cars as Mustang, so as soon as some engineering time was available, Ford went to work to create a high-output package.

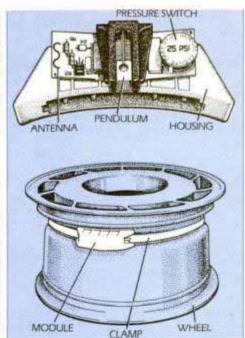
The truck cylinder head has conventionally positioned intake valves, so it allows greater mixture flow. Ford also retuned the intake manifold and installed a larger throttle body to take advantage of the cylinder head.

Why cut compression ratio? At 9:1 (compared with 9.2:1 in '86), a lot more spark advance can be used with the truck head without knock on unleaded regular. So, in this case, the power gained from the spark advance more than offsets the loss from the drop in compression ratio. Horsepower for 1987 is up from 200 to 225 and torque from 285 to 300 lb.-ft.

4-wheel-drive

Ford's '87 Tempo is the first domestic car to get a 4wd system built off a frontwheel-drive platform. When you order a new Tempo, you'll be able to order 4wd just as you would automatic transmission, power windows or any other option. For the initial run, however, 4wd has to be ordered with automatic transmission and the high-output 2.3liter 4-cylinder. Early estimate: \$1000 for the 4wd only. The Tempo 4wd is a bolt-on design that required no changes in the floor pan, which is why Ford picked it for the first conversion. So if you have a 1985 or 1986 model, you could retrofit the system. It only costs money (and very likely much more than the price for an '87 option).

The transfer case is a compact design that replaces the oil pan in a conventional front-drive transaxle. Two pro-



Low air pressure sensors in Vette wheels send warning to a receiver on the chassis.

peller shafts with a total of three crossand-roller universal joints carry the power to the rear, into an extension housing that bolts to a compact differential. Two constant-velocity joints would have done the job of the three Ujoints, but the CV is larger than a crossand-roller and wouldn't fit the slim tunnel in the floor pan. Despite the compact design of the differential, the rear control arms on the right side had to be bowed so they would fit in.

The driver can switch from 2wd to 4wd by pressing a dashboard switch. This operates a solenoid vacuum valve, which applies vacuum to a diaphragm unit on the transfer case. The diaphragm unit linkage moves a dog clutch to lock the transaxle to the transfer case shaft.

Goodbye carburetor

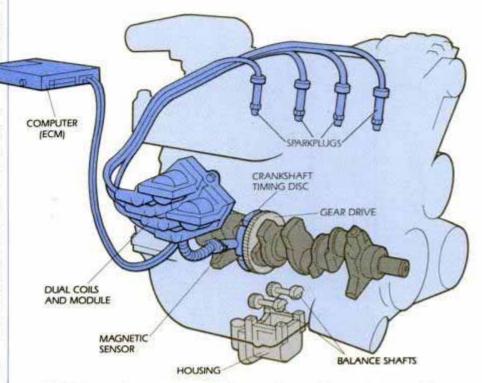
Unless you're a cop, kiss the carburetor goodbye on '87 Ford cars. The police package with the 351-cube (5.8-liter) V8 is the last carbureted passenger car. Even the Escort 4-cylinder and 3.8-liter V6 have fuel injection (though less expensive throttle-body units) in '87.

The last truck engines with a carburetor are the optional 351 and 460 V8s. By 1988, you can bet at least the 351 will be injected.

Glued-together car

Ford's gradual move toward the gluedtogether car takes a major step in 1987. The '87. Mustang gets the adhesive treatment along the inner wheelhouseto-floor joint, and along the outer wheelhouse to quarter panel—basically what was done on the '86 Thunderbird. The '87 Bird also gets a line of glue along the whole perimeter of the roof, where it attaches to the body. In addition, for the first time in a gluedtogether experiment, Ford took out 20 percent of the welds at the roof-body joint, so it will be a meaningful test of the durability of the technique.

The glues that Ford is using aren't library paste, but special adhesives that have structural strength equal to or better than welding. Further, the adhesives produce a quieter seal and do not undermine the rust-resistance of the coated metal, as welding often does.



GM 2.5-liter engines get a new C-3 distributorless ignition and balance shafts.

Improvement by subtraction

Sometimes, a good way to improve a product is by subtraction. And Ford has done this on the 1987 Tempo/Topaz, for which it is touting the FLC transax-le. FLC stands for fluidically linked converter, which means that Ford is back to the old type of torque converter it used before the fuel economy standards foisted the lockup converter clutch on the public.

That clutch was the cause of many complaints because of its effect on shift quality and driveability.

Variable suspension stiffness

The '87 T-Bird Turbo coupe has electronically controlled shock valving, using a system imported from Japan, where it was pioneered by Mazda. A computer takes signals from an accelerometer, a steering position sensor, and a brake switch. During cornering, hard acceleration and braking, it operates motorized valves to stiffen the shocks and struts. Flip a dashboard switch from AUTOMATIC to FIRM and enjoy (?) the stiff ride all the time.

The Mazda system was more a field test of the hardware, as few could tell the difference between the soft and the stiff ride. The T-Bird Turbo doesn't go from marshmallow to hard rock, but the difference is much more noticeable.

General Motors

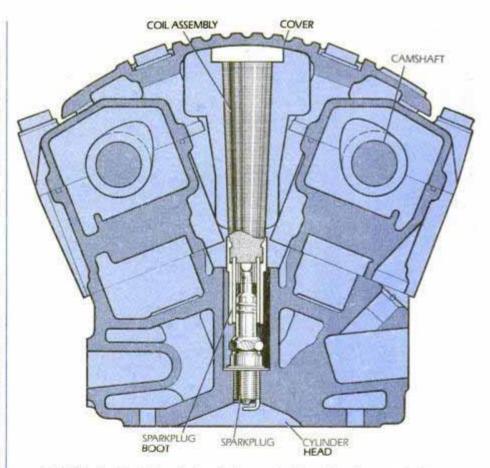
The old GM engine habit of fix-and-run is clearly over in 1987. When an engine had big problems, the General would throw bundles of money and time at it to solve them, then choke off production. Remember the Corvair flat-Six, the Vega aluminum-block Four, the Caddy V8-6-4, the diesels?

It's an expensive way to operate and it had to end. GM hasn't got an apparently all-new engine for 1987, but if you look at the blueprints, you can see the new policy in effect: Even if it takes a monumental redo to fix and update, keep it in production.

The 1987 2.5-liter 4-cylinder, the old "Iron Duke," resembles previous versions only in displacement and basic layout. This engine is used on A-cars (Celebrity, 6000, Century and Ciera), N-cars (Calais, Grand Am and Somerset), and the Pontiac Fiero.

The '87 has a balance shaft housing in the oil pan (a la Chrysler) to reduce high-speed vertical shaking forces, something that afflicts all 4-bangers. The shake forces are squared as engine rpm rises, so the problem is worst in engines that are revved the highest, such as larger cars with manual transmissions.

There are two balance shafts with gears at one end that mesh with each



Olds' 16-valve Quad 4 engine has Saab-type ignition with colls near the plugs.

other; one gear also meshes with a gear added to the crankshaft. As the crank spins, it turns one balance shaft counterclockwise, which turns the other shaft clockwise. As the shafts rotate, weights on them will align to produce a counterforce to the engine shake force.

Shaking forces, modest at idle and part throttle, hit 5000 pounds at 5000 rpm on a 2.5-liter Four. The counterrotating balance shafts, which spin at twice the engine speed, reduce that number to 10 pounds. The shafts don't affect idle shake, which is a combustion force reaction. Only the Mitsubishi Silent Shaft design, with the shafts mounted higher and offset from each other, has any real effect on that, and then primarily at fast idle.

The balance shaft housing gave GM a way to move the oil filter from the back of the 2.5-liter, where it was hard to reach on A-cars. It's now attached to the housing, and there's a big access plug in the oil pan. You loosen the plug to drain oil; remove the plug and reach in for the filter.

Weight of pistons and rods contributes to high-speed shake, too, so the 650-gram piston is gone, replaced by a 600-gram part (introduced on the '86 Fiero) for the A-cars and a 530-gram one for the N-cars. The pistons are the silicon-alloy design introduced last year to cure the old pounding-out-the-ringlands problem. It's expected the engine will be revving higher, so lightening the rod wasn't possible, but it was reshaped for 40-percent greater stiffness with the same weight.

The '87 2.5-liter engine also gets GM distributorless ignition with two electronically controlled double-end ignition coils for the four bores, installed where the distributor used to be. It includes a crank-position sensor that projects through the engine block close to a notched timing disc on the crankshaft (the other half of the disc has the gear that drives the balance shafts). There are two notches close together to signal the module and engine computer when the No. 1 piston is at top dead center, and five others spaced so the computer can calculate crank speed for precise ignition timing. Distributorless ignition eliminates another 2.5 service headache: access to the distributor.

The 2.5 has no way (manual or automatic) to change ignition timing. GM says the engine won't knock even with low-quality fuel, but if the problem occurs, you'll need a new PROM to reprogram the computer.

The 2.5 block was modified and quality control was tightened up at the foundry to eliminate the problem of cracking coolant passages.

The cylinder head ports and the intake manifolds also were reshaped, to open up restrictions, a move that continues to prove that designs for air-fuel mixture flow and performance are in the same league as alchemy. Recently, manifolds and ports have been restricted to cause high swirl of the air-fuel mixture going into the cylinder, for economy and low-end performance. The '87 2.5 manifolds and ports are very open to increase air-fuel flow, but the mixture enters at one side, where it hits the bore and swirls a little. The added flow more than compensates for the reduced swirl, and horsepower is up from 92 to 98 (torque from 134 to 135 lb.-ft.) to prove the point. Is another combustion chamber theory on the way? Stay tuned.

Other engines

The '87 2-liter pushrod engine in most J-cars (Cavalier, Cimarron, Firenza and Skylark, but not Sunbird) has also been extensively reworked. It has distributorless ignition and an aluminum head with a machined-in (instead of cast-in) combustion chamber for a more precise shape. Larger valves and freer breathing ports add 3.3 of a 5-hp increase (90 vs. 85). Reductions in engine friction, including lower-tension oil rings, do the rest.

The 2-liter gets gasketing changes somewhat similar to what GM has done for other engines to reduce oil leaks. The sheetmetal valve cover is replaced by a shallow aluminum one grooved to hold a precut silicone gasket. The oil filler cap (a common source of leaks when left off or loose) is gone, but the dipstick tube is enlarged to take over this function, too, as done on automatic transmissions. The oil drain plug's metal gasket has an embedded rubber Oring to prevent leaks even if the plug isn't all that tight. You can buy this gasket for a simple retrofit.

The engine continues to use silicone paste as an oil pan gasket (along with molded silicone side seals), but the gasket surface now has a raised bead so the paste isn't squeezed out when the pan is bolted on.

The 2.0 pistons are turned in a single lathe, using a new process that results in very consistent sizes. Combined with changes to reduce bore distortion, it means that any piston can now be installed in any cylinder and the fit should be right, instead of the traditional (and labor-intensive) method of select-fitting. The new pistons also are lighter, reducing high-speed shake.

Many similar changes were made to the 2.8-liter V6, which is in A and J cars, Fiero and conventional rear-drive models. It, too, has distributorless ignition and aluminum heads (on all transverse installations), and specially machined pistons to eliminate selectfitting. A single-piece silicone rubber oil pan gasket (including side seals) has steel reinforcements to prevent overtightening.

With the widening use of multipoint

(port) fuel injection, GM worked on the problem of port injectors plugged by gum, sulphur and carbon deposits affecting performance. The deposits accumulate at the base of the injector, where there is just a .05mm gap between the pintle and the opening. A minor accumulation is enough to cause a power loss.

New injectors, introduced on the 2.8 V6 for '87 (and coming soon for other engines), eliminate the pintle and move the key parts well up into the injector. Now there's a ball-type plunger and, once it lifts, the fuel sprays through six holes in a "director plate" and then out the opening at the base. Even if normal deposits accumulate at the base, the restriction would be too minor to have any effect.

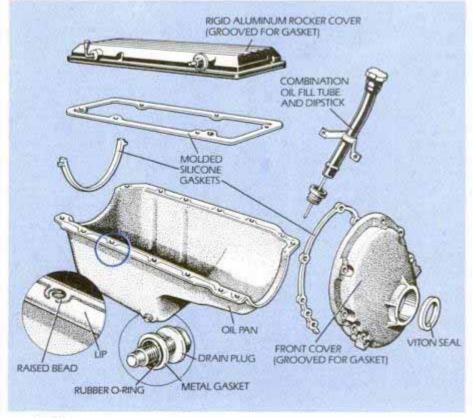
German tranny

The 2.8 is mated to an all-new 5-speed gearbox, designed by Getrag of Germany and made by GM. Getrag designs gearboxes for Mercedes, BMW and Porsche, and its new model is a supercompact design (13.3 in. from bellhousing to end plate bolt heads), yet it can handle 200 lb,-ft. of torque. Secrets of its size are in the clever ways Getrag shapes parts so they fit over and around each other, and precise sizing of the gears. Further, the gears will get a special heat treatment that goes very deep, so they can be shaved after the heat treatment. This removes any distortions from heat treating, so the gears run quieter. The axle shafts with the Getrag are of equal length to reduce torque steer.

GM has a second 2-liter Four for 1987: a bored and stroked version of the 1.8-liter overhead-cam Brazilian engine in the Sunbird (optional on Firenza and Skylark). The ports were modified and a semituned intake manifold was added for freer breathing, so the '87 engine produces 96 hp at 4800 rpm, up from 84 hp last year. The turbo option develops 165 horses at 5600 rpm, up from 150 hp in '86. A quart of coolant capacity was taken out of the engine to speed warmup for better heater operation. Sounds simple, but virtually all engine parts are new, including the block, which was shrunk around the reduced coolant passages.

GM's largest performance improvement is on the Cadillac 4.1-liter aluminum-block V8, as installed in the Allante. A lot of people, including many GM engineers, were betting this engine would go the way of the Caddy V8-6-4, but the oil and coolant leak problems are apparently finally under control, and Cadillac has juiced it from 130 to 170 hp (with premium fuel only). That won't make it a stormin' stocker, but if an Allante should ever make it to the Autobahn, Cadillac claims it will cruise at 200 kph (120 mph).

The engine has sequential multipoint fuel injection (compared with throttlebody injection on the 130-horse version in other models), and the air intake system with its highly tuned intake manifold is a free-breather. Taking a



GM 2-liter engines get detail changes to stem the flow of oil to the garage floor.

page from carburetor technology, the air-only throttle body has a staged twin throttle plate, with the second plate set to open gradually for a smooth transition to wide-open throttle.

The 4.1 still has a distributor because GM currently has distributorless modules only for Fours and Sixes.

The high-performance 4.1 is mated to a 4-speed automatic with semi-electronic shifting. Although this has long been used in European and Japanese cars, it's a first for a domestic box. A computer controls the converter clutch, plus THIRD and FOURTH gear shift valves by operating a solenoid valve in the transmission's hydraulic valve body. The same computer operates Cruise Control, so it's programmed to reduce the annoying up-and-down shifting of the transmission as the Cruise acts to maintain preset speed.

The new gearbox does have a Cadillac exclusive picked up from the 3-speed automatic in its other front-drives: a silicone fluid coupling that allows minute transmission slippage to dissipate the shudder from the converter clutch. Only modest changes were made to GM's most potent automobile engine—the Corvette 5.7-liter V8—but it also has more muscle in '87, 240 horses with premium fuel vs. 230 on regular in '86. Roller lifters (for reduced friction) and software changes in the port fuel injection also contributed to the power boost.

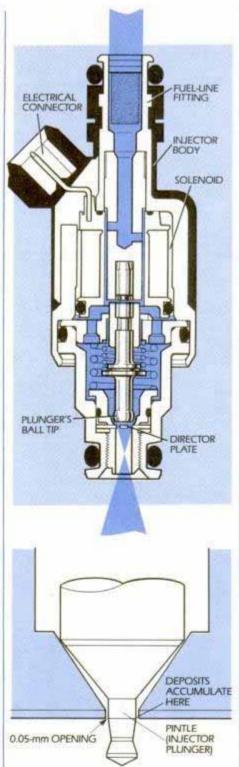
Olds Quad 4

The most dazzling GM engine is a brand-new, port-fuel-injected, aluminum-head, 2.3-liter 4-cylinder developed by Oldsmobile. It's delayed from '87 to '88 because the engineering crews that fit engines to car platforms are running behind schedule. The engine first will go into the '88 Calais.

Called the Quad 4, it's a 4-valve-percylinder design with a single roller chain driving two overhead camshafts. The chain, which also wraps around a water pump sprocket, is automatically tensioned by a ratchet mechanism operated by engine oil pressure.

Although it produces a healthy 150 hp in stock trim (from 142 cubes), the Quad 4 also develops 180 horses with a touch of tuning, and 250 hp with a turbo, numbers more than competitive with Japanese and European engines.

The combustion chamber is a pentroof type, with two valves on each side and a central sparkplug. The small valves give the air-fuel mixture the necessary swirl, and the shape produces combustion similar to a hemichamber. Intake and exhaust manifolds are tuned so the mixture rushes in and the exhaust gets out in a hurry. The engine weighs just 300 pounds and the pistons and rods are among the light-



New GM fuel injectors with recessed nozzles (top) should stop injector clogging troubles of the old, exposed design (above).

weight parts, so high-speed shaking forces are low. Still, a balance shaft version is in the works for upscale installations.

The ignition system is a new version of distributorless ignition, in which all sparkplug wires are eliminated. The sparkplugs fit between the twin camshaft chambers and over them are two electronic ignition modules in line, one module for two plugs. Although the plugs are completely out of sight, you just remove four bolts and lift off a

cover (actually a heat sink). With it comes the pair of ignition modules and, with them off, you have access to the plugs. Although the system resembles the one used by Saab, it works on different electronic principles.

The absence of plug wires is one obvious advantage. Also, the entire ignition system is shielded from road splash and provides less interference to other electronic components in the car.

Electronics

The Japanese once led in bells and whistles, but GM is competitive in '87, via the magic of electronics. Topping the list is an industry first: multiplexing for all lighting on the Allante. Multiplexing means a single wire can simultaneously carry many completely different signals between an input and an output module. So, for example, there's just one wire from a module in the dashboard to one at the front or rear of the car to control several lamps.

No one cares if GM saves a few feet of wire, particularly on a \$50,000 car. However, those modules are actually small computers, so if a turn-signal bulb burns out, the computer will flash the parking light on that side in place of the burned out turn signal. If a high beam blows, it will turn on the low beam and if the low beam fails, a fog light goes on in its place. In addition, a warning notice appears on the dashboard.

The '87 Corvette will have an optional low-tire-pressure warning system. In each wheel is a module with a pendulum that swings back and forth on an arm that actually is a piezo-electric generator. Electricity from the pendulum movement charges a capacitor and when a switch detects air pressure below 25 psi, it triggers an FM transmitter that signals an in-car receiver, which turns on a warning message.

The message board could tell which tire is low, but because the tires can be rotated, this is not done. It will be done in 1989, when the Vette gets 1-position tires and a TV tube in the dashboard.

The '87 Oldsmobiles have a solution to an old complaint of PM readers: leaving on the turn signal because they can't hear the flasher. A new version of the chime module (for seatbelts, headlamps and key-in-ignition) is wired to the car's speed sensor and flasher. If the flasher operates for more than a half mile, the chime sounds. A retrofit is possible for previous models.

The 1987 Pontiacs with the optional steering-wheel radio controls will use that feature to retard theft. If disconnected from the battery, the radio won't work again until battery power is restored and the steering wheel MUTE button is depressed. The thief could take the steering wheel too, but it's hoped he'll look for an easier target.

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SATELLITE RECEIVERS

(Continued from page 140)

in stereo, you have to tune the left and right audio channels independently! Again, the most recent satellite receivers handle these chores without making you leave your easy chair.

Stereo, by the way, isn't standard on every receiver. It's also more complicated than the FM radio in your car.

You can buy a no-frills receiver with monaural audio only, and add an outboard stereo processor later on. (To take full advantage of the stereo sound, you'll want to route your satellite audio to a hi-fi system, or to a TV set with



Radio Shack's block-downconversion receiver selects polarity and stereo format.

stereo amps and speakers built-in.)

One argument in favor of stereo reception is that besides the many TV programs with multichannel sound, there are many high-quality FM radio stations that use satellites to beam their programming far beyond

(Please turn to page 156)



Uniden's UST 7000 has remote control actuator plus block-downconversion receiver.

Unscrambling Scrambling

You might need more than a dish and receiver to watch satellite TV.

Some cable television programmers, who transmit their shows to local cable operators via satellite, don't want satellite TV households to watch their shows free of charge. Home Box Office was first to adopt this stance and scramble its signal. By year end, it's possible that another 20 channels might scramble.

The device you need to unscramble these signals is the VideoCipher II. It's made by M/A-Com of Hickory, North Carolina, and costs \$395. But this isn't the last fee you'll pay to make scrambled satellite TV viewable. You can expect to pay a monthly programming charge too, just the way cable TV subscribers do.

Once you've paid your subscription (either to the local cable operator or directly to the programmer), the service will send a coded signal to your VideoCipher II. This signal authorizes the component to unscramble the appropriate program. To receive authorization, you must turn on your receiver and aim your dish at the satellite transmitting the program.

If you fail to pay your monthly fee, the programmer can discontinue your satellite television service-electronically. That's

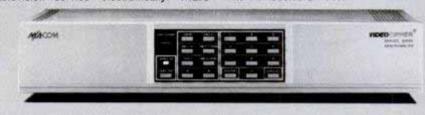
because each VideoCipher II can be addressed individually.

What turns it on and off is a 56-digit key that works like a password. It's inscribed on a microprocessor inside the machine. Until that key is turned by a satellite signal from the programmer, the VideoCipher II won't descramble.

Think you can crack the code? Maybebut there are 72 quadrillion combinations. A quadrillion is a billion millions, or 72 followed by 15 zeroes.

To further secure the system, each VideoCipher has several keys inscribed, which the programmer can address alternately. In practice, then, cracking one key might give you free access only to part of a program. But the next show might use another key entirely.

Though M/A-Com, the inventor, is the only company now selling VideoCipher II, other brands are likely to offer the descrambler before long. For the time being, the VideoCipher will remain an outboard. add-on unit-mainly because there are still dozens of unscrambled satellite TV channels. But if scrambling becomes more widespread, you can bet that manufacturers will build descramblers into their satellite TV receivers.-F.V.



You'll need M/A-Com's VideoCipher II to receive scrambled satellite TV programs.

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SATELLITE RECEIVERS

(Continued from page 152)

the local audience. To receive these "broadcasts," make sure your receiver has variable tuning. This means it's capable of receiving the full frequency range, from 5 through 8 megahertz. Receivers with the more-common fixed tuning limit audio reception to the 6.2 to 6.8 MHz band.

When you buy a stereo receiver or processor, you'll notice a selector for multiplex, discrete and matrix stereo.



Remote control (top) operates Luxor 9900 CKu receiver/actuator (bottom). Blockdown-conversion allows use of Luxor 9500 (center) as slave receiver.

Unlike FM radio, which has one common, standard transmission format in the U.S., satellite stereo can be transmitted three different ways (discrete and matrix are the most popular). With a processor or a basic stereo receiver, you'll have to consult a program guide and set the format yourself.

To improve your audio reception, some receivers offer wide- and narrow-band selection. Others incorporate Dolby or another form of noise reduction. In the video domain, some advanced receivers have built-in terrestrial interference filters that you can deploy to clean up a noisy picture.

Yet another feature is the misnamed "parental lockout"—meant to prevent the kids from watching "adult" programming.

Perhaps the most important features you should look for in any receiver are compatibility with a signal descrambler, and dual reception for C-

(Please turn to page 158)



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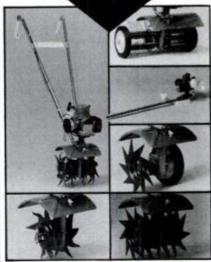
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SATELLITE RECEIVERS

(Continued from page 156)

band and Ku-band transmissions. Both have more to do with the satellite TV's future than its present.

Though microprocessors are making satellite TV systems easier to operate, the systems themselves might need an extra part thanks to the decision by popular cable TV programmers (such as HBO) to scramble their satelliteborne signals. Most receivers can accommodate an add-on descrambler (see Unscrambling Scrambling on page 152), which you'll insert between the dish and the receiver.

In the future, descramblers might be



Actuator, stereo processor add to basic Channel Master 6135 block-down receiver.



Janell also takes component approach. From top, SP2000 stereo processor, AP2000 actuator, BCR 2000 block-down receiver.

built right into receivers. That's how satellite equipment manufacturers are now preparing for the eventual expansion of satellite transmissions to the Ku-band of frequencies.

Right now, most satellite TV signals use the range of frequencies known as C-band. Trouble is, C-band (from 3.7 to 4.2 gigahertz) is also used for telephone microwave communications on Earth, and this results in TV signal interference in some areas. Ku-band operates at the higher 11.7 to 12.2 gigahertz (GHz, or billions of cycles per second). Because there's no possibility of terrestrial interference, satellites can transmit a stronger signal-and let you use a smaller receiving dish.

At this writing, many new receivers can tune in both C-band and Ku-band the way radios handle both AM and FM. And given the pace of microprocessor automation, satellite TV might soon become as easy to operate as the familiar broadcast variety. PM

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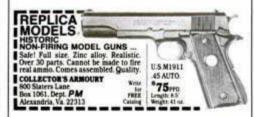
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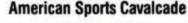
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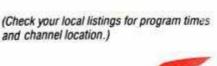




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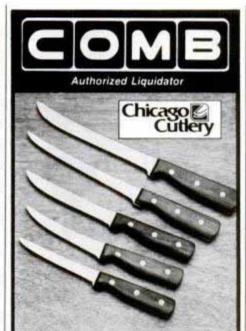


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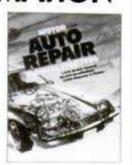
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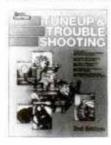
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165

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TIME MACHINE

POPULAR MECHANICS

The first seaplanes fly.

NEW POWER FROM THE SUN

POPULAR MECHANICS 75 YEARS AGO: October 1911
Aero-hydroplanes

We call them amphibians today, but in 1911, they were aero-hydroplanes. The French firm Fabre led the way with a monoplane, but the British Navy, sticking to biplanes, took the first bold step in turning the new aero-hydros from experiments to important aircraft. Britain developed an aerohydro rescue craft with a seaworthy hull and no pontoons. The craft proved able to patrol the London harbor area, although it had to be refueled every hour and couldn't fly in fog.



The first car telephone

Cellular mobile telephones were nowhere to be found in 1911, but Bell already produced the first car phone that year. You drove up to the nearest telephone road station, plugged-in your phone jack and placed a call as the man in the rear seat above did. The car phone system proved too cumbersome and never caught on.

50 YEARS AGO: October 1936

Whale of a boat

A German company, basing its design on the body of a killer whale, developed a new passenger ferry that plied the waters at a then-unbelievable 50 mph. The big new development, however, was the powerhouse, a pair of "air screw" prop engines that blew the boat forward like an Everglades swamp craft. Made of lightweight metals, the noisy boat carried 36 passengers. Its flat bottom reduced roll yet made the craft flop up and down wildly as it sped along the water.



Bobbing along

A Berlin amusement park featured bobsleds on rollers that sped down a wooden course at high speeds. The new ride was the first major deviation from traditional roller coasters.

Nothing new

"Today, a new connection between the sun and the Earth is being studied," PM wrote in 1936. About every 54 days, scientists had just learned, shortwave reception disappeared entirely from the Earth for several hours. It was as if all the fuses on all the world's receivers blew out at once and stayed out for several minutes. They theorized cor-rectly that the disturbance had to do with some kind of flare that rotated with the sun. Solar flares and spots are better understood today.

SEPARATE SECTION

German airboat went 50 mph.

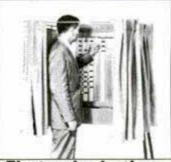
25 YEARS AGO: October 1961

Fours and Sixes

Two new engines-the Chevy straight Four and the Buick V6-were introduced to a public increasingly aware of fuel economy, but still interested in powerful engines. The new Chevy engine was built for the Chevy II. It displaced 154 cu. in. and provided 90 hp. The Buick V6 was a somewhat more powerful engine and we gave it a 1000-mile road test prior to the model year. The 198-cu.-in. engine with 155 hp received high grades for performance and gave us 20.6 mpg at 60 mph.

Baseball rabbit

In 1986, everybody's talking about the baseball with the rabbit inside. That is, many fans think the ball that's made today is livelier than the balls made in previous years, accounting for more home runs. The same question was raised in 1961, the year Roger Maris broke Babe Ruth's seasonal homerun record with 61 roundtrippers. But laboratory tests of current and older baseballs indicated it was the same old cowhide with the cork center. It was just a good year for home runs.



Electronic elections

The latest political technology was a 150-pound electronic voting machine that used punchcards to count ballots. Today, such machines are commonplace during election time.



New engines for economy.

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