

FEBRUARY 1982 \$1.25

Popular Mechanics

**COMPLETE GUIDE:
ALL THE 1982
IMPORTED CARS**

6 COMPLETE PLANS

- Kitchen Cabinets You Can Build
- A Laminated Cube Coffee Table to Make
- Serving Bar...and More!

NEW-CAR TESTS

CHRYSLER'S CONVERTIBLE
Return of the Ragtop
GM'S CAMARO/FIREBIRD
World-Class Performance

STEREO: PM TESTS
9 BEST NEW MEDIUM-
PRICE CARTRIDGES

939,000-MILE DRIVE REPORT

Cadillac's Cimarron
Pleases Owners—but
They Want More Power

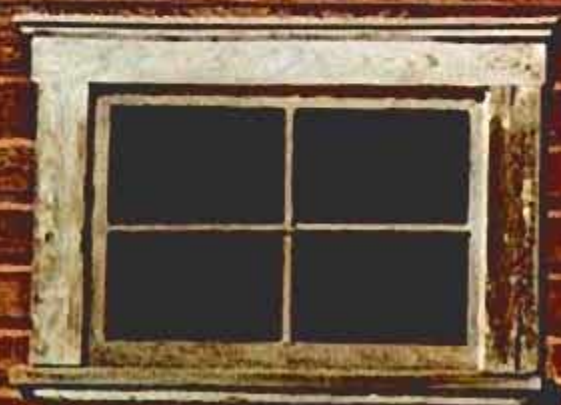
EXCITING NEW PLAN
FOR CHANNEL TUNNEL

PM'S PICK OF NEW BOATS

**GOLD VAST PRIZE
FOR HIGH-TECH DIVERS**



Marlboro

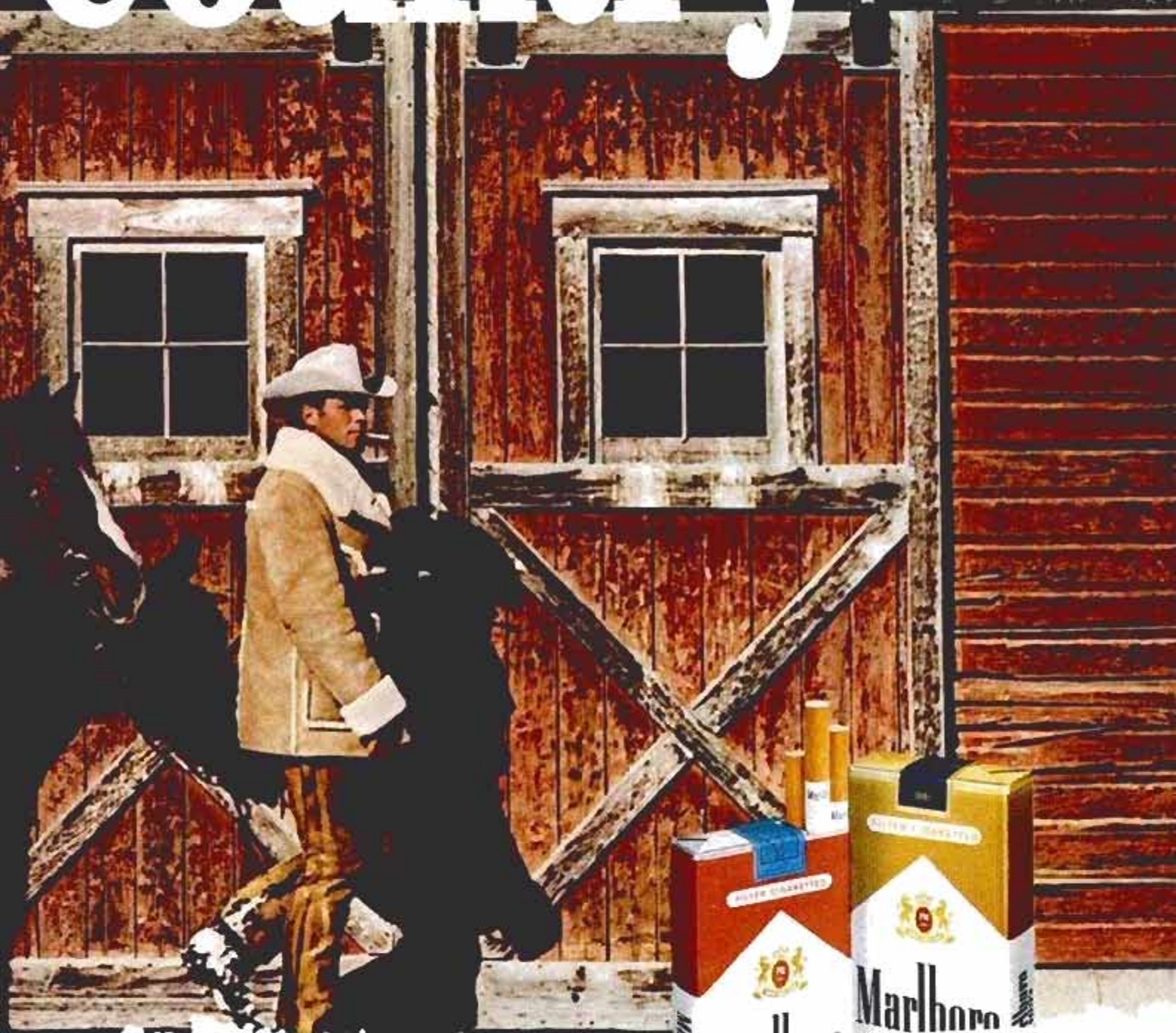


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The Shopsmith MARK V — the tool to start with . . . the system you grow with. It's a 10" table saw, a 16½" vertical drill press, a horizontal boring machine, a 34" lathe and a 12" disc sander.

Experienced craftsman . . . all-round handyman . . . weekend do-it-yourselfer — you've probably dreamed of owning your own complete home workshop to let you do more accurate woodworking. Let's face it, a few hand-held power tools just aren't enough. They won't let you handle those complex remodeling jobs, money-saving home repairs, or build furniture, cabinets and other beautiful wood projects.

You **should** have a big-capacity table saw, a top-quality drill press, a horizontal boring machine, a lathe and a disc sander.

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Published by The Hearst Corporation

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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 959 Eighth Avenue, New York, N.Y. 10019, U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harrison A. Mitnick, Treasurer; Harvey L. Lipton, Vice President and Secretary. Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Brink, Executive Vice President and General Manager; Raymond J. Petersen, Executive Vice President; Thomas J. Hughes, Resident Controller; William S. Campbell, Vice President, Director of Circulation.

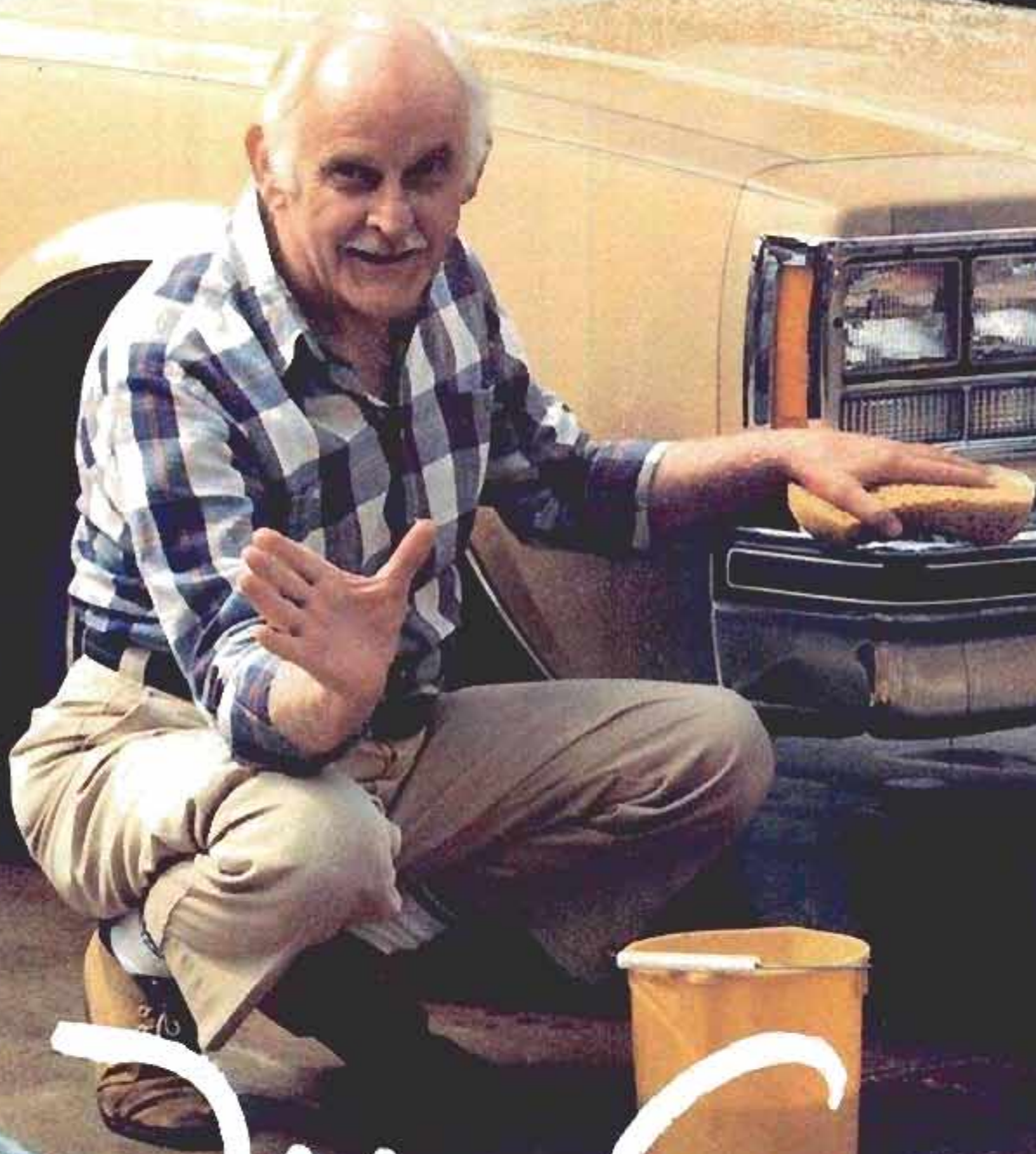
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AT THE END OF THE DAY, EVEN A FIRE
TURNS TO RED.

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Mr. Goodwrench is trained by General Motors to understand GM cars. He knows how to analyze problems. Fix them. And get me rolling again. Fast. And he can get genuine GM parts. To me, it's important to keep my GM car GM all the way through.

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So keep that great GM feeling with genuine GM parts at participating independent Mr. Goodwrench dealers selling Chevrolets, Pontiacs, Oldsmobiles, Buicks, Cadillacs, GMC and Chevy trucks.



Mr. Goodwrench



LETTERS TO THE EDITOR

Those super-slippery cars

I read with great interest Rich Taylor's article on automotive aerodynamics (*Searching for the Perfect*, 10, page 75, Sept. '81). I was very happy for the recognition of my late father's work.

Your readers might be interested in seeing a car similar to the one Rich mentions (photo below). It's a Citroen DS-19 that I modified 15 years ago to verify my father's experiments. Note the tailfins. They moved the center of pressure rearward, thereby stabilizing the vehicle and making it insensitive to side winds. It was a remarkable car to drive.

Today, we achieve satisfactory directional control and stability through other aerodynamic means in place of fins.

However, while they may result in more acceptable styling, they do not represent true aerodynamic stability. That's why we



Reader Kamm's test car, a Citroen, sprouting tailfins for aerodynamic experiments.

need—and have—vertical stabilizers on airplanes. Congratulations on a fine article.

IRMIN O. KAMM
TOWACO, N.J.

Irmin Kamm is the son of Prof. Wunibald Kamm, the noted German aerodynamicist whose pioneering studies more than 40 years ago helped to lay the groundwork for modern research on low-drag, high-mileage economy cars.

More fly-in fun coming

I enjoyed your *Notes from the Editor* column in the November '81 issue (page 16). I'm glad you liked our EAA Fly-In at Oshkosh, Wis., as all who attended seemed to.

Your readers might like to know about another aviation convention,

not quite as large as Oshkosh, but very friendly and lots of fun. It's the EAA's week-long Sun 'N Fun Fly-In to be held this spring at Lakeland, Fla. The dates are March 14 to 20. This event is sometimes referred to as "Oshkosh South."

Support of progressive magazines like yours is essential to the success of the little man in his continuing quest to fly. Congratulations for putting out such a superior magazine for so many years.

RUSTY HARDING
EAA CHAPTER 99
VERO BEACH, FLA.

Thanks for the kind words; we'll be following the Sun 'N Fun Fly-In, too. For readers who may have missed it, a report on some of the most outstanding homebuilt sports planes from the Oshkosh Fly-In appeared last month (see 12 Hot, New Sports Planes You Can Build, page 79, Jan. '82). Also watch our upcoming issues for an article on the latest in ultralights.

Yes, the Goose really flew

We greatly enjoyed Charles Barton's article on Howard Hughes's Spruce Goose (*The Day the Goose Flew!*, page 114, Nov. '81). It was very good and brought back many memories, as my husband, Harold Huntsman, was the engineer for the radio news team on that eventful flight.

They were the only radio news people allowed on the plane and were covering the story for all radio stations on a pool basis. Jim McNamara was the announcer, and Harold ran the tape recorder.

ETHEL H. HUNTSMAN
CONCORD, CALIF.

Where did Charles Barton get his information that the Spruce Goose actually flew?

I was stationed in San Pedro in the '40s and lived in a house that overlooked the bay. From my window, I could see every stick they put into the plane.

I watched the pile of lumber taxi from San Pedro to Long Beach and anyone who says it got off the water should have his eyes examined—or maybe his head. If you can show me one photo of it flying, I might change my mind.

CECIL MOORE
SGT., USA (RET.)
MONROEVILLE, N.J.

The photo we published with the article (reproduced below) clearly shows the Goose airborne. Many observers, both on board and nearby, also confirmed the liftoff. Perhaps



The Spruce Goose barely—but unmistakably—airborne in San Pedro Bay, 1947.

you were too far away, or too high up, to notice the separation between the hull and the water.

Can anyone help?

Your article *The Prinsendam Fire: History's Greatest Sea Rescue* (page 102, April '81) was spellbinding. As a writer, I am attempting to get in touch with one of the female survivors to do an article on her experiences. I wonder if any of your readers could help me.

DOROTHY C. LYNCH
9 ROSLYN CRESCENT
WINNIPEG, MAN. R3L 0H6

Forty-five minutes to Tokyo?

Having read your article on the airport launch system proposed for the space shuttle (*Tech Lines*, page 175, Sept. '81), I offer what I believe is a much simpler way of getting into space.

Why not just fit a Boeing 747 or similar large jetliner with auxiliary rockets? The craft would climb to maximum altitude on its jets, then switch over to rockets for orbital flight. Once it was clear of Earth's atmosphere, such a rocket liner could make the run from New York to Tokyo in about 45 minutes.

MITCHELL MCCLURE
BIG PINE KEY, FLA.

Intercontinental rocket liners may be an intriguing thought for the future, but the shuttle is designed for extended work in space and, because of this, requires highly sophisticated—and necessarily expensive—technology.

Sears goes nose to nose with the leading competitor.



Us.

The Sears Craftsman 20-HP Full Featured Garden Tractor gives you all this:

- Smooth-operating hydrostatic transmission
- 20-HP twin-cylinder engine
- Hydraulic lift for controlling attachments
- Optional front and rear P.T.O. (Power Take Off)
- Pinion and gear steering; 2 turns lock to lock

But the Sears Craftsman also has all these other important features:

- Gives you an average of 10% more horsepower at the drawbar than they do... More power where you need it.
- Sure stopping... because the hydro control returns to neutral as soon as you hit the brake.
- A 3-way seat that adjusts to your height, your weight and your driving angle as well.
- Three models: 18, 20 and the most powerful gas-powered garden tractor you can buy, 24-HP.
- **Only \$4,499.** About \$697 less than the leading competitor, based on an October 1981 market survey.*

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Available at most Sears retail stores.
Prices apply only to the continental United States.

*Based on the average negotiated price for a 19.9-HP tractor in an 8-market survey of 23 dealers. Prices vary by dealer.



Them.

The comparable model of the leading competitor's garden tractor gives you all this:

- Smooth-operating hydrostatic transmission
- 19.9-HP twin-cylinder engine
- Hydraulic lift for controlling attachments
- Standard front P.T.O. Optional rear P.T.O. (Power Take Off)
- Power steering; 2 3/4 turns lock to lock

I want to know more about the complete line of Sears Craftsman Full Featured Garden Tractors. Send me the facts. Mail to: FF Tractor, Sears, Roebuck and Co., Sears Tower, BSC 20-04, Chicago, IL 60684.

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For power and performance
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PM22

PM ELECTRONICS MONITOR

Canny calculators

If you need a programmable calculator, Hewlett-Packard has just come out with two new ones—the HP-12C and the HP-11C—that we think are super. The HP-11C is a full-feature scientific, and the HP-12C is a financial model.

First thing that impressed me about these calculators was their styling. They are both slim enough to fit in a shirt pocket, and they're complete with liquid-crystal displays. And one push of any of their inscribed buttons reveals the quality click-click feel of the keyboard.

It took a few calculations before I discovered another enjoyable feature—this in the LCD display. These calculators display numbers as you probably learned them—complete with commas. They're two of the few calculators on which it's hard to mistake 1,000,000 for 10,000,000.

Both models feature 200-line program memories. And they both include all of the special programming tools, such as indirect addressing, flags and conditionals, that are needed for the most complex programming chores.

Even used as nonprogrammable, everyday calculators, their built-in



HP-12C is one of two new Hewlett-Packard programmable calculators that we tested.

functions make them impressive. The HP-11C has everything you might need in math, engineering and statistics, and the 12C features such one-button pushes as compound interest, cash-flow analysis and internal rate of return.

I had never used an HP calculator before for any length of time and wondered how I'd adjust to the RPN—Reverse Polish Notation—system of entering numbers. These calculators have no EQUALS (=) key, only one labeled ENTER.

To do a problem like 2×4 , you first hit 2, then ENTER. Then you hit 4 followed by the \times key. Sounds confusing, but I found a few days' practice made it even easier than the usual



Don't nix the nixie

In the days before LEDs, the bright, lit-up, orange fluorescence of the nixie tube reigned supreme. We think they're still great for circuits that supply the voltage they need to operate (100+ v.).

Brighter and clearer than today's LEDs, nixies work as shown above. Stacked inside their neon-gas-filled shells are cathodes, shaped

like numbers. Each cathode can be lit independently of the others. This is done by energizing the cathode, which causes the fluorescent gas around it to glow (the cathode itself does not visibly light up, although the effect is essentially the same).

So next time you need numbers—think of the nixie.

algebraic method to which I was accustomed.

One problem: I wish HP had included lights on the LCD readouts. In a dimly lighted room, you can't see even a hint of these displays.

All in all, the HP-11C (\$135) and the HP-12 (\$150) are great values. Of course, those are list prices; hunt for bargains.

Loudmouth clock

Radio Shack's new VOX Clock was, I thought, only a gimmick. After all, a talking clock? But its conversational delivery can charm you.

A cube of less than 3 inches, with a blank, silver grille and button on top, it looks unassuming. But press the button and you'll hear some of the best voice synthesis I've heard from any appliance.

I'm still not sure if it's just a gimmick—but now, I respect it. The VOX Clock sells for \$59.95.

Floppy trilogy

"The Galactic Saga," from Borderbund, is a series of computer programs for the TRS-80 and Apple II which open new vistas, both in computers and literature. The Saga began as three computer programs ("Galactic Empire," "Galactic Revolution" and "Galactic Trader"), and recently a fourth ("Tawala's Last Redoubt") was added.

The programs follow the rise and fall—and attempted rebirth—of a

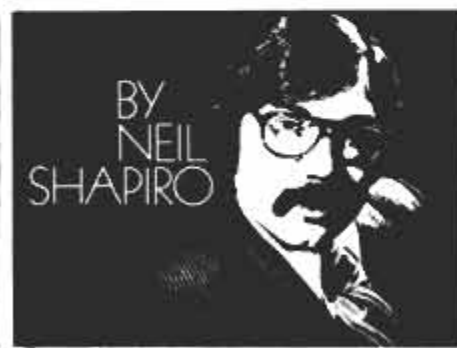
repressive galactic empire. And like the best in space-opera fiction, most of the action is seen through one protagonist's eyes.

In this case, Julian Dubuque is the name of the central character. But the computerist actually becomes the protagonist in this adventure.

Everything from operation of the spacecraft to collecting intelligence reports—and all of Dubuque's decisions—are controlled from the computer keyboard in the war against the somewhat rotten emperor Tawala.

I've gone through all of the programs and can attest that there's nothing else like them. No other computer programs show the depth of characterization evident here. And no other form of literature allows for this wondrous interaction between story creator and reader/protagonist.

The programs sell for \$24.95 apiece at computer stores. **PM**



RCA SELECTAVISION 650

NO VCR LETS YOU GET MORE OUT OF TELEVISION

RECORD YOUR FAVORITE SHOWS ON VIDEO TAPE.

If you don't own a video cassette recorder, you're not getting the most out of television. And no VCR lets you get more out of television than RCA's new SelectaVision 650.

Now you can watch what you want, when you want. With SelectaVision 650, you'll be able to record up to six full hours of your favorite TV shows on a single cassette.

Your recording sources are virtually unlimited. SelectaVision 650 has a new Cable-Ready Tuning System that can be set to include any of up to 35 CATV channels—12 VHF, 9 mid-band and 14 super-band channels.

That's a lot of entertainment. But then, SelectaVision 650 is a lot of VCR.

It records automatically, too. A 14-day memory lets you program selections to be recorded when you're not at home. Preset it to tape as many as eight different shows. Or set it to record the same show every day.

With SelectaVision 650, prime time television is yours any time.



PLAY THEM BACK WITH SPECIAL EFFECTS.

Ever slow down a rocket launch? Stop a stampede of buffalo? Or run a mile in less than two minutes? SelectaVision 650 lets you do all this, and more.

A new Infra-Red Cordless Remote Unit gives you the freedom to control special effects like *slow motion*, *stop action* and *fast motion*—from almost any point in a room. It also lets you advance the picture frame by frame. And freeze it whenever you choose.

That's not all. The new cordless remote also has a *picture search mode* that enables you to locate footage at 9X normal speed without having the screen blank out. And a *remote pause* for editing out unwanted material while recording.

SelectaVision 650. When you see it at your RCA Dealer's, you'll see why no one gives you more VCR than RCA.



RCA
VCR
No one gives you more

Simulated TV picture

For the complete line of SelectaVision VCR models and color video cameras, write to RCA Consumer Electronics, Department 32-312, 600 North Sherman Drive, Indianapolis, IN 46201.



RCA-Video Equipment
Supplier to the NFL.

Multiple units may be required. © 1981 RCA Consumer Electronics

IMPORTS & MOTORSPORTS

Show time!



Cosmo comes with rotary or piston engine.

With a thrust, a jab and a chop, the little Japanese carmakers are trying to trip up Toyota. At the recent Tokyo Motor Show, Toyo Kogyo slipped its .32-Cd Cosmo Coupe into place and had U.S. Mazda dealers wishing they could have it next to RX-7s in their showrooms.



Honda City is a three-door hatchback.

Nearby, Honda kicked up a frenzy with its City slicker. The 133-in.-long City, expected here in '83, was the star of the show. It is cleverly designed to fit a 1.2-liter, 67-hp, aluminum Four under the hood, seat tall passengers in the back seat and still have room in the hatchback for a 50-cc, fold-up moped that comes with the car in Japan. A bit of a gimmick to be sure, but so was Sony's Walkman, remember?

Just for show

Brace yourselves: Here comes the "Year 2000" assault. Two-zero-zero-zero is going to be the model number for everything. Volkswagen is first out—with its Auto 2000, shown at the Frankfurt Auto Show late last year. It's one of the most tantalizing little cars to grace a display stand.



VW Auto 2000 will be built before then.

Its coefficient of drag is .25 and power is 45 horses from VW's experimental, three-cylinder, turbocharged diesel. As with Honda's City, aluminum and various plastics are used to keep weight to a minimum. Hear that, Rusty Jones?

Big-bore Four

You can tell it's not a 924—too wide and terribly aggressive, clearly derived from the Carrera GTS. And under the hood is a new Porsche engine, a 2.5-liter Four. In Europe, it generates an astounding 163 hp, which gives this street car a top end of 138 mph and 0-to-60-mph acceleration in the eight- to nine-second range. The U.S. version of the 944 will be available in a month or so and



Porsche 944 is latest version of the 924.

probably cause some sorting out in the 924 line—possibly replacing the 170-hp 924 Turbo.

Detroit GP

Woodward Avenue won't be the only Detroit drag strip come June 6th. Plans are underway for a 2.5-mile Grand Prix course at the river front. The Formula 1 race will fall just before the Canadian GP on the calendar. Here's how the '82 season shapes up:

Jan. 24 South Africa	June 13 Montreal
Mar. 7 Argentina	July 4 France
Mar. 21 Brazil	July 18 England
Apr. 4 Long Beach	Aug. 1 Germany
Apr. 25 Italy (Imola)	Aug. 15 Switzerland
May 9 Belgium	Aug. 29 Holland
May 23 Monaco	Sept. 12 Italy (Monza)
June 6 Detroit	Oct. 3 Las Vegas

Defending champ is Nelson Piquet, who took the '81 title by one point last season at Las Vegas.

Metro with muscle

The Metro from BL Ltd. is a pleasant enough little car—in the same way that the Chevette is "nice." If you have no other way to get from A to B, they'll get you there. But for Brits who want to enjoy getting where they're going, there's the option of a Metro that's been to body-building classes. The conversion is marketed by Frazer Cars Ltd. with the body and engine hop-up handled by Tickford, the engineering arm of Aston Martin. The Frazer



Frazer Tickford is a hopped-up BL Metro.

Tickford, as it's called, gets 80 hp out of the 1.3-liter Metro engine and it moves like a modern—you guessed it—Mini-Cooper.

Mean, lean Lancia

There's no resting on laurels in motor racing, so Lancia is after the World Rally Championship again. The Italian manufacturer's new rally car is based on the Monte Carlo/Scorpion mid-engine sports car and it should be ready for competition in April. Lancia is one of the Fiat group (which also includes Ferrari); for complete lineup of its cars sold here, see *Imports '82* on page 75. **FM**



Lancia's rally car is stalking '82 title.



BY BILL HARTFORD

Nationwide taste tests prove it! Windsor Canadian beats V.O.!



Five hundred serious Canadian Whisky drinkers coast-to-coast just compared Windsor Canadian to the higher-priced Seagram's V.O.

Windsor was preferred.

So try a sip of Windsor and a sip of V.O. and prove to yourself what the taste tests just proved.

With Windsor, you can't beat the taste.

And you sure can't beat the price.

WINDSOR 
ONE CANADIAN STANDS ALONE

ALL OUTDOORS

Cold adventure

One by one, we rocketed over the crest of a hill, cranked into a tight turn on a steep new downslope and shot between trees lining a twisting, snow-packed trail. Mild forest sunlight flickered across the drifts, but at 30 mph the wind chill was still below zero in the lee of the woods, and frost was clouding the plastic face masks of our crash helmets. Suddenly, a sharp drop launched us out onto the flat racecourse of a frozen lake. Speeds pushed up to nearly 50 through roostertails of swirling snow as we headed for a restaurant



A snowmobile safari of 600 miles is the newest driving and eating endurance sport.

on the far shore. It was an introduction to the new sport of snowmobile cross-country safaris.

The rolling hills of Laurentian Quebec were a fitting setting. Snow-machine sport started its boom there about 20 years ago as more and more snow-region northerners discovered the new machine that didn't require the skill of skiing and could carry families out over miles of white countryside. Then came the specialized sports of closed-course racing and point-to-point marathons—contests that were often dominated by modified hot-rod machines and factory drivers. Clubs would gather for an all-day or evening trail ride. Half a dozen hardy types might plan a longer test, with an overnight camp at a distant cabin before the run back home.

But now the latest snowmobile challenge is a scheduled group drive of several days that covers hundreds of miles, with preplanned resort stops along the way. Snowmo drivers can attempt the complete circuit, or join up for a day or so and then drop out again. They can use rental machines or bring their own.

The safari is a natural combination of the 500-mile marathons and nonracing jaunts of local clubs. We signed on for a Canadian run covering nearly 600 miles of outstanding

provincial trails during four days, returning finally to the starting point. Our group of 20 men and women ranged in ages from 18 to 70. Organizers included Ski-Doo and Moto-Ski snow machines, O'Keefe beer and the Quebec Federation of 295 snowmobile clubs, an organization of over 500,000 members who have developed and use 32,000 miles of groomed and marked trails.

We found that, to average nearly 150 miles a day and on into the night for a group follow-the-leader run over strange new trails, you learn a lot. Exciting it certainly is, and considerable experience is necessary. The drive proved something of an endurance test, with the challenge of getting through remarkable French Canadian feasts at every food stop and then trying to continue on at breakneck speeds to a party at the next resort. What other sport could put nerve, stamina and stomach to such a test in such picturesque surroundings?

There's no doubt that snowmobile safari caravans will be a success, though they may require special training in snow driving through arctic cold, the French language, and gourmet dining and revelry. Further information is available from the Federation des Clubs de Motoneigistes du Quebec, 1415 Est. rue Jarry, Montreal, Que. H2E 2Z7, and Peter Ohrt, Bombardier Ltd., Valcourt, Que. J0E 2L0.

New for nearer home

Some recently announced equipment adds convenience for camping out, but will work just as well if you never leave your back yard. Like many outdoorsmen who are traveling less, Coleman—with its assortment of lanterns, stoves, ice chests, tents and sleeping bags—now is turning attention to yards and patios. The results will be in stores shortly and include a new propane yard light, plus charcoal and propane grills and smoker-grills.

According to a new *Coleman Smoker-Grill Patio Cookbook*, also available, you can moist- or dry-smoke, roast or bake, steam barbecue or simply grill with the new equipment. The grill can cook up to 25 pounds of meat at a time, and an optional kit will be able to convert it for smoking. The Smoker-Grill will take 50 pounds. Accessories include refillable LP-gas tanks, long-

stemmed thermometer, rib rack, propane hose and adapter, and hickory wood chunks for smoking.

Indoor heating and cooking with wood, in a cabin or at home, is covered in a \$2 booklet, *Woodburner's Manual*, from Leo Prince, 47 Lochinvar Rd., Kingston, Ont. K7M 6R9. Choosing and installing stoves, picking woods that give the most heat, preventing chimney fires and cutting firewood are explained.

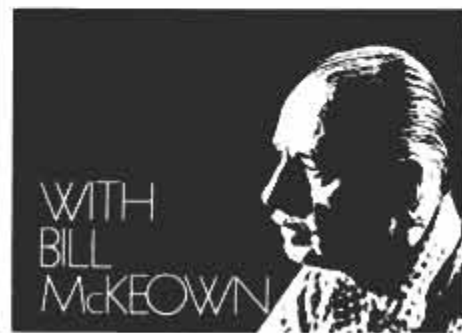
And for pleasure-craft skippers who make their back yard their boatyard this time of year, a new guide to home boat repair is *Boat Maintenance* by Bob Whittier. It's \$12.95 at bookstores or from Aztex, Box 50046, Tucson, Ariz. 85703. Whittier's *How to Buy a Boat* and *Seamanship for Sportsmen* are the same price from the same address.

Fishing facts from space

Since it was launched last June from Vandenberg Air Force Base in California, a special environmental satellite has been in orbit to monitor water temperatures. A scanning radiometer aboard measures and records visual and infrared imagery in five spectral channels to evaluate land, ice, water and cloud temperatures. The Commerce Department's National Oceanic and Atmospheric Administration (NOAA) plans sea-surface temperature charts that should benefit fishing and marine industries, weather forecasters and sportsmen with information about where good fishing should be.

Old-time tip

Scientists of the U.S. Army's environmental medical research offer this reminder: The best thing readers can do for older parents and friends this time of year is to talk them into wearing a knit cap indoors. It may look strange, but oldsters with reduced blood circulation will feel warmer all over. **PM**





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NOTES FROM THE EDITOR

John A. Silbitt

One of our most graceful and versatile writers, Hans Fantel, has a byline that's familiar to audiophiles everywhere. His most recent of many articles for PM is a report on nine new hi-fi cartridges (page 80). Hans also writes a nationally syndicated column on audio for the *New York Times*, and his new book, *Better Listening—a Practical Guide to Stereo*, was just published by Scribner's.

We've called on Hans in years past to report on such diverse subjects as nuclear fusion, atomic accelerators, the Orient Express and a probe of Mars.

With his writing published so widely and so frequently, we were, frankly, amazed to learn that English is his adopted language. A native of Vienna, Hans spoke only German as a young man. He escaped to the United States during World War II, and only then began to learn English.

He recalls having been enraged time and again over the frustration of trying to read American newspapers. Some three years of persistence paid off with such facility that he became a technical translator for the Air Force and for the Library of Congress, and, later, editor of *Stereo* magazine.

It's not the usual path to becoming an American writer, but in Hans's case, we're happy it worked.



This month's hi-fi layout is the focus of conversation with Author Fantel and Electronics Editor Shaprow.



Cover model: Latest fashion for divers.

Think you could breath a gas mixture containing only 3 percent oxygen at a pressure of 350 pounds per square inch—and survive? That's exactly what divers lived on as they recovered some \$90 million in gold from a ship 800 feet underwater (page 84). Divers learn to work in that hostile environment at such centers as the Professional Diving School of New York, where cover artist Ed Valigursky observed trainees in action (photo). A brand-new hyperbaric chamber system there can simulate dives greater than 1,000 feet, helping prepare divers to push the underwater frontier deeper than ever.

PM

New from NRI!

The first at-home training in videocassette recorder repair with exclusive videotaped lessons.

Learn Video/Audio Servicing... includes RCA state-of-the-art VCR, NRI Action Video lessons, plus full training in color TV and audio repair.

Now, you can learn the hottest, most wanted skill in home entertainment electronics... servicing and repairing videocassette recorders and video disc players. Well over 2 million units have already been sold and the demand is just starting! Already, qualified VCR technicians are in short supply... people are waiting up to a month for VCR repair. Good jobs at good pay are going begging. And NRI can get you in on the action with convenient and effective at-home training.

Choice of Specialized Training

NRI offers you three Master Courses in Video/Audio Servicing, each complete, each with equipment and training for the specialty you want. Each course thoroughly prepares you for color TV plus audio and video equipment. Then, you take the specialized hands-on training on the equipment you select.



Learn as you work with equipment you keep.

You can get specialized audio experience as you build your own AM/FM stereo system complete with speakers. Or gain real bench experience with hands-on TV training as you build a 25" (diagonal) fully-computerized, programmable color TV and professional test instruments. Or train with your own RCA videocassette recorder and NRI's exclusive Action Video servicing lessons on videotape.

State-of-the-Art VCR

This modern VCR features high-technology design with electronic pushbutton tuning, remote control, three recording speeds with up to 6-hour capacity, high-speed visual search, built-in clock/timer, memory rewind and audio dubbing capability. Direct drive motors and azimuth recording give outstanding picture reproduction.

It's yours to keep, as part of your training. You'll not only use it to learn operation and servicing techniques, but to play the absorbing NRI Action Video lessons that come as part of your specialized training. In word and picture, you'll learn theory, construction, and service procedures, see them explained in graphic closeups. And you get this unique training only with NRI!

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More than 65 years and a million and a half students later, NRI is still the first choice in home-study schools. A national survey of successful TV repairmen



shows that more than half have had home-study training, and among them, it's NRI 3 to 1 over any other school.

That's because you can't beat the training and you can't beat the value. Only NRI combines exclusive fast-track training techniques with modern state-of-the-art equipment to give you the skills you need for success quickly and easily. Only NRI offers such complete training with so many timely options for specialized bench experience. Send for our free catalog and get all the facts on these exciting Master Courses in Video/Audio servicing.

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Mail the postage-paid card today for your free copy of our 100-page look into tomorrow. It shows all the equipment you get, describes each lesson in detail. And it tells you about other important career opportunities in Microcomputers and Microprocessors, Digital and Communications Electronics, Electronic Design Technology, and more. Send today and get started on a big new future for yourself. If card has been removed, please write to us.



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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Fuel monitor

The miles-per-gallon game is on everybody's mind these days, especially if you have a lead foot like mine.

Whistler, known for its radar, has a fuel-monitoring device called Fuelscan. Installation consists of five electrical connections and a me-



Compact Fuelscan monitors miles per gallon and distance, in miles, to an empty tank.

chanical distance transducer between the speedo cable and the back of the speedometer. No connections are made to the fuel lines or to the fuel tank. Instead, fuel flow is monitored from the fuel gauge in your car. Fuelscan will tell you how many gallons you have in the tank, miles until empty and (instantaneous) miles per gallon.

The Fuelscan retails for \$169.95. Whistler's address is 410 Great Rd., Box 37, Littleton, Mass. 01460.—*Joel Breault*

Tire gauge

It's a proven fact that tire pressure affects gas mileage as well as tire wear. Here's an easy way I found to



Pressure gauge mounts on valve stem and indicates tire pressure when it's pushed.

check inflation with hardly any effort at all: Air Chek on-the-wheel tire gauges.

Each plastic unit fits on the valve stem of your tire. With a slight push and a twist of the wrist, the Air Chek displays air pressure from 10 to 42 pounds. The package of four retails for about \$5 and is manufactured by Kalinco Inc., 1154 Floyd Dr., Lexington, Ky. 40505.—*Joel Breault*

Plug-in adapter

My Chevy Cavalier has only one 12-volt cigaret-lighter socket and I have three accessories I want to use. The solution? Dynamic's Triple Plug-in Adapter. The small box mounts on the underside of the dash via double-faced tape or in the glove-box. It plugs into the car's existing socket, has an on/off toggle switch, a power "on" indicator light and three electrical sockets.

The adapter sells for about \$14.95 at most auto stores. The Dynamic



Adapter lets you use three accessories from your car's cigaret-lighter socket.

Instrument Corp. is located at 933 Motor Pkwy., Hauppauge, N.Y. 11788.—*Joel Breault*

All-battery jumper cables

Inside the jaws of Cobra Clamp jumper cables are hefty, swing-out spade connectors for side-terminal car batteries. Thus, you can use Cobra Clamps on batteries with either conventional top-mounted posts or the side-terminal sorts found in late-model GM and some imported cars.

Cobra Clamp uses an especially flexible copper cable, and the plastic sheathing also remains flexible, even in cold weather. These jumper cables come in 250- and 400-amp. ratings and varying lengths. The 6-foot, 250-amp. set retails for about \$9 in chain stores. Cobra Clamps are man-



Clamps have fold-out adapters which you can clip onto side-mounted battery posts.

ufactured and distributed by Auto-Line Manufacturing Corp., 40 Railroad Ave., Copiague, N.Y. 11726.—*M.L.*

Fog lights

KC HiLites now offers a tremendous range of aftermarket lamps for cars, trucks, off-road vehicles, cycles, vans—just about everything on wheels.

Fog plagues the valley where I live, so I installed a set of KC's quartz lamps on our family Fairmont. These are 8,700-candlepower units with a range of 1/4 mile. Set under the bumper, as near the road



Fog lights from KC mount below the bumper to throw a strong beam low on the road.

surface as possible, they really do cut the mist, particularly at night.

KC's Type 1553, which retails for \$37.60, comes with an illuminated dashboard switch, all wiring and connectors, plus instructions.

To obtain a catalog, send 50 cents to KC HiLites Inc., Williams, Ariz. 86046.—*M.L.*

CLASSES ROOM

Our Cougar wagon is designed to do more than carry lots of groceries.

It's designed to go lots of places. Because this is one wagon that's at home at the opera as well as the supermarket.

The plush Cougar appointments provide a feeling of unusual luxury in a practical, mid-size wagon.

There's a new V-6 engine option.

And options like a choice of sound systems and a two-way liftgate let you tailor your wagon just the way you want.

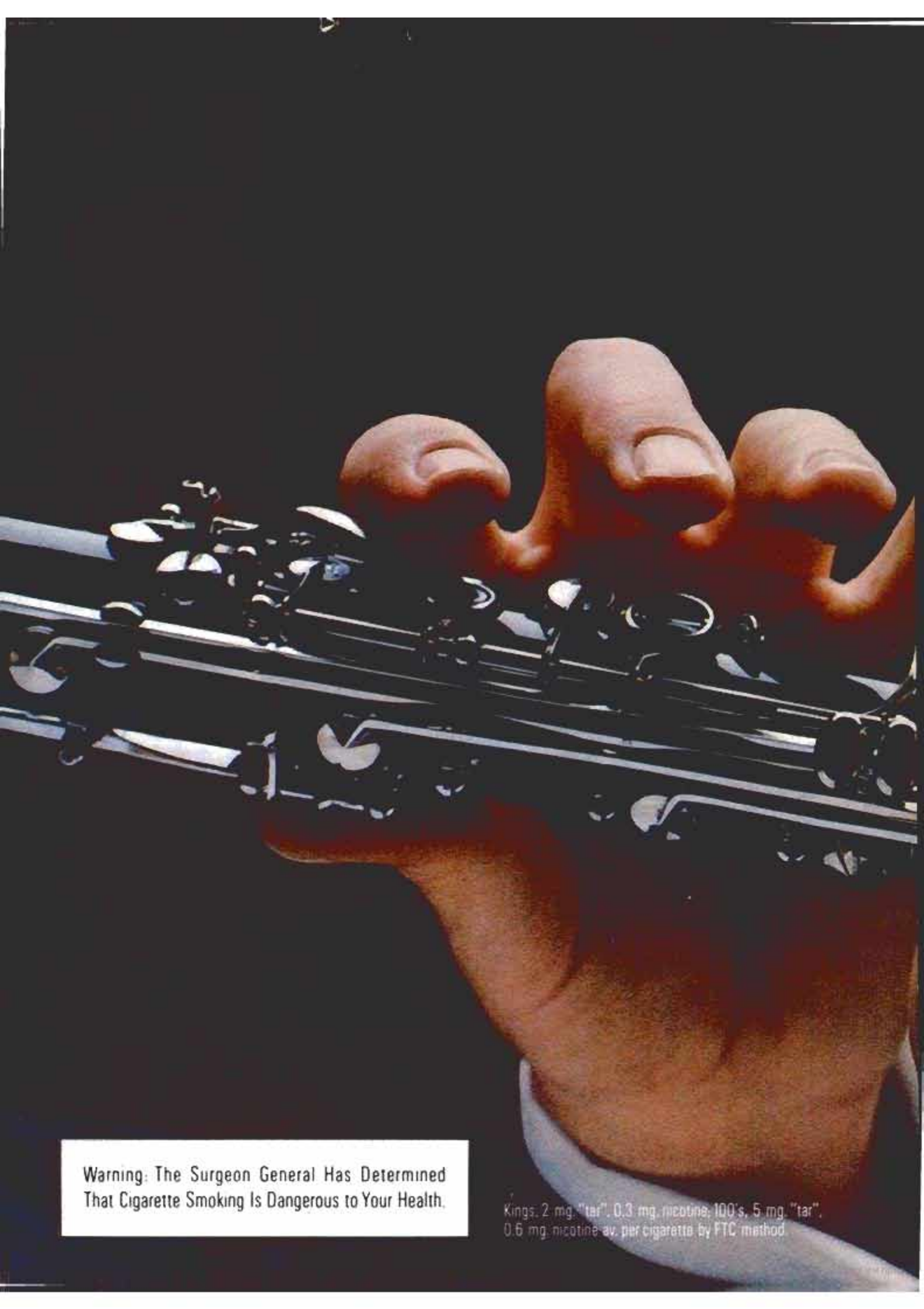
After all, the most important thing your new Cougar wagon will carry will be you.

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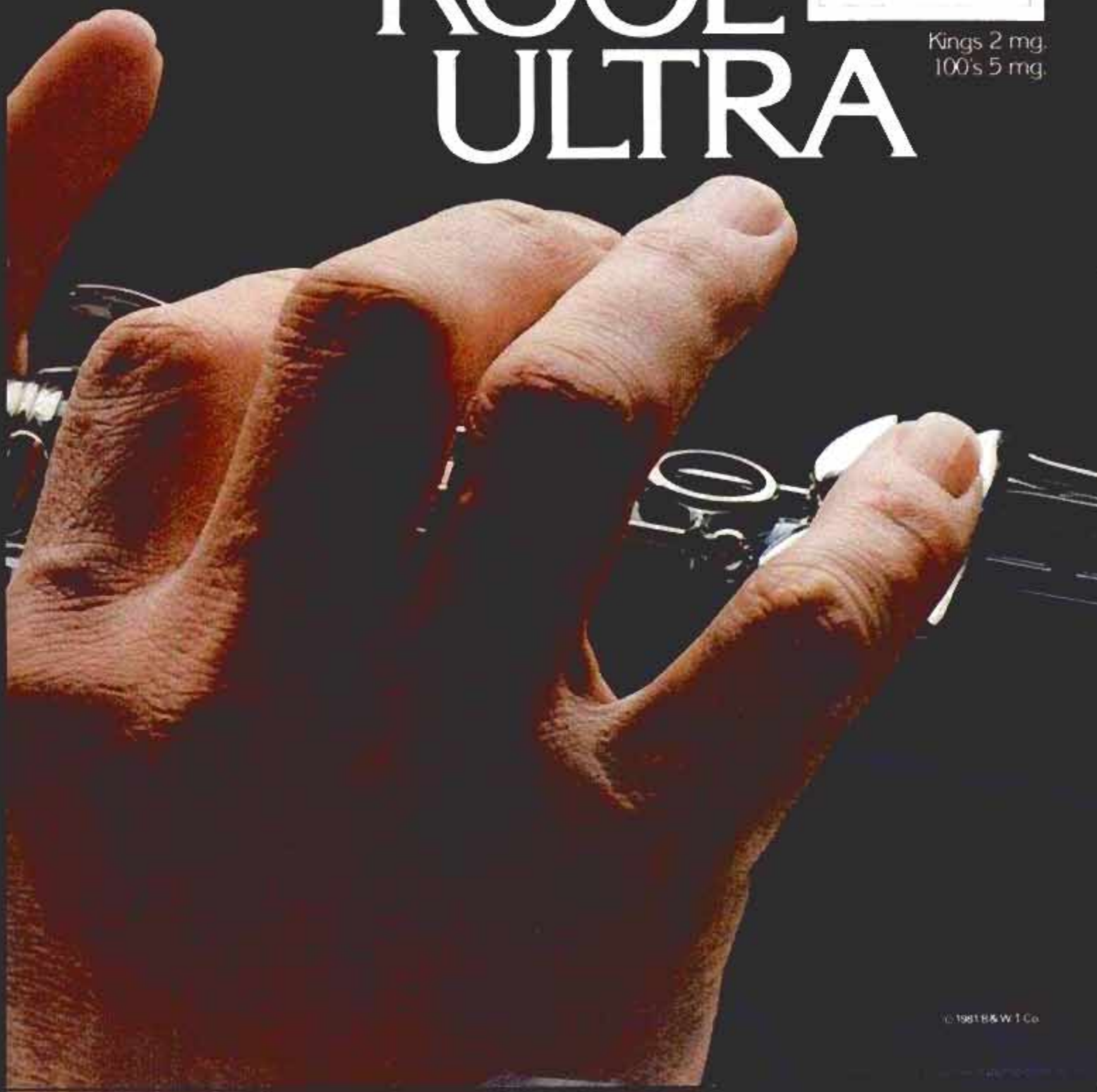
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SCIENCE WORLDWIDE

Salmon going up

Fish and Wildlife officials report a record 515 spawning Atlantic salmon made their way into the Connecticut River in the 1981 spring run. That's about double the 1980 count and is encouraging to naturalists who hope to see salmon fishing in New England this decade for the first time in 200 years.

The salmon disappeared from the river when industrial dams were built. Then, in the 1870s, the Holyoke Water Power Co. created the first of three unsuccessful fish ladders—a system of locks and levees—over its dam.

By the 1950s, scientists understood the problem: The ladders weren't providing the strong water turbulence that attracts salmon upstream. That's when Holyoke opted for a fish elevator, located in the area of maximum turbulence at the base of the dam, to attract fish into a trap. Then they're hoisted to the top of the dam.

The elevator hauled only shad up the dam until the 1970s, when officials began to restock the river with salmon. The elevator is the mainstay of the system: Of the 515 returning fish in the record run, more than 300 went up the easy way.

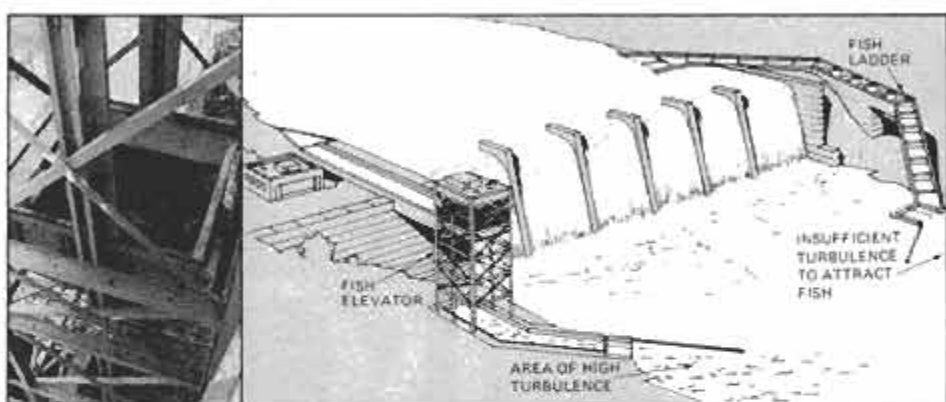
Scientists watching the Connecticut salmon run still have a lot to learn about how the fish know which tributary leads to their home spawning grounds. Several workers are researching the salmon's ability to smell chemicals associated with the waters of their spawning grounds.

Some fractures are miscast

Some orthopedic surgeons "make a fetish out of applying plaster casts," according to a University of Toronto medical researcher studying treatment of injured and diseased joints.

In both human and animal studies, injured synovial joints (knees, elbows and hips) healed more completely when set in a specialized "splint" that permitted a preset range of motion. The findings by Dr. Robert B. Salter were reported in the *Journal of the American Medical Association*.

Salter believes the restricted motion works better because it allows nutritious, natural synovial fluid to flow through the joint. He also notes that elderly arthritics may unwittingly use the restricted-movement



Holyoke Dam's turbulent water is shunted to base of fish elevator, attracting salmon that wouldn't follow calmer waters to fish ladder. Photo at left shows elevator going up.

regimen when they move back and forth continuously in their rocking chairs.

Meantime, in Greenwich

Astronomer Charles Kowal will visit Greenwich, England, later this year in search of a 10th planet in our solar system. The California Institute of Technology skywatcher, who discovered two of Jupiter's 15 moons in the 1970s, excited the astronomical world in 1977 with his discovery of Chiron.

When first observed, Chiron was identified by Kowal and others as possibly being a 10th planet, whose existence and gravitational influence was long suspected because of slight wobbles in the orbit of Neptune.

Later that year, however, astronomers changed the classification to planetoid (which is the same as asteroid). Closer observation indicated that Chiron, at less than 200 miles in diameter, was a bit too small to be called a planet.

Of course, questions persist about Neptune's orbit, and near-space astronomers think that they haven't exhausted the search for planet No. 10. While in Greenwich, Kowal plans to go over sky charts created by the Astronomer Royal (like Poet Laureate) that include observations of Neptune made in the 18th century. That's about 100 years before it was designated a planet and when it still was seen as a star.

Armed with that data, Kowal will return to his Pasadena computers and telescope to resume the search. Kowal, incidentally, is an unusual researcher in that he hasn't pursued a degree beyond the B.S. He says he's content with charting the skies and hunting for unknown objects.

Search for a little genius

If you're a high-school junior or senior, you're likely watching the mail for your College Board Scholastic Aptitude Test (SAT) grades. Top score is 800, but you're probably just hoping for a score approaching 700 on math and 630 in verbal abilities, achieved only by the top five percent of America's 16- and 17-year-olds. But you don't have to be 16 or headed for college to be able to take the test.

In fact, if you're 13 or younger and have achieved a very high SAT score, Johns Hopkins University researchers want to know about you. They've joined colleagues from Duke, Arizona State and the Midwest Search Committee in a hunt for an estimated 800 preteens believed capable of scoring with the best in either math or science.

For information on the math search, write: Dr. Julian Stanley, 125 Ames Hall, Johns Hopkins University, Baltimore, Md. 21218. Information on the verbal test is available from: William George, Merryman Hall 104, also at Johns Hopkins. To register for the \$10.50 SAT exam, contact the College Entrance Examination Board (CEEB), Princeton, N.J. 08541. **PM**



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On a recent, 18,000-mile, two-week whirlwind tour of Germany and the United States, I drove four of the newest cars to come out of Germany. While they all share a common homeland, they have very different personalities and are designed to appeal to very different segments of the market. Moving from east to west, here's a rundown of what these new cars are like to drive.

Mercedes 380SEC

First stop was Frankfurt, Germany, where my Mercedes-Benz hosts put me behind the wheel of the European-version 380SEC and pointed me toward Baden-Baden. This two-door coupe is the latest addition to the S-class cars, which include the 300SD four-door Turbo-diesel and 380SEL gasoline-powered four-door. The 380SEC shares the same all-aluminum, 3.8-liter V8 engine with the SEL, but is some 3.4 inches shorter in wheelbase and overall length.

The torrential downpour that followed me every inch of the way gave me an excellent opportunity to try Mercedes' ABS antilockup braking system, which is not yet available in this country. The ABS brakes are designed to prevent the wheels from locking up under severe braking. The system senses impending lock-up and automatically modulates pedal pressure, four times per second, until the car comes to a complete stop. It is an excellent system and one I look forward to seeing in U.S. versions.

On one particularly dreadful evening coming into Baden-Baden, the ABS system proved its worth when I came upon a 900-cc Renault R5 pattering along on the wrong side of the road at some 30 kilometers per hour. I was doing about 120 kmph around the curve and had to stand on the brakes for all I was worth. The pedal went to the floor

(Please turn to page 28)

FIRSTHAND REPORT

Driving four new German cars

Something old, something new, something borrowed and something with a rev limiter.

by Tony Assenza
AUTO EDITOR



The Quantum, VW's new flagship, based on Audi 4000, replaces the Dasher in VW's lineup.



High rollers rejoice: The 380SEC, the latest addition to Mercedes' S-class, is here.



Restyled, but mechanically unchanged, the new Scirocco slices the air with a low .39 Cd.



BMW's 528e is a brand-new old car with an efficient, 2.7-liter fuel-injected engine.

BE YOUR
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BOSS!



Now you can cash in on the huge demand
for SHARPENING SAWS and TOOLS.

Make \$8⁰⁰ an hour...

or more. Work part time, full time, right at
home. No layoffs. No strikes. Provides
a steady source of year round income.

**Read What These Foley
Shop Owners Say:**

Shop will gross \$40,000...

... likes being independent

"I worked in various industrial jobs for years, and always wondered if I could make money for someone else, why I couldn't do it for myself. So after losing my regular job, I opened my Foley sharpening shop in the basement of my home. I only had a minimum of cash to start with, but Foley financed the balance. My shop will gross over \$40,000 this year, and I like the feeling of running my own shop without answering to someone else."

William Wescott

Willoughby, Ohio 44094



Husband and wife have a going spare time shop

"I'm a construction foreman, and my wife is a nurse's aide. Our Foley shop fits in nicely with our regular jobs, and we earn extra money. Our sons help out too, so ours is a real family business."

"I'm still too young to retire, but when I do I'll have a very good business built up. Foley equipment helps us to do good work and brings customers back with more jobs on a regular basis... we have a lot of repeat business the year around."

Victor Kosloski

Sturgis, Michigan 49091



Glad he chose Foley for his saw shop

"I worked as a carpenter all my life, but when a back injury forced me to quit I decided to go into sharpening full time. I'm very proud of my shop and glad my choice was Foley equipment... it is superb. I made over \$48,000 last year, and this year it will go more than \$50,000."

Victor Johnson

Lincoln, Nebraska 68507

This can be one of the most important decisions you ever make

Going into business for yourself can be the most exciting and rewarding decision you're likely to make in your lifetime.

Owning your own business brings you a sense of independence. You're the boss, setting your own work hours. Your own effort builds the business for yourself and your family. You can achieve great satisfaction and profits, if you choose and manage your business wisely. That's why so many men, just like you, are cashing in on the big profits to be made in this fast-growing service field.

The sharpening business allows you to get started with only a minimum investment, requiring little space and effort for a successful operation. It lets you build and expand as fast, or as slowly as you like. You pocket most of the money you take in, because there are exceptionally high profits with no investment in merchandise.

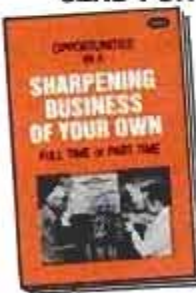
If you need only \$200 or \$400 extra income each month, a sharpening business is ideal for spare time. The additional dollars can be SPENT for more of the good things of life. Or they can be SAVED in a rainy-day fund that the family can bank on.

More sharpening businesses are needed every year

As original equipment continues to climb in cost, owners are becoming more concerned that the equipment be maintained so that it performs like new. This means more companies, contractors, carpenters and home owners are having their old saw blades and tools resharpened many times, where in the past, they would have replaced them with new blades or tools. This is where you

can step in with the much needed service of sharpening saws and practically any kind of tool.

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Thousands of good men have been inspired by this fact-filled book into making that first important step of starting their own

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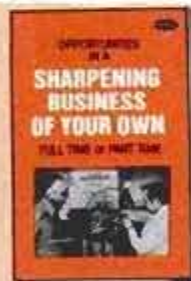
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Despite the all-new sheet metal, the 528e looks almost identical to the 528i it replaced.



Warning lights set in the headliner alert the driver to a variety of malfunctions.

FOUR NEW GERMAN CARS

(Continued from page 26)

and the system kicked in, going chunk-a-chunk. The nice thing about this system is that it allows you to maintain control of the steered wheels while braking for dear life.

As much as I liked the ABS system, I can't say the same for Mercedes windshield wipers. They're just not quick enough to move the water off the windshield in the really wet stuff. Too bad, because the rest of the car is an absolute marvel.

Driving down the Autobahn at 220 kmph in the rain is an experience only a Mercedes can provide. It's surefooted, quiet and more comfortable than a Barcalounger. And on top of all that, it handles with the precision of a sports car.

On the twisty mountain roads of Friedrichsruhe the always-gracious Mercedes hosts persuaded me to test their car on a very wicked test loop. In the dry, this loop would be a challenge—in the rain it was a form of lunacy. But it's the kind of lunacy a Mercedes lets you indulge in and live to tell about.

Any car's suspension and handling characteristics are a compromise. Engineers must trade off ride compliance against cornering ability, transient response against steady-state handling and so on. Perhaps the thing that makes a Mercedes a Mercedes is its ability to make the best of all possible compromises—to the point where you feel no compromises have been made.



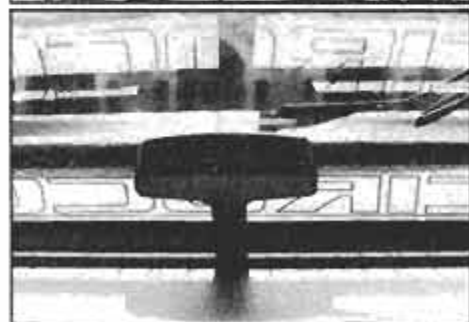
High-efficiency eta engine gives lots of low-end torque, is fitted with a rev limiter.

In typical Mercedes fashion, this new car has been massaged and stroked in every conceivable way, many of which an owner will never notice unless he rolls it or wads it up against a telephone pole.

There are, however, a few things about this new car that are out of place.

The absence of a B-pillar, for instance, necessitated mounting the front passenger's seat-belt anchors in the rear panel. The belts are connected to a safety-belt feeder. This is a mechanical arm which extends when you slip the key in the ignition. It looks and acts much like the mechanical arm that fed Charlie Chaplin a diet of nuts and bolts in his movie *Modern Times*. It's very spacey, cute and clever, but it's an

(Please turn to page 30)



In direct sunlight, Scirocco's rear vision is hampered by spoiler, logo and wiper motor.



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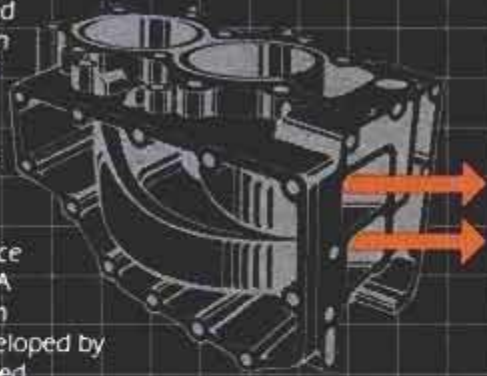
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Quantum hatch looks a bit like a mini-Citation, though in base form, it's \$3,000 more.

FOUR NEW GERMAN CARS

(Continued from page 28)

annoyance to have this mechanical arm thrust a seat belt in your face. Frankly, that sort of thing is, to me, just gimmickry.

The other thing that bothered me about the car was the new seats. They look very much like aftermarket, high-buck Recaro seats. Several other testers and I had a real problem getting comfortable in them. They were great in fairly short rides, but after a few hours, they were uncomfortable and required juggling the six-way power adjusters to get settled in again. Some fine tuning here should clear up the problem, we hope.

VW Quantum and Scirocco

Two days later and 5,000 miles west of the Swabian mountains, I was in a Quantum in the rolling hills of western Pennsylvania—and in rain again. The Quantum is VW's all-new flagship in this country, though it has been available in Europe for about a year. The Quantum is essentially an Audi 4000 dressed down to look like a Volkswagen. It's a nimble car that drives and feels quite a bit like the 4000, but priced a few dollars cheaper. On the slick, leaf-strewn back roads of La Belle, Pa., the car was a ball to drive. Though lacking the grace and style of a Mercedes, it's well balanced and very sure of itself in rapid, twisty motoring. It's not a ball of fire off the line and it takes quite a bit of stick stirring to keep the car moving along. The gear ratios, however, are nicely spaced and it's easy to find the right gear for any given corner.

The test car came equipped with excellent Goodyear NCT radials, which helped the car substantially. There were times when the suspension had all but given up, fully compressed and riding on its bump stops, but the car still managed to keep a nice tight line through the snaky two-laners, thanks to the tires. You could feel the tires nibbling and getting just a tad sideways, but never going away com-



The Quantum's interior is quite pleasant and comfortable, if somewhat uninspiring.

pletely, to the point where you would get into real trouble.

The styling, both inside and out, is somewhat underwhelming. It just doesn't look like a flagship car. While comfortable and pleasing, the interior is lackluster and actually looks dated.

The Quantum will be available in three body styles—a four-door wagon, two-door hatchback coupe and four-door sedan. The wagon will be the first car in the showrooms, with the coupe to follow in the spring of '82 and the sedan by the fall of '82. All share the identical 1.7-liter Four and virtually the same interior trim and appointments. The coupe, incidentally, bears a striking resemblance to the Chevy Citation in the cut of its roofline and the glass area.

The Scirocco, looking all new in its aerodynamic bodywork, remains largely unchanged from last year's model. Dr. Ing. Rolf Buchheim, VW's aerodynamicist, has massaged the shape of the Scirocco to the point where it now slices the wind at a very low Cd of .39. This was done by increasing the windshield rake, removing rain gutters and substituting troughs in the roof to act as gutters and restyling the entire rear of the car. The rear glass is now curved and follows the form of the body.

On the road, the Scirocco feels fabulous. To my mind, it's the standard for any other front-wheel-drive sport coupe on the market. It's tight,

(Please turn to page 32)

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Protect your Home and Business with this new micro-computer burglar alarm "FREE" for 30 days.

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COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines pre-entry protection with micro-electronic circuitry to provide the most protection at the lowest cost.

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We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 26 year reputation for satisfied customers.

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To order simply send your check for \$199.95 plus \$5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

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THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the most advanced security system available for consumer use. With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

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HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for



This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.

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KING: 15 mg. "tar", 1.1 mg. nicotine, av. per cigarette by FTC method.

FOUR NEW GERMAN CARS

(Continued from page 30)

precise, quiet and has a wonderful combination of ride quality, road feel and responsiveness that makes any good car fun, yet forgiving to drive quickly.

It's a bit cramped on the inside—you don't so much get in the car as wear it. But once you're buttoned up in the deeply bolstered seats, fire up the ohc 1.7-liter Four and grab the thick wheel, you'll find it hard to keep it anywhere near the speed limit. The car wants to be driven quickly.

We spent a pleasant week with the new Scirocco, moving from the aforementioned twisty two-laners of Pennsylvania to the sinister cut-and-thrust of New York City traffic. In both environments, the Scirocco proved to be a reliable weapon. It smooths out the craters that pass for streets in this town and it squirts through the merest hint of a hole in the traffic pattern. The ohc 1.7 is zappy enough to allow you to play hide-and-seek games among the slugs that take possession of the road at rush hour. But the car is not without its faults.

First off, the excellent aerodynamics work to its disadvantage in the rain. Due to its single, centrally



Win

Nobody does it

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mounted windshield wiper, it leaves a large triangular area unswept just to the left of the driver. At highway speed in the rain, the water in the unswept area is driven back up the windshield, where the wiper slashes it up and down in front of the driver's face.

The other problem is with the rear-glass area. Rear vision is obscured by both the rubber spoiler that cuts across the bottom of the glass and the rear-wiper motor. The motor is housed in a T-shaped pod, mounted directly on the glass. This is bad enough, but in direct sunlight, the Scirocco logo stenciled in outline type across the bottom of the glass just below the spoiler is reflected all over the back of the rear glass. On one occasion, I peeked into the rear-view mirror and saw the back of my car following me, and not very much else.

Inside is cramped

My one remaining criticism is interior space. There isn't enough of it. It's cramped up front and the two rear seats are useless for anything but a tote bag—and a small one at that. But then again, I suppose that if you want rear-seat room, VW wants you to buy the Quantum. You'll have all the room you want. But you'll miss that handling.

BMW 528e

Our final stop on the 18,000-mile odyssey was Santa Barbara, Calif. We were there to ask the question, "What is going on with BMW, anyway?" Frankly, the 528e left us more than just a bit puzzled. The e stands for eta, the Greek symbol for efficiency. And the all-new engine is built with that principle in mind.

I first sensed some peculiar notions in Bimmer-land when I scrambled up the Centinella St. on-ramp of the San Diego Freeway. I slipped the car into first gear, let up the clutch and buried the pedal. The engine revved beautifully but, just as the tach needle hit 4,700 rpm, the engine started cutting on and off. I thought I had broken the silly thing. I got it into second, and tried it again. At 4,700 rpm the engine started cutting on and off again—a rev limiter!

On straight, level roads, even at elevated speeds, the car is flawless. It tracks straight, feels stable and is well insulated against road and wind noise. But try to climb a steep grade; you'll find yourself being passed by semis and Buicks.

The problem lies with the eta concept. What BMW has done is move the power curve down from 4,300 to around 3,500 rpm. They've also made the engine more efficient by reducing frictional losses. This was

done by, among other things, going with light valve springs. Since the springs are so light, valve float becomes a problem at high rpm: The rev limiter became necessary to avoid bent valves.

As anemic as the engine felt, it certainly is economical. On a run from Los Angeles to Monterey and back, we averaged a steady, flow-of-traffic 65 mph and got 27.8 mpg—a phenomenal number, considering the engine had less than 600 miles on it when we started.

Carbon copy

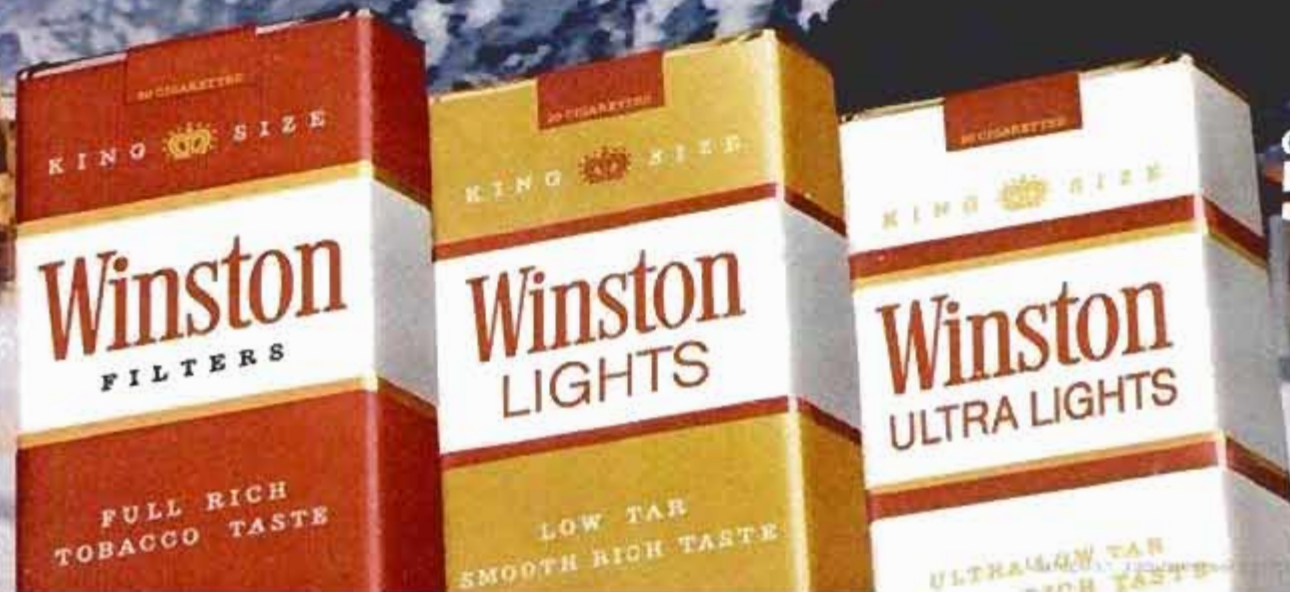
One area in which 528e owners won't get their money's worth is its status value. Although the only parts the i and e share in common are the roof and door panels, the two look almost identical. If they were starting with a clean slate, why didn't they go the whole route and make the radical change which seems long overdue in that series? The argument that they wanted to retain a family resemblance seems weak. A major redo need not obliterate all traces of heritage. Just look at the new 300SD. Despite the clean break with the past, it's obviously a Mercedes. For \$23,000, a new 528e owner might be justified in feeling that he could have gotten a bit more for his money. **PM**

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Winston

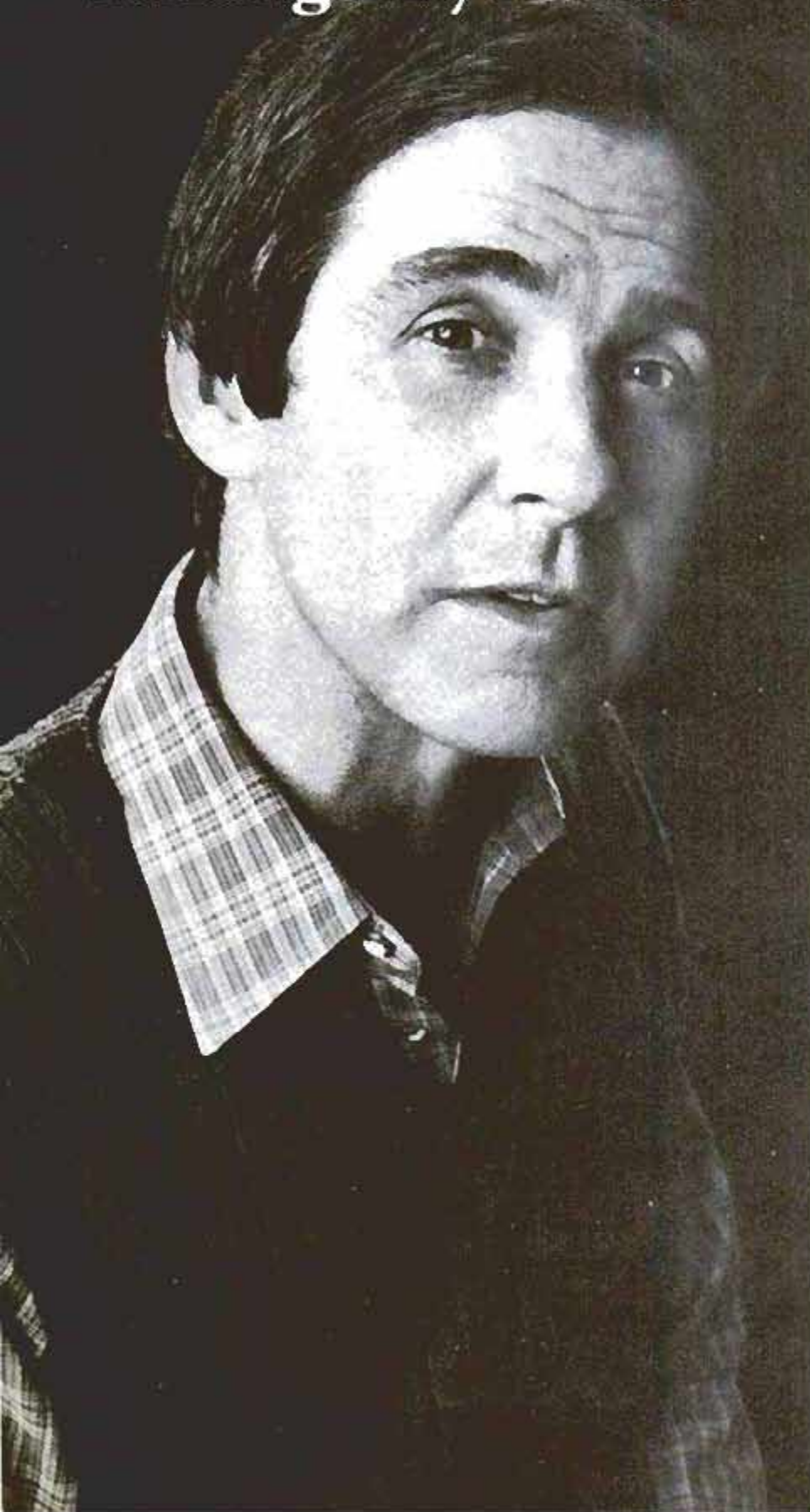
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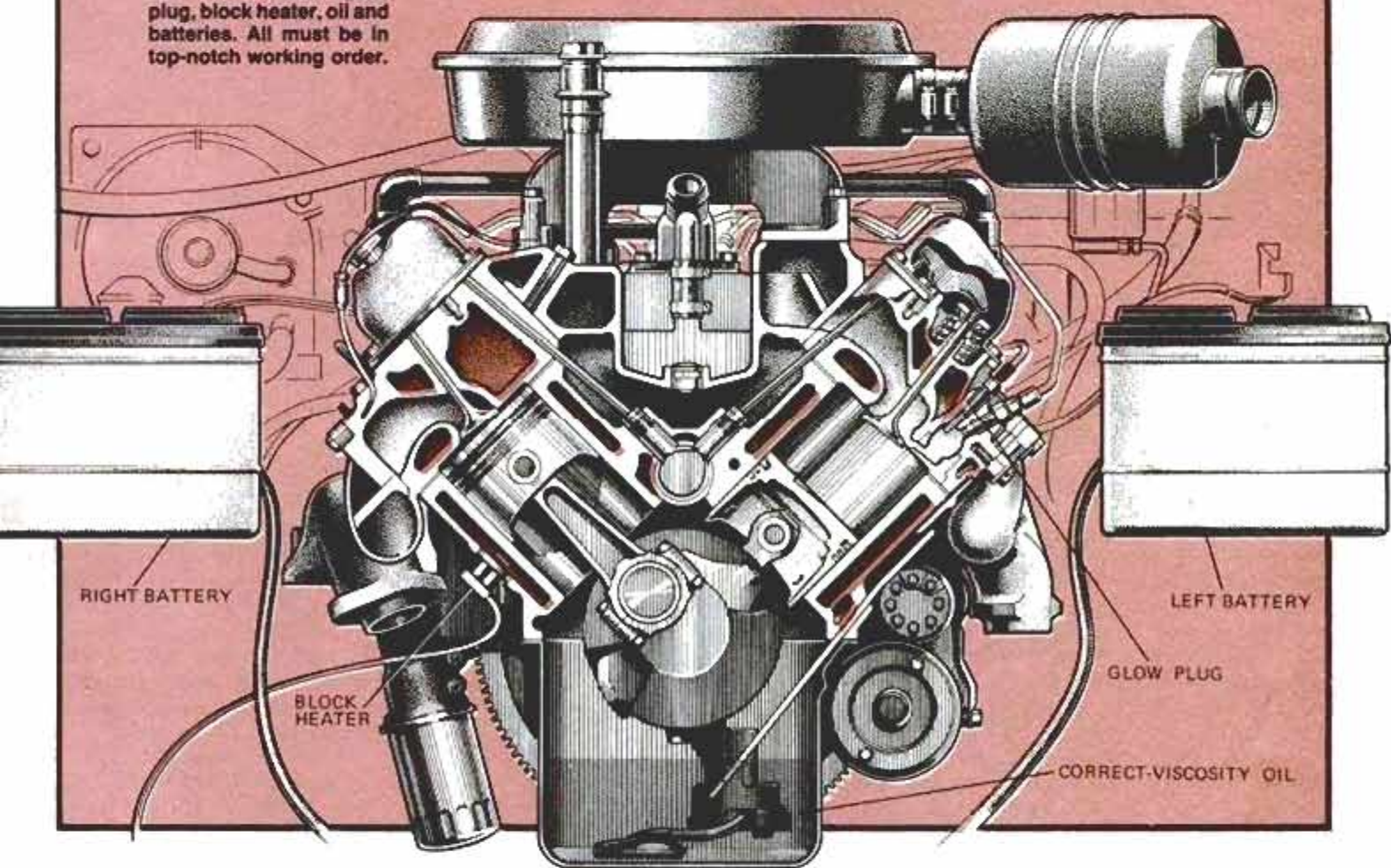
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Winter-proofing your 5.7-liter GM diesel engine

by Mort Schultz

PART 2

Cutaway of GM diesel, from front, shows glow plug, block heater, oil and batteries. All must be in top-notch working order.



This is the time of year when owners of diesel-engine cars worry about not getting started.

In this *Saturday Mechanic*, we'll explain how to avoid no-starts that are caused by engine-oil thickening and glow-plug failure. We're focusing specifically on the GM 5.7-liter (350-cu.-in.) diesel, since there are a good deal more of this particular engine on the road than there are of any other.

Last month we discussed choice of diesel fuel for cold weather, and the steps you should take to install the special fuel-line heater (see *Troubleshooting GM's 5.7-Liter Diesel V8, Part 1*, page 37). Let's get started on Part 2 by cranking over that cold diesel.

Speed's the ticket

Engine oil gets thicker as the weather gets colder, and thicker oil slows down engine cranking speed. This condition is more critical in a diesel than in a gasoline engine.

In a gasoline engine, sparks from sparkplugs ignite the fuel mixture. Chances are the gasoline-and-air mixture would ignite and the engine would start with the crankshaft revolving at only 30 revolutions per minute.

In a diesel engine, fuel is ignited by heat generated as pistons compress diesel fuel. To attain sufficient compression (and enough heat), the crankshaft has to rotate at least 100 revolutions per minute. Engine oil that's too viscous can keep the

crankshaft from reaching fuel-igniting speed.

The first step to assure sufficient crankshaft speed is to use oil that has a viscosity recommended by GM. The second step is to equip the engine with a block heater.

Step 1: Viva viscosity!

There is no compromising when selecting oil for your GM diesel. You have two choices: SAE 10W-30 or SAE 30. Owners of cars with gasoline engines have more latitude. You don't.

■ Use SAE 10W-30 weight oil if the temperature expected in your area before the next oil change is going to be between 75°F. and -25°F.

■ Use SAE 30 weight oil if the tem-

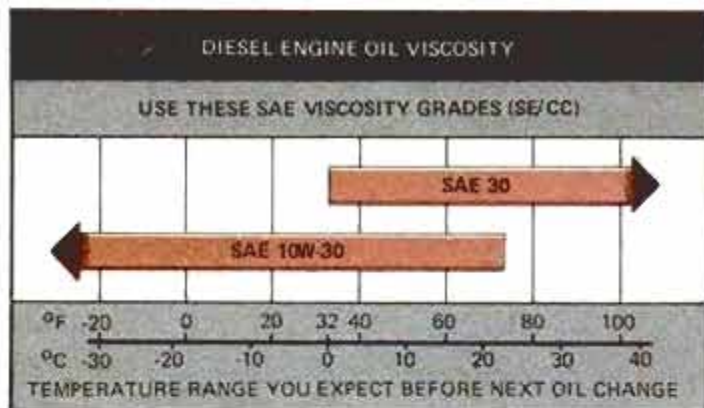
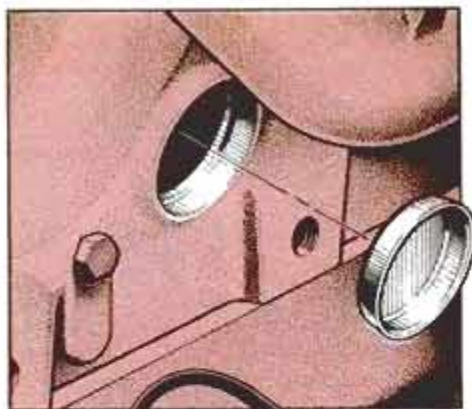


Chart at left illustrates the right oil viscosity for the range of temperature in your area. To install a block heater, remove a freeze plug (right) and press the block-heater coil in place (below). A block heater is available at GM dealers for approximately \$25.



perature expected in your area before the next oil change is going to be between 110°F. and 32°F.

■ When the temperature allows you to choose either SAE 30 or SAE 10W-30 weight oil, let your decision be dictated by this advisory from GM: "Single-viscosity grade oil (SAE 30) is more satisfactory than multiviscosity oil (SAE 10W-30) for sustained high-speed driving."

■ Never use any other multiviscosity oil except SAE 10W-30. Other multiviscosity oils are too thick and cause rings to stick.

If you ruin your engine because you use a multiviscosity oil other than SAE 10W-30, don't look to your warranty.

"Engine component failures of any nature which are due to incorrect oil viscosity are not considered a manufacturing defect," GM states.

Alphabet soup

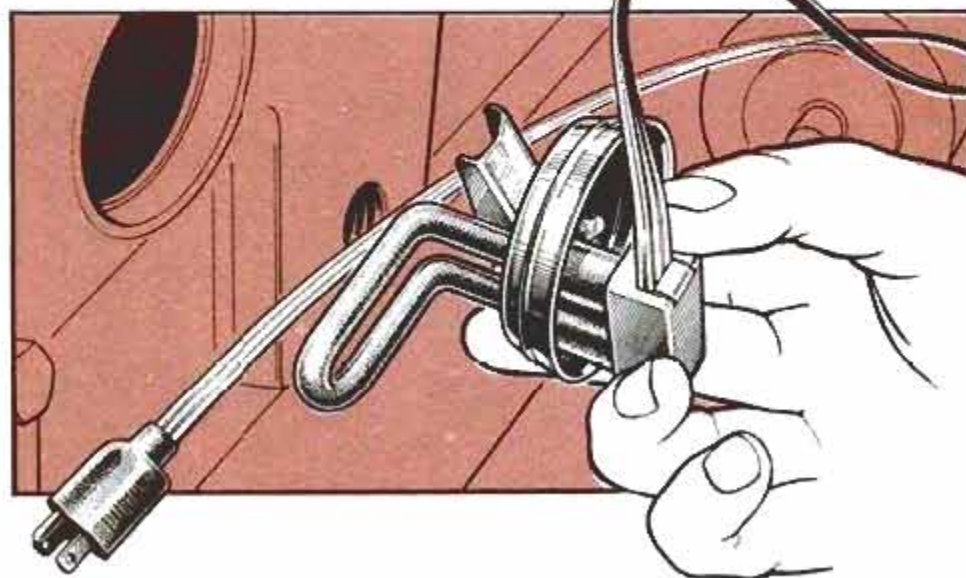
In selecting oil, viscosity isn't the only consideration. You must also think about the oil API designation.

API stands for American Petroleum Institute, which provides a grading system for oil based on its ability to serve a particular purpose. The API designation, as well as viscosity, is listed on the oil can.

Here are rules covering the API designation for your GM diesel engine; again, there should be no deviating from these rules:

■ If the car is a 1978 model, use oil marked with API designation SE-CD. Several other designations may be printed on the can, but these designations must be present.

■ If the car is a 1979 or 1980 model, use oil marked with the API designation



SE-CC. The order of the SE and CC designation is not important. However, if the designation CD appears on the oil can, do not use the oil in your 1979-80 engine.

■ If the car is a 1981 or 1982 model, use oil marked with the API designation SF-CD or SF-CC. Warning—Oil in cans labeled SE or SF, but not bearing the CC or CD designation, must not be used in a GM 5.7-liter diesel engine. Both must be present for the oil to give your engine adequate lubrication. Even if the warranty is still active, GM will not be responsible for repairs if engine failure results from using oil having the wrong API designation.

One more warning: "Do NOT use ANY supplemental oil additives. Using oil additives may cause engine damage and may affect your warranty." The words and capitalization for emphasis are GM's.

For 1981 GM diesel owners: Your

owner's manual may be wrong regarding which oil filter to use. It should be a PF-45. You should change oil and oil filter every 5,000 miles. This advice also applies to those who own 1982 diesels. Owners of pre-1981 diesels should change oil and oil filter every 3,000 miles.

Step 2: Turn on the oven

What do you do if SAE 10W-30 weight oil thickens just enough to prevent crankshaft rotation at 100 rpm, keeping your engine from starting? This may happen when the ambient temperature hits 0°F. or below. Simple—you use your engine-block heater.

It's simply an electric coil that you install in one of the holes in your engine block normally covered with a freeze plug. It can be a life saver. A block heater keeps the engine warm in cold weather when the car is parked. Warm engine metal trans-



Width of the glow-plug connector will indicate which glow-plug system you have. The plugs are not interchangeable.

Don't swap one glow plug for another by modifying connector; it'll only cause tip of plug to overheat, curl up and break off.

fers heat to oil, keeping the oil from thickening.

To use the block heater, just attach a three-prong electrical cord to it and plug it into any 110-volt household outlet. If the ambient temperature is 0°F. or lower, keep the block heater plugged in overnight to assure a quick start in the morning.

If the temperature hovers above 0°F., cranking will be difficult, so guarantee starting by plugging in the block heater two hours before you want to use the car. However, you won't cause any harm by keeping it plugged in for longer periods.

You probably won't need an engine-block heater if you park your car in a garage—unless the garage temperature goes below 10°F.

If you didn't order your GM diesel with an engine block heater, don't worry. You can buy one from a GM dealer for about \$25 and install it yourself. Just punch a hole in a freeze plug and pry it out of the engine. Then, press the block heater into its place.

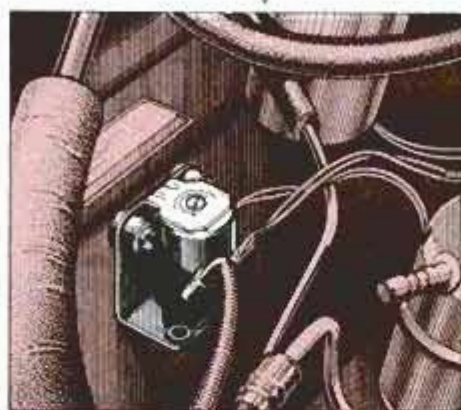
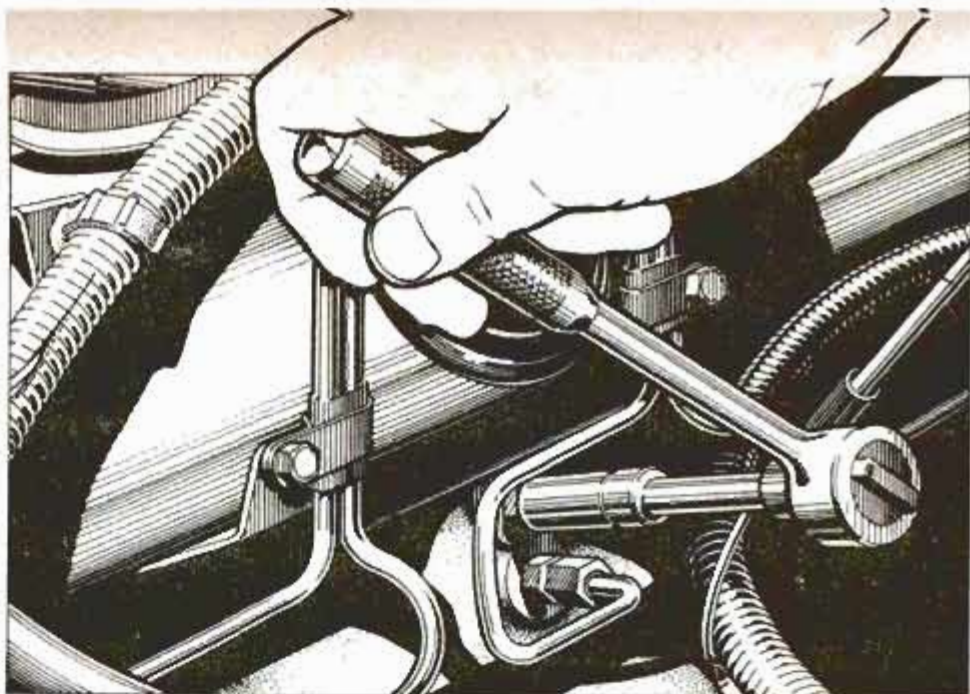
All aglow

A glow plug that isn't working will prevent a diesel engine from starting in cold weather. The GM 5.7-liter diesel has eight glow plugs—one for each cylinder.

Glow plugs receive electric current from the car batteries (there are two in GM cars with diesel engines). When the glow plugs are heated to a cherry-red glow, and cylinders are warm, the light on the instrument panel signals that the engine is ready to be started. As soon as the engine starts, glow plugs are automatically turned off.

In warm weather, there is no problem starting a diesel engine if several glow plugs lose their glow. As weather gets colder, however, all the glow plugs are needed if the engine is to start. Between 10°F. and 20°F. even one malfunctioning glow plug will keep you from starting.

Incidentally, an indication that you've got a malfunctioning glow plug is an engine that starts in warm weather, but idles rough and emits white smoke for some time after starting. Keep this in mind,



Glow plugs can be removed with a 3/8-in. socket (above). The glow-plug relay (left) should never be bypassed to energize plugs. Full jolt of juice will ruin them.

being applied to these plugs, which reach operating temperature in six seconds.

If you own a 1979 model and aren't sure which glow-plug system you have in the car, pull a connector from one of the plugs and measure the plug terminal. The terminal of a fast-start (6-volt) glow plug is 5/16 in. wide; that of a slow-start (12-volt) glow plug is 1/4 in. wide.

Some people have tried fiddling with the terminals of 6-volt glow plugs to get them to fit in place of 12-volt glow plugs, so they can have a fast-start system. This won't work: Since 6-volt glow plugs installed in a 12-volt glow-plug system don't have ample resistance to withstand 12 volts, they curl, break off and fall into the engine when battery voltage hits them.

Keep these other points in mind: ■ The fast-start system is outfitted with a heavy-duty relay, which is located on the right-hand inner fender panel. This relay controls the flow of current from the battery to the glow plugs. It should *never* be bypassed. Some people may get the bright idea they can energize the glow plugs (if the relay fails) by

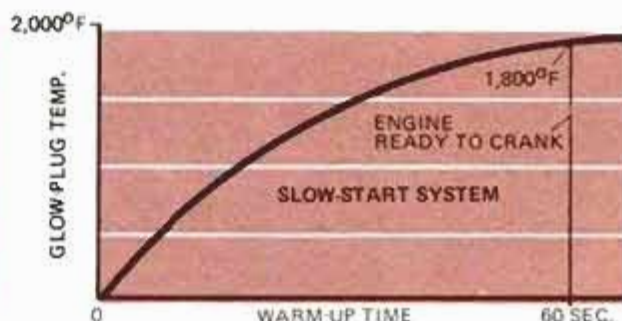
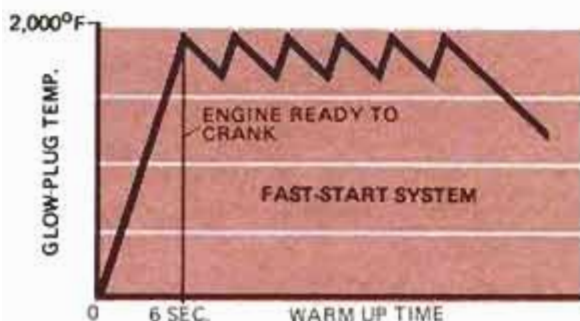
because it may enable you to detect a bad glow plug before the weather turns cold.

Slow down or speed up

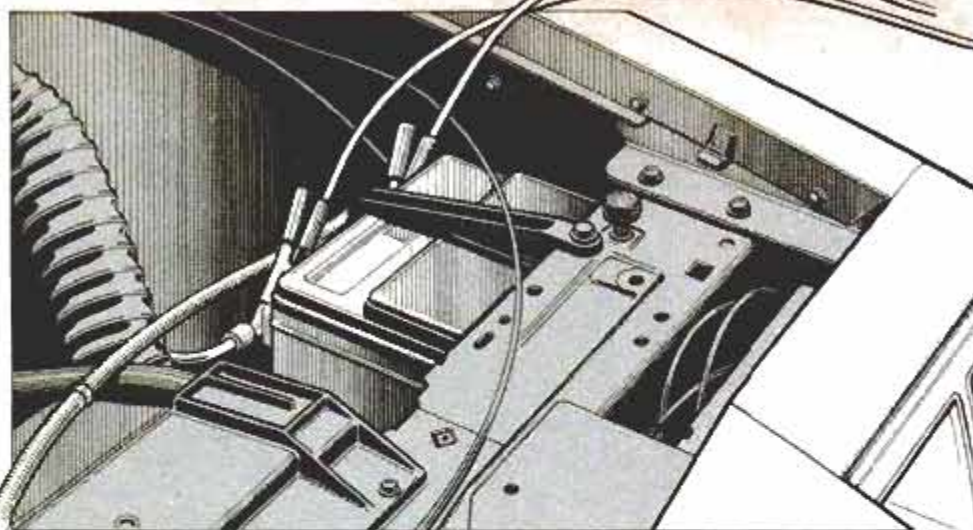
One of two types of glow-plug system is in your GM 5.7-liter diesel engine—a slow-start system or a fast-start system.

The slow-start system, which is installed in 1978 and some 1979 models, uses 12-volt glow plugs rated at 85 watts each. A one- to two-minute "glow" time (ignition key on—no cranking) is needed before starting the engine.

The fast-start system, which is installed in some 1979 and all 1980-82 models, uses 6-volt glow plugs rated at 180 watts each. Battery voltage is dropped to six volts before



Fast-start glow-plug system takes practically a full minute less to fire up your engine than does a slow-start system.



If your diesel needs a jump start, use the battery located on the left side of the engine. Since the cables are shorter on that side, there is less resistance.

extending a jumper across the relay terminals. They'll energize the glow plugs, okay—right to extinction. When a full jolt of battery voltage hits the defenseless plugs, they'll burn up.

■ If you break off the tip of a glow plug while removing it, don't run the engine until you remove the cylinder head and extricate the tip, or you'll damage the engine.

Testing glow plugs

If starting becomes a problem in cold weather, test glow plugs to see that all are working, as follows:

1. Connect a 12-volt test light to ground.

2. Turn on the ignition, but don't start the engine.

3. Touch the test light to each glow-plug wire connector terminal, in turn. If the test light doesn't glow, there's a problem in the glow-plug circuit, and battery voltage isn't reaching the plug.

4. Remove the wire connector from the glow plug. Attach the 12-volt test light alligator clip to the wire connector terminal.

5. Touch the other test-light lead to the glow plug. Look for one of the following conditions:

■ If the engine uses 6-volt glow plugs, the test light should begin cycling on and off in rhythmic fashion six seconds after the ignition is turned on. A glow plug that doesn't do this is bad.

■ If the engine uses 12-volt glow plugs, the test light won't glow until it's been in place for one minute. At this time, the test light should come on and stay on approximately 90 seconds before switching off. If you don't get this reaction, replace the plug.

Glow plugs are as easy to replace as sparkplugs. Use a 3/8-in.-deep socket wrench to loosen them. Then,

you simply remove them by hand.

To install glow plugs, tighten the plugs by hand, then use a torque wrench to snug them to 12 ft. lb.

Helpful starting tips

■ If a diesel engine cranks, but fails to start, pumping the accelerator pedal is a waste of time. Since the fuel-injection pump delivers only raw diesel fuel to the cylinders, pumping the accelerator pedal won't make fuel in the cylinders richer.

■ If a diesel engine fails to start in 30 seconds, stop cranking and wait two minutes before trying again. Because of the high compression generated in a diesel engine, prolonged cranking can put excessive strain on the starter motor. If the engine fails to start after two tries, there's a mechanical malfunction.

■ If your battery system dies on you and you have to jump-start the engine, do it the same as you would a gasoline engine with a single battery. First, make sure the state-of-charge indicator eyes of both maintenance-free batteries aren't pale. If both are pale, replace both batteries. If one eye is pale, replace that battery. Don't jump-start the engine if one or both eyes are pale. The battery or batteries may explode.

Here's the jump-start procedure:

1. Connect one booster cable to the positive terminal of the booster battery. Connect the other end of this booster cable to the positive terminal of the battery that's on the driver's side of your car. This battery is closer to the starter motor and there will be less resistance to starting than if you connect the booster to the other battery.

2. Connect the other booster cable to the negative terminal of the booster battery. Connect the other end of this cable to a ground in your car. You can use the airconditioner compres-

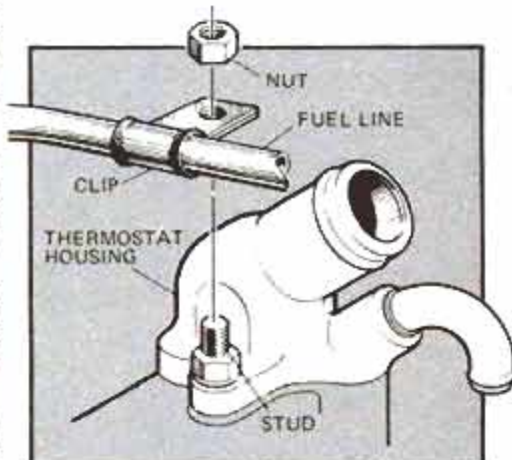
or or alternator-mounting bracket as a ground. The ground should be at least 12 inches away from a battery, so if sparks shoot out, there's little chance of them igniting the hydrogen gas given off by the battery.

3. If the booster battery is in another car, start the engine of that car. Now, crank the engine of your car, but first wait for glow plugs to heat up. When the engine starts, disconnect booster cables. Also, be aware of the following precautions:

■ Never push or tow a car that has a diesel engine in an attempt to get the engine started. It won't work.

■ Never use a battery charger or a jump-start power pack that exceeds 16 volts.

Despite all efforts, you may have trouble getting a 1981 GM diesel engine started when the engine is cold. This condition may be caused by a crack in the fuel-supply pump where the fuel line is connected to the fuel pump. The crack could have been caused by the fuel line vibrating against the fuel-pump housing. Air entering the fuel system



To avoid a cracked fuel line, a common problem in GM diesels, replace the hold-down bolt with stud at thermostat housing. Use new bracket, washer and nut.

through this crack makes starting difficult. This has happened. Fortunately, GM has a fix for this.

To correct the problem or keep it from occurring (preventive maintenance), do this:

1. Remove the bolt from the right-hand side of the thermostat housing.

2. Install a stud (part No. 6270979) in place of the bolt.

3. Disconnect the fuel line at the fuel-supply pump. Slide a clip (part No. 343463) on the fuel line. Push the clip onto the stud.

4. Screw a washer face nut (part No. 10008001) onto the stud, so the clip is secured.

5. Replace the cracked fuel-delivery pump.

6. Connect the fuel line to the pump.

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CAR CLINIC

SOLUTIONS
FOR MECHANICAL
HEADACHES
BY
MORT SCHULTZ



A Little problem

My 1978 Ford Fiesta is too feisty. After its engine warms up, it idles much too fast. Mechanics I've approached with the problem have not been able to figure out why. Other than this, the car, which I bought used, has lived up to expectations. Your suggestions would be appreciated.—William Little, Cuyahoga Falls, Ohio

My first suggestion is for you to make sure the throttle-valve cable isn't catching when you take your foot off the gas pedal to bring the engine to idle. The throttle-valve cable extends from the gas pedal to the throttle-valve control on the carburetor and relays your "command" for more or less engine speed. If the cable catches when the engine is supposed to be idling, it would be as if you were still maintaining foot pressure on the gas pedal.

Once you've determined that the cable isn't hanging up, my second suggestion is that you look inside the choke housing. It's in here that the fast-idle cam and fast-idle-cam operating spring of the Fiesta are located. These parts are supposed to keep the throttle partially open, so the engine will run faster at idle when it is first started. The fast-idle system prevents cold-engine stalling. Once the engine is warm, the fast-idle system is supposed to release itself automatically. Yours may not be doing this.

Several 1978 Fiestas had a problem with the fast-idle cam moving too far and wedging the fast-idle-cam operating spring. This prevents the cam from coming off the fast-idle position after the engine gets warm. In other words, the wedged spring keeps the cam where it should be with the engine cold—not warm. There's a fix for this.

Face the choke housing and remove the choke housing-to-carburetor retaining screw that's in the 11 o'clock position. Install a fast-idle-cam stop (part No. D8RZ-9L459-A) and a new cover screw (part No. E603531-572). The cam stop will put

a hold on the fast-idle cam and prevent it from moving far enough to wedge the fast-idle-cam spring.

Waste not, want not

It hurts to see precious gas wasted, but this is what's happening every time I fill the tank of my 1979 Chrysler LeBaron. When the automatic control on the gas pump nozzle releases to shut off delivery, gas spits out of the car filler pipe and spills on the ground. Is this the car's fault, or should I blame gasoline station equipment?—Russ Taylor, McLean, Va.

Blame the car—specifically the shape of the fuel filler pipe. Owners of 1980 LeBarons, 1979 and 1980 Diplomats, and 1980 Miradas and Cordobas may experience the same irritating problem.

About a year ago, Chrysler Corp. authorized a fix. Outlined in service bulletin 14-19A-80, it calls for replac-

ing the existing fuel filler pipe in LeBarons and Diplomats with a new pipe (part No. 4185309). On 1979 models, you also have to replace the fuel tank cap with a new cap (part No. 4186237). If a 1980 Mirada or Cordoba is gushing gas, the new fuel filler pipe that it needs carries part No. 4185311. Since the problem is caused by a design fault, you should not have to pay for repair, even though your warranty may no longer be in effect.

X-rated X-body

My 1980 Pontiac Phoenix has a front-end wobble, which is most noticeable when driving between 25 and 35 miles an hour. I thought the cause was out-of-round tires, but a new set hasn't eliminated the feeling. My dealer indicates that this is a chronic problem with X-body models. Please help.—Harlan Wilson Jr., Charleston, W. Va.

There have been cases, but "chronic" is a poor choice of words. In fact, the problem to which your dealer is referring and the one you're having are as different as G-rated and X-rated movies.

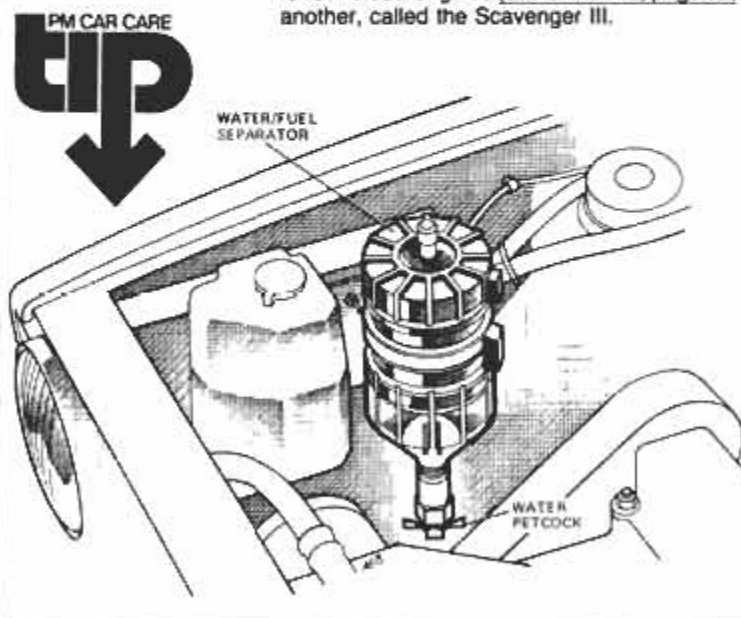
When the first 1980 X-body models were built, some were inadvertently outfitted with poorly machined constant-velocity (CV) front axle joints. The defective joints caused a vibration at speeds below 5 miles an hour. The condition was cured when GM issued an advisory telling dealers to replace the bad joints; this may be

(Please turn to page 44)

Flood insurance

Water in fuel could be the nemesis for nearly two million owners of cars equipped with diesel engines in the United States. If water isn't purged before it reaches the danger level, it could ruin the fuel-injection pump and fuel injectors. Repairs cost megabucks.

To combat water, manufacturers have developed warning systems, in addition to whatever filter may have been installed at the factory. I reported on one such system for GM diesel engines (see *Car Clinic*, page 50, Jan. '81). Now there's another, called the Scavenger III.



You can obtain the fuel filter/water separator at a cost of \$79.95. You have to periodically drain the filter bowl from under the hood. There's a drain cock in the bottom of the bowl. Additional information about the Scavenger III may be obtained by calling CR Industries of Elgin, Ill. The toll-free number is 800-323-4704. In Illinois, call 800-942-8141. In Canada, call 519-753-4136.



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CAR CLINIC

(Continued from page 42)

the "chronic problem" your dealer is talking about. Cut-and-dried—nothing sexy about this.

From the way you've described it, I think your wobble is being caused by a condition automotive engineers call sympathetic resonance. Sympathetic resonance refers to the titillation of the engine by an adjacent component. As the engine is excited, it moves; this movement creates the front-end wobble you feel.

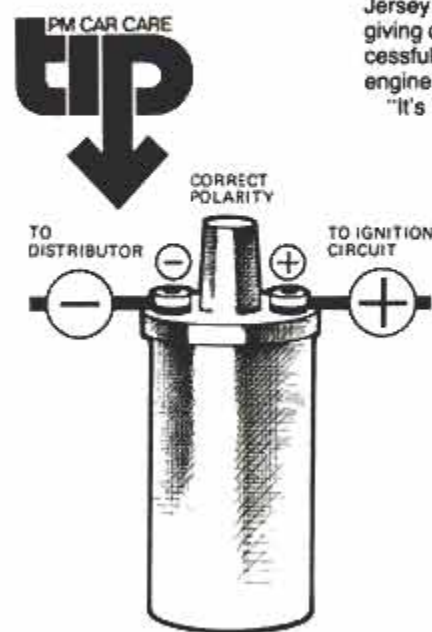
Unfortunately, it's easier to describe sympathetic resonance than to pinpoint the cause. It could be one of any number of components, including a tire that has more rubber in one spot than in other areas, a less-than-perfect wheel or a loose component in the suspension. To get rid of sympathetic resonance, you have to find out what's exciting the engine. From what you said, I don't think your dealer is going to be much help. Your best bet is to call the GM zone office listed in the owner's manual. If need be, the GM representative will consult with Pontiac engineers at the factory, who have, by this time, prepared a checklist of all possible stimuli.

Gastronomical

My Colt's got the colic. It's a 1981 model that has to be cranked and cranked before it will start. This happens when the engine is warm. Cold-engine starts are quick. My dealer, who's been a prince, has pinpointed

the trouble, but he can't fix it. When the ignition is turned off, gas percolates from the carburetor float bowl into the engine, causing the engine to flood. The dealer rebuilt the original carburetor and then replaced it. Other than feeding the engine antacid

Life of the party



Recently at a party, a Saturday mechanic looked as if he was at a wake. His 1977 Chrysler Cordoba couldn't pass the New Jersey annual vehicle emissions inspection, because it was giving off high levels of hydrocarbons (HC). After two unsuccessful attempts to pass the test, he'd been advised to get an engine overhaul.

"It's the only way to lower the HC level," one of the car inspectors had told him.

"It'll blow two weeks' pay, but I guess I'll have to get the engine overhauled," he said forlornly. "Maybe it'll also correct the miss."

It took me 10 seconds to find the trouble. When doing the tune-up, he had installed a new ignition coil. The old one was shot. But he had installed it the wrong way, connecting the negative side of the coil to the positive side of the circuit and the positive side of the coil to the negative side of the circuit.

So take a lesson. The polarity of an ignition coil—as the polarity of any electrical component—must not be reversed. With a negative-grounded automotive electrical system, this means that the wire coming from the ignition-switch side of the ignition circuit is connected to the coil terminal marked (+) or POS. And the wire going to the distributor is connected to the coil terminal marked (-) or NEG. Now, back to the party.

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tablets, do you know of any repair?—
Larry E. Peterson, no address

The carburetor design of the Colt 1,600-cc engine is unique. Coolant traveling between the heater and radiator passes through the base of the carburetor. This causes gas to percolate from the float bowl when the engine is shut off.

The design is a nuisance when trying to restart a warm engine, but the flow of warm coolant vaporizes fuel, helping to provide maximum fuel economy and good driveability.

Unless your "beast" is exceptional, holding the accelerator pedal smack on the floor as you crank the engine will usually get the engine fired up within three seconds.

Readin' the right 'rithmetic

To try and stop an oil-consumption problem, I want to replace the valve seals of my 1975 Honda Civic station wagon. It has the CVCC engine which, as you know, has four intake valves, four exhaust valves and four auxiliary valves. My Honda service manual shows that only the intake valves take valve seals. Yet, the seal set I bought contains 12 seals. Is the manual wrong?—Bernie Caron, Harrisburg, Pa.

Yes and no, Bernie. The 1975 Hon-

da Civic CVCC engine uses seals on the four intake valves and four auxiliary valves (your manual is wrong on this score), but not on the four exhaust valves (here, your manual is correct).

You have 12 seals in your "seal set," because in addition to intake and auxiliary valves, the exhaust valves of CVCC engines from 1976 on require seals. In other words, Bernie, you not only have too many seals, but you also have the wrong seals. They won't fit your 1975 engine.

Honda does not package valve seals in a "seal set," so you apparently didn't buy the parts you have from a Honda dealer, which is okay. You don't have to use factory stuff.

Whether you now buy valve seals from an independent auto-parts dealer or from Honda, you should use the following part numbers to order them:

- For intake valves—057222.
- For auxiliary valves—057429.

GOT A PROBLEM WITH YOUR CAR?

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

SERVICE TIPS

■ If your GM dealer has been unable to fix an oil leak in a 5.7-liter diesel engine, suggest that he probe the flow-control valve hole in the air crossover. Some weren't drilled completely through, which prevents functioning of the flow-control valve. A nonfunctioning flow-control valve results in high crankcase pressure, which can push oil out of the engine—even through properly sealed joints.

■ Speaking of diesels, if you want to know where diesel fuel is available, there's now a *Diesel Fuel Directory*. One company selling it is Nationwide Distributors, 12027 Southwest 17th Court, Miami, Fla. 33186. Cost is \$9.95 plus \$1 for postage. To save the dollar, call auto-parts or diesel-fuel distributors in your area. I'm sure others sell the directory.

■ Unless the guy who does your front end work has the latest specs for your 1980 and 1981 GM X-body car, you may not get the front-end camber set properly. The manual, which is wrong, calls for a spec of $.50 \pm .50^\circ$. The revised spec calls for a camber setting of $+1.0^\circ \pm .50^\circ$.

■ Does your 1981 K-car have a tendency to keep going in the same direction as the turn you make? If so, Chrysler says its steering "memory" may be out of whack. The condition is discussed in service bulletin 02-05-81 (8/3/81). Replace the ball bearings and spacers in the front struts with new parts carrying Nos. 5204595 and 5204615, respectively.

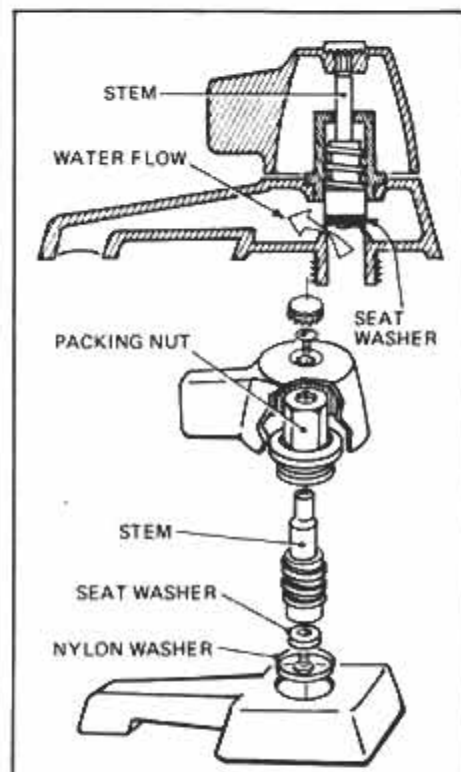
HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Squealing faucet

We have a faucet that squeals when it is turned on partially. The squeal stops when the faucet is turned past a critical point. What causes the squeal and what can I do to remedy it?—William F. Talbot, Ardsley-on-Hudson, N.Y.

A squealing water faucet is usually the result of a worn washer. When the stem is backed out (someone



Worn part of seat washer inhibits water flow and produces the same effect as reed in a wind instrument. Result: noises.

turns on the water) and the clearance between the frayed washer and the valve seat reaches a certain distance, the washer will vibrate and squeal like the reed in a wind instrument. As the valve is opened more, the space becomes greater and the reed effect—and noise—cease. Simply replace the washer.

Furnace sizing

I'm planning to add 450 sq. ft. to my small, 900-sq. ft. house. I heat the present structure with a 67,000-B.T.U. oil furnace. Will it be large enough to heat the added space? All information I receive from repairmen, contractors and textbooks is contradictory. Some say the unit is oversized for the square footage, while others say I'd need a furnace

twice as large. Who is right? I don't want to spend extra money on a larger furnace if my present one is large enough.—John H. LaRush, Nancy, Ky.

John, join the many, many people who erroneously equate heating needs with square footage. There are so many variables to consider, such as number of windows and type of glass, amount of insulation, floor and ceiling make-up, type of construction and site orientation, that any rule of thumb applied to sizing a furnace wouldn't even qualify as an educated guess.

I would contact a licensed mechanical engineer to determine not only the furnace size, but also the location of your registers or radiators. As most additions are on the end of the supply line, a separate zone with its own thermostat may be in order.

Resurface or replace?

I have a large concrete driveway that's about 30 years old. Part of it is in fair condition and could be patched and resurfaced. Would it be worthwhile to blacktop it, or should I replace it with concrete?—Chester B. Swanson, Moline, Ill.

Broken concrete driveways can be surfaced with a topping of asphalt using the concrete as a base, as long as it is solid. Remove any broken and loose concrete, then compact the base and patch the holes with concrete to the level of the existing concrete. The feasibility of this type of patching will depend on the number of patches and their size. A reputable asphalt contractor will steer you in the correct direction on this.

If the area is small enough, he may decide that a patch of gravel and sand, wetted down and tamped for proper compaction, is all you need. The contractor should coat the surface with liquid asphalt first, to assure that a minimum of 1½ in. of asphalt surfacing will adhere to the concrete.

The Asphalt Institute says to be certain the concrete is clean and dry.

Do you have a home maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send orders(s) to PM, Box 1014, Radio City Station, New York, N.Y. 10101.

The thickness of the asphalt surfacing may vary, depending on the geographical location. Colder areas may require thicker applications. This is where a reputable contractor can give direction.

Blistering exterior plywood

I built a small rear porch last spring using Texture 1-11, ½-in.-thick, exterior-grade plywood siding. After completion, I applied two coats of a top-quality, semitransparent stain for a redwood finish. After four months of exposure, the siding developed blisters and cracks in the top veneer. Spot applications of stain didn't halt the condition. Do you have a solution?—John N. Klein, Mount Penn, Pa.

First of all, check the trademark on the back of the plywood siding and copy all of the information on it for reference purposes. If it is exterior plywood (Texture 1-11 is one of the American Plywood Assn.'s exterior siding panels), it shouldn't ever delaminate. Delamination is a separation between the veneers at the glue line; this is sometimes referred to as blistering. However, face checking (small cracks in the veneer) is a natural occurrence in wood and doesn't affect the strength or durability of the siding.

If the problem is delamination, the plywood wasn't manufactured properly; you should contact your supplier with the details of the problem. If he doesn't take action, contact the manufacturer directly. The name may be on the trademark. If it isn't, however, and the plywood has an APA stamp, send all this information, including the copy on the stamp, to: American Plywood Assn., 1119 A St., Tacoma, Wash. 98401. The association can tell you if your siding is actually exterior plywood, such as Texture 1-11, and it can provide you with the name of the manufacturer. **PM**



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out why in the R-values.

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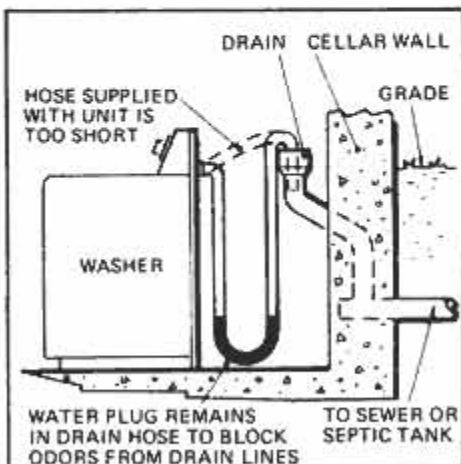
APPLIANCE CLINIC

QUESTIONS ANSWERED

Stagnant water

For the past six months, there has been an odor of stagnant water from our Kenmore Non-Suds washer Model 110.7214600. Is the filter at fault?—Harold Fateley, Mesa, Ariz.

Since your clothes apparently smell fresh and clean and you only



A water plug at bottom of the drain hose blocks odors from a sewer or septic tank.

notice the odor around the unit, we suspect there's something wrong with the drain, not the filter.

Check to see if your drain line is properly fitted with a trap in the wall, under the floor or wherever it leaves the house. Also, check for a broken or leaking drain line under the floor or in the wall. You should also look for any leaks or drips from the drain lines under the machine.

A simple way to trap a drain line and to block foul-smelling sewer and water gases is to replace your current machine drain hose with a longer one (as shown in the drawing). Let the drain hose loop down almost to the floor in back of the machine, then up and out to the drain pipe or tub. This bend puts a natural trap in the line which holds a "plug" of water and prevents stagnant gases from venting back into the room.

Frost in the frostless

Our 1973 Signature automatic frostless refrigerator/freezer, Model UFO-2170-00D, forms ice in the bottom. What can you suggest?—J.H. Smeaton, Millington, Mich.

First, check that the ice does, in fact, melt when your unit is in its automatic-defrost cycle. Open the door and see if water runs down the tube at the back.

Then inspect to be sure that the water passages from the freezer section are clear. Remove any food or packaging particles that may obstruct them.

Remove the cover over the defrost mechanism and check for a blocked hose. You can run a flexible wire into the tube to help remove any obstructions. While the cover is open, check the defrost-unit action by advancing the defrost timer. Rotate the dial clockwise.

The fact that your refrigerator runs frequently could indicate that fan, coils and compressor need cleaning. You may also have a low Freon level. You should check this.

More on ice cube connection

In "Ice cube connection" (*Appliance Clinic*, page 46, Aug. '81), we suggested that a reader check the micro-switch in his Sears refrigerator as a possible cause of trouble with his icemaker. We had a good idea, but the wrong unit.—The Editors

"...I was puzzled by your answer. I am a service technician and have never heard of a microswitch in a Sears refrigerator, such as pictured in your column.

"In that model, we use an eight-cavity, nonremovable ice tray with direct-drive ice stripper and cam-operated fill switch. Our icemakers, except the "flex tray," have adjustable water fill. I think the problem could be corrected by adjusting the water fill. Oversize ice cubes jam in the chute and won't move through the auger."—John Kahr, Las Vegas, Nev.

Heatless blankets

We have two electric blankets that barely heat when on the top setting. One is a Sears Model 320-7147-7148; the other is a J.C. Penney 180-watt blanket. Both check out on continuity, and the controllers appear to be operating.—R.H. Sproull, Yorktown, Va.

It may sound too simple, but have you checked the voltage at the wall outlet? This is important with any appliance. If you are using an extension cord, try another one; sometimes the wires in extension cords break due to kinking. With your blankets spread out and plugged in, set the temperature control at mid-range and check the temperature with a thermometer. It should be in the mid-70° F. range. Finally, blan-

kets should be uniformly warm. If there are any cold spots, send the blanket out for repair.

Dry cycle not drying

Our built-in KitchenAid KDS-17A dishwasher has a problem with the drying cycle. Dishes are not hot when the machine is opened; the fan seems to be working. I suspect a burned-out heater. What do you think?—J. Westheimer, Somerset, N.J.

First, are you certain your hot water is at least 130°F? Check your source: This could be the problem and not the dryer. Possibly one of the pushbutton controls is not operating properly: Check them. The timer could be malfunctioning, too. Also, you have two button-type thermostats in series with the heater; these may be inoperative.

To check the heater or thermostats—and, incidentally, to check for loose wires—first turn off the power. Then remove the bottom kick plate held by a screw at either side, lift it up and out and put it to one side. To check the heater, disconnect one wire and place your volt/ohmmeter probes on either end of the heater connections, using either the Rx1 or Rx10 scales. If you get any reading at all, the heater is defective and should be replaced. Check the button thermostats the same way.

A reader writes

In "Burned-out range" (*Appliance Clinic*, page 28, Sept. '81), you ran a letter from a Mr. D. Watkins who had experienced repeated replacement of lower heating elements in his range. As a one-time owner of an appliance-repair firm, I agree with the advice you gave. But I believe you may have left out one important possible cause: overuse of oven cleaner! Oven cleaner is murder on heating elements; they must be covered with aluminum foil so no cleaner gets on them. (Remove foil after cleaning.) Elements that have failed from contact with oven cleaner typically have a break in the outer protective tube, and this is usually burned through completely.—M.B. Williams, Potomac, Md.

If you have a question about any appliance, send it along with the model and serial numbers to *Appliance Clinic*, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be discussed in this column.

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*Based on R. L. Polk & Co. cumulative registrations as of July, 1980.

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26 (18)

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FORD ECONOLINE

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PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Solar black paint

Thurmalox Solar Collector Coating is a specially formulated, silicon-based, black paint for use on absorber-plate surfaces. This product selectively absorbs solar wavelengths with the greatest heat content—visible and infrared light—thus collecting more heat energy than non-selective black paint. The coating won't peel or discolor and it functions best on collector panels with glazed covers.



Fluorocarbon-free spray can allows easy application.

Available in 13-oz. spray cans, the product sells for \$7.25 at solar-supply houses, or for \$8.95 postpaid direct from the maker: The Dampney Co., 85 Paris St., Everett, Mass. 02149. The coating is also available in bulk containers for solar-panel manufacturers.—Rosario Capotosto

Versatile droplight



Trouble light is made of heavy-duty flexible plastic to reduce impact damage and eliminate corrosion.

The Pivotlite is a trouble-free trouble light with several good features. Its housing, cage and reflector are all made of rugged, flexible plastic, as is the full-swivel hanger hook. A double ball joint allows 360° circular movement and 170° right-to-left movement, while the handle houses



Powerful magnet in the handle base makes the light especially useful for auto work.

an easy-to-operate pushbutton switch and convenience receptacle. A powerful magnet on the base of the handle permits attachment to most metal surfaces.

The standard Pivotlite has a 25-ft. cord. It's \$31.95 postpaid from Plymouth Products Inc., 464 Merrick Rd., Oceanside, N.Y. 11572. Available options include a cigaret-lighter adapter with a 12-volt, 50-watt bulb (\$4) and a 50-ft. cord (\$3.50).—H.W.

Sparkling discovery

Total Finish is a transparent polymer coating that makes porcelain, ceramics, glass, plastics and polished metals more resistant to staining. After cleaning and drying the bathroom sink, I applied Total Finish with a cloth, much like applying a polish. The porcelain gleamed like new and also stayed cleaner longer than usual. According to the manufacturer, the product is abrasive-resistant, won't discolor and is unaffected by solvents and detergents.



Liquid coating is water-, soil- and stain-repellent.

The 8-oz. bottle is available at hardware stores for \$4 and is made by Unelko Corp., 506 Taft Dr., South Holland, Ill. 60473.—P.S.

Window and door locks

If you have sliding aluminum windows or a sliding patio door, you can help protect your household against forced entry by installing one or more of the Vent-Lock Home Security Hardware devices. Among the choices are a foot-controlled Patio



This easy-to-install and inexpensive security hardware was designed especially for aluminum sliding doors and windows.

Door Lock (No. 555, \$3.30), an adjustable Patio Vent Lock, which lets you lock the door in a partially open position (No. 333, \$2.20), a Deadbolt Sliding Window Lock (No. 235, \$2.48), and a wedging-action Sliding Window Lock (No. 222, \$2.59).

All these security products are available—at the above prices—at hardware stores, home centers and from the manufacturer: Vent-Lock Div. of Hawkins Co., Box 3023, Oakland, Calif. 94609.—S.W.

Home and shop update

Several readers have written to ask where PM's book, *500 Home and Shop Tips*, discussed in this space in the Nov. '81 issue (page 142) can be purchased.

The folks at Hearst Books assure us that the book can be ordered through local bookstores. But if you're having difficulty getting it there, send a check or money order to Dale Boehle, Book Service, Hearst Books, 250 West 55th St., New York, N.Y. 10019.

The hardcover edition is \$12.95; the paperback is \$8.95. There is no charge for postage or handling. Allow three to four weeks for delivery.—H.W.

If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

DETROIT LISTENING POST

Cold feet on minis

Everyone knows that eventually there will be a strong minicar market here in the United States, but no one knows when. Demand for tiny, super-economy sedans like those already skittering around in Japan and Europe could materialize overnight with the next major fuel crisis—or could be delayed for years if fuel prices and supply remain fairly stable.

The rub is that high-tech teeny cars aren't much cheaper to build than larger ones and they're equally (or more) expensive to develop. And none of the Detroit makers is yet willing to invest a few billion dollars on a product for which the demand is so uncertain. With sales still slow and money tight, the trend is to invest in sure things: For Detroit, the surest thing has always been mid-sized, mid-priced family sedans.

Yet while everyone seems reluctant to be first into these uncharted waters, no one wants to be left out, either. All four automakers have partners in Japan and/or Europe, most of whom already build and market minis on their home turf and would like to bring some here. What could be more logical than to team with these overseas arms in preparing state-of-the-art minimobiles for U.S. import as soon as demand materializes?

This state of affairs led GM to make a deal with Isuzu, a long-time GM partner, and Suzuki. This should lead to certified, U.S. minis sometime after 1985. Chrysler has been plotting similar products with both Mitsubishi and Peugeot for some time, while Ford negotiates with partner Toyo Kogyo and (until recently) Toyota. American Motors, of course, is married to Renault.

Who will pioneer this new market segment, which research firm J.D. Powers predicts could account for six to nine percent of U.S. passenger-car sales by 1985? Both Ford and Chrysler have a head start on ultra-conservative GM through their Japanese partners, but like GM, they continue to drag their feet. One of the Japanese makers could decide to test the waters independently; but they, too, are unconvinced that a U.S. minicar market exists.

I look for Volkswagen of America, which has been suffering right along with Detroit of late, to shock every-

one by importing its next-generation, smaller-than-Rabbit mini by sometime in 1984. It takes both money and nerve to be a pioneer, and VW has both. If the product and its price are right, it should become America's next "Beetle" and clean up while the others play catch up.

Big cars not dead yet

The steady fuel situation and a resulting revival, however small, in big-car sales have at least one Detroit maker already back-pedaling on plans to scuttle its "full-size" family sedans. Contrary to previous reports (all were true) that Chevrolet would drop its Impala/Caprice B-car series after this year, division general manager Bob Lund now insists that these cars will be around "as long as the market demands them"—or at least until replaced by smaller, fwd models around mid-decade.

That leaves Pontiac out on a limb as the only GM division without a full-size entry, although the slightly smaller and more fuel-efficient rear-drive intermediates—renamed Bonneville Model G for '82—seem to be doing a creditable job of filling in. It also, incidentally, gives Pontiac GM's highest Corporate Average Fuel Economy (CAFE) rating of 27.4 mpg for the 1982 model year. That's just a whisker short of the federally mandated CAFE requirement of 27.5 mpg for 1985.

Meanwhile, it seems Ford will keep its current full-size LTD and Mercury Marquis—and the V8 engines that power them—around for three or four more years, while state-of-the-art fwd replacements are developed. Until recently, reports were that the smaller, fwd Granada and Cougar series were being groomed to take over Ford's family-car market as early as next year.

Chrysler already has dropped its largest cars and will soon deep-six its remaining fwd intermediate sedans (which picked up the full-size New Yorker and Gran Fury names for '82) in favor of stretched K-based luxury and family sedans a bit larger than the new LeBaron/400 "Super Ks."

Better zip for mid-year Js

About the time you read this, there will be a lot going on in GM's J-car ranks. First, Buick and Olds divi-

sions will be unveiling their own interpretations, Skyhawk and Firenza. Second, Chevrolet (Cavalier) and Cadillac (Cimarron) will be benefiting from the addition of an optional 2.0-liter engine (a stroked version of the Chevy-built standard 1.8), five-speed transaxle and a shorter 4.10:1 axle ratio. Third, Pontiac (J2000) will begin offering a Brazilian-built overhead-cam 1.8 along with a five-speed.

All this will help quell complaints of the Js' indifferent performance and driveability and make them more competitive with the imports at which they're aimed. Makes one wonder though, why "smart" GM execs thought they could get by with boggy, poorly responding engines in the first place.

Like Ford management, which made the same mistakes with the '81 Escort line, perhaps they're finally learning that small cars need more than high EPA fuel economy numbers to compete successfully these days.

Chrysler minivan

Another potentially fertile field awaiting harvest is the minivan market. Both GM and Ford have running prototypes, but Chrysler appears to be closest to production, possibly by the '84 model year. Strangely, the Japanese have been reluctant to develop minivans for U.S. import, despite their huge success here with small pickups.

Like most everything else the company is developing, Chrysler's little six-passenger van is based on the transverse engine, fwd K-car platform and powered by the 2.2-liter four-cylinder engine. The Mitsubishi 2.6-liter Silent Shaft is a likely option.

Wheelbase is stretched to about

(Please turn to page 54)



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DETROIT LISTENING POST

(Continued from page 52)

109 inches, but overall length, at 175 inches, is a tad shorter than the Reliant/Aries K-cars, making it an easy fit in the average garage. Plans are to market both Plymouth and Dodge versions and build them in the Windsor, Ont., truck plant.

'83½ T-bird and XR-7

Ford is speaking of its sleek, super-aerodynamic '83½ Thunderbird and Cougar XR-7 as "sporty family sedans," indicating they'll have gener-

ous rear seats in the Mercedes/BMW/Audi tradition.

Styling, too, is clearly European, with rounded fenders sweeping back from Mercedes-like grilles, slim-pillared greenhouses and black-wall tires on functionally styled wheels. Thankfully absent (so far) are the clichéd wire wheel covers, vinyl-capped roofs, opera windows and the like.

A performance package will feature a five-speed manual transmission, hitched to a turbocharged 2.3-liter engine. Planned introduction is January 1983.

AMC four-cylinder engine

American Motors is well along in development of its own four-cylinder engine, derived from the current six and featuring the company's patented, thin-wall block design and some major aluminum components for light weight. Like the Pontiac-built four it will replace in calendar 1983, its displacement will be in the 2.5-liter range and throttle-body electronic fuel injection is a good possibility. AMC also plans to offer diesels in all its lines within three years.

America's fastest tire

I just had the pleasure of attending a highly unusual press preview—unusual because the product being discussed, displayed and tested was not another new car, but a special new tire. From performance-oriented B.F. Goodrich Co., it's the ultra-performance, 140-mph Comp T/A, first and only very-high-speed "V-rated" tire made in North America.

Not that anyone advocates driving that fast except on a race track, but it's comforting to know that a tire designed for safety at such speeds can be counted on for extra security under less demanding conditions. In fact, prototype Comp T/A's were tested and developed on 170-mph race cars in competition at places such as Daytona Speedway.

BFG engineers used the Italian Pirelli P-7, widely thought of as today's ultimate "super tire," as their design target. And based on our head-to-head comparison tests on Firebird Trans Ams and Porsche 911s and Turbo 924s at Ohio's Transportation Research Center, it seems they've matched or bettered the P-7 in every way.

Both cornering and braking traction on dry pavement were at least equal to the Pirelli in most conditions and better in some. Also, the Comp T/A's displayed more stable and controllable "breakway" behavior at the cornering limit.

They also showed far better wear characteristics after our day of very abusive testing. We weren't able to test wet traction, but BFG says the Comp T/A has a *substantial* edge on wet surfaces.

Obviously, this is not the tire for everyone, nor for the average family car. Intended for serious drivers of high-performance cars, Comp T/A's range from \$200 to 300 each and are available in seven 15- and 16-inch sizes from 195/50VR15 to P265/50VR15 and 205/55VR16 to 225/50VR16. What if your car has 13- or 14-inch wheels? "Most people who go to this type of tire also buy special wheels," says BFG; "it's no problem to go up a size or two." **FM**

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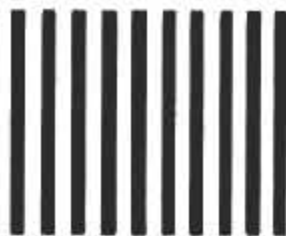
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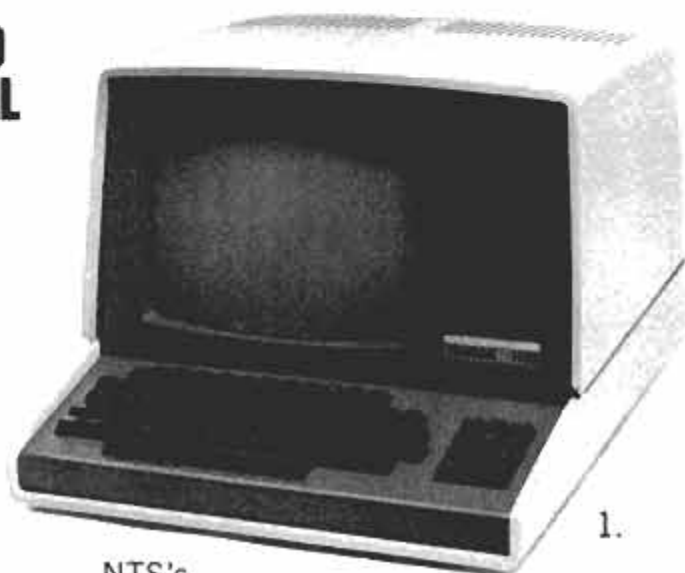
For example, we offer you three different programs in the booming microprocessor field. And each includes one of today's sophisticated microcomputer models for you to assemble and keep.

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It's also important to note that our microcomputers are not home-made training devices. They are production model micro-systems, identical to many you'll encounter in the field. We believe this makes your training a lot more exciting and relevant.



NTS's Master Course in Microcomputers includes the NTS/HEATH H-89 Microcomputer (#1 above). It features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory expandable to 48K. HDOS included.

The NTS/Rockwell AIM 65 Microcomputer (#2) is included in our Microprocessor Technology Course. It's a single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. This 6502-based unit also has 4K RAM memory, expandable, 8K monitor ROM and 8K advanced BASIC interpreter on ROM.

And in NTS's Master Course in Electronics and Industrial Technology, you'll work with the NTS/KIM-1 Microcomputer (#3). This unit features a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. It's a 6502-based microcomputer with 1K of RAM memory, expandable.

HOME ENTERTAINMENT ELECTRONICS

Simulated TV Reception



NTS has many different electronics programs to choose from. One of our most popular is Color TV Servicing—and it's no wonder. You build and keep an NTS/HEATH 25 inch (diagonal) digital color TV as part of your training. Choose Communications and you'll train on an NTS/HEATH 2-meter FM transceiver that you'll also build and keep.

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A master craftsman shows how to create a work of art in wood

Here's how to make your own sculptured butterfly wall hanging.

by Jeffrey Briggs



You can make this graceful butterfly wall graphic for your living or family room; or you can give one as an unusual gift. The butterfly is made of pine, redwood and aromatic cedar, taking advantage of variations in the knots, grain patterns and tones of the wood.

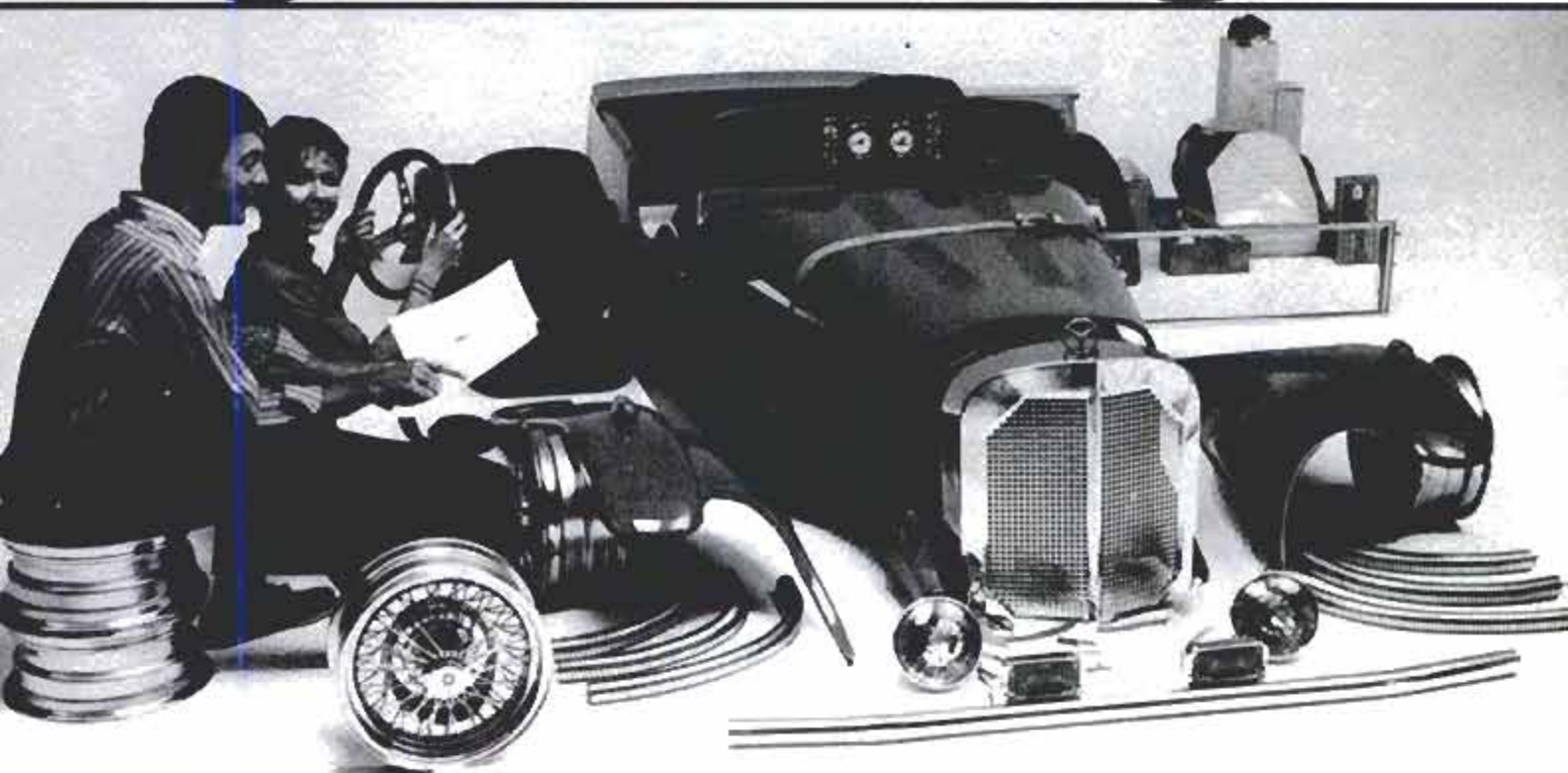
To make a butterfly, you must slice 24 wood slats in pairs—one slat for each wing. Slats are arranged so the wings will be mirror images of knots and grain patterns. The body is created from a single block of wood shaped to fit the wings.

Selecting the wood is probably the

most important step in making the butterfly, since strategically placed knots and interesting wood grain are the basis of its design appeal. When you select pine, look for the *poorest* grade available. At the lumberyard, browse through the No. 4

(Please turn to page 162)

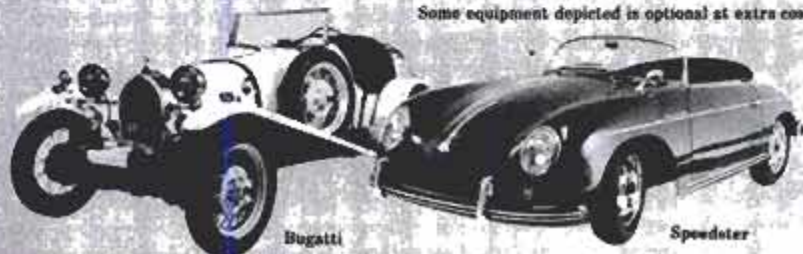
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Zap your NiCd batteries to life

When an old NiCd wouldn't accept another charge, you used to throw it away. Now, you can bring these "dead" batteries back to life.

by Herb Friedman

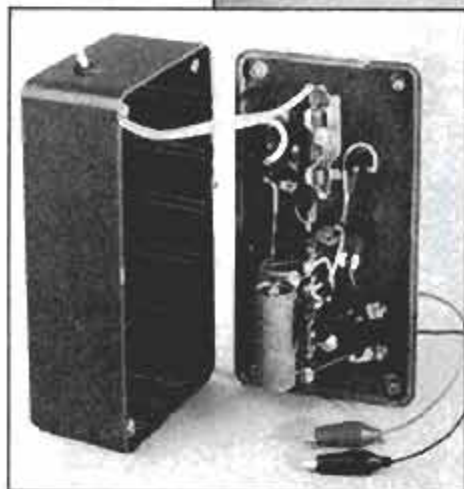
Though NiCd cells and batteries are capable of being recharged hundreds of times, many "die" before they are recharged even 100 times; some even go bad before 50 recharges.

In most instances, a NiCd goes "dead" because of an internal short, yet the NiCd can be resurrected from the dead with a relatively heavy surge of direct current that "burns" away the short. Once the short is removed, the NiCd can be recharged in the usual way.

Some tough cases—NiCds that have been "dead" for many months or those with several internal shorts—require repeated high-current surges before the short(s) opens. But eventually, even the toughest NiCd will "open up" for recharging. Naturally, if the NiCd has "died" from natural causes and is simply "used up," it can't be restored.

PM's NiCd NuLife, which can be assembled from components available from Radio Shack or most electronic-parts distributors, is an easy-to-build device for restoring NiCds. Note that the NuLife is powered directly by the 120-volt powerline. It should be assembled in a plastic cabinet, and except for the binding posts, no metal component that can be touched by the user should be connected to any part of the circuit. This includes the mounting screws for power switch S1 and the terminal strip. Make certain there is no connection to the terminal-strip lug that also serves as the strip's mounting foot.

The unit is assembled in a Radio Shack plastic Project Case, measuring approximately 6 x 3 x 2 inches.



If you cannot obtain a double-pole, single-throw (d.p.s.t.) switch for power switch S1, use a double-pole, double-throw (d.p.d.t.) type and use only the connections on one side.

Lamp NL1, the "charge indicator," is a 120-volt neon lamp assembly that consists of a neon lamp and an internal resistor in a single housing. Any of the 120-volt variety sold by Radio Shack and Calctro can be used—use the least expensive one. Do not, under any circumstances, substitute just an NE-2 neon lamp (without the resistor): It will blow out almost instantly when you apply power. NL1 must be a 120-volt neon-lamp assembly; the "120-volt" means an internal current-limiting resistor is built into the assembly.

Use any Silicon Controlled Rectifier (SCR) similar to the one specified in the parts list. Just make certain the one you use is not designated "high-gate sensitivity": The project requires an ordinary, inexpensive, general-replacement SCR. The SCR's leads must be extended to fit



NiCd battery rejuvenator, which we've named the NiCd NuLife, is shown (above) hooked up to zap four AA-size cells. A press of the charge button will bring to life even old, "dead" cells. The wiring on the case front panel (left) is quick and simple.

the terminal-strip's lug spacing. Tack-solder about 3 inches of insulated wire to each SCR lead and then slip a short length of insulation tubing down the wire and over the SCR leads. If you have used shrinkable-tubing insulation, heat it with a match so it shrinks tightly over the leads.

The only special component you'll need is capacitor C1. If you plan to restore only single-cell NiCds—such as the AA, C and D sizes—C1 can be 20 microfarads (mfd.). If you intend to restore multicell NiCds, use 40 mfd. A 20-mfd./150-v. capacitor is a common size, so if you need a 40-mfd. capacitor and can't locate one, connect two 20-mfd. capacitors in parallel, as we did in our own unit, shown in the component-side photo, page 64. (Radio Shack doesn't stock C1, but it is available in the Calctro parts line. If you don't have a Calctro distributor in your area, try a local TV-service shop.)

Operation

The AA, C and D NiCds are most easily handled by mounting them in an inexpensive cell holder. Connect an insulated clip lead from the battery's positive terminal to the NuLife's positive terminal; repeat this

(Please turn to page 64)

PLANT NOW—STEP BACK—WATCH IT SKYROCKET FORTH!

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and keeps on skyrocketing 30-40-50 EVEN UP TO 60 FEET HIGH OR MORE in less time than most trees nudge themselves a few feet off the ground.

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IT GROWS AS MUCH AS A FULL 1/2 FOOT EACH WEEK AFTER EVERY TIME YOU WATER IT!

Yes! Based on amazing growth rates reported by plant scientists—it grows SO FAST ... arches out SO WIDE ... you can actually take a ruler and measure the incredible difference in height every 2 to 3 days! OR, to really leave your neighbors gasping in awe and wonder, give them a yardstick and let them measure the difference IN FEET every 2 to 3 weeks!

Yes, goes on to thrust itself so high, so fast that it actually towers over even a Japanese Red Maple, Cherry Tree or even the most graceful silky willow in such a ridiculously short time you will simply refuse to believe your eyes! Think of it!

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Because according to plant experts, Govt. scientists and Botanical Gardens who researched this wonder-hybrid ... once established, you merely water it once-a-week, and be absolutely floored as, during its SUPER-SOARING growing season, it GROWS AS MUCH AS A FULL 1/2-FOOT WEEKLY AFTER EVERY TIME YOU WATER IT!

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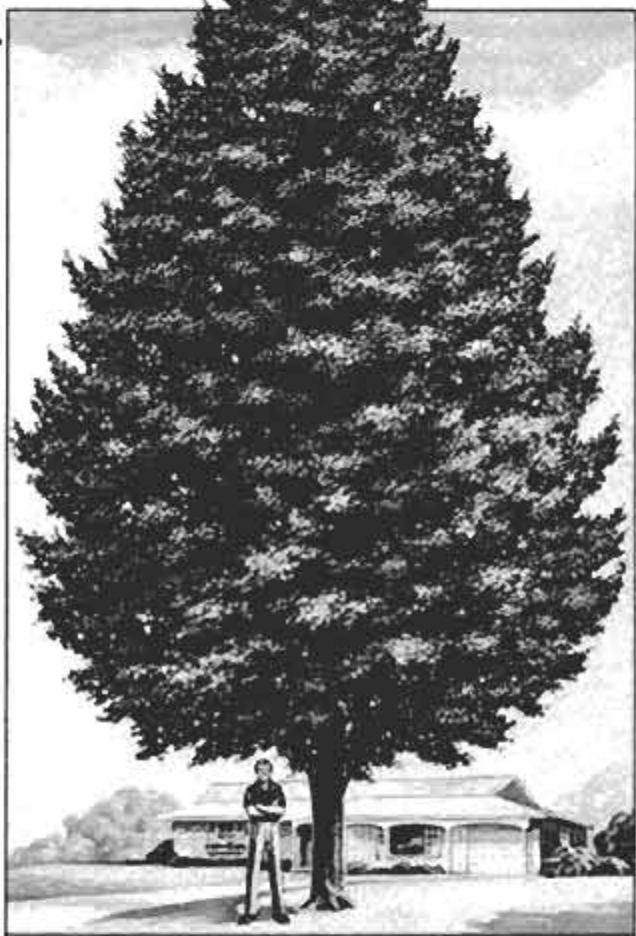
Now the price of this super growing shade tree is not \$20 or \$30 as you might expect, but a mere \$3.95!

That's right, only \$3.95 for this magnificent Beauty that rewards you with such a glorious display of growth IN JUST ONE SINGLE YEAR. However, our supply is limited! Full supplies from the growing fields will not be ready until late 1982 or early 1983. Therefore, all orders must be shipped on a first-come, first-shipped basis, to make sure you don't miss out ... ACT NOW!

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ZAP NiCd BATTERIES TO LIFE

(Continued from page 62)

procedure for the negative connections. Then plug in the unit and set power switch S1 ON. Initially, it will take about 10 seconds for NL1 to light, indicating C1 is charged. Depress charge pushbutton PB1 momentarily. NL1 will go out instantly. That's the only indication anything has happened. If there is a dirty connection between the battery and the holder, there might be a small spark and "pop" as the current burns through the dirt.

Release PB1, and when NL1 lights (about three seconds), again press PB1. Give the NiCd a few surges.

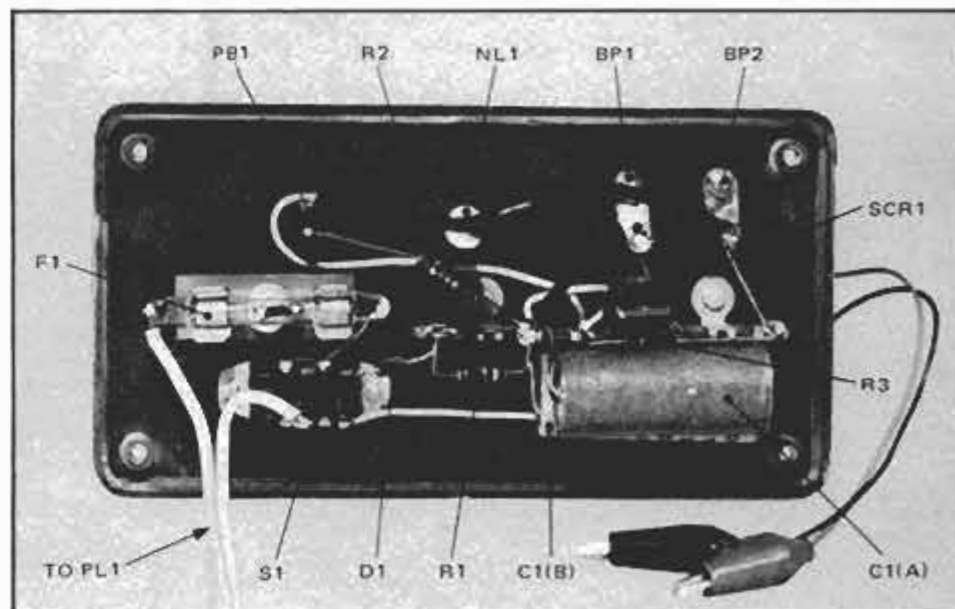
If you check the NiCd with a voltmeter, you'll get an insignificant reading (less than .1 v.) which indicates the cell is ready for charging. If there is no meter movement, connect the NiCd to the NuLife and give it 5 to 10 more surges.

Don't handle any connecting lead, the battery or a binding post if NL1 is ON. To "close down," or remove a NiCd, set S1 to OFF and then press PM1. When NL1 goes out, the connections can be handled. The circuit is designed so that even without a NiCd connected, pressing PB1 will discharge C1 (extinguishing NL1).

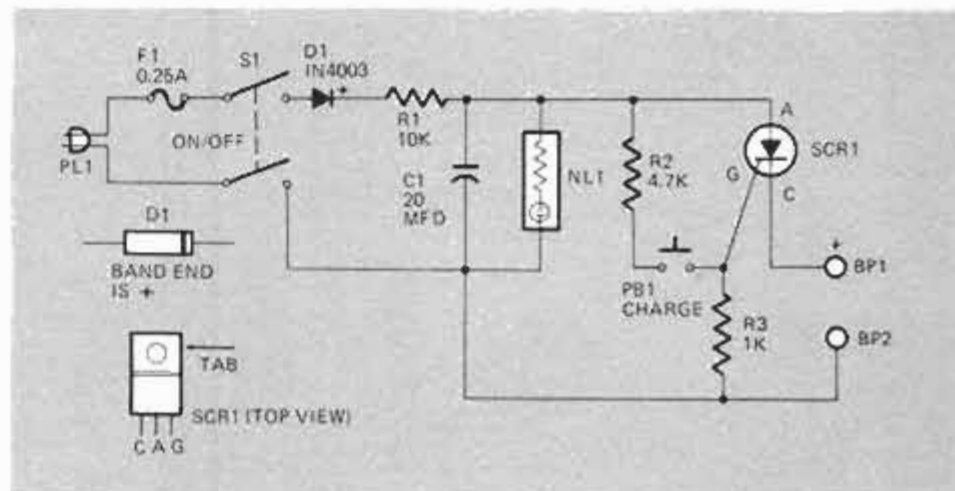
Recharge your batteries normally. If they hold a charge, all is okay. If not, try the NuLife one more time before throwing in the towel. **PM**

PARTS LIST—NiCd NULIFE

BP1, BP2—binding posts (Radio Shack 274-661 or equivalent)
C1—20-mfd. electrolytic capacitor, 150 v.d.c. (see text)
D1—IN4003 silicon rectifier (or equivalent)
F1—0.25-amp. fuse, type 3AG
NL1—neon-lamp assembly, 120 v.
PB1—pushbutton switch, n.o. (normally open)
PL1—power plug with cord, 120 v.
R1—10,000- Ω (10K) resistor, 1/2 w.
R2—4,700- Ω (4.7K) resistor, 1/2 w.
R3—1,000- Ω (1K) resistor, 1/2 w.
S1—d.p.s.t. switch, slide type
SCR1—200-PIV, silicon-controlled rectifier (Radio Shack 276-1067 or 276-1020 or equivalent)
Misc.: Cabinet, wire-terminal strip, press-on lettering, hardware.



The wiring of the components for the NiCd NuLife (above) is all done point-to-point on the back side of the case's top panel. See text for an explanation of C1 (A) and (B).



The schematic diagram (above) will allow you to customize your wiring to fit inside a case different from the one that's shown, since the placement of parts is not critical.

PHOTO HINTS

Zip out dust



A lady's garment bag makes a handy place to hang film for drying. It can be hung in a closet or other out-of-the-way place.

—Mike Plake

Tighten up



A set of precision jeweler's screwdrivers should be in every photographer's gadget bag: There's absolutely no substitute.

—Ken Oberrecht

Longer life



Tray life of most developers is given as 24 hours. To lengthen that time, you can place a sheet of glass over the tray. This will keep air out when you leave it.

—A. Weber



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How GM's throttle body fuel-injection system works

Eventually, nearly every new car will have a fuel-injection system replacing the carburetor. For '82, GM's TBI leads the way.

by Tom Yates

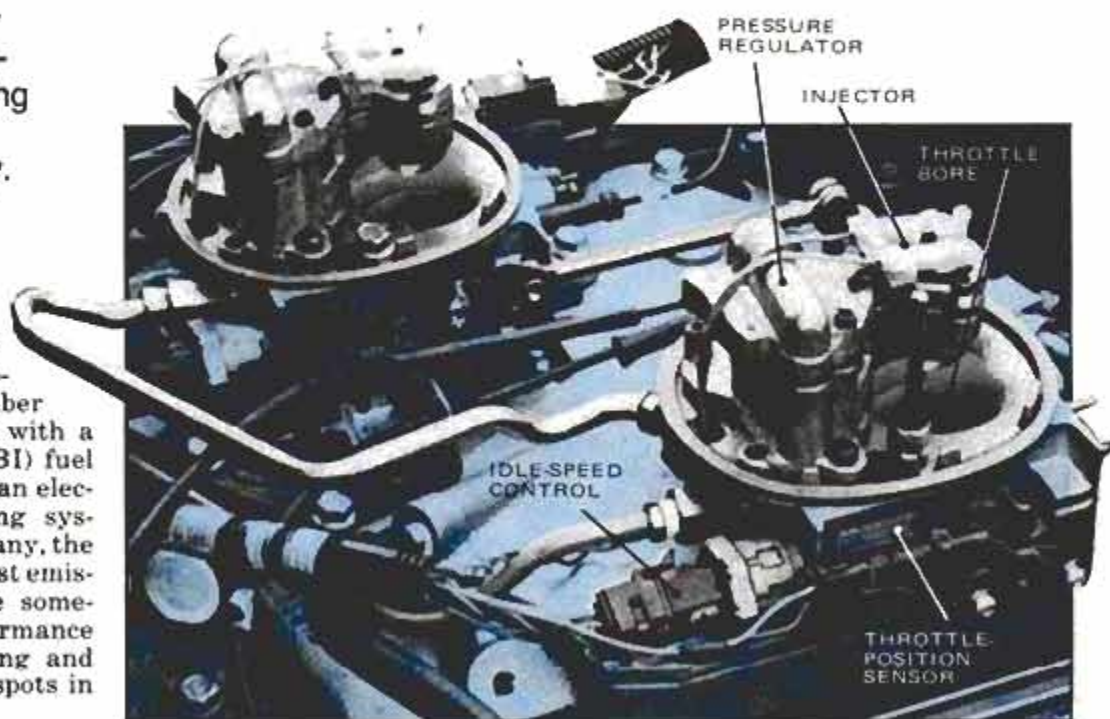
In what seems to be an endless search for the perfect engine, General Motors is equipping a large number of its 1982 model-year cars with a Throttle Body Injection (TBI) fuel system. GM describes it as "an electronic injector fuel-metering system." According to the company, the TBI system will lower exhaust emissions, improve gas mileage somewhat, return some performance punch, improve cold starting and running and eliminate flat spots in acceleration.

While fuel injection isn't new to gasoline engines (the Wright brothers used it on their first airplane), it has been used primarily on high-performance or racing engines. In those applications, fuel injection has worked fine. When it comes to street use, though, mechanical fuel-injection systems have fallen down on the job. No matter what mechanical method they used, problems cropped up. Usually, it was in the cold starting and running of the engine.

The newer, electronically controlled fuel-injection systems by Bendix, Bosch and Lucas have overcome most of the early problems. One of the greatest improvements was the use of a sensor to measure airflow to the engine. With this information, an on-board computer calculates the proper air/fuel ratio for the engine.

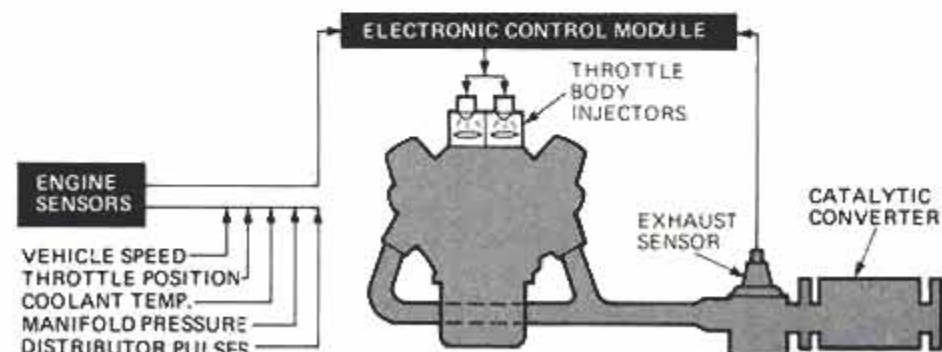
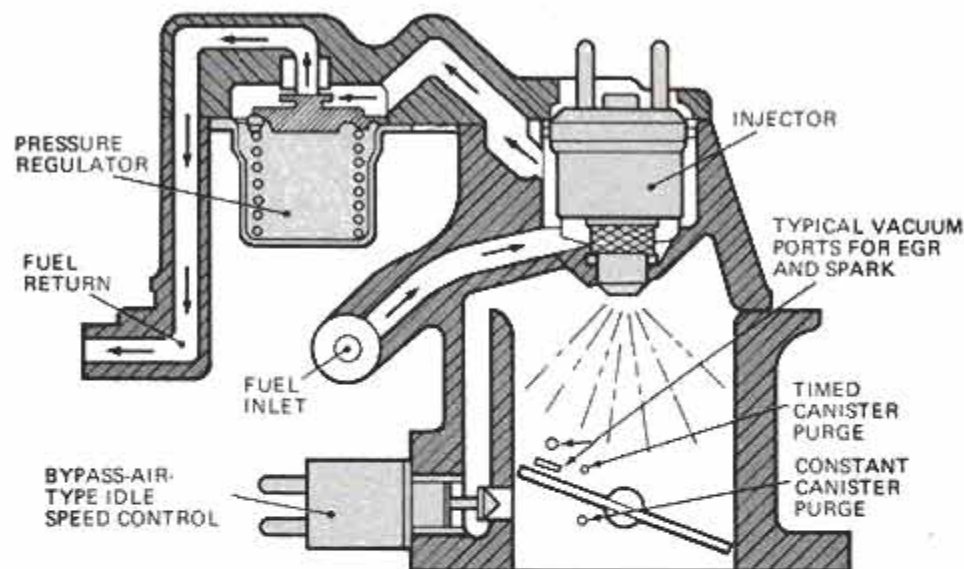
The GM TBI system uses an on-board computer to handle the air/fuel ratio. It's an updated version of the 3C computer used on the '81 engines (see *GM's Computer Command Control*, page 140, May '81). In operation, the Electronic Control Module (ECM) monitors the throttle position, engine rpm, manifold absolute pressure (MAP), coolant temperature, vehicle speed and exhaust oxygen level. The ECM then compares this information with its pre-programmed memory and calcu-

(Please turn to page 68)



Twin, throttle body injectors on the Corvette V8 do away with yards of plumbing that were required with the carburetor.

Each injector feeds the opposite bank of cylinders to ensure the maximum gas velocity and proper fuel atomization.



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BURGLAR ALARM and SECURITY SYSTEMS training. Covers all phases of Burglar, Hold-Up and Fire Alarm servicing and installation. This valuable and timely instruction includes all special tools and supplies. ONLY Belsaw offers such extensive training in this rapidly expanding field as a part of your Locksmith training.

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Sam Walker Prichard, Alabama



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GM'S THROTTLE BODY FUEL-INJECTION SYSTEM (Continued from page 66)

lates the exact stoichiometric (chemically correct) air/fuel mixture that will give lowest emissions and maximum power. The ECM then sends a signal to the injector unit(s), telling them when and how long to inject fuel into the intake manifold. At the same time, it also sets the ignition timing.

The TBI system itself consists of a tank-mounted fuel pump, the ECM, the injector(s), fuel filters and supply and return lines. There are two types of injectors used: a single- and double-bore unit. The single-bore unit is used on smaller engines such as the L-4. The larger V6 and V8 engines use either a double-bore unit or two single-bore units.

Low-pressure fuel

The tank-mounted, turbine-type fuel pump supplies fuel to the injectors via a filter in the fuel line. The entire fuel system is under a relatively low 10-p.s.i. pressure. Pressurizing the fuel system eliminates one of the most common hot-weather problems for automobiles: vapor lock. Since the fuel is under pressure from the time it leaves the fuel tank until it's sprayed into the manifold, it can't flash into vapor.

From the fuel filter, the fuel goes to the injector unit itself. The injector looks much like a carburetor that has been stripped of everything but the throttle bore. The float bowl, the mechanical choke, accelerator pump, and high- and low-speed fuel-metering circuits are gone. The remaining unit has two parts: a throttle body with the throttle plate to control airflow and the fuel-body assembly, containing the injector and a fuel-pressure regulator. A throttle-position sensor is mounted on the throttle-plate shaft to signal the throttle opening to the ECM. There is also a controller for the idle speed to compensate for engine loads, such as the power-steering pump or airconditioning compressor.

The injector is mounted directly over the throttle bore, so the fuel is sprayed in a conical pattern directly onto the bore walls. The injector is a normally closed ball valve, which is opened by a solenoid, on a signal from the ECM. The incoming fuel enters the lower section of the injector/regulator unit, passes through a fine-screen filter surrounding the injector nozzle and is sprayed onto the throttle-bore walls. The ECM regulates the amount of fuel and length of time it is injected, based on the information supplied by the various engine and vehicle sensors.

Excess fuel passes from the injector to the fuel-pressure regulator and is channeled back to the fuel tank.

The fuel-pressure regulator is a diaphragm-operated relief valve with injector fuel pressure on one side and air-cleaner pressure on the other. As the fuel flow to the engine increases, the fuel-pressure regulator closes off the return line to the fuel tank, so a constant 10-p.s.i. pressure is maintained to the injector. By balancing the air-cleaner air pressure against the fuel pressure, the regulator maintains a constant pressure drop across the injector throughout the entire operating range of the engine. This ensures a constant fuel supply.

The manifold-mounted TBI system offers several advantages, aside from the performance, economy and emissions benefits. It's considerably cheaper than an intake-port-mounted system because there are fewer injectors. Instead of one injector per cylinder, there are only one or two injectors mounted at the manifold inlet. With the carburetor fuel bowl eliminated, brake stalls, turn cutouts and fuel boiling are all things of the past. Dieseling, too, is no longer a problem, since the fuel flow is stopped as soon as the ignition is turned off.

Cold-weather hope

TBI offers a brighter future for cold-weather driving. With no mechanical choke, cold starts and running are improved. There are no mechanical parts to jam open or stick shut, causing hard starts and restarts or poor fuel economy. The ECM and injector deliver the precise amount of fuel needed to start and run the engine when it's cold. An overrich mixture isn't needed to compensate for fuel that normally condenses on manifold and cylinder walls in cold weather.

With the high- and low-speed metering circuits replaced by the injector, there's no throttle stumble or any flat spots during acceleration. That's because there's no transition from the relatively rich low-speed circuits to the leaner high-speed circuit. What's more, the ECM can compensate for high-altitude operation, as well as coasting conditions to reduce fuel consumption and pollutants. With the ECM, the engine receives only the fuel it needs.

All in all, the TBI system means that some of the '82 GM cars will use less fuel, start and run better in cold weather, accelerate more smoothly and pollute less—all at the same time.

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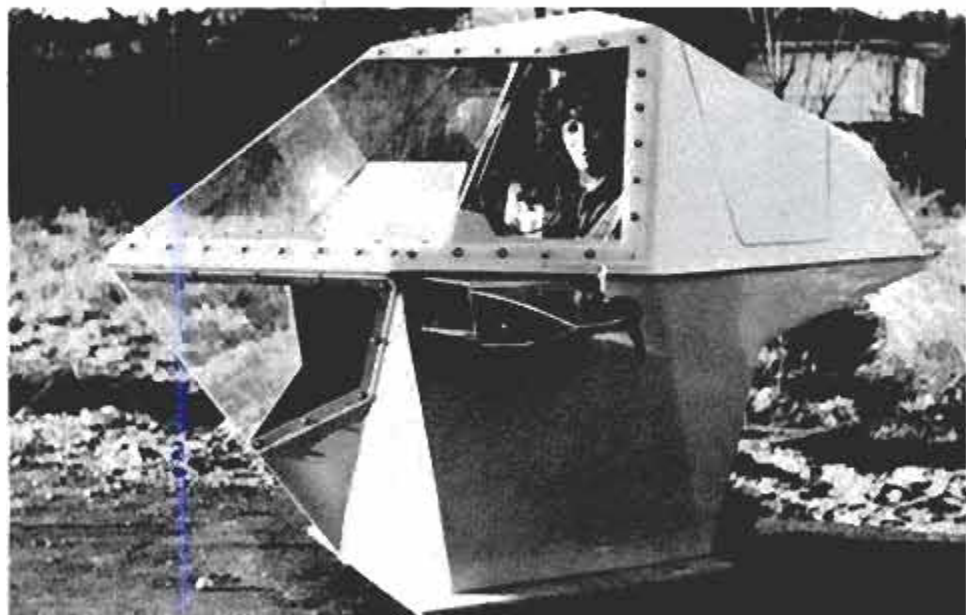
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PM's Whatsit

Take a deep breath on this one, because one look tells you it's either a time machine or something else way out of its element. It's identified in detail on the following page.

Suddenly, wood waste is a glamour fuel . . .

Giants in the wood-products industry are the logical interests to be leading the country in use of wood wastes as fuel, and they are going at it with a vengeance. Georgia-Pacific Corp. has four giant "heat cells" in place at various manufacturing sites in the United States and is completing a fifth, which will be as high as a two-story building. A fuel/air mixture—anything flammable will do, but sander dust is ideal—is combined to exact proportions in the heat cell, which functions like a huge carburetor. The mixture is then burned to generate as much as 40 million B.T.U. per hour, the equivalent of heat supplied by 25 barrels of fuel oil.

Rival Louisiana-Pacific Corp. is currently supplying 74 percent of its total energy requirements from wood waste—bark, sawdust and sander dust. L-P is even firing boilers with wood waste to generate electricity. Overall, building-products companies are now deriving an average of 70 percent of their energy requirements from waste. Louisiana-Pacific is also looking into wood gasification, a process which converts wood waste to a combustible gas.

. . . But, there could be a hitch

At least two scientists think wood burning on the residential scale, apart from increased industrial uses, poses a new danger in the form of carcinogenic (cancer-causing) by-products polluting the air. Edward Calabrese and Salvatore DiNardi, professors of public health at the University of Massachusetts in Amherst, say that polycyclic organic compounds, known as POMs, are being found in increasing concentrations in the air as wood burning intensifies. POMs have been identified as carcinogens in several government studies, they add. DiNardi explains that "airtight" or slow-burning-type stoves produce far more hydrocarbons and POMs than open-fire burning because they don't actually burn wood so much as they distill it.

"I used to be anti-nuke," says DiNardi, "but if I had to choose between living downwind from a nuclear power plant or living where everybody was using wood or coal stoves, I'd have to seriously consider living downwind from a nuclear power plant."



Louisiana-Pacific's wood-waste mountain.



Georgia-Pacific's carburetor-like heat cell.



Whatsit revealed

Of course, it's a submersible—the one field of conveyances where radical looks are considered the norm. This one is called the Manta Ray and it's engineered by Argus Leisurecraft of Maple Ridge, B.C. It's technically an "ambient-pressure" submersible in which two divers keep their heads and shoulders dry in a trapped pocket of air which can be supplied by scuba gear, surface air, mixed gases or the new cryogenic systems. The manufacturer says divers can exit and enter the craft easily at any depth down to its 600-foot operating maximum. Twin thrusters give speeds of up to four knots.

Off the wall

Never mind antiques—rising costs for both fine woods and the craftsmen who work with them are making instant heirlooms out of contemporary musical instruments. The facts of the matter are well known to burglars, who are increasingly targeting musical instruments along with other household valuables. We know your key ring is probably already crowded with home-security keys, but if you own a fine guitar, consider locking it up against the wall (in its case) with this unit made by Kiyo Locking Systems, 197 Friar Way, Campbell, Calif. 95008. The kit is expensive—\$49.95—but the yoke is 1/8-in.-thick, hot-rolled steel and should foil a hack-saw artist.



Why robots will eventually take over

It is becoming the best of times for robots. The Army recently conducted its first test—deemed successful—of a robotic



Binks spray-painting robot on the job.

"counter-obstacle" vehicle. Essentially, it involved a modified tank chassis that's equipped with "brains" to clear its way through a mine field, pushing a mine-clearing roller, and mark the path for troops to follow. And Lockheed-Georgia made aviation history by putting robots to work for the first time on an aircraft sheet-metal-assembly production line. Lockheed's robots assemble cargo floor bulkhead webs that consist of 11 separate parts and 154 rivets. Nice going, guys.

But even these milestones were eclipsed by the news that Binks Mfg. of Franklin Park, Ill., is marketing the Thermwood spray-painting robot worldwide. The Model 88-8800 spray painter has a disc-memory option that can store hundreds of programs for spray painting anything that will hold still. And when they perfect the steak-barbecue cassette option, it may well be marketed as a replacement for the American husband.



3-passenger seating,
standard.

Tinted glass,
standard.

14.8 gallon fuel tank
for long range:
562 EPA estimated
highway miles.

Swing-out
side vent
windows,
standard.

Intermittent
windshield wipers,
standard.



Steel-belted
radial tires,
standard.

5-speed
overdrive transmission,
standard.

It's hard to believe this is the lowest-priced truck sold in America.

1982 Mazda B2000 Sundowner
\$5895*

You can believe it. The Mazda B2000 Sundowner is today's lowest-priced truck. Yet it comes with an astounding number of standard features, including a 5-speed and steel-belted radials.

Not one of these features is available on Toyota's or Datsun's lowest-priced truck, each of which costs hundreds more.

Just one look inside the cab and you'll see more of the Mazda B2000's exceptional



value. There you'll find a three-passenger seat detailed in textured vinyl. New instrumentation with electronic check panel. And handsomely trimmed door panels complete with armrests.

You can also believe this

truck is built to haul a heavy payload—1400 pounds of it. Even so, its 2-litre, 4-cylinder engine delivers outstanding fuel economy.

38

27

EST. hwy. mpg. EST. mpg.

If you still find it all a little hard to believe, we invite you to visit your Mazda dealer for a close-up look at the B2000 Sundowner.

Seeing is believing.

MAZDA

The more you look,
the more you like.

*Manufacturer's suggested retail price for B2000 Sundowner Shortbed. Actual prices set by dealers. Taxes, license, freight, options and other dealer charges extra. Prices may change without notice. Availability at dealers of vehicles with specific features may vary. **1982 EPA estimates for comparison purposes for B2000 Sundowner Shortbed. Your mileage may vary with trip length, speed and weather. Actual highway mileage will probably be less. Calif. 36 Est. hwy. mpg. 26 Est. mpg.

Think you' the lowest Think



Why do you think your brand is lowest? Because its ads say so? But other brands' ads are saying the same thing—that they're the lowest in tar.

Just where is a tar-conscious smoker supposed to turn?

Well, numbers don't lie. So we've put the tar levels of all these claiming-to-be-lowest brands into the chart on the right.

That way you can see just how much tar your brand has—and that there's one brand lower in tar than any of the other "lowest" tars.

Now is the lowest 100s, Box or Soft Pack. And there's no cigarette in any size that's lower in tar than Now.

Do you want to know for sure that you're smoking the Ultra Lowest Tar™ brand?

Well, there's only one—Now.

BOX, BOX 100's: Less than 0.01 mg. "tar", 0.001 mg. nicotine, SOFT PACK 85's FILTER, MENTHOL: 1 mg. "tar", 0.1 mg. nicotine, SOFT PACK 100's FILTER, MENTHOL: 2 mg. "tar", 0.2 mg. nicotine, av. per cigarette by FTC method.

NOW

Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

Are you smoking tar brand? again.

**NUMBERS DON'T LIE.
NO CIGARETTE, IN ANY SIZE,
IS LOWER IN TAR THAN NOW.**

	80's box	85's soft pack	100's box	100's soft pack
NOW	Less than 0.01mg	1mg	Less than 0.01mg	2mg
CARLTON	Less than 0.01mg	1mg*	1mg	5mg
CAMBRIDGE	Less than 0.1mg	1mg	—	4mg
BARCLAY	1mg	1mg	—	3mg

All tar numbers are av. per cigarette by FTC method, except the one asterisked (*) which is av. per cigarette by FTC Report May '81.

The Lowest

The lowest in tar of all brands.

CANADA AT ITS BEST[®]

Light. Smooth. Imported Canadian Mist.[®]
The whisky that's becoming America's favorite Canadian.



Share some tonight.

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Photographed at Lake Beauvert, Jasper, Canada.

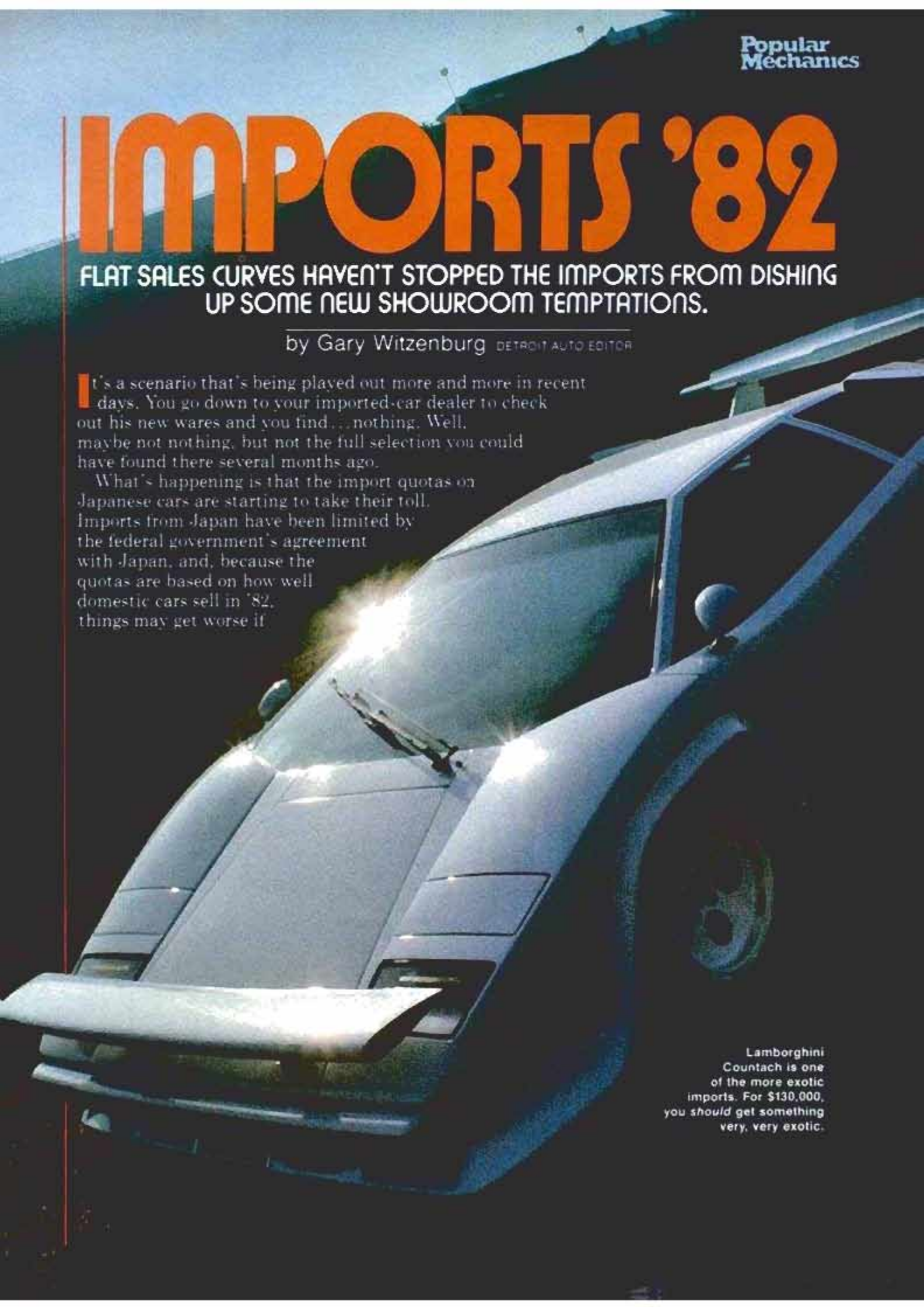
IMPORTS '82

FLAT SALES CURVES HAVEN'T STOPPED THE IMPORTS FROM DISHING UP SOME NEW SHOWROOM TEMPTATIONS.

by Gary Witzenburg DETROIT AUTO EDITOR

It's a scenario that's being played out more and more in recent days. You go down to your imported-car dealer to check out his new wares and you find... nothing. Well, maybe not nothing, but not the full selection you could have found there several months ago.

What's happening is that the import quotas on Japanese cars are starting to take their toll. Imports from Japan have been limited by the federal government's agreement with Japan, and, because the quotas are based on how well domestic cars sell in '82, things may get worse if



Lamborghini Countach is one of the more exotic imports. For \$130,000, you should get something very, very exotic.



Celica Supra

Toyota's slick new Celica Supra packs a double-overhead-cam, fuel-injected 2.8-liter Six that pumps 145 hp. L-Type Supra, shown here, offers extra luxury features such as digital electronic instruments and plush interior.



Mercedes-Benz 380SEC

Mercedes 380SEC offers some unique touches, like a heated area at base of windshield to keep wipers from freezing and an automatic seat-belt feeder.

Nissan Stanza offers tremendous interior space and good fuel economy wrapped up in a slick aerodynamic package. It's aimed at the heart of the J-car market.

Nissan Stanza coupe



IMPORTS

Detroit doesn't boost sales rather quickly.

Happily for those of you shopping for an import, there is no restriction on European imported cars. And the Japanese themselves seem undaunted by the regulations. They're grinding out new model after exciting new model—quotas or no quotas.

There's no question that many of the new models are going to give the domestics fits. Toyota's new Celica and Celica Supra are as good-looking new cars as you'll find this side of Turin. Volvo's Turbo is quick, comfortable and practical, albeit at a price. There's a new Honda Accord, as well, and others that have a lot going for them.

We've covered many of the new imported cars in previous reports. Several new models have been introduced in recent weeks and, for completeness, we've recapped many of the models we've written about in previous issues. If you're planning to buy a new car and you're considering one or more of the imports, we suggest you



Toyota Celica

Liftback is powered by 2.4-liter, ohc Four that's good for 96 hp at 4,800 rpm.

'82

check the information here and in your back issues of PM. Then go out and drive the cars at local dealers. There's no substitute for slipping behind the wheel and getting a feel for the way a car drives, accelerates and handles. It's not a bad way to spend a Saturday afternoon, either. Here's the lineup, country by country.

JAPAN

Datsun (Nissan)

210—Unlovely, but inexpensive, Datsun's best-seller has a 1.5-liter Four driving rear wheels through a four-speed or five-speed manual or three-speed automatic transmission in sedan, hatchback coupe and wagon. MPG version has a 1.4-liter Four with five-speed manual.

310—This fwd econocar gets a redesigned 1.5-liter engine for better economy and performance, less noise and vibration for '82; there are three-door sedan and coupe, and five-door sedan models, all with handy hatchbacks.

Stanza—These all-new, fwd, three-



Honda Accord sedan

Honda has cloned its new Accord in the image of BMW. Good ride quality, fuel economy and classy interior has kept it one of the most wanted cars around.

Volvo's Swedish brick is a wolf in sheep's clothing. Addition of a turbocharger has put muscle under the hood and handling has been improved to match it.



Volvo GLT turbo wagon

door and five-door, five-passenger hatchbacks have a new, 2.0-liter Four and standard five-speed manual or optional three-speed automatic. Space efficiency and excellent economy are the best features of this 510 replacement, which is marketed worldwide under the parent Nissan name.

200-SX—This Toyota Celica rival comes in sporty notchback and hatchback variations with new, fuel-injected 2.2-liter engine and standard five-speed or optional lockup automatic. Nissan's vocal warning system is a new option.

Maxima—With lowest priced models and the 810 designation dropped for '82, Nissan's Maxima luxury sedan and wagon feature a choice of a 2.4-liter gas Four or 2.8-liter diesel Six with five-speed or automatic transmission. The unique, vocal warning system is expanded to include key-in-ignition, low-fuel, door-ajar, parking-brake and lights-on messages.

280ZX—Datsun's sport/GT car comes in two-seat and 2+2 variations, with 2.8-liter Six, optional turbo and five-speed or automatic transmission. New for '82 are upgraded interior, vocal warning system, full-length side moldings and body-color bumpers. Styling and handling have suffered as ride and feature load have gotten more luxurious, but Turbo-Z performance has returned driving excitement.

Honda

Civic—Honda's basic car features fwd and peppy performance in three-door hatch, four-door sedan and five-door wagon body styles. Supereconomy FE version is new this year. In real-world driving, it's been clocked at 48 mpg.

Accord—Redesigned for '82 with a longer wheelbase, wider treads, improved aerodynamics, more interior room and new standard and optional features, the fwd, three-door hatch and five-passenger, four-door sedan continue as the standard against which others in this class are measured. The 1.8-liter Four, five-speed and automatic transmission remain.

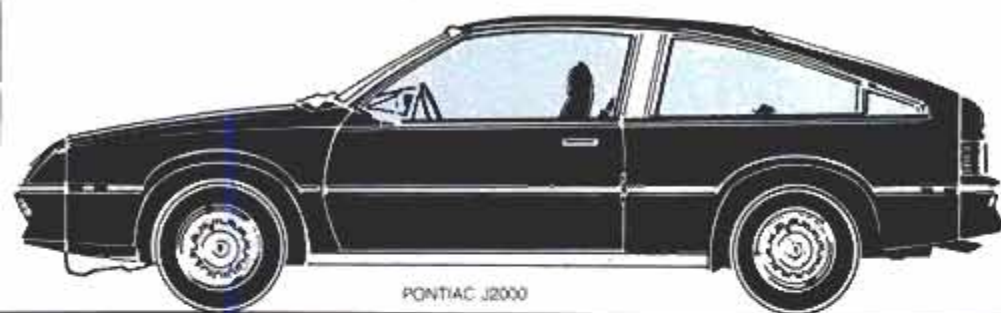
Prelude—Honda's sport coupe has a conventional trunk, unconventional looks and 2+2 (children only) rear seating. It features the fun-to-drive Accord power train and excellent fwd handling.



THEIR CARS

	BASE PRICE		
SUBCOMPACT			
Datsun 210	\$4,799	Toyota Celica Supra	13,598
Datsun 310	5,689	VW Scirocco	10,150
Dodge Colt	5,543		
Honda Civic	4,799	INTERMEDIATE/LUXURY COMPACT	
Mazda GLC	5,295	Audi 5000	13,665
Plymouth Champ	5,543	BMW 528e	23,000*
Renault LeCar	4,795	Datsun Maxima	11,049
Subaru	4,839	Peugeot 505	10,990
Toyota Starlet	5,578	Peugeot 504 wagon	11,900
Toyota Corolla	5,448	Saab 900	10,400
Toyota Corolla Tercel	4,998	Toyota Cressida	12,249
		Volvo DL/GL GLT/GLE	9,785
COMPACT			
Audi 4000	9,755	LUXURY SPORT	
Fiat Strada	6,200*	BMW 633Csi	36,995
Honda Accord	7,399	DeLorean	25,000
Isuzu I-Mark	5,917	Ferrari 308GTBI/308GTSI	50,000*
Mazda 626	7,245	Ferrari Mondial	63,939
Nissan (Datsun) Stanza	6,799	Jaguar XJS	32,100
Renault 18i	7,400*	Lotus Esprit	40,000*
Toyota Corona	8,939	Mercedes-Benz 380SEC	49,827
VW Quantum	10,250	Mercedes-Benz 380SL	39,961
VW Jetta	8,375	Porsche 928	39,500
FULL SIZE			
No Competition		LUXURY	
SPORT/GT		BMW 733i	33,315
Alfa Romeo Spider	15,000*	Jaguar XJ6	29,500
Alfa Romeo GTV6 2.5	17,455	Mercedes-Benz 240D	20,989
Audi Coupe	12,370	Mercedes-Benz 300D/300CD/300TD	28,483
BMW 320i	13,290	Mercedes-Benz 300SD/380SEL	35,268
Datsun 200SX	7,739	Peugeot 604	19,595
Datsun 280ZX	14,499	Rolls-Royce Silver Spirit/Silver Spur	109,000
Dodge Challenger	8,036	Rolls-Royce Corniche	146,160
Fiat X1/9	10,900	Rolls-Royce Camargue	152,000
Fiat Spider 2000	12,290	FOUR-WHEEL DRIVE	
Honda Prelude	7,995	Audi Quattro	35,000*
Lancia Zagato	13,000*	Subaru DL/GL	6,889
Mazda RX-7	9,695		
Plymouth Sapporo	8,036		
Porsche 924	16,770		
Porsche 911	28,365		
Porsche 944	20,000*		
Renault Fuego	12,000*		
Toyota Celica	7,159		

*Indicates estimated price. All prices are for two-door base models as of November 1981, unless otherwise indicated.



PONTIAC J2000

OUR CARS

SUBCOMPACT

	BASE PRICE
AMC Spirit	\$5,576
Chevrolet Chevette	5,788
Ford Escort	5,462
Mercury Lynx	5,502
Pontiac T1000	5,781
VW Rabbit	5,990

COMPACT

AMC Concord	5,954
Buick Skyhawk	7,500*
Buick Skylark	7,427
Chevrolet Cavalier	7,271
Chevrolet Citation	7,109
Dodge Omni	5,499
Dodge Aries	5,990
Ford Fairmont	5,985
Mercury Zephyr	6,411
Oldsmobile Firenza	7,500*
Oldsmobile Omega	7,388
Plymouth Horizon	5,499
Plymouth Reliant	5,990
Pontiac J2000	6,998
Pontiac Phoenix	6,964

FULL SIZE

Buick LeSabre	8,774
Chevrolet Impala/Caprice	8,378
Ford LTD	8,312
Mercury Marquis	8,674
Oldsmobile Delta 88	8,603

SPORT/GT

Chevrolet Camaro	9,000*
Chevrolet Corvette	18,750
Dodge O24	5,799
Ford EXP	7,387
Ford Mustang	6,345
Mercury LN-7	7,787
Mercury Capri	6,711
Plymouth TC3	5,799
Pontiac Firebird	9,000*

INTERMEDIATE/LUXURY COMPACT

Buick Century	8,980
Buick Regal	8,712

Cadillac Cimarron	12,181
Chevrolet Celebrity	8,712
Chevrolet Malibu	8,536
Chevrolet Monte Carlo	8,576
Chrysler LeBaron	8,143
Chrysler Cordoba	9,197
Dodge 400	8,043
Dodge Diplomat	7,750
Dodge Mirada	8,619
Ford Granada	7,126
Ford Thunderbird	8,492
Mercury Cougar	7,983
Mercury Cougar XR7	9,094
Oldsmobile Cutlass	8,712
Oldsmobile Cutlass Supreme	8,588
Oldsmobile Cutlass Ciera	8,847
Plymouth Gran Fury	7,750
Pontiac Bonneville Model G	8,526
Pontiac Grand Prix	8,333
Pontiac 6000	8,729

LUXURY SPORT

No Competition

LUXURY

Buick Electra	11,713
Buick Riviera	14,272
Cadillac deVille	15,249
Cadillac Eldorado	18,716
Cadillac Seville	23,433
Chrysler New Yorker	10,781
Chrysler Imperial	20,988
Lincoln Town Car	16,100
Lincoln Mark VI	19,452
Lincoln Continental	21,302
Oldsmobile 98	12,116
Oldsmobile Toronado	14,462

FOUR-WHEEL DRIVE

AMC Eagle	8,719
AMC Eagle SX/4	7,451
AMC Eagle Kamback	6,799

*Indicates estimated price.
All prices are for two-door base models as of November 1981, unless otherwise indicated.

Isuzu

I-Mark—America's newest importer enters its second season with expanded availability of the solid, but outdated, I-Mark rwd coupes and sedans. Their major virtue is a sophisticated and highly efficient optional 1.8-liter diesel engine. The standard gas engine also displaces 1.8 liters, and four-speed, five-speed and automatic transmissions are available.

Mazda

GLC—Tough, fwd, econocar competitor debuted a year ago with angular good looks and strong, but thrifty, 1.5-liter Four coupled to either four-speed, five-speed or automatic transmissions in three-door hatch, five-door hatch and four-door sedan variations. The GLC wagon, though, is still conventional rear-wheel drive.

626—The mid-range rwd coupe and sedan are aging gracefully and hardly seem to need the overhaul they're scheduled to get for the '83 model year. Five-speed with 2.0-liter Four is standard and automatic is optional.

RX-7—It gives terrific performance and sports-car value with Mazda's unique rotary engine and five-speed or automatic transmission. Fuel economy and handling are much improved over past models, but the RX-7 is still a little "tail-happy" when cornered at the limit.

Mitsubishi

Champ/Colt—Imported by Chrysler Corp. and marketed through Plymouth and Dodge dealers, Mitsubishi's fwd econocars offer state-of-the-art styling, performance and economy with choice of 1.4 or 1.6-liter Fours and automatic, four-speed or unique "twin-stick" (four-speed plus high/low range) manual transmissions. The five-door hatchback model joins the three-door hatch for '82.

Sapporo/Challenger—Plymouth and Dodge versions of Mitsubishi's handsome rwd sport coupes, redesigned a year ago, have a 2.6-liter Four with silent-shaft engine balancing and choice of five-speed or automatic transmissions.

Subaru

DL/GL/GLF—Beginning with a price-leader base hatchback and ex-

(Please turn to page 116)

Stanton 680EE



Micro-Acoustics 100-e



Shure M75HE



Pickering V-15 Micro IV



Of the nine new hi-fi cartridges, four are moving iron type (the AKG P10E D/L, Bang & Olufsen's MMC 10E-C, the Empire 200-E, and Stanton's 680EE), one is a moving coil type (the Audio Technica AT 10E), three are moving magnet types (Pickering V-15 Micro IV, Shure M75HE and Shure M95HE) and one is electret type (the Micro-Acoustics 100-e). We recorded lab test results and then made subjective listening reports of these nine \$55 to \$125 cartridges.

The phono cartridge—the little device at the tip of the tone arm—is where the music really starts. It's the gateway by which music enters the sound system. As the originator of the audio signal, it holds a strategic position. If it doesn't read out the sound correctly from the record groove, the music gets distorted at the source. No matter how good your amplifier or your speakers, they cannot correct the faults introduced at the start by an inferior cartridge.

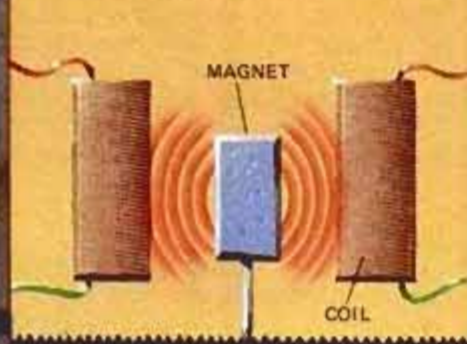
Next to the speakers, the cartridge has the most notable effect on the kind of sound you hear. And like your speakers, the cartridge adds its own distinctive

(Please turn to page 142)

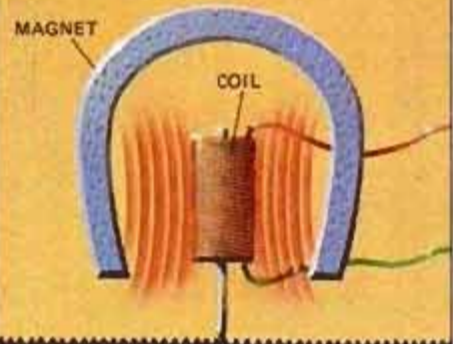
Bang & Olufsen MMC 10E-C



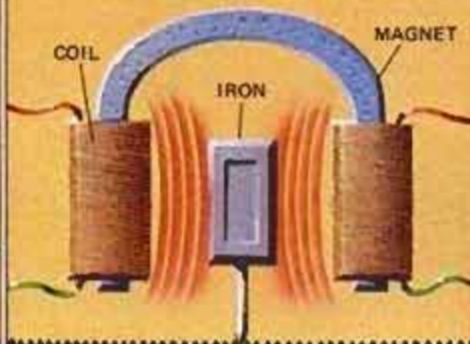
MOVING MAGNET



MOVING COIL



MOVING IRON





Empire 200 E



Audio-Technica AT 30E

AKG P10ED/L



PM's tough test of 9 new hi-fi cartridges



Shure M95HE

Shure M95HE is installed on tone arm for PM test. Connecting cartridges is delicate work, but easy.

We connected our test equipment and let a test record spin to sound out the latest medium-priced phonograph cartridges.

by Hans Fantel

Moving-magnet design shows the stylus attached to magnet, suspended between coils. The coils, by inductance, pick up the magnet's movements as stylus tracks grooves. The moving coil uses coil attached to stylus; its movement sets up fields in stationary magnet. Moving-iron type has stylus attached to an iron bar; its movement induces signals in coils on magnet. The rarer, electret (not shown) has no moving parts. A crystal responds electrically to stylus movement.

FIRSTHAND REPORT

Driving Chrysler's K-car Convertible and the Rampage mini-pickup



Spirited, sunshine motoring is back—brought to you by the folks you thought were down and out.

by Gary Witzenburg
DETROIT AUTO EDITOR

It had to come to this, of course. No way was Detroit going to let all those body shops, car dealers, custom car shops and other outlets have all that business to themselves.

What business? In case you haven't noticed, convertible conversions have become a very big business in the past four years. It started out with custom body shops chopping the tops off some of the more popular sporty cars around—Camaros, Firebirds, Mustangs, Toyotas and so on. It's so big now that car dealers in

just about every major city have a convertible-conversion shop nearby.

Now, after watching all those dollars float off into the hinterlands, never to be seen again, one of the Detroit automakers—Chrysler Corp.—has brought back the ragtop.

If a convertible brings back all those mouth-watering memories of your youth, join the club. That's what Chrysler is counting on to make its new Chrysler LeBaron and Dodge 400 con-

(When you buy a car, page 150)

Chrysler LeBaron convertible is exceptionally clean of line, as seen in these two views. Dodge 400 version is nearly identical. Both have fwd, a 99.9-inch wheelbase and are 179.7 inches overall.



Dodge Rampage pickup is half car, half truck like the familiar Chevy El Camino and Ford Ranchero. But, unlike them, it has fwd. Powerplant is 2.2-liter Four, and payload is 1,140 pounds in the cargo box. Rampage has a 104.2-in. wheelbase, is 183.6 in. overall, stands 51.8 in. high and is 66.8 in. wide.



HIGH-TECH TREASURE DIVERS ROB DAVY JONES

Technology born in undersea oil fields
opens a hot quest for deep salvage.

The *Andrea Doria* sank 26 years ago. The battle cruiser *Edinburgh* was mortally wounded by the Germans, then scuttled by the British, in 1942. Yet it was no mere coincidence that these two ships, lying on the sea bottom thousands of miles apart, gave up both secrets and precious cargoes to human salvagers within a few weeks of each other last year. Nor was it a coincidence that these remarkable efforts were being planned simultaneously with a separately mounted search for the most famous shipwreck of all, the *Titanic*.

Undersea technology is opening a new salvage frontier, one that appeals mutually to what man has never lacked: an appetite for adventure and a fascination with wealth nearly beyond measure. Almost ironically, it has been the quest for a

far more mundane substance—petroleum—that has recently yielded the technology enabling men to dive for the heretofore forbidden deep treasure of sunken ships.

In August 1981, four divers from a Houston company, Oceanering International, with four others, utilized the technique known as saturation diving to spend a month working at a depth of 73 meters (240 feet) off Cape Cod. The job culminated with the recovery of a steel safe—contents still kept secret by the project's sponsors from the *Andrea Doria*.

Two months later, the same techniques allowed three divers from Wharton Williams Ltd. of Aberdeen, Scotland, to cut a hole in the side of the British cruiser *Edinburgh*, lying 244 meters (800 feet) down in icy waters north of Murmansk in

Continued on page 110



DIVING VESSEL
"STEPHANITURM"

CROSSING
"EDINBURGH"
ON 1952
4000 METERS (13120)
ON 1952
PROBABLE

EDINBURGH
1952

800 METERS

Diving vessel *Stephaniturm* lowers divers
in bell 800 feet down to the *Edinburgh*.

COMMUNICATIONS
AND POWER CABLE

BELL HOIST
CABLE

BELL
PRESSURIZED
TO 60 P.S.I.

WELL
HEAD
FOR
SHELF
BARS

BELL
HOISTED
ABOARD

STATION

DIVERS'
LIVING
QUARTERS

Hoisted aboard support ship, bell remains at working pressure.

Most remarkable gold-recovery dive in history, the *Edinburgh* salvage dive was made possible by undersea oilfield operations techniques. Specially built diving bell, designed by the West German firm of Dräger A.G., was lowered to within 50 feet of the sunken British cruiser. Connected to bell by umbilical delivering breathing gases and warm water circulated through suit, divers cut hole in the hull with torches, loaded 22-pound gold ingots into basket.

TANKS HOLD
BREATHING
GASES AND
TORCH FUEL

UMBILICAL CARRIES
BREATHING MIXTURE
AND WARM WATER

EMERGENCY
BREATHING
TANK

CADILLAC CIMARRON

Strong Caddy image, say owners,
but the engine's a weakling.

*"It's a classy little car with
all the refinements of
a big car."*

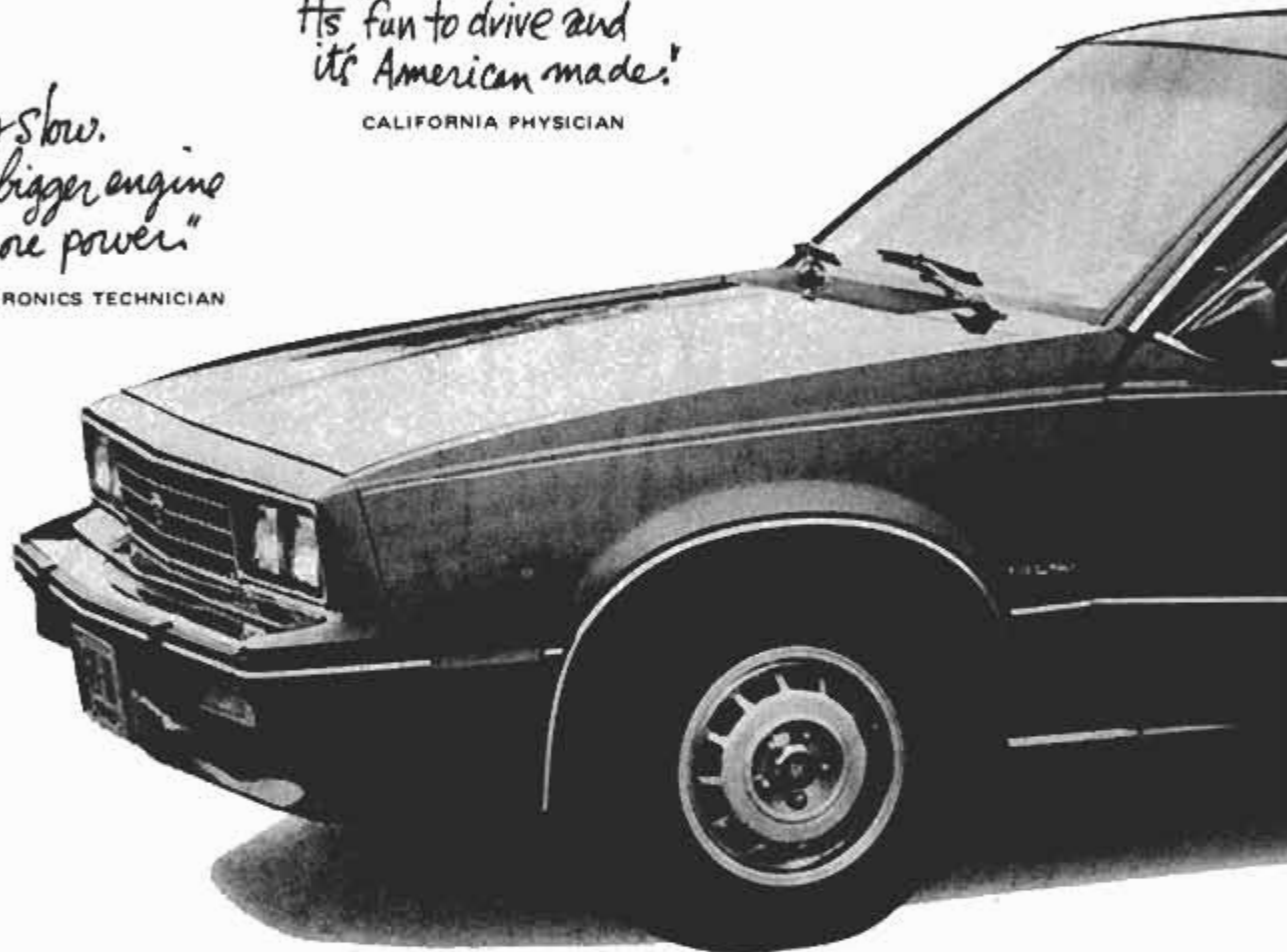
FLORIDA ATTORNEY

*It's fun to drive and
it's American made!*

CALIFORNIA PHYSICIAN

*"It's really slow.
It needs a bigger engine
and more power."*

MICHIGAN ELECTRONICS TECHNICIAN



It's easy enough to be critical of America's only subcompact luxury car. Several automotive magazines already have itemized its shortcomings, when compared to the imports it's challenging. And people in car merchandising pretty much agree that Cadillac Div. (in general) and the Cimarron (in particular) have two very hard rows to hoe in America's changing auto marketplace.

Still, the Standard of the World has never been bashful, and Cadillac ads boldly pit the new Cimarron against the likes of the BMW 320i, Audi 5000, Volvo GLE and Saab 900S. How well does the 1982 Cimarron really stack up against such formidable competitors? And how does Cadillac's J-car come off in the eyes of actual owners?

To find out, we mailed questionnaires to 1,000 Cadillac Cimarron purchasers across the country. Their tabulated an-

swers brought several surprises, but showed us that, by and large, Cimarron owners like their cars and consider Cadillac's *haute couture* combination of size and elegance a total success.

First, the surprises. Surprise No. 1



Driver gets royal treatment, with handling the best thing about the car, say owners.

came when we learned that (in our survey, at least) well over half of all Cimarron owners are more than 50 years old. That's quite a revelation, because Cadillac had hoped the Cimarron would reach out to a much younger age group. Cadillac needs a pool of more youthful Cimarron buyers who will eventually graduate to its more traditional models.

The second surprise has to do with attracting new buyers of all ages to Cadillac—buyers who *hadn't* been with Cadillac before. Cadillac needs conquest sales. Apparently, conquests aren't happening either, because a third of the Cimarron purchasers we queried already owned Cadillacs.

And the third surprise came at the end of our survey, when we asked whether owners would buy another Cimarron the next time they needed a new car. A little

(Please turn to page 114)

*"A lot less legroom
than I expected."*

CALIFORNIA ENGINEER



*"Comfortable ride,
with snappy looks and size."*

NEW YORK RETIREE



Original 1.8-liter Four is disappointment, but '82 buyers get ohc mill.

What do you get for \$12,131?

It's no secret that Cadillac's Cimarron shares all basic body and mechanical components with GM's other two J-cars, the Chevrolet Cavalier and the Pontiac J-2000. Sedan versions of those two cars, though, list for \$7,541 and \$7,557, respectively. So what does Cadillac give its customers that the others don't?

Leather upholstery, leather-wrapped steering wheel, power steering, added sound insulation, vented brake rotors, tungsten halogen headlamps, specific suspension calibration, alloy wheels, stainless-steel exhaust system, airconditioning, AM/FM stereo with four speakers, electric remote mirrors, matched steel-belted radial tires, plus a certain amount of hand-finishing and special attention to paint and trim.

In all, if you total the Cimarron's extras, you'd pay about the same for a similarly equipped Cavalier or J-2000.

The Cimarron was introduced with the 1.8-liter (112.4-cu.-in.) pushrod transverse Four and X-car-derived four-speed transaxle common to all J-cars. This year it will get a new 2.0-liter mill and five-speed stick for a little more of the performance it should have had from the beginning.

PM's pick: New boats for '82

Fuel cost has not cut off the growth of high-style, high-performance craft.

by Bill McKeown BOATING EDITOR

Wellcraft's Scarab Sport models power out with dual 235-hp outboards, and are proof that the offshore-racer look isn't limited to inboards.



Robert Hammond's 18-foot Contender V-1850 XL is a new runabout model for '82; high style and performance are features of Hammond boats, which ride on a deep-V hull with sterndrive or outboard.



Newest from Baja Boats mounts 175-hp outboard. Many performance design innovations start on the West Coast, as this streamlined, no-windscreen, ski-boat look illustrates.

Boatmen haven't let higher prices shut down their favorite sport. New models announced for introduction this spring show that builders are anticipating a lot of action afloat this coming season. We've picked some of the new models we think will be trailing a big wake this year. First, though, some of the trends.

Powerboats still outsell sailboats, in spite of predictions that pleasure boatmen might all switch to sailcraft, where the wind is free. Instead,

lighter, more efficient and more seaworthy craft needing less fuel or windpower to push them are being built.

Marine aluminum, with its high strength-to-weight ratio and resistance to corrosion, appears to be becoming more popular again. Synthetics such as Kevlar, and materials that use fewer petroleum derivatives, are being tested, though they are still expensive. Designers continue to look for ways to

shape a hull so it moves through the water with less resistance.

To provide the power, Outboard Marine is introducing prototype Evinrude and Johnson V8 outboards reported to be the most powerful ever produced. As in the past, they are being tested first on the racing circuits. Sterndrive and inboard engines adapted from the new, smaller, automotive blocks are passing along improved fuel economy. Diesels are em-



Grumman's aluminum 5.0, 17-footer, designed by Bill Shaw, gets a deeper V-bottom and provides a softer ride for fishermen cruising farther offshore.



Dufour Wing holds record for first sailboat around Cape Horn: 137 miles in 24 hours. Sailboats are fastest growing of all designs.



Silverline's 16-foot Scrambler GTL features raked windscreens and the look of speed combined with open bow-riding convenience.

Cruiser's Series III VeeSport 26 Special Edition from Mirro has a Jim Wynne fiberglass hull and a spoiler that styles the helm position.



Fisher Marine Marsh Hawk V aluminum 16-footer bass boat comes in three models that can mount up to 70-hp outboard motors. All convert easily for water skiing.

ploying turbocharging to boost power without adding much to size and weight. Because of high compression, contained by their heavier engine blocks, diesels still weigh and cost more than gasoline engines of similar power, but claim dependability, fuel efficiency and longer life.

Bringing down boat weight without losing hull strength has always been a way to cut fuel costs and get more nautical miles per gallon. Foam and balsawood cores are being used in fiberglass layups to provide structural framing and stiffening without adding poundage.

Hull shapes are changing, too. Ideally, a flat-bottomed hull would plane with least resistance as it slid across the surface of the water. It would pound dreadfully, however, once any waves came up. Ideally, a deep-V hull would cut through waves for a smoother ride. It would be difficult to power up and across the top of the water, however, so that it was planing on the surface instead of displacing and plowing water out of the way. So, this year's pleasure hulls have compromise lines—bottoms with enough forward vee to cut the waves, and flatter surfaces aft to reduce rolling and lift the hull on plane.

Good length-to-width proportion in smaller craft is influenced again by the eight-foot-beam restriction for trailered boats. You can tow a boat to water as long as it is less than eight feet wide; any wider, and it requires a special highway permit. As a result, most trailerable craft will be less than 25 to 30 feet overall, but in that range now are a number of family cruisers with cabin accommodations for overnighting, open offshore outboard and inboard fishing machines, and some high-speed sport craft.

For high performance, marathon ocean racing has been a major influ-



Supercat 17, from the Multihulls Div. of Boston Whaler, has already won titles as a high-speed performer. Whaler also builds 15- and 20-foot Supercat models.



Rally Sport 20-footer, the pleasure model of the successful Baker deep-V racer, mounts a Suzuki 140 here, can take 300 hp.



Glastron Aventura 197 sterndrive 19-foot cabin cruiser is new addition to its 30-boat line for the company's 25th anniversary.



ence, with many boats today derived from the Formula, Donzi, Magnum and Cigarette speedsters developed by Miami's Don Aronow. Wellcraft's extensive line is now topped by Scarab sport models that can handle outboards, sterndrives and straight in-board power for offshore running. Chris-Craft, with a new parent company, also will feature offshore-performance designs.

Baycraft has divided its lines into small, fast Sport boats, Trophy models for fishing, Family boats that include cruisers, Explorers with a trawler influence and Yachts for luxury cruising. There are 45 models ranging from 14 to 68 feet in powerboats, 18 to 42 for sailcraft.

Glastron has a 30-boat line of family boats, fishing models, runabouts and Glastron/Carlson sport boats to celebrate its 25th anniversary in the boat business. Typical of today's market demand is the V-197, an 18-foot, 8-inch sterndrive cruiser with cabin and two V-bunks forward, and enough speed for water skiing. Stern boarding ladder, galley, head, and canvas to enclose the cockpit are among the options.

Starcraft will have a new, 25-foot, all-aluminum cabin cruiser in its line, with fishing and/or weekending capabilities.

Trojan now has center console open fishing models that are 20, 22 and 26 feet long, plus an impressive new 10-meter cruiser.

For flashy color in hull design, new models from Hydrostream, Sleekcraft, Waterbird, Checkmate and Baker attract attention. For styled interiors, the look is imitation leather to give an expensive sports-car appearance.

Major development in sailcraft, of course, will be the breakout this year of the sailing surfboards. In addition to the original Windsurfers, there are a great many other choices—even an inflatable is available—and late in the year Coleman, builder of the Hobie Cat, is expected to enter the field. This year will see more ways to go afloat—with or without an engine for power. **FM**



Ranger 622, a trailerable 22-foot, open-water, offshore fisherman with self-balling cockpit and high and safe freeboard, is new addition to a famous line of bass boats.



Sea Nymph SS-170, Sea Sport's 17-foot bowrider, powered here with a Mariner 80 outboard, is finished in slick-looking aluminum.



Old Town's Penobscot model is ABS plastic. Oldest of the canoe builders also uses fiberglass and Kevlar in addition to wood.

New boats that are easy to take along

Minis that cartop or ride a trailer for easy towing behind a compact provide low-cost fishing and runabout action.

Small, light, multipurpose craft are taking over many of the activities that used to belong to the big boats. They're bringing along new advantages—and problems.

You're likely to see them first on the highway, riding bantam-size trailers or secured to the tops of some of the smallest cars. Once dockside, they launch easily. Lifting the boat off the trailer, down from the

car roof, or unpacking it from a trunk, can be a one- or two-man job.

Hauling out is equally simple, and a back yard, garage ceiling, basement or attic can be the boatyard for storing a miniature rig. Light and strong synthetics—some an outgrowth of the space program—plus aluminum, plywood and low-maintenance fabrics, are making possible the new little skiffs, runabouts,

bassboats, canoes, johnboats, sailcraft and inflatables. Most are light enough to plane over the water rather than pound through it, powered by small, versatile outboard motors that provide good speed because they have fewer pounds to push.

Choice of today's small boat, however, can be more critical than picking a larger one. Price is important—you still get what you pay



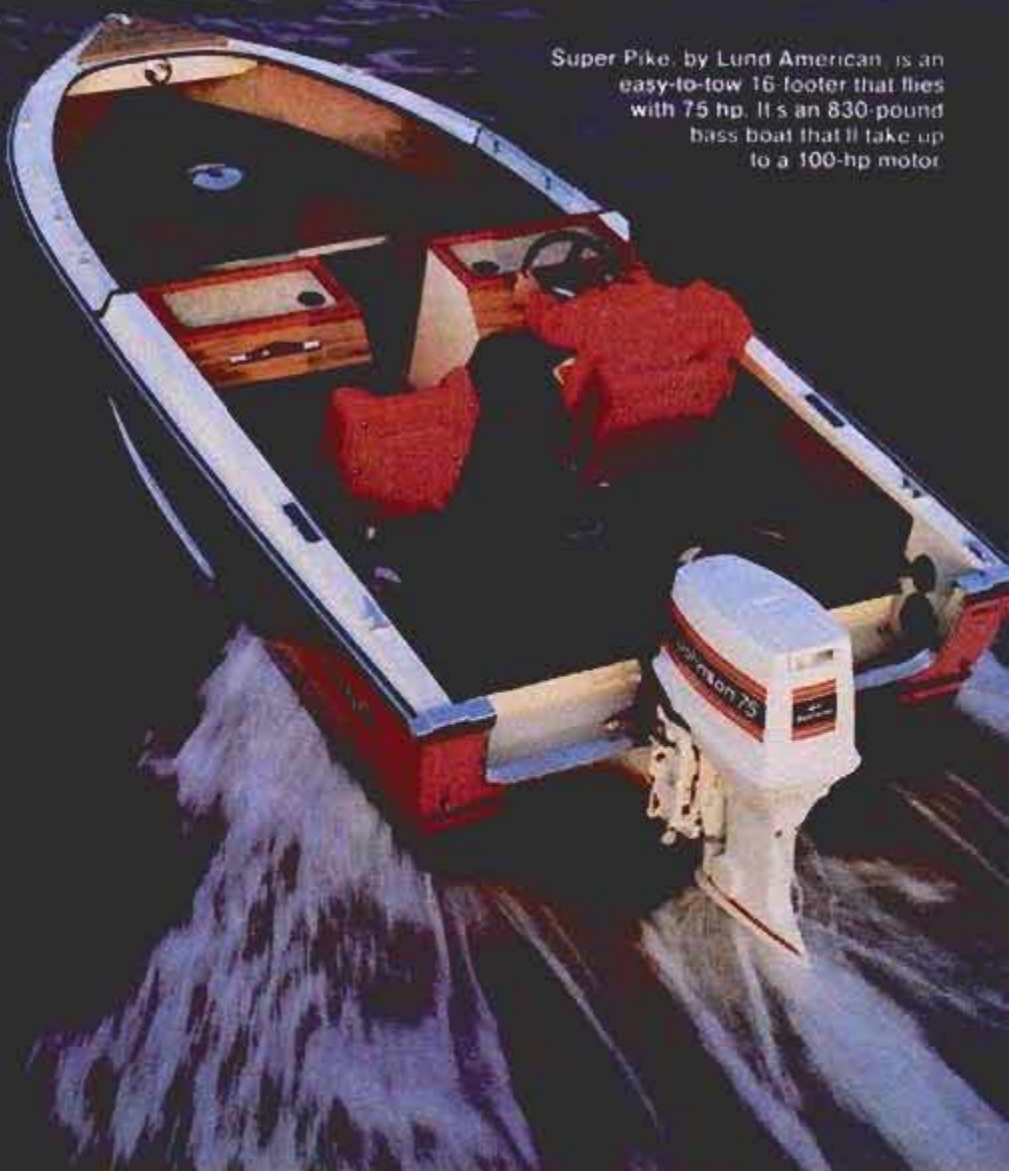
Mini-runabouts come in sizes a compact car can tow easily. Sundance, by Arctic Marine, is a 12-footer that can jet at 30 mph.



Aluminum is lightweight for portability. MirroCraft 10-foot Resort weighs only 120 pounds, but is rated to carry up to 500.



For fishermen, a 16-foot Mr. Pike, little brother of Super Pike, is like bigger bass boat. 600-pounder can take 75 hp.



Super Pike, by Lund American, is an easy-to-tow 16-footer that flies with 75 hp. It's an 830-pound bass boat that'll take up to a 100-hp motor.



New Carleton from Old Town, a 78-pound 16-footer of Royalite, comes as a semi-kit.

for—and a design that lets waves wash aboard over low sides is no bargain at any price. A good inflatable isn't a swimming-pool toy and costs as much as a conventional type. Fold-ups are clever, but should be tested first. Overloading, overpowering or oversteering a mini is especially dangerous. Convenience, in a small hull, is less important than seaworthiness and safety. **FM**



Some minis can mount inboard or outboard power options. Two-seater Sundance with 50-hp Arctic Power jet (foreground) or 35-hp outboard (background) can do 30-plus mph.

Six economical ways to power one lightweight canoe



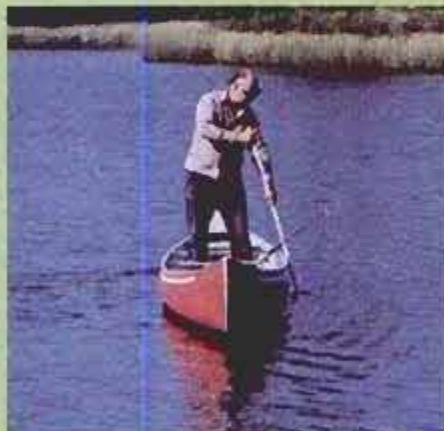
With paddles: In traditional fashion, muscles glide you along. Racing canoeists feel the light, laminated, angle-blade models give a more sustained thrust and speed.



With outboard motor: Merc 3.6 is fast.



With oars: Rowing rig is a performer.



With pole: Pushing requires stable hull.



With electric mill: Silence is golden.



With a sail: New tall rig adds push.

The canoe—America's oldest boat design—may also be the most versatile of today's low-energy performers.

Tests with a 17-foot, 75-pound aluminum Grumman, fitted with a variety of standard accessories, showed that there are at least six ways to push it along with minimum fuel expense and elbow grease.

For paddling, the new angle-blades favored by racers were used. Poling proved easy in the stable hull. Rowing supplied even more speed.

An electric motor eased the hull along silently, and Mercury's 3.6 outboard added zip. For sailing, Grumman's new taller rig boosts performance.



For sail or power, the modern 20-foot Faering Design Sloop (above) from Suttons Bay, Mich., and the 21-foot Hacker Special racer (right) by Ace Speedboat, Amesbury, Mass., are up-to-date craft in the time-honored wooden-boat tradition.

They're still building them of wood

Restorations and replicas are bringing glowing old favorite boats back afloat.

by Bill McKeown BOATING EDITOR

Pleasure craft constructed of wood are not becoming extinct, after all. A look around almost any harbor this spring will show they may not even belong on the endangered list. The boom in fiberglass and metal boats of the last few years was supposed to replace them all, with plastic hulls popped out of molds and aluminum shapes formed by machine. It hasn't worked that way. Boats built from trees are not about to take over the sport again, but it looks like they're here to stay.

Looks are the primary reason. Wood has a warmth of color and texture that is seldom duplicated by other materials. There is a glow to the finish of a well-built, well-maintained wooden craft that can resemble the sheen of fine furniture. Part of the appeal to experienced boatmen may be the knowledge of the hours of effort and craftsmanship that go into "brightwork"—that un-

ainted, transparent finish created with coat after coat of varnish that lets the grain and characteristic color of each wood show through.

And then there are the classic designs of the past—the skiffs, guide boats, racers, runabouts, duckboats, canoes, punts and sailing craft of every size. Some are valuable rebuilt and restored antiques that now are being appreciated once again. Others are new replicas which faithfully duplicate the fine lines of the originals. The antique-boat collections of the shipyard museums at Clayton, N.Y., Mystic Seaport, Conn., and elsewhere attract more visitors every year.

Final proof of the wooden-boat renaissance comes at the wooden boat in-the-water festivals, parades and shows that are now yearly affairs at Port Townsend, Wash., Clayton, N.Y., Mystic, Conn., and Newport, R.I.;



The classic old Sailing Surf Dory (top) is still built by Lowell's Boat Shop in Amesbury, Mass., a company that was founded in 1780 and may be the oldest in the country. The 16-footer can be rowed, or sailed with a sliding gunter rig. The makoal shown is from Fortune of Falmouth, Mass. Boston Whitehall with warm brightwork (above) is by Gary Weisenburger, boatbuilder of Oakdale, Conn.



Wooden craft, crowding the harbor at Newport, R.I., show the popularity of the type.

here you can walk the docks for hands-on inspection of classics, attend classes in do-it-yourself shipwright skills, and watch famous craft cruise the harbor under power and sail. Some specialty yards can now build to order or restore boats, and the success of Jonathan Wilson's magazine, *WoodenBoat*, in Brooklin, Me., confirms the trend.

But while the best of modern wooden boats can look exactly like the best of yesteryear, they fortunately are not the same. Some of the synthetics and chemicals that threatened to replace woodcraft are now giving new life to the material. Wood's advantages as a boatbuilding material—buoyancy, appearance, comparative ease of carpentry—have always been balanced against its disadvantages in a marine environment. It comes in small pieces, expands and contracts, absorbs

water, splinters, and is susceptible to fungus diseases and marine borers. Now there are some cures.

Plywood, of course, provides large, strong sheets that can supplant narrow planks. Chemicals such as Cuprinol can give wood resistance to dry rot fungus. Great strength, durability and stability can result from treatments such as the wood epoxy saturation technique. Known as the W.E.S.T. System, it has been developed by the Gougeon Brothers Boat Works in Bay City, Mich. Fiberglass, applied with a transparent, no-pigment resin, can cover a hull or deck with an almost invisible shield that adds strength and resists leaks.

Even with the rising cost of petroleum-based resins, it's unlikely that plastics will price themselves out of the boat-construction market. But it's good news that the future looks bright again for wood afloat. **PM**

YOU CAN BUILD YOUR OWN—WITH WOOD

There is a romance that surrounds a wooden boat, whether it's in the shop or out on the water, and building one yourself can add to this pleasure. Wood is relatively cheap to buy and easy to work, glue and fasten. It can be very forgiving, and, instead of becoming obsolete in this age of high technology, it has adapted itself in remarkable ways. It feels good, it smells good, and boatbuilding with it can bring much satisfaction.

There are two ways to build your own wooden boat: You can work with a set of plans and a pile of lumber, or from instructions and a kit of pre-cut pieces. Plans and kits are available for anything from a lightweight canoe to a heavy cruiser, from an oceangoing ketch to a globe-circling catamaran. And if that

isn't enough, there is a mail-order marine accessories industry with the tools, gear and fittings necessary to provide you with abundant choices.

If you've never built a boat before, it may be hard to understand the work required, and there are probably unfinished boats in basements everywhere. With the right guidance, however, anyone can do it. You just must determine first what you want from the final result, from the project itself and from your own skills.

If plans and a pile of lumber strike fear in your heart, consider the plywood kits, with their many levels of materials and designs. Before you plunge in, absorb as much of the available literature as possible. A good starting point is *The Boatbuilder's International Directo-*

ry, \$5 from Box 519, Friday Harbor, Wash. 98250. It covers sources for boat designs suited to amateur construction, kit boat manufacturers, engine manufacturers, sailmakers, and suppliers of books, hardware and accessories. It's a source book of where to contact the kit boat makers that can provide the catalogs and brochures you may need.

With these in hand, you can narrow down your choices. Keep in mind that kits usually are only slight modifications of existing successful and traditionally constructed types. Most designs of standard craft can be modified to suit plywood construction. Plywood cannot conform to a compound curve, but handled properly, fitted carefully and finished patiently, it is a very satisfactory

(Please turn to page 121)

PM photo: Bill Hartford



In restoration and construction shop at Mystic Seaport, a Rangely Lakes rowing canoe takes shape (left). Rangely Guide Boat (above) is built to classic lines by R.K.L. Boatworks, Mt. Desert Island, Me.

A YEAR OF PM OWNERS REPORTS: OWNERS OF '81s STILL GIVE IMPORTS THE EDGE

by Michael Lamm
WEST COAST EDITOR

Without a doubt, Toyota's ultra-thrifty Starlet walked away with our Owners Report championship of 1981.

When we looked back at all the cars we surveyed last year, it surprised us not at all that the Starlet ended up logging last season's best fuel mileage (34.7 mpg in the city and 42.5 mpg on the highway). But the jolt came when, of the dozen cars we buttonholed owners about during 1981, the Starlet also won honors for workmanship. It recorded the fewest mechanical problems, and an overwhelming majority voted the Starlet "the car I'd buy again." That's quite a testimonial from the thousands of owners we queried in 1981.

Thus, the Starlet proves once more that a car doesn't have to be expensive to be good.

How our Owners Reports work

For those of you who aren't familiar with our Owners Reports, here's the way they work. We choose 12 to 14 new cars each year—usually those that are most changed—then we ask owners questions about them. We send questionnaires to 1,000 registered owners in as many



Toyota Starlet (Sept., page 94) was favorite of owners.

states as possible. R.L. Polk, the automotive statistical service in Detroit, does the actual mailing.

Owners give us information about all aspects of their cars—everything from what attracted them initially, how they like the vehicle, what they dislike about it, whether the dealer takes good care of them, how they rate comfort, workmanship, service, and the like. We also ask them to record fuel mileage and mechanical problems, and to tell us what changes, if any, they might suggest to improve their cars.

Once the questionnaires come back to us, they're tabulated by computer. These data, along with the completed questionnaires, are sent to our West Coast Editor, Michael Lamm, who does the final writeup,

"... as objectively," he says, "as possible." Meanwhile, we've photographed each car and familiarized ourselves with it.

PM began publishing Owners Reports in 1951. Those first surveys were conducted by the late Floyd Clymer, whose books on automobilia are still being published and are, in fact, legendary. Later in the 1950s, the Owners Report series was taken over by Auto Editor Art Railton, who subsequently became vice president of Volkswagen of America. The methods established by these two



Datsun 280ZX was in February, page 128.

WHY DID YOU BUY THIS CAR?

(Answers in percentages)

Make and model	Styling	Economy	Handling	Size/ comfort	Past experience	Other	WOULD YOU BUY ANOTHER?	
							Yes	No
AMC Eagle SX4*	33.0	25.7	5.6	5.9	—	78.0	85.2	14.8
Cadillac Sedan de Ville	17.5	5.2	—	22.0	43.0	12.3	93.3	6.7
Chrysler Imperial*	64.6	—	9.6	—	16.7	—	92.7	7.3
Chrysler K-cars	27.6	60.5	—	32.1	—	22.1	88.1	11.9
Datsun 280ZX	58.8	27.3	10.8	—	16.5	11.5	93.2	6.8
Ford Escort*	18.7	71.3	—	7.6	—	16.8	93.7	6.3
Ford EXP*	73.7	69.7	12.4	8.8	—	—	88.3	11.7
Ford Granada†	47.9	25.9	—	25.1	—	—	91.9	8.1
Mazda GLC†	22.4	61.7	11.8	—	16.8	—	92.9	7.1
Oldsmobile Cutlass	33.2	20.3	—	13.4	38.2	—	87.7	12.3
Renault 18i	45.2	39.6	16.1	20.9	—	19.1	81.7	18.3
Toyota Starlet†	9.7	91.1	—	—	—	10.0	94.7	5.3

*Quality was cited as a consideration among 5.6% of AMC Eagle SX4 owners; 14.1% of Chrysler Imperial owners; 16.5% of Ford Escort owners; 10.6% of Ford EXP owners.

†Price was cited as a consideration among 7.2% of Ford Granada owners; 30.2% of Mazda GLC owners; 20.1% of Toyota Starlet owners.

innovators are still in use today.

Owners Reports, we feel, have the unique capability of drawing out honest and thoughtful opinions from people who've really lived with their cars. Unlike conventional road tests (which we publish in our magazine), Owners Reports can get deeper into specifics. It's our contention, for example, that the fuel-mileage figures we get by averaging real-life responses from hundreds of drivers is nearer reality than the EPA's rather questionable laboratory test numbers.

Cars weren't pitted one against another, so these results haven't come from any sort of direct competition. Rather, the figures mirror

(Please turn to page 130)

FIRSTHAND REPORT

Driving the '82 Firebird and Camaro

by Gary Witzenburg DETROIT AUTO EDITOR

Their shapes are the most sensuous ever on mass-produced cars from a Detroit automaker, and they've got handling to match.

It's a Z28 and it's black—shiny black—as the paint glistens in the broiling Arizona sun beating down on GM's Mesa Proving Ground.

I jump in and ease the car toward the road course set up for this press preview of the '82 Chevrolets. I stop the car on a long, straight stretch, lock the

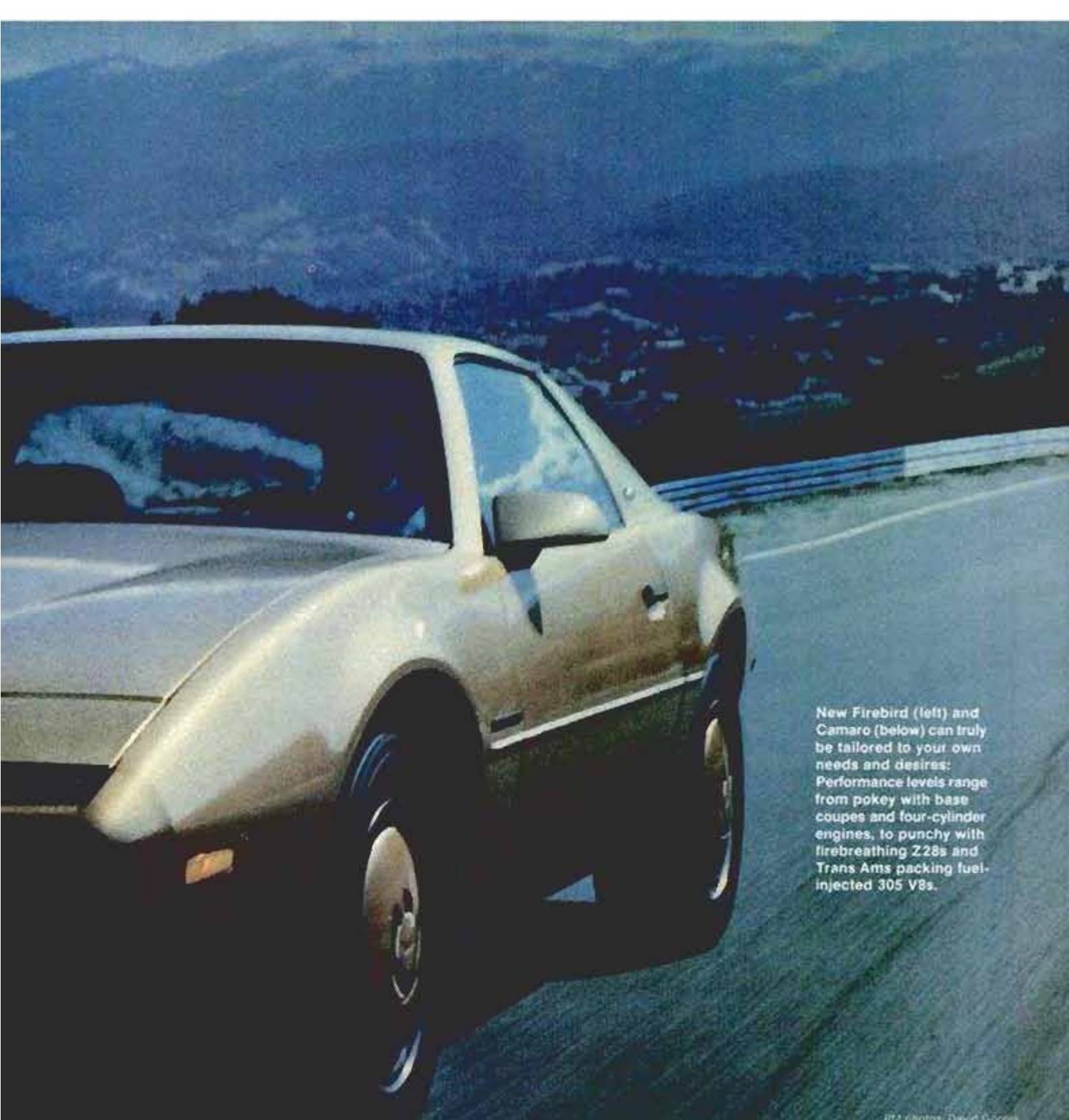
brakes with my left foot, rev the twin crossram, fuel-injected V8 with my right, and let it happen.

Suddenly, I'm jammed back into the form-fitting seat, the rear wheels spinning and smoking and the car fishtailing all at the same time. I correct the steering, feeding small inputs to keep the car on track. The spin-

ning and smoking tires finally bite and I get rammed back into the seat a second time.

Finally, the tach hits 5,500 rpm and it's time to shift. A small push on the auto trans selector lever and I'm in second gear. Again, the tires break loose. This Camaro just won't quit.

A smooth left-hand turn looms



New Firebird (left) and Camaro (below) can truly be tailored to your own needs and desires: Performance levels range from pokey with base coupes and four-cylinder engines, to punchy with firebreathing Z28s and Trans Ams packing fuel-injected 305 V8s.

PHOTOS: David Gossling

ahead and I dive down toward the apex. The Z28 takes a set, then digs in and just careens through the corner, tires biting, sway bars working and the chassis sucking up and spitting out Mesa asphalt as fast as I can push the car down the course.

This thing just flat works, as

(Please turn to page 139)



Cabinets to build for your eat-in kitchen

When you enlarge your kitchen, you can visually connect the new to the old with shop-built cabinets that match

by Harry Wicks HOME AND SHOP EDITOR

By now, everyone knows that American homeowners are staying put and improving what they already own. For some, home improvement may mean adding a bedroom in the attic or basement. To others, a new family room may be needed. For many, there is a need to create a bigger kitchen and possibly, an eat-in area in that room.

We enlarged the kitchen shown by knocking out a section of an exterior kitchen wall after relocating several appliances. We built new cabinets which matched the originals in the existing kitchen, thereby creating a smooth visual transition. And we covered the walls with rough-sawn planking and fitted the ceiling with false beams to achieve a country look.

The room's designer, Shirley Regendahl, ASID, also pulled the rooms together visually by using a careful combination of colors. For ease of application, she chose the latest paints from Pittsburgh Paints' DesignaColor System. For the colors used, see the list on page 103.

Adding a room

Once you've decided upon the location and size of your addition, you must determine whether the

Information on how to build cabinets appears on the following pages. The text continues on page 123.

PM photos: Hans van Nes Studios



Old table, freshened up with glossy-finish latex-alkyd paint, is new dining center.





Dining area was created by removing the outer kitchen wall and building an addition. Handsome new cabinets were made to match those in the kitchen.

Building the cabinets

If your kitchen is large enough for cooking, but lacks the space for family breakfasts and lunches, the room shown is one way to solve the problem. Its walls were skinned with rough-sawn planking—brand-new stock from the lumberyard—which was coated with paint to achieve a barn-board effect. (Using solid wood on the walls also makes it easier to hang the new wall cabinets.)

The beams overhead are false (hol-low), installed over furring strips that are nailed to the joist undersides.

PM's cupboard

As can be seen in the drawings, the cupboard is built in base- and wall-cabinet modules. No exotic woodworking techniques are used here; the cabinets are built using the straightforward methods employed in many cabinet shops.

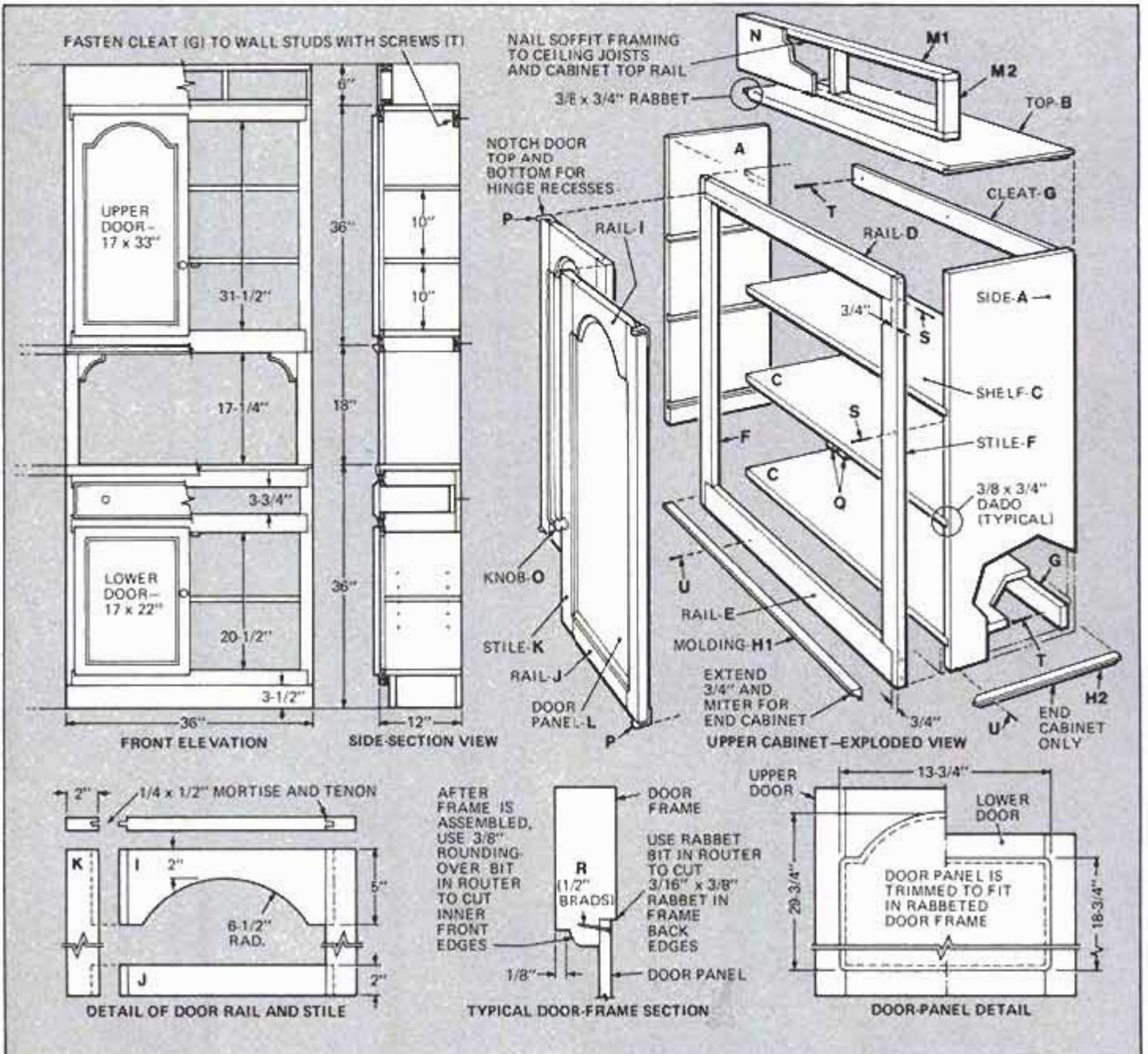
Use white glue throughout for all joinery. Since you're working with pine stiles and rails, you can secure joints with 6d and 8d finishing nails. The nails should be set and hidden with wood filler. When nailing near a board end, prebore a head hole to avoid splitting the wood member.

We suggest you build the cabinets in your shop, then haul them to your new

room for installation. Install the cabinets by securing them to wall cleats nailed to wall studs. Be absolutely certain that you build the cabinets in your run with a "scribe." A scribe is simply an over-wide outside stile. Thus, the stile that abuts the wall should be cut and installed on the cabinet so that it extends about 2 in. beyond the cabinet's side. This extra material can then be scribed to the wall, using a divider to ensure a perfect fit. If

MATERIALS LIST—UPPER CABINET

Key	No.	Size and description (use)			
A	2	3/4 x 11 1/4 x 36 3/8" plywood (side)	M1	2	3/4 x 1 1/2", length to suit, furring strips (soffit plates)
B	1	3/4 x 11 1/4 x 36" plywood (top)	M2	1	3/4 x 1 1/2", length to suit, furring strips (soffit studs)
C	3	3/4 x 11 1/4 x 35 1/4" plywood (shelf)	N	1	1/2" drywall
D	1	3/4 x 2 1/4 x 34 1/2" pine (rail)	O	2	1 1/2"-dia. wooden knob
E	1	3/4 x 3 x 34 1/2" pine (rail)	P	2 pr.	Vertical, stile-mounted pivot hinge for overlay door
F	2	3/4 x 1 3/4 x 36 3/4" pine (stile)	Q	2	Magnetic catch
G	2	3/4 x 2 1/4 x 34 1/2" pine (wall cleat)	R	1	1/2" brad
H1	1	3/4 x 7/8 x 36" solid crown molding	S	1	8d finishing nail
H2	1	3/4 x 7/8 x 12 1/4" solid crown molding	T	1	3" No. 12 fh screw
I	2	3/4 x 5 x 14" pine (upper door rail)	U	1	2d finishing nail
J	2	3/4 x 2 x 14" pine (lower door rail)			*As required.
K	4	3/4 x 2 x 33" pine (door stile)			
L	2	1/4 x 13 3/4 x 29 3/4" plywood (door panel)			



there's any gap between the end of the cabinet run and the wall, conceal it with a narrow molding.

Painting the cabinets

Though it takes a little more time, it's better to paint the cabinets after they are

up. This way, you can patch, sand and conceal any damage that may have occurred during their installation. To speed the job somewhat, however, apply the prime coat of paint while the cabinets are still in the shop.

Painting the two colors on the molding

detail (bead shape on door fronts) takes both time and a steady hand.

These accent colors should be added after the cabinet has been painted and you have allowed ample time for it to dry.

To avoid wavy lines, use masking tape on both sides of the molding detail. Make certain that you press down the edge securely so the paint won't bleed underneath.

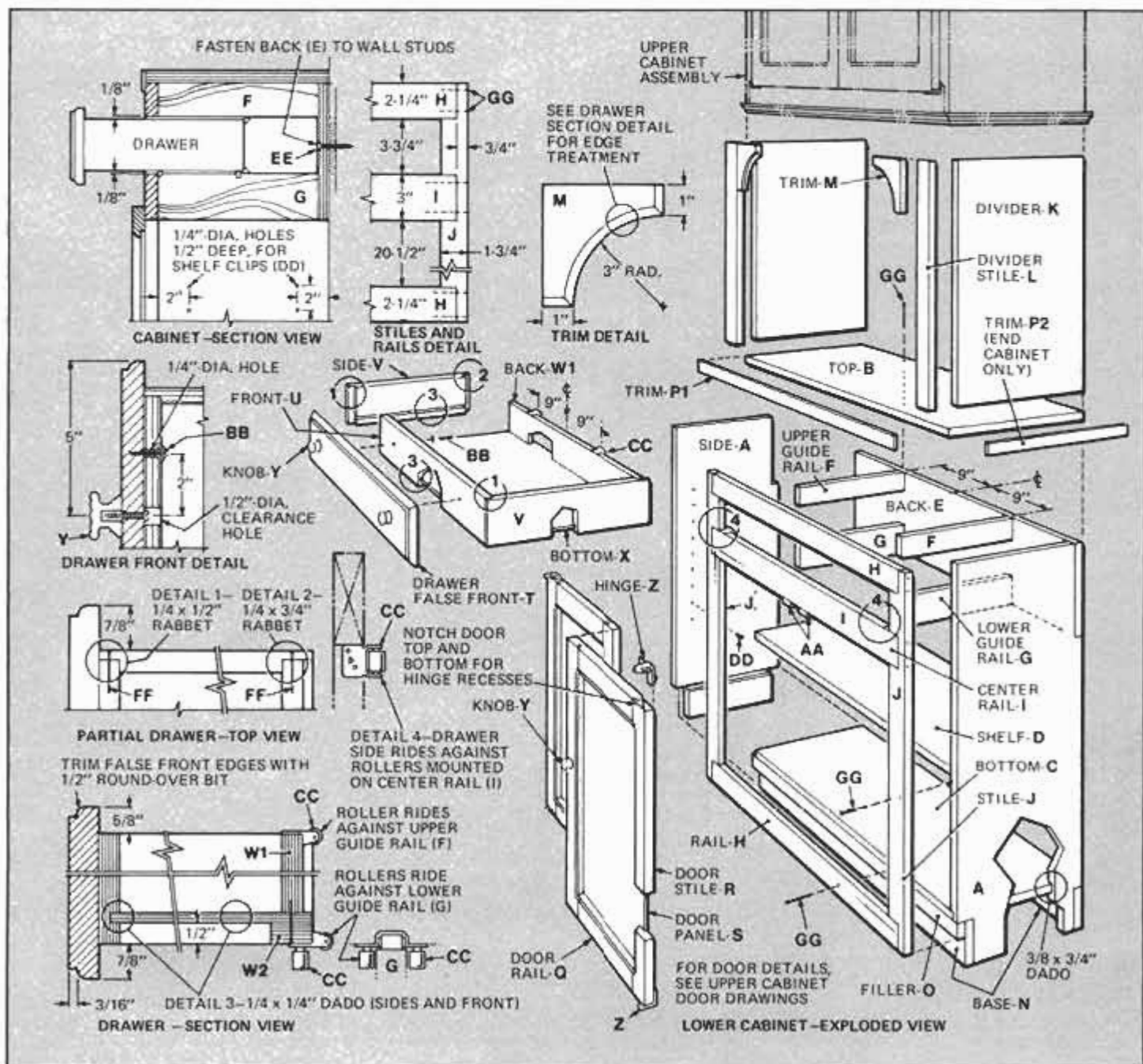
MATERIALS LIST—LOWER CABINET

Key	No.	Size and description (use)	S	2	1/8 x 13 3/4 x 18 3/4" plywood (door panel)
A	2	3/4 x 11 1/4 x 35 1/4" plywood (side)	T	1	3/4 x 5 x 24" pine (drawer face)
B	1	3/4 x 12 x 36" plywood (top)	U	1	1/2 x 3 1/2 x 31 3/4" plywood (drawer front)
C	1	3/4 x 11 1/4 x 35 1/4" plywood (bottom)	V	2	1/2 x 3 1/2 x 9 3/4" plywood (drawer side)
D	1	3/4 x 11 x 34" plywood (adjustable shelf)	W1	1	1/2 x 2 3/4 x 31 3/4" plywood (drawer back)
E	1	3/4 x 9 x 36" plywood (rail)	W2	2	1/2 x 1 x 3" pine (roller cleat)
F	2	3/4 x 2 1/4 x 10 1/2" pine (upper guide rail)	X	1	1/4 x 9 1/2 x 31 3/4" plywood (drawer bottom)
G	2	3/4 x 3 x 10 1/2" pine (lower guide rail)	Y	4	1 1/2"-dia. wooden knob
H	2	3/4 x 2 1/4 x 34 1/2" pine (face rail)	Z	4	Two pair of vertical, stile-mounted pivot hinges for overlay door
I	1	3/4 x 3 x 34 1/2" pine (face rail)	AA	2	Magnetic catch
J	2	3/4 x 1 3/4 x 32 1/2" pine (stile)	BB	2	1" No. 8 fh screw and washer
K	2	3/4 x 11 1/4 x 17 1/2" plywood (divider)	CC	2	Plastic roller set
L	2	3/4 x 2 x 17 1/2" pine (divider stile)	DD	4	Shelf support clip
M	2	3/4 x 4 x 4" pine (trim)	EE	3	3" No. 12 fh screw
N	2	3/4 x 5 x 36" plywood (base)	FF	**	2d finishing nail
O	1	3/4 x 1 1/2 x 36" pine (filler)	GG	**	8d finishing nail
P1	1	1/4 x 1 3/8 x 36" pine lattice (trim)			
P2	1	1/4 x 1 3/8 x 12 1/4" pine lattice (trim)			
Q	4	3/4 x 2 x 14" pine (door rail)			
R	4	3/4 x 2 x 22" pine (door stile)			

*Roll-eez drawer rollers are available from Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461
**As required.

KITCHEN COLORS

Floors: D4757 Bituminous
Walls in kitchen area: M3192 Coral Reef
Countertop in kitchen: M3427 Lunar Green
Cupboard shutters under sink cabinets: P2484 Vanilla Cream
Cabinet trim: M3192 Coral Reef and Lunar Green
Ceiling, planked walls: M3756 Mariner's Grey
Beams: P2185 Precious Peach
Table: Lunar Green
Chairs: Precious Peach
All paints are latex alkylid from Pittsburgh Paints' DesignColor System.

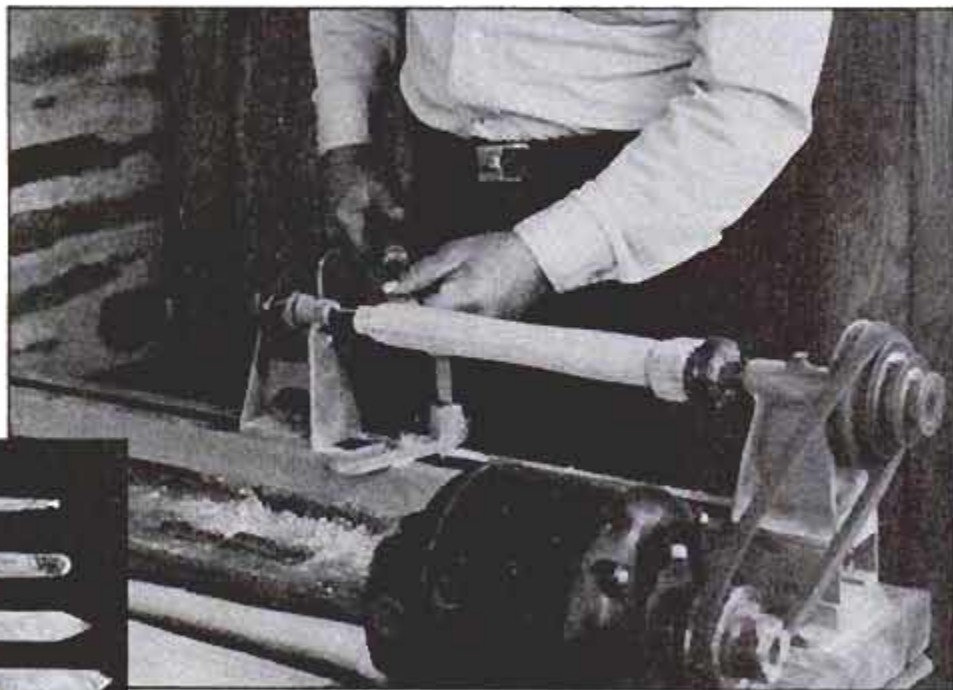


6 lathe chisels you can make from scrap

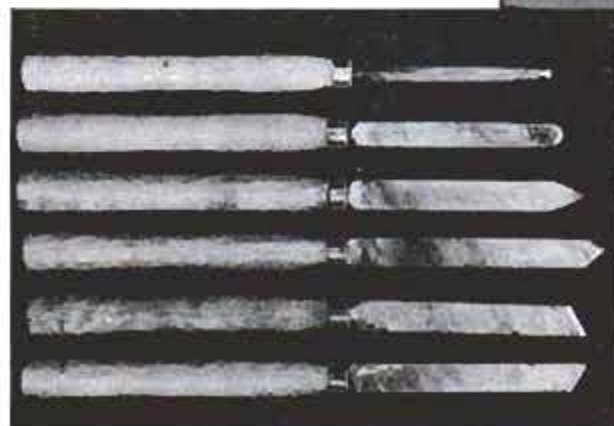
You create this handsome set of turning tools using worn files and hardwood.

by Ralph S. Wilkes

According to recent catalog prices, a good woodturning chisel now costs \$10 and up. However, for a fraction of the cost, you can make a set of these lathe tools that will serve the same purpose and hold



Finished woodturning chisels (left) are made from scrap hardwood, old files and copper tubing. Tools were used to cut the second set of chisel handles (above).



a cutting edge almost as long as the expensive ones. All it takes is six worn-out files, a seasoned chunk of hardwood and a short piece of $\frac{3}{4}$ -in. inside diameter copper tubing.

Begin by selecting some reasonably straight-grained hardwood such as maple, beech or hickory for use as the handles. My material came from a firewood pile, but you can buy $1\frac{1}{2}$ -in.-thick hardwood stock

at most lumberyards in your area.

Cut this stock into six pieces that measure $1\frac{1}{2} \times 1\frac{1}{2} \times 12$ in. long. Then either look at pictures in a tool catalog to find a handle design you like, or pick one of the four handles in the drawing on the facing page. After you choose a style and start turning the first handle, make any minor design adjustments as you go, until the handle feels comfortable in *your*

hand. (I prefer a fairly long handle—the ones in the photos are 10 in. long—because I think it increases my control over the chisel.)

It's best to turn the handles with all the waste on the headstock end as shown. This permits occasional removal from the lathe so the ferrule can be test-fitted.

You may be able to find ready-made brass ferrules in your local hardware store, but I found that cutting $\frac{3}{4}$ -in.-dia. copper tubing into $\frac{3}{8}$ -in.-long pieces works fine and gives the chisels a distinctive handmade look. Use a tubing cutter to ensure a neat cut and ream the inside edges



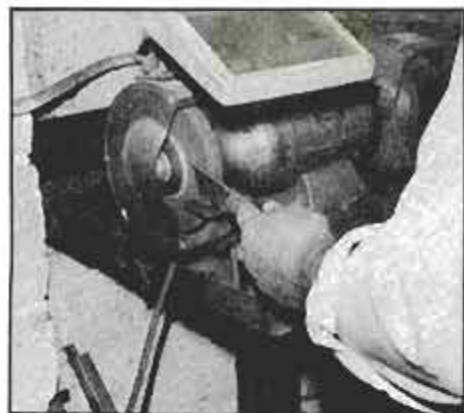
Shape handles with a skew chisel, leaving waste on headstock end. Cut tang end of handle to precise diameter for ferrule.



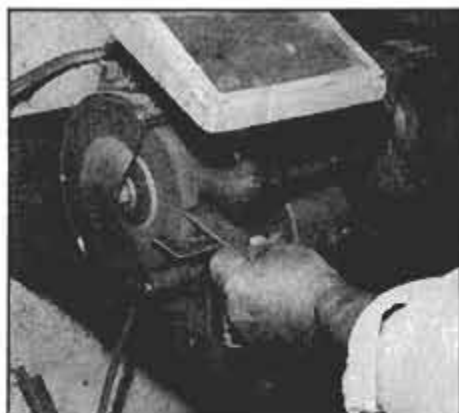
Once the first handle is turned, use it and outside callipers to ensure that following handles are turned to uniform shapes.



After sanding the handle and installing the ferrule, apply the finish to wood with the lathe turning at a low rate of speed.



Before grinding the bevel, flatten the file side opposite the bevel by grinding it on the side of the grinder stone. This removes the file teeth and gives the flat surface that is essential for a sharp edge.



Grind the cutting edge according to the given specifications. Quench tool in water frequently to keep edge from burning, or steel will lose temper and hardness, making it difficult to maintain sharp edge.

smooth before trying the ferrules on the handles.

If you accidentally remove too much stock and the ferrule is a loose fit, simply attach it to the handle with a 1/4-in. No. 2 roundhead screw. (This step is a must if the wood is not well seasoned; green wood shrinks as it dries.) Once the handle is shaped, remove the toolrest from the lathe and sand the wood while it turns in the lathe.

You can stain and varnish the handles if you like, but a French polish finish is the quickest and, possibly, the most attractive method to use. Simply fold a pad of lint-free cloth into the shape of a small catcher's mitt. Pour a little boiled linseed oil into the middle of the "pocket" and float some white shellac on top of the oil. Then apply it while the handle is spinning in the lathe at low speed. The heat from the friction dries the finish immediately.

There are two key safety rules for finishing in the lathe:

- Make sure the toolrest is removed before beginning.
- Don't wrap the cloth around your fingers.

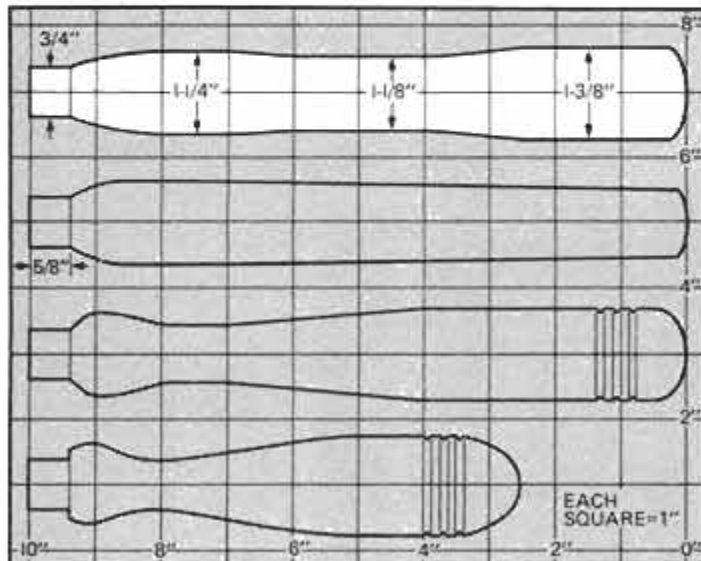
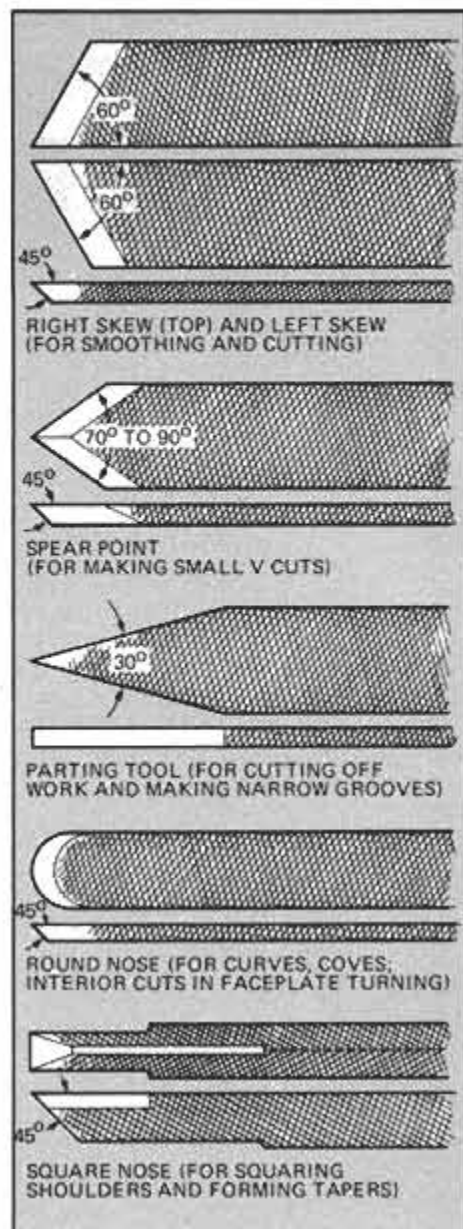
Grinding the blades

The size of the file to use is determined by the lathe chisel you plan to make. For most cutting tools, an 8- or 10-in. flat file is suitable, but if you plan to turn miniatures, smaller files and handles are better.

You should join a file to its finished handle before grinding it so you'll have a safe and comfortable grip.

To do this, clamp the handle in a vise, padding it first with cloth on both sides to protect its finish. Using a portable drill, bore a hole in the ferrule end to a depth equal to file-tang length. The diameter of the drill bit should be slightly smaller than the tip of the tang. However, since the tang becomes wider at the file heel, shape the hole accordingly by cautiously moving the drill bit back and forth to "ream" opposite sides of the hole. Again, trial and error is important here; you may want to practice on scrap. Don't bore the hole so large that the tang won't fit snugly. Finally, remove the handle from the vise and drive it onto the tang, using a wooden mallet.

Since files are made of very hard



The tool handle at top is the one shown in the photos; the other three are optional shapes. The size and shape of these handles are largely determined by personal taste and comfort. Because they are turned from scrap wood, experimentation is not costly; try a few handles before you decide which one you like best.

steel, the grinding process takes some time. Safety glasses or goggles must be worn even if you have a shield on your grinder. Also, have a basin of water close at hand so the chisels can be frequently dipped (quenched) to avoid overheating. (Burning causes the steel to lose its temper, thus its hardness. When this happens, the tool won't retain a cutting edge.)

First grind the file side opposite the bevel side so that it's smooth and flat, as shown. Next, bevel the tip as shown in the drawings; finish by honing edges on an oil stone.

A final note: You can also make gouges from large triangular files or half-round wood rasps by hollowing out the inside on a convex-edge grinding wheel. I have done this, but it is an extremely slow process. Therefore, I recommend buying a wide gouge and a narrow gouge to round out your woodturning set. After all, when you think of the money you saved on the other ones, this isn't a very high price to pay.

4 great projects for your home

Here are plans for four exciting projects from the PM Vacation Home that you can use in your own home: two tables, a bar and a hanging glass rack.

These attractive home-furnishing projects help you make the most of your living space. The two tables, bar and hanging glass rack were designed for the PM Vacation Home, introduced in April '81 (page 106). Following are plans and how-to tips on making the items.

For the most part, we used A-D (good-one-side) plywood covered with plastic laminate to construct the tables. If you will use a sabre, circular or radial-arm saw, cut the plywood with the good face down. Position the good side up if you'll be using a table saw.

Before the projects are assembled, fill all exposed edges of the plywood with wood filler. Then sand all parts with 100- or 120-grit abrasive paper. To assemble the projects, glue mating surfaces together. Then drive and set nails to hold the work while the glue dries.



- 1 Sized to sofa height, the triangular table provides a surface to display favorite objects and satisfy storage needs.
- 2 The cube coffee table is a relatively simple, contemporary project to construct; it also can be used as an end table.
- 3 Keep stemware readily at hand—where it belongs logically—installed on the ceiling, directly over the service bar.
- 4 Interior decorator Debbie Seaburg, ASID, utilized wasted space for this handsome bar/buffet unit for a family room.

1 Triangular storage table

Besides providing storage space and a display surface, this triangular table serves as a backup for a sofa. The table is topped by a platform supported by recessed cleats to give the visual effect of a floating top.

Study the drawing of the table (below), and cut the table sides, noting the edges that receive a 45° bevel. Notice that one end of each shelf is cut at a 45° angle. Plow dados in the table sides and shelf back to receive the shelves.

Join the sides with three vertical cleats; two of the cleats have beveled sides (see drawing details Nos. 1 and 3). After assembling the sides, shelves, rail and top, let the unit dry overnight.

In a well-ventilated room, away

from cigarettes, sparks and open flames, cover platform J with plastic laminate. Laminate the platform edges first, one at a time. Laminate the top after trimming edges with a router and straight carbide cutter.

Cut the laminate at least 1/4 in. wider and longer than the surface to be covered. Apply the adhesive evenly to the laminate with a short-nap (mohair) paint roller or bristle brush; then coat the wood surface. When you can touch brown paper to the surface without it sticking, the adhesive is ready for bonding, usually in 20 to 30 minutes.

Place clean wood strips, dowels or brown Kraft paper over the plywood. Lower the laminate carefully, keeping it aligned with the plywood. When the pieces are aligned, slide out the first dowel or paper and press the laminate onto the plywood at one corner. Continue removing the separators and pressing the laminate in place.

To ensure good bonding, apply pressure over the entire surface

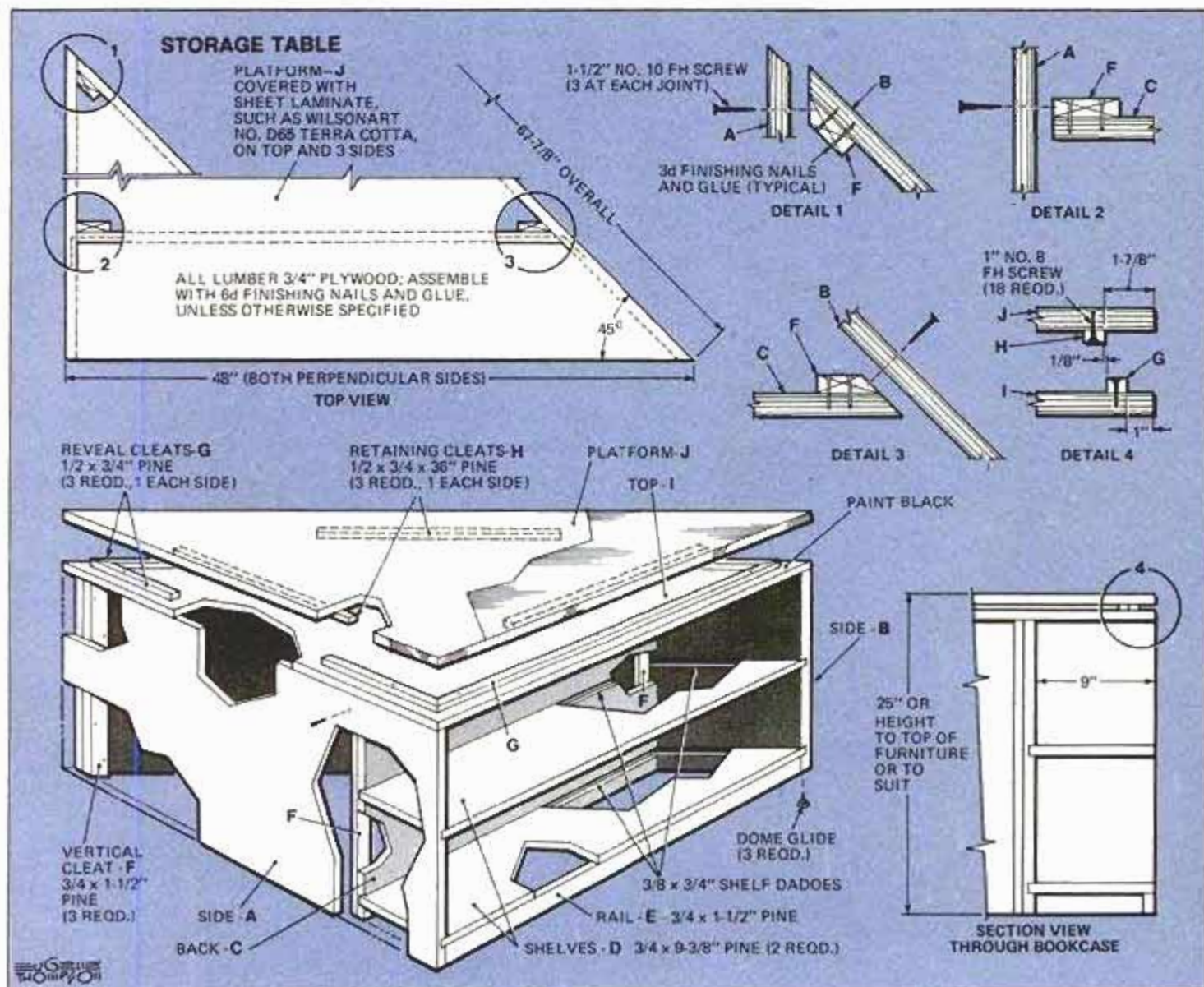
with a wooden rolling pin. Use a router and a straight carbide cutter to trim off the overhanging waste material. Make sure the plywood edge that the router follows is straight. If any voids are present, fill them with wood filler and sand the spots smooth. Otherwise, the router will follow the irregularities and miscut the laminate.

Bevel all corner edges with a 22½° carbide cutter in a router, or use a plane with a sharp blade set for scant removal. Smooth edges with a file, applying pressure only on the downstroke. Remove excess contact cement with lacquer thinner. Attach retaining-spacer cleats to the platform.

Paint the rest of the table. First prime the plywood with a pigmented shellac such as Bin or Enamelac. Let it dry overnight, then paint with an alkyd or latex paint.

Position the platform on the table. The retaining cleats under the platform should fit within the reveal cleats on the tabletop.

Project designs: John Gaynor, Debbie Seaburg, ASID, Armstrong World Industries Inc.; Eugene Thompson, Harry Wicks, PM photos: Gary Bradt



2 Cube coffee table

You can build this cube table in a single shop session and finish it with plastic laminate in a color to match or contrast with other furnishings in the room. This piece serves as a coffee, end or corner table.

Cut the plywood sides and top and the pine cleats to size, as shown. Fill any holes in the edges with a quality wood filler such as UGL's Wood Patch. Then sand all surfaces smooth and brush them off.

Begin assembly by gluing and nailing one cleat to each side. Position the cleats as shown in the drawing. When nailing, drive and set all nails and fill the holes with wood filler. Then join the corners with glue and screws. Finally, glue and nail the top in place.

Make sure all edges are smooth before laminating. For laminating tips, see the first project (triangular storage table). Cut all pieces slightly oversize and laminate one side at a time, trimming the laminate to size before proceeding to the next side. Finally, apply the top laminate, trim it to size and dress the edges.

3 Hanging glass rack

This overhead stemware rack has a "sculptured" look that is achieved by using your table saw. Begin by cutting the seven supports for the glasses and the three cross braces to length.

Set the table-saw blade to a 1/4-in. elevation and the fence 1 in. from the blade to make the vertical cuts for each support. Then reset the table-saw blade at approximately a 20° angle and relocate the fence about 7/8 in. away on the other side of the blade. Test-cut in scrap wood, then turn the support on edge to cut out the waste.

Locate and bore screw and eyebolt holes in the braces on a drill press or with a portable drill.

Before assembly, sand parts smooth with 100-, then 120-grit abrasive paper; dust and wipe with a tack cloth. Space the supports, position the braces and mark the screw position on the braces. Then attach the supports to the braces. Mark the endpieces and cut them to length, using a band saw to create the "rounded" look on one side of the rack (see "top view" in the drawing).

Hang the rack temporarily, and brush on a primer, such as Bin or

Enamelac. Follow this with coats of alkyd or latex paint to match decor. Allow adequate drying time between coats.

To install the rack, fasten eyebolts with hex nuts, washers and acorn nuts to the four corners of the rack. If joists and blocking are in the area where you wish to hang the glass rack, install hefty screw eyes through the ceiling tiles into the wood behind; suspend the rack using S-hooks and chain. If no joists are situated in the exact position you need, secure the rack to a wood plate you attach to the joist undersides (see "alternate ceiling detail").

4 Bar/buffet counter

We converted lally columns from obstructions to assets by framing around them to support this bar/buffet counter. The lally columns and counter base are framed with 2x3s, spaced 16 in. on center and assembled with 8d common nails. Use a level to check that framing is installed plumb.

The counter is a hollow-core door, covered with plastic laminate. (See project No. 1 for lamination suggestions.) First, laminate the counter edges, one at a time; then cover the top.

We used prefinished 1/4-in. paneling from Georgia Pacific over the framing. Mark all stud locations on the floor and ceiling before install-

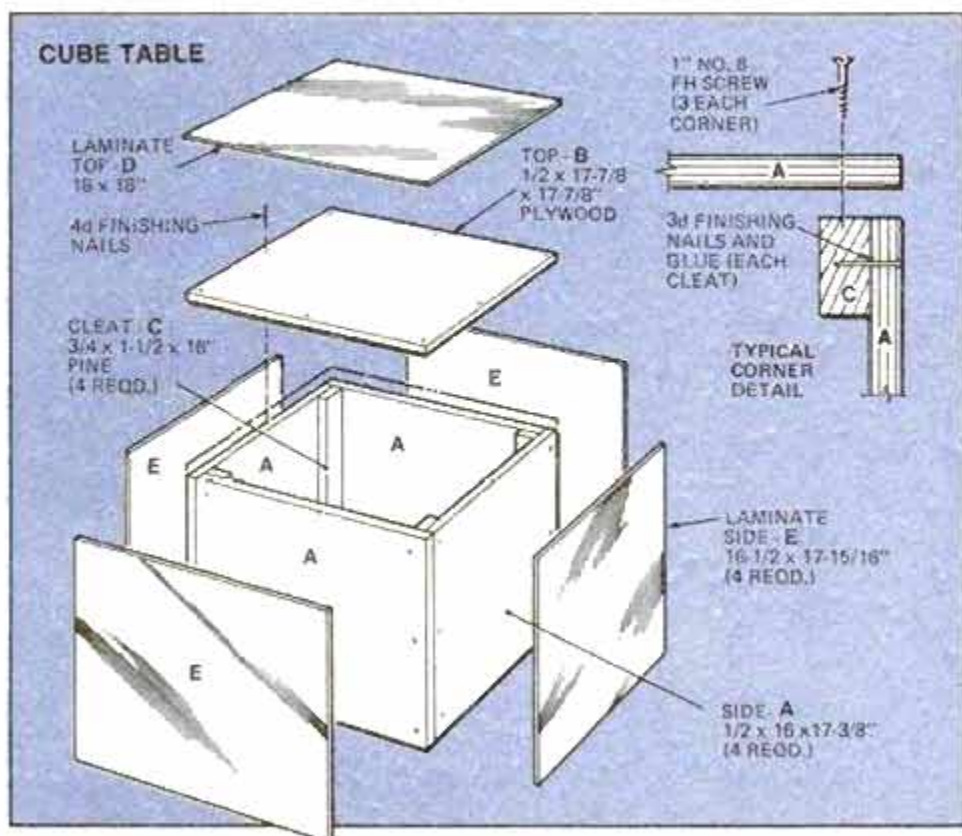
ing panels, so you'll know where to nail. Use a sharp plywood blade to cut the paneling. Position the paneling face up if you're using a table saw. With a radial-arm, portable circular or sabre saw, cut with the finished face down.

First, install the paneling that will adjoin the counter on the inside of the columns. Fasten the countertop to the column studs with 3-in. lag-screws and finish paneling the column framing and counter base. Use 3d (1 1/4 in.) finishing nails or 1-in. brads every 6 in. along the edges and every 12 in. on intermediate studs. Set all nailheads and conceal them with special crayon-like sticks. Or, use color-coated nails with a slight head. Such nails aren't set.

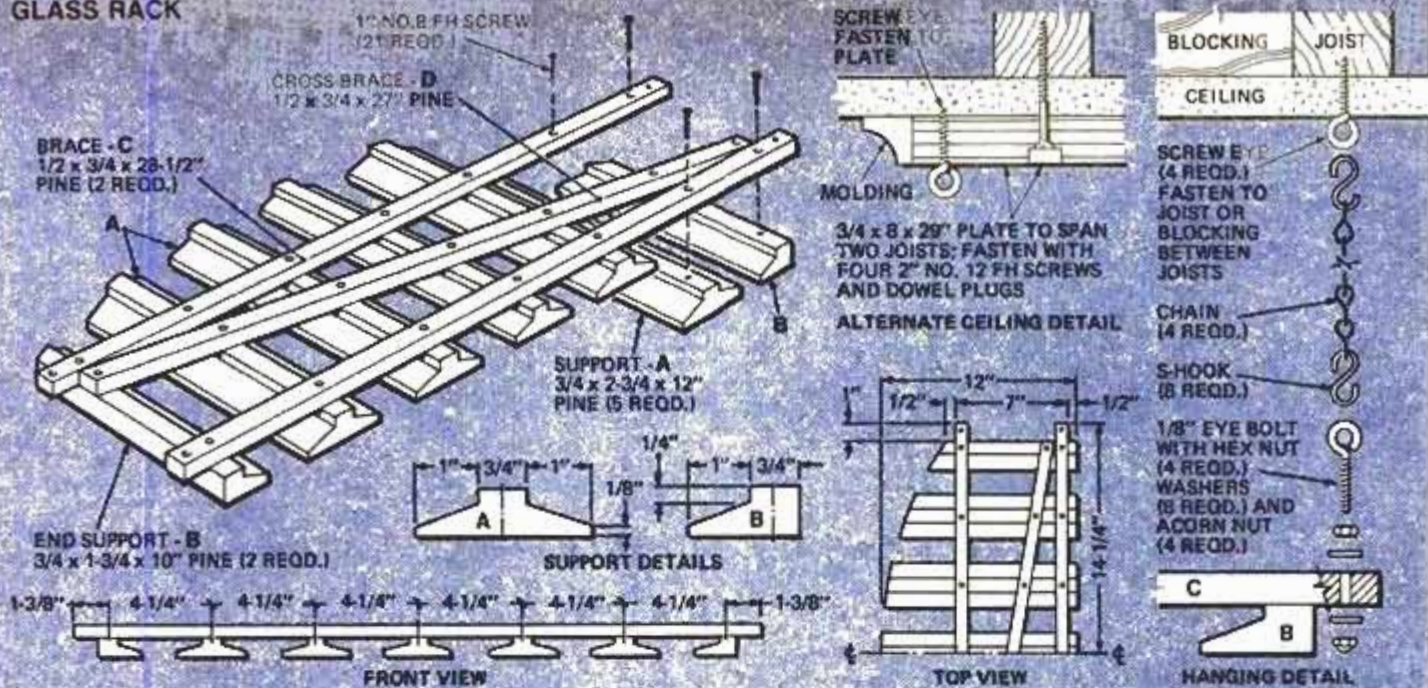
If you use panel adhesive, use fewer nails. Squeeze a bead of adhesive onto each stud face; nail the panel along the top edge only. Then wedge a scrap of 2x3 between the panel bottom and the studs to "air" the adhesive. After five minutes, remove the scrap wood and nail the panel to the studs.

Use prefinished corner guard to cover the paneling edges at the outside corners. If you use wooden corner guard, set the nailheads and conceal them with filler. Use only color-coated nails with vinyl corner guard.

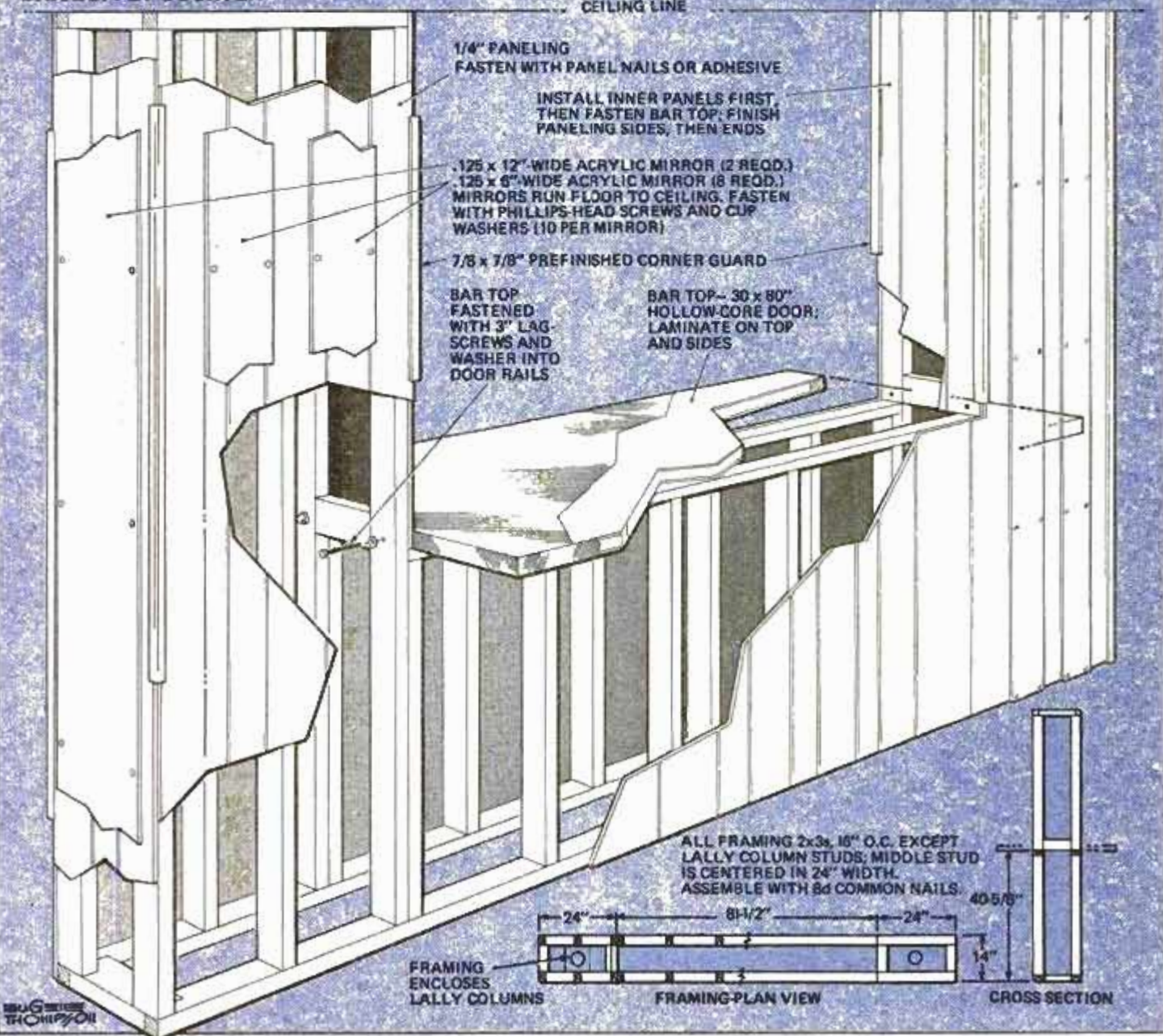
To attach strips of mirrored sheet acrylic, bore oversize holes in each corner and center holes near the edge of each side of the strip. Secure acrylic to paneling with Phillips-head screws and cup washers. **PM**



GLASS RACK



BAR/BUFFET COUNTER



Build this 'oil-proof' gun rack

After shopping unsuccessfully for a suitable gun rack, I designed this one to hold guns upside down with their muzzles at the low point. This prevents oil from saturating and weakening the wood stock, as it does when guns are stored vertically and rest on their stocks. The rack holds long guns and handguns by their trigger guards. The firearms hang on dowel pegs, which aren't likely to dent or scratch the stocks. Since there are no children in the household and I store ammunition elsewhere, I don't use trigger or cable locks on the guns. However, the rack has a storage compartment for cleaning gear, hunting hats and binoculars.

Anyone with access to a table saw or radial-arm saw can make this rack with a few hours of work. It's also helpful to have a band saw to cut the scrollwork, but a sabre saw or even a coping saw will work. I also used a router to cut a decorative beaded edge along the scrollwork.

Cut out a cardboard pattern using a 1-in. grid before you cut the top of the rack (part A). Then outline the pattern on the wood, bore out waste in the four circular curves with a 3/4-in.-dia. bit and cut out the part on a band saw.



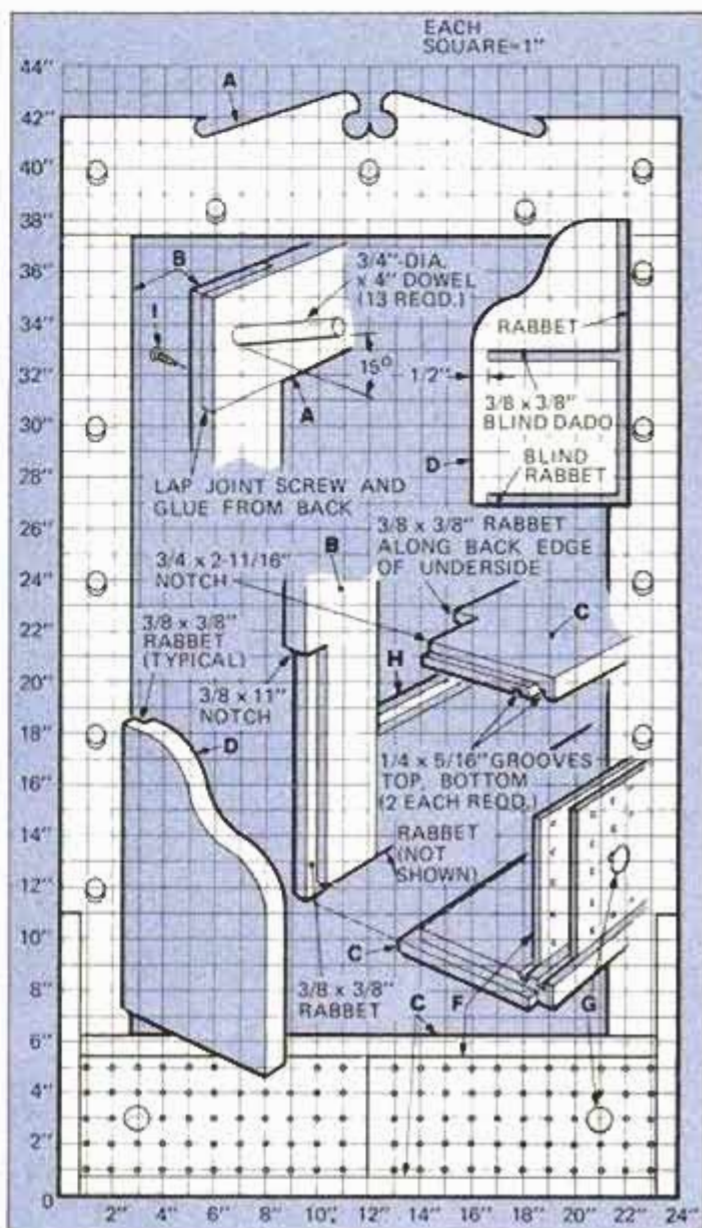
This gun rack is designed to hold four long guns and five handguns upside down. Oil from the barrel and action flows away from the wood stock and doesn't saturate and weaken it.

MATERIALS LIST—GUN RACK		
Key	No.	Size and Description (use)
A	1	3/4 x 5 1/2 x 24" pine (rack top)
B	2	3/4 x 2 1/8 x 41 5/8" pine (vertical members; rip a 1 x 6 in half)
C	2	3/4 x 5 1/2 x 23 1/4" pine (compartment top, bottom)
D	2	3/4 x 5 1/2 x 11" pine (compartment ends)
E	13	3/4"-dia. x 4" dowel (rack pegs)
F	2	1/2 x 5 1/4 x 12" perforated hardboard (doors)
G	2	1"-dia. wooden knobs
H	1	3/4 x 5 1/2 x 18 3/8" pine (compartment back)
I	*	3/8" No. 10 fh wood screws
Misc.:		Carpenter's glue; stain and finish. *As required.

Join the rack sides and top with glue and screws in corner lap joints. Use a try square to lay out the parts and draw lines for the width of the lap cuts. Then use a table saw to make a 3/8-in.-deep shoulder cut; turn the stock on edge, set the rip fence and clear out the waste. The vertical legs of the rack are notched and rabbeted to receive the ends and bottom of the compartment. Mark the locations and bore 3/4-in.-dia. x 3/8-in. deep holes at an angle for the rack pegs. Cut them to size and glue them in place.

The compartment top, bottom, back and ends are cut of pine. Parts are joined as shown in the drawing. The doors for the compartment are of perforated hardboard and they slide in grooves cut in the compartment top and bottom pieces. The top is notched to fit around the rack legs. The compartment's top fits into blind dados in the end pieces.

Test-fit the compartment parts, then sand them smooth with 120-grit abrasive, tack off and attach knobs to the doors before joining parts with carpenter's glue. Keep glued surfaces in contact with a web clamp or two while the glue sets. Apply stain and finish as desired.—Gary P. Hansen



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WORKSHOP MINICOURSE

FINISHING BASICS



Oil stain is author's first choice for beginning woodworkers because it gives the user greatest control. To stain a piece of softwood, all you need is the stain, an inexpensive brush and a lint-free rag.



Stir stain thoroughly to make certain all pigment is dissolved in the solvent. Apply stain with a brush, using overlapping strokes. Work a small area at a time so you can control the length of time that the stain remains on each surface. When possible, turn the surfaces so that you will be able to apply the stain horizontally.



Allow stain to soak in for 10 to 15 minutes—the longer it sets, the darker the finish will be—then wipe it with a clean cloth. The author uses one rag for initial wipeoff, then turns to another to make the final wipeoff (using with-the-grain strokes).



If your project is on an open-grain hardwood such as oak, mahogany or walnut, the wood's pores should be filled with a paste wood filler. The filler is mixed with a small amount of the stain so the material will blend well with the surrounding surfaces when it is packed in the pores.



Fill a small area at a time when working with wood filler. Apply it using a brush and across-the-grain strokes, as here.



Finish application using with-the-grain brush strokes to level the filler paste.

Of all the subjects discussed in my adult-education wood-working course, none seems to mystify students more than putting a finish on wood. For that reason, I have evolved a simple procedure that is sure to produce satisfactory results every time. All it takes is some practice on scrap to learn the materials and techniques.

Because they give the best control, oil stains should be used by beginners. While an oil stain can hide some grain, keep in mind that you can thin (thus, lighten) it by adding turpentine (turps). One of the beauties of oil stain is that you gain the ability to mix stains and come up with a custom color if the project demands it.

If you plan to finish a piece of open-grained hardwood conventionally, with a varnish, the open pores should first be packed with paste wood filler. (Often, master craftsmen skip the pore-filling step if the final finish will be a wash coat; i.e., a thinned coat of shellac.)

Several important points to keep



Allow the filler to set until it loses its sheen—about 25 minutes, depending upon temperature and humidity. As soon as it does, wipe off all excess, using across-the-grain strokes to pack the pores.

in mind regarding paste wood filler:

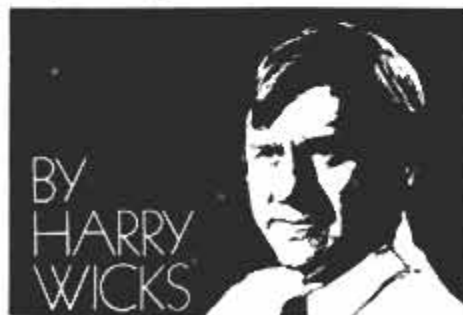
1. Don't let the store clerk tell you that wood putty or other wood patches are the same thing; *they are not*. A paste wood filler is an oil-based material mixed to the consistency of heavy cream using turps.

2. Don't work too great an area at once or you'll never get the stuff off.

3. Read all instructions on the can before starting.



Use a relatively clean cloth to finish the job, wiping with the grain. A coarse cloth, such as burlap, is good for this chore, but any semi-coarse, lint-free rag will do. After the surface is wiped, check it carefully to make certain that you haven't left any filler residue on the wood. If you have, it will cover the grain like paint.



Gas Saver Patented

Low Cost Water/Vapor Injector

DENVER—The Copley News Service reported that United States Patents have now been issued to Wm. Trevaskis, veteran electrical engineer, for his Vapor-Jet® brand water vapor injector.

Trevaskis has developed what can amount to a 15 cents per gallon "rebate" potential on gasoline, by designing a low-cost injector for automobiles, light trucks, vans and recreational vehicles.

Water injectors were developed to a highly refined state during World War II, to give combat planes increased speed and range improvement potential. However, up to now, the low price of gas and the high cost and extremely difficult installation required for earlier injectors combined to make them unattractive.

The Vapor-Jet® has an unconditional 60-day money-back guarantee. **How does the Vapor-Jet® system work?**

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and a mist to form in the upper part of the reservoir. This mist is then drawn by vacuum through a hose which is connected to any intake manifold suction hose. This connection is made very simply by our exclusive hypodermic-like injector nozzle which contains a regulator to allow just the right amount of mist to pass into the combustion chamber.

The introduction of this mist into the fuel air mixture has a cooling effect that increases the mixture density, extends the burning rate, and improves combustion efficiency. This significantly reduces ping (predetonation) and dieseling (after running of engine). Since steam is a good cleaner, it also helps dissolve carbon deposits on the spark plugs and cylinder walls of older vehicles and helps prevent carbon buildup in new ones.

How much mileage increase can be expected?

Mileage may vary due to geographical area, driving habits, vehicle, and weather conditions.

Will Vapor-Jet® fit all cars, and is it easy to install?



Yes. Vapor-Jet® is easily installed on all domestic and foreign cars, vans, light trucks, R.V.s, campers, motor homes, and small boats. It will work with unleaded gas, gasohol, or propane-burning cars. The same kit fits all cars. Simple installation instructions with a diagram are included, and even a novice should be able to install it. Simply take an ice pick or drill and make a small hole through any intake manifold suction hose (i.e., PCV hose, brake assist hose, vacuum advance hose, etc.). Screw the injector nozzle into the hole, mount the reservoir by means of the bracket and screw supplied, and connect the reservoir to the injector nozzle by means of the hose supplied. If you don't want to install it yourself, most service stations will for a few bucks.

Can Vapor-Jet® damage my engine or cause rust?

Absolutely not! Vapor-Jet® cools down the fuel air mixture giving a better burn and suppresses ping thus improving your engine. The mist that enters into the engine turns immediately into vapor. All excess mixture exits through the exhaust immediately.

What is the purpose of the methanol V.I.M. (Vapor Injector Mix) and how long does it last?

The reservoir measures 3½" x 5½" x 7½" and has capacity of just under ½ gallon fluid. A full reservoir should last about 1,000 miles. Methanol (wood alcohol) is mixed with water mainly to prevent freezing and to keep the injector nozzle clean in non-freezing weather.

The cost of methanol is minimal (about \$5 a gallon) and will last up to 8,000 miles when mixed with water. Sources of methanol are chemical supply houses, paint stores, and drug stores. Substitutes are gas line antifreezes that contain methanol such as "Heet."

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OWNERS REPORT: CIMARRON

(Continued from page 86)

over a quarter said no, although in fairness, nearly 90 percent stated they'd go for another Cadillac next time—just not a Cimarron. The reasons were manifold.

We asked, for example, what attracted buyers to the Cimarron in the first place.

A Louisiana housewife told us: "I was looking for a compact car and was impressed with the Cimarron's mechanical details, its front-wheel drive, body styling and other features, such as fuel mileage."

A Georgia chemist: "Good value—should have excellent resale."

A Florida machinist: "I've always driven big cars. I figured a Cadillac product might help me adjust to smaller cars. It has."

And a retired California hospital administrator: "I believe in buying American. The Cimarron gets better gas mileage than the Seville, and I found the Cimarron very comfortable and easy to handle."

Handling, in fact, became one of the Cimarron's best liked attributes. Nearly half the owners we surveyed put handling at the top of their list.

A New York schoolteacher remarked, "Its size makes the Cimarron very maneuverable, and fwd helps it hold the road well."

A Minnesota homemaker: "We live on a high hill. The Cimarron's front-wheel drive made getting home much easier in the winter."

And a Florida retiree confided, "Handles beautifully, but it needs a little quicker pickup."

As it turned out, just over a third of our respondents agreed with that sentiment and echoed similar complaints about anemic acceleration. "Cadillac ought to put an engine in it," wrote a Tennessee salesman. "The Cimarron handles well, it's solid, but it has no power. And I'm not a hot rodder—I'm 61 years old."

A Texas machinist grumbled, "It needs more horsepower to climb hills without the automatic transmission having to shift into a lower range."

Several drivers suggested that Cadillac offer an optional V6, perhaps a turbo-charger, or at least a slightly larger four-cylinder engine. Owners of Cimarrons with manual transmissions seemed more satisfied, generally, with their cars' performance than did those who had automatic transmissions. (What new owners did get this year is a larger, 2.0-liter Four, which will improve performance, especially when coupled to a new five-speed, also available this year.—Ed.)

Another point of dissatisfaction—although considerably milder—resulted from lower-than-EPA gas mileage. Some 14 percent of the drivers we queried had expected better fuel economy, especially on the highway.

According to EPA, a 1982 Cimarron

with four-speed ought to deliver 26 mpg in the city and 42 mpg on long trips. According to our survey, the EPA's city figure is surprisingly accurate (26 vs. 25.1 mpg actual), but on extended trips the EPA estimate falls nearly six mpg short.

A Tennessee maintenance foreman summed up the dilemma this way: "Ideally, I'd like to see Cadillac give us performance plus economy. If they can't give us



Cimarron may be tight on legs, but 93.5 percent rate comfort good to excellent.

both, though, why can't they at least give us one or the other?"

Some owners voiced concern, too, about what they felt wasn't enough of a Cadillac look. For example, a Texas widow noted, "People think it's a Datsun or a Toyota." And a California steel analyst confessed, "I spent \$139 extra and had to beg the sales staff to put Cadillac emblems on both sides of the trunk and hood. When you pay \$15,000 for a Cimarron, you want people to know you're driving a Cadillac and not a Chevrolet."

Over half of our respondents gave the Cimarron's workmanship a rating of excellent, and another 31.3 percent rated it good. That aspect, at least, is right up there with BMW, Audi, Volvo and Europe's best. A New York attorney glowed, "This is the first American car I've ever bought that had nothing wrong with it when I took delivery, and nothing has gone wrong in 7,400 miles of driving."

A retired California pilot posited, "Excellently put together. Everything fits!" A Texas educational administrator: "Quality is just as fine as our large Cadillac." But a retired Michigan judge opined, "I have had Cadillacs before and would always rate them excellent. This car, though, does not quite reach that same level of quality."

And a Wisconsin waitress: "Superb coachwork, but my husband and I see a need for better quality control in the electrical system."

What she's referring to is a minor problem that occurred on several early Cimarron

rons and probably on other GM J-cars as well. The windshield wiper switch in these cars had a habit of turning on at odd times, probably due to an intermittent short. About half the owners we questioned reported some sort of early mechanical malfunction (a high figure among luxury cars), but most of these tended to be trifling. The majority were electrical—of the sort just described.

As for dealer service, Cimarron owners seem to be treated better than most. "The service department at my dealership," said a Texas trucking manager, "is more

conscientious than most hospitals." And an Illinois sales rep praised, "My dealer repaired the wiper control in five minutes. Actually, a shop supervisor did the work because the mechanics were out on strike. Now *that's* service!"

We asked owners to list anything they felt would improve the Cimarron. Here are some of their recommendations.

"I'd like a fuel-injected, 2.0-liter engine with a five-speed manual transaxle," suggested an Illinois sales representative.

"They ought to eliminate the rear-seat divider so three people can sit

abreast."—Wisconsin artist. [GM has eliminated this divider from later-production Cimarrons.]

But most suggestions had to do with increasing engine power. Cadillac would make no mistake adding a few more beans.

Finally, from a North Carolina lumberman: "I've been waiting for General Motors to come out with a small luxury car equal to the best of the imports. I think GM made one that's better, in terms of dependability and service, and just as good in terms of gas mileage." **PM**

SUMMARY OF 1982 CADILLAC CIMARRON OWNERS REPORTS*

Total miles driven 938,055	Comfort: 33.8 Ride 19.7	Good 28.8 Average 4.7 Poor 1.9	Number of vehicles owned: Cimarron only 23.9% Two cars 51.8 Three cars 17.0 Four or more cars 5.5
Average miles per gallon Four-speed manual In town 25.1 Long trips 35.1	Specific dislikes: Lack of power 34.2% No complaints 18.6 Gas mileage 14.1 Workmanship 5.0 Automatic transmission sluggish 5.0	Had any mechanical trouble? Yes 50.7% No 49.3	Makes of other cars owned: Cadillac 33.1% Chevrolet 15.1 Buick 15.1 Oldsmobile 12.0 Ford 9.6
Three-speed automatic In town 22.6 Long trips 29.5	What changes would you like? More powerful engine 45.2% No changes 12.5 Better gas mileage 6.2 Different seat shape 5.8	What type of trouble? Electrical 24.1% Windshield wipers 20.4 Airconditioner 13.9 Transmission 11.1 Carburetor 10.2	Age distribution of owners: 15-29 years 4.9 30-49 years 34.9 50-plus 60.3
Transmission choices: Automatic 85.2% Manual 14.8	Workmanship opinion: Excellent 53.5% Good 31.3 Average 8.3 Poor 6.9	Dealer repairs satisfactory? Yes 71.8% No 28.2	Would you buy another Cimarron? Yes 74.5% No 25.5
Why did you choose the Cimarron? Economy of operation 44.8% Size 34.8 Style 20.0 Quality 14.8 Made in America 14.3	Comfort opinion: Excellent 64.7%	Dealer service opinion: Excellent 47.0% Good 26.5 Average 15.5 Poor 11.0	Would you buy another Cadillac? Yes 88.8% No 11.2
Specific likes: Handling 48.8% Economy 39.9 Styling 38.5			

*Percentages might not equal 100% due to rounding or insufficient data.

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IMPORTS '82

(Continued from page 79)

tending through fwd DL and luxury GL sedans, hatchbacks and wagons, GLF sport coupe and unique 4wd versions, Subaru offers an ever-improving line of strong and functional small cars. They're powered by an unusual, H-shaped, "flat-four" 1.8-liter engine and four-speed, five-speed and automatic transmissions.

Toyota

Starlet—It's a plain, but economical, rwd, three-door hatchback coupe with 1.3-liter Four and five-speed manual only. The Starlet does have some added equipment for '82, however.

Corolla Tercel—It's a bit of an ugly duckling in two-door, four-door and three-door hatchback form, but the Tercel is Toyota's least expensive car and its only space-efficient fwd. It comes with a 1.5-liter Four with four-speed or five-speed manual or three-speed automatic.

Corolla—It's the world's best seller, offering good styling and value for the money, despite nonefficient, rwd configuration. Sedan, wagon, hatchback, hardtop and sport-coupe body styles have 1.8-liter, four-cylinder power, coupled to choice of four- and five-speed automatic transmissions.

Corona—This rwd, mid-range, four-door sedan, five-door hatchback and wagon has five-speed manual or four-speed overdrive automatic with a 2.4-liter Four.

Celica—Toyota's popular four-cylinder sport coupe and hatchback are redesigned and much improved throughout, but they keep their 2.4-liter Four and choice of four-speed, overdrive automatic or five-speed, manual transmissions. Both can be identified by extreme shovel-nose styling and flush, slip-forward headlamps.

Celica Supra—Restyled and reengineered in stretched, Celica hatchback body with twin-cam, the Supra sports a 2.8-liter, six-cylinder engine, independent rear suspension, multiadjustable seating and pop-up headlamps in the long, low nose. A digital/graphic dash is optional on the luxury L-type and extra-wide tires in flared fenders are standard on the performance version; you have your choice of five-speed manual or four-speed overdrive automatic. It's a ball to drive.

Cressida—It's a luxury sedan and wagon with 2.8-liter Six with four-speed, overdrive automatic only, plus a standard, trip computer for '82.

GERMANY

Audi

4000—Audi's mid-size, fwd family car offers two-door and four-door body styles, 1.7-liter gas and 1.6-liter diesel, four-cylinder engines with four-speed transmission. Five-speed and automatic transmissions are available with 2.2-liter, five-cylinder gas engine, and a new turbodiesel engine is on the way.

Coupe—This handsome sport-coupe version of the 4000, with 2.2-liter, five-cylinder, five-speed power train, was introduced in mid-'81. It gives good performance and fwd handling, but it's a bit dated on the inside. A turbocharged, 4wd "Quattro" version will be introduced in mid-'82.

5000—Audi's flagship fwd sedan is powered by a 2.2-liter Five and automatic transmission. Optional Turbo version is the ultimate Audi, with outstanding comfort, ride, handling, performance and Teutonic good looks for about \$18,500—a reasonable price compared to competitive, German luxury cars.

BMW

320i—A precise look and feel, lively performance, adequate handling and high price tag characterize this BMW entry. It has a 1.8-liter, four-cylinder engine and is available with five-speed or automatic.

528e—The e stands for eta, the Greek symbol for efficiency. And while it may be efficient, it's also down on horsepower and comes equipped with a rev limiter which cuts off fuel at 4,700 rpm. Ride quality and luxury are still its strong points.

733i—The only U.S.-market luxury sedan available with five-speed manual as well as automatic, this 3.2-liter, six-cylinder four-door is for those willing to pay to enjoy driving as a sport. An on-board computer with digital electronics and an "Energy Control" fuel-economy meter is new for '82.

633CSi—This high-ticket, high-style, sporty coupe is BMW's flagship. It has a 3.2-liter Six with five-speed or automatic, and digital electronics are new for '82.

Mercedes-Benz

240D—Mercedes' bottom-line, 2.4-liter, four-cylinder diesel sedan is priced like top-line domestics. It's the only Mercedes with manual transmission (four-speed) as well as optional four-speed automatic; it's slow, but frugal and solid.

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300D/300CD/300TD—With gas six-cylinder discontinued for fuel-economy reasons, Mercedes' mid-range sedan, coupe and wagon are all newly powered by a lively (for a diesel) 3.0-liter, five-cylinder turbodiesel with four-speed, automatic transmission.

300SD/380SEL—These three-liter turbo-diesel and long wheelbase, 3.8-liter, gas V8 versions of new-for-'81 top-line sedans both come with four-speed automatic. The latter is some \$10,000 more expensive, but it's plusher and offers more features.

380SL—This two-seat convertible sports car with removable hardtop, 3.8-liter V8 and four-speed automatic shift is a favorite of the jet set.

380SEC—A two-door version of the SEL, this car is MB's latest statement on the performance-luxury market. The interior makes a clean break with tradition with the nicest seats ever seen in a car. Gone is the Mercedes molded seat; it's replaced by high-bolstered, sculpted buckets. The SEC boasts outstanding handling and performance for a car of this size and luxury.

Porsche

924—This bottom-of-the-line, 2.0-liter four-cylinder, front-engine, five-speed Porsche is expensive for its fairly mild performance, but it's a good looker and sweet handler. The turbocharged 924 looks and handles even better, offers much more engine power and surprisingly good fuel economy for approximately \$5,000 more.

944—A new model based on the 924, the 944 has racer-like flared fenders and a new 2.5-liter, high-performance Four, due early this year.

911—The ultimate "Beetle" is still fast and fun to drive, with rear-mounted, air-cooled flat Six and five-speed transmission. The discontinued turbo version is the cornerstone of Porsche's worldwide racing legend and part of the reason the 16-year-old 911 is still Porsche nuts' favorite, despite evil handling and other deficiencies.

928—This front-engine, 4.5-liter, V8 2+2 sports car with five-speed or automatic is Porsche's flagship. Fast, agile and technically sophisticated, yet comfortable and civilized, it puts other expensive exotics to shame.

Volkswagen

Quantum—Based on the Audi 4000, this car replaces the Dasher in

(Please turn to page 118)

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IMPORTS '82

(Continued from page 117)

the VW lineup and becomes its new flagship. It carries a longitudinally mounted, 1.7-liter, fuel-injected Four, which powers the front wheels. While sure-footed and agile, roomy and well put together, it lacks the kind of styling or personality that would earn it a devoted following.

Scirocco—Newly restyled along aerodynamic lines, this car remains mechanically unchanged. Powered by the same 1.7-liter Four of the Quantum and Rabbit, the Scirocco's hallmarks are good handling, precise steering and excellent ride quality. Its only faults are a cramped interior and a stiff retail price.

Rabbit—The bunny remains largely unchanged from last year's model, with the exception of the E-light as standard equipment. The E (for economy) light blinks on to tell you when to upshift for the best fuel efficiency. Sciroccos, Quantums and Jettas also have the E-light as standard. A 1.6-liter diesel and a convertible-top version are also available.

Jetta—The Rabbit with a giant trunk doesn't give you much more than a Rabbit, except the formal roofline and a surprisingly voluminous cargo area. With the diesel option, it's America's second highest mpg car. Number one is the Rabbit diesel.

ITALY

Alfa Romeo

Spider—This classic Italian roadster is creaky with age, yet it's still appealing and fun to drive, despite an awkward, cramped-arm driving position. The double-overhead-cam (dohc), 2.0-liter four with five-speed transmission is the only available power train.

GTV6 2.5—Introduced a year ago, Alfa's latest entry combines a lusty 2.5-liter dohc V6, rear-mounted five-speed transaxle, sleek, four-seater coupe body, and sophisticated suspension. It's the most exciting, reasonably affordable Italian sportster in years.

Ferrari

308GTB/308GTSi—One of the most beautiful automotive shapes ever built, Ferrari's mid-engine, 3.0-liter V8, five-speed sports car delivers thrilling performance and handling, as well as instant status. The GTSi version has a removable Targa roof panel.

Mondial—New for '82, this 2+2 luxury sports car shares the 308's mid-

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engine V8 power train and suspension. It's not as quick, but far more civilized.

Fiat

Spider 2000—This two-liter sports car remains largely unchanged, but has received a horsepower boost in the form of a turbocharger. The Pininfarina-styled roadster is beginning to look dated; a major revamp is overdue, but not forthcoming.

Strada—Fiat's fwd, Rabbit-type econocar is now discontinued in the United States, but cars are still available until they're sold out. It's great fun to drive, with surprising performance from its fuel-injected, 1.5-liter Four.

X1/9—Still contemporary and fun to drive after eight years on the market, the tiny, wedge-shaped, Targa-roofed, mid-engine Fiat performs and handles wonderfully, with its fuel-injected, 1.5-liter Four and five-speed transmission.

Lancia

Zagato—This handsome, fwd 2+2 convertible, with a removable Targa panel and a fold-down rear soft-top, is Lancia's only U.S. entry for '82. It shares Fiat's 2.0-liter injected Four and has a five-speed transaxle.

GREAT BRITAIN

Bentley

Mulsanne—This car is identical to the Rolls-Royce Silver Spirit, except it doesn't have the \$630 Rolls-Royce grille. Bentley versions of the Rolls Corniche Coupe and convertible are also available.

DeLorean

With rustproof, stainless-steel, bolted-on body panels over a fiberglass body and gull-wing doors, this unique, rear-engined exotic sports car is built in Northern Ireland by the former GM executive's company. It's powered by a Peugeot/Renault/Volvo 2.8-liter V6 with five-speed or automatic transaxle. Optional turbo power is promised later this year.

Jaguar

XJ6—This classic, British luxury sedan has updated its ancient 4.2-liter, six-cylinder engine and coupled it to an automatic transmission. Improved fuel economy and interior appointments, plus additions to the long, long standard-equipment list are new for '82.

XJS—Jaguar's flagship V12-powered sport coupe features sophisticated, new, engine-cylinder heads

for much-improved economy, plus standard cruise control, electrically operated outside mirrors and new, light-alloy wheels. It sports controversial styling, but sensuous, sumptuous appointments, performance and handling.

Lotus

Esprit—A sexy, wedge-shaped mid-engine sports car, this Lotus entry features racer-like handling and new fuel-injected, 2.2-liter, four-

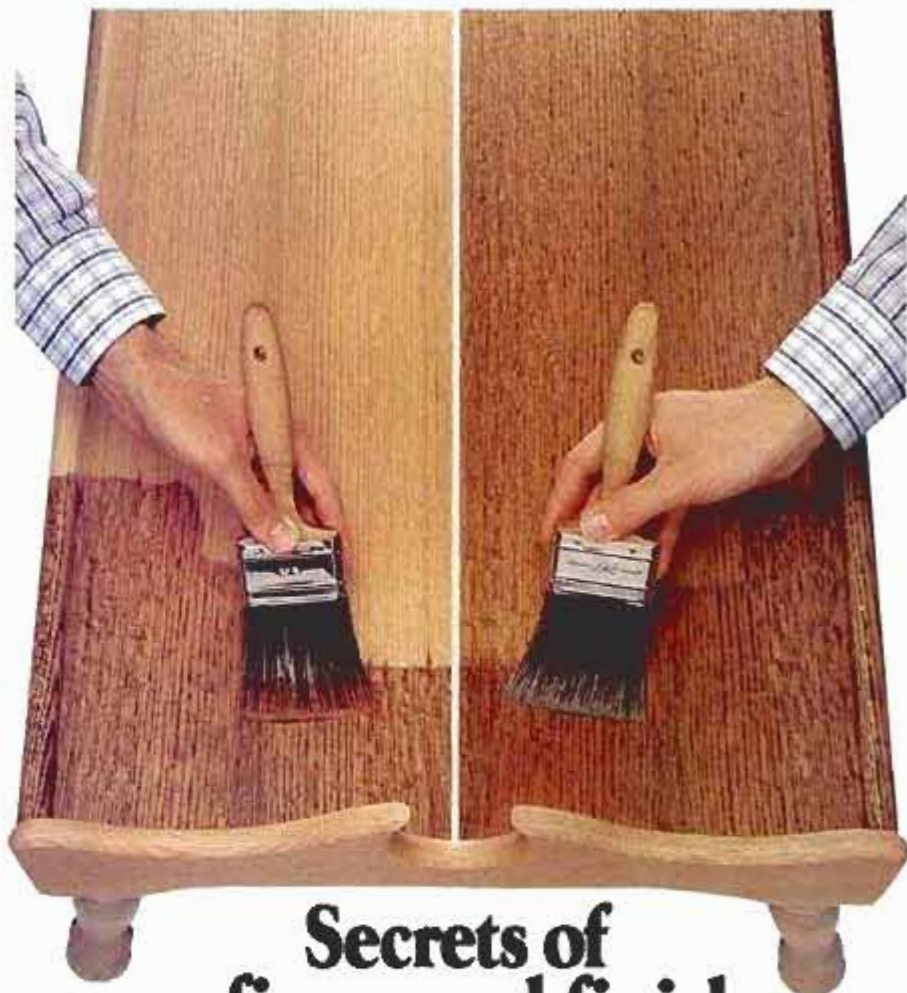
cylinder driving through five-speed transaxle.

Rolls-Royce

Silver Spirit/Silver Spur—The first new RR sedans in many years share the same 6.8-liter V8 and cost-is-no-object appointments and engineering for near-ultimate automotive status. The Silver Spur is a long-wheelbase, vinyl-topped version.

Corniche—This coupe or convert-

(Please turn to page 120)



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IMPORTS '82

(Continued from page 119)

ible is for the idle rich who want more style and exclusivity than provided by the new sedans.

Camargue—The "sporty" Rolls coupe, if there is such a thing, boasts styling by Italy's Pininfarina.

FRANCE

Peugeot

504—Only a 2.3-liter, four-cylinder diesel wagon remains in Peugeot's aged 504 series, the rest of which was replaced by the new 505. Economy, durability and good cargo capacity atone for its sluggish performance and ho-hum looks.

505—The modern Peugeot sedan has four doors and a choice of 2.0-liter gas, 2.3-liter diesel or turbodiesel power with four-speed, five-speed or automatic transmission. A new top-line STi model offers special paint, leather interior and a super TRX suspension on what was already an excellent handling automobile.

604—Peugeot's older and larger luxury sedan is reintroduced here with the 2.3-liter turbodiesel engine, spacious interior and traditionally plush French-style ride and appointments.

Renault

Le Car—Sold at both Renault and partner AMC's dealers, the 1.4-liter, four-speed, fwd "French Rabbit" is low on style, but high on personality and practicality. A five-door hatch version joins the three-door model and revised controls and an optional sport package are new for '82.

18i—Nicely styled and economical, this fwd, small family car comes in four-door sedan and wagon variations. It's powered by a somewhat noisy, 1.6-liter Four with four-speed, five-speed or automatic transmission.

Fuego—This 18i-based sport coupe, with unique aerodynamic styling, will be introduced to the U.S. market early this year with optional turbo engine.

SWEDEN

Saab

900—A high-tech, slightly eccentric, roomy and comfortable car, the fwd 900 comes in a four-door sedan or three-door hatchback, both offered in optional turbo versions with exciting performance and handling. Power is from a sophisticated 2.0-liter Four coupled to your choice of a four-speed, five-speed or automatic transaxle.

Volvo

DL/GL/GLT/GLE—These two-door, four-door sedans or wagons with brickbat styling are offset by high quality and interior comfort. DL, plusher GL and sporty GLT are 2.1-liter, four-cylinder powered, the latter with optional turbo, while the top-line GLE has 2.8-liter V6. All four models offer a choice of four-speed (with optional electric overdrive) or automatic transmission. Six-cylinder, 2.4-liter diesel power is optional.

Super exotics

Exotic cars have been hard to buy—no matter how much money you have—because safety, emissions and fuel-economy laws with regard to these vehicles have chased them out of the marketplace in recent years.

But some are making a comeback.

England's Aston Martin, famous for building the James Bond wonder cars of the early movies, is importing its fast and handsome 5.4-liter V8 Coupe and the Volante convertible. Both come with five-speed or automatic transmission, at prices ranging from \$96,000 to \$118,000. There is also a high-performance version of the Coupe called the Vantage at just over \$100,000. The futuristic, wedge-shaped Lagonda four-door is also scheduled for a June debut—all yours for \$150,000.

Italy's Maserati still sells the sleek Merak mid-engined V6 sports car here (1980 models are certified for that year's emission standard). Since they're technically 1980 cars, which were in the pipeline before the '81 standards took effect, they're still allowed to be sold. Meraks are about \$40,000 each. The big news for '82, though, is the big, Mercedes-like, four-door called Quattroporte (four-door in Italian). It's loaded with every conceivable luxury feature, powered by a 4.9-liter V8 and priced at \$64,000.

Then there's the trickle of hyper-exotics—the ones that make your heart beat faster just looking at them. This rarefied group includes the 12-cylinder Lamborghini Countach and Ferrari 512 Boxer, the six-cylinder BMW M1, Renault 5 mid-engined Turbo and the occasional one-off Lola, Porsche 935 Kremer K3s, 917s, Chevrons and so on. These are individually certified by small tuning firms and heavily modified to meet bumper, emissions and related safety standards. The price for all this? If you have to ask . . . **PM**



Catspaw, a 12½-foot dinghy which is adapted from Herreshoff lines, can be built and rigged (above, below and left) from plans costing \$4.95, available from WoodenBoat Books, Box 78, Brooklin, Me. 04616.



boatbuilding material. It must be marine-grade plywood, of course, with the appropriate waterproof glues and the added laminations per sheet for greater stability. Kit makers supply the plywood stock, and the builder should know the grade of plywood used.

To judge the looks and performance of a boat, compare it to one you know, or ask the advice of a knowledgeable boating friend. In general, a craft that looks graceful is usually functional. One that's cumbersome and boxy is likely to perform like a box.

A good profile or sail-plan drawing will also show the width, or beam, of the hull and the depth, or draft. Fortunately for beginners, there are no radical kit boats—with the possible exception of boardsailing types. The best boat kits come with meticulously complete instructions. The pieces are precisely cut and clearly identified, and the structure usually takes advantage of the remarkable adhesives available today.

You don't need exotic tools and techniques to build the average kit boat. Learning the skills of working with wood is among the satisfactions of building a boat, and much can be learned from experienced friends and publications such as the bimonthly magazine *WoodenBoat*, published at Brooklin, Me. Only launching and leaving shore in a craft you've built yourself can match the plea-

(Please turn to page 122)



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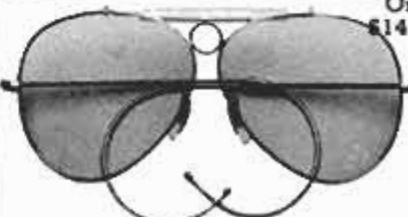
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(Continued from page 121)



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CABINETS FOR YOUR KITCHEN

(Continued from page 100)

wall to be removed is a bearing wall (one which supports the load imposed by the roof). If you lack the know-how to determine joist run and how a roof is supported, play it safe: Call in a professional engineer and follow his advice.

If it is a bearing wall, install a temporary wall, located about 1 ft. inside the house wall, to support the joists overhead during the tearing out and rebuilding. Use 2x4s for the plates and studs for the temporary wall, and drive shims beneath the bottom plate, if necessary, to assure the wall being wedged securely in place. The building codes and zoning laws in many communities require a permit before the building lines of a residence may be altered. So check with your local building department before you put a saw to the wall. If you proceed without a building permit and you get "caught," you may be required to tear down all of what you've just built.

At this time, determine whether there are any water or heat pipes, or electrical wires in the wall. If there are, take every precaution to avoid damaging them during the rip-out operation. To be safe, turn off water to water pipes, electricity to electric lines, and so on before starting.

Locate your opening and use a large-diameter bit in your drill to mark the upper corners of the cut-out. Next, go outside and pinpoint the interior floor elevation on the outside wall, using the holes to guide you.

Your footings and block wall (or slab) must be installed before you make the wall cutout—but first you must know the floor elevation.

Knocking out a wall

Remove the siding, then use your spirit level to mark the horizontal and vertical lines to be cut. Set your saw blade to cut to a depth of about 1/8 in. (standard siding thickness is 3/8 in.) and make the cut. *Caution:* Only an experienced saw user should make this type of wall cutout with a portable circular. There is a great possibility of kickback—especially when moving the saw overhead. If you have any doubts about your expertise, have a carpenter make the cutout.

Take off the sheathing below, then remove the interior wall, in the same fashion. Finally, cut out the studs. Next, install the appropriate-size header and posts to support it. If it's not a bearing wall, you can use a pair of 2x6s, spiked together. If the wall carries weight from above, ask the

local building department, or a professional engineer, to calculate the size header needed.

If you plan to build the addition yourself, you'd be wise to buy a good carpentry reference book. I recommend *Modern Carpentry*, by Willis H. Wagner, published by The Goodheart-Willcox Co. Inc., South Holland, Ill. It's available at bookstores, or write the publisher for availability and price.

Making an add-on work

There's an important design consideration when planning a house

addition—how it will look both outside and inside. The shape of the add-on, plus the materials used for siding, roof, windows and so on should blend perfectly with what is already there. New windows should match the old in style and should be installed at the same elevation as the existing ones.

Inside, it's important to create a finished room that feels as though it has always been there. Color is an effective device here: A careful selection of paints and wallpapers can make an add-on compatible with any connected room. **PM**

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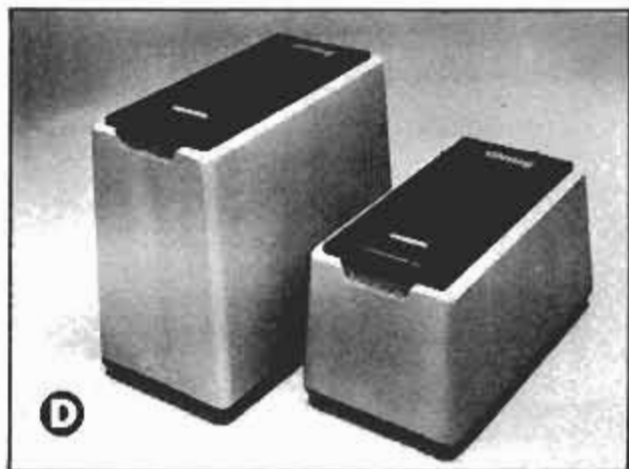


A The lightweight Stihl 010AV chain saw is now available in a Bonus Pack that includes a 14-in. bar, a carrying case, a sharpening file, a 5½-in. splitting wedge, a sprocket-cover wrench, a spare chain and an 8-oz. can of engine oil. Woodcutting and chain-maintenance booklets are also included, as is a Hook-N-Adjust tool used for cleaning the guide-bar groove, adjusting the carburetor and checking the chain cutter angle. The Pack sells for \$210 to \$230, depending on the local distributor. It's made by Stihl Inc., 536 Viking Dr., Virginia Beach, Va. 23452.

B Woodstock is a new collection of self-sticking vinyl flooring, designed to look like real wood. The six different styles—four parquets and two plankings—are available in light or dark wood tones. The 12-in.-square parquets and the 6 × 18-in. Pennsylvania Planks (see inset) cost about \$2 and \$2.50 per sq. ft., respectively. The Random Planking (larger photo) comes in 36-in. lengths and 2½-, 4- and 5½-in. widths for about \$3 per sq. ft. All are at flooring stores and home centers; made by Armstrong World Industries Inc., Box 3001, Lancaster, Pa. 17604.

C A new line of 133 strippable vinyl wall coverings and 33 companion fabrics has been added to the Wall-Tex Sampler Collection. Called Sampler II, these products were designed to complement all traditional American furniture designs, according to the manufacturer. The wall coverings cost \$9.95 to \$11.95 per 5½-sq.-yd. roll; the fabrics are \$16.95 per sq. yd. Available at home centers, they're made by the Columbus Coated Fabrics Div. of Borden Chemical, 1280 North Grant Ave., Columbus, Ohio 43216.

D The Sentry Survivor I and Survivor II are UL-listed, steel- and concrete-walled safes, designed to protect small possessions and documents from fire. The 33-lb. Sentry I is 8½ × 13¾ × 15½ in. and has a 527-cu.-in. interior capacity; the 22-lb. Sentry II measures 8½ × 8½ × 15½ in. with an interior capacity of 257 cu. in. Priced at \$54 and \$38, respectively, these key-locked safes are sold at home centers and office-supply houses. Made by John D. Brush Co. Inc., 900 Linden Ave., Rochester, N.Y. 14625.



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SCRAM™ is a home-size version of the commercial pest control device that's safe for people, pets and the ecology. Try it in your home for 30 days.

It happens every year. Cool, autumn months drive flying, creeping, crawling pests into your home. What do you do? Fight an endless battle using dangerous traps, poisons or sprays? Or shell out good money for high-priced exterminators? Well--here's an ingenious new space-age "Pied Piper" that will eliminate common household pests--and keep them out!

PESTS GET THE MESSAGE LOUD AND CLEAR: SCRAM!

SCRAM™ is a home-size version of an electronic pest control device that's used by professional exterminators. Its heart is a special quartz crystal speaker that sends out ultrasonic waves on varying frequencies (so the pests can't develop an immunity to it). You can't hear it. Neither can your pets. But mice, rats, roaches and other pests can. And the message they get is unmistakable: SCRAM!

Pests can't stand SCRAM's™ ultrasonic waves. It causes them extreme discomfort and pain. In fact, SCRAM's™ ultrasonic output bothers them so much, they'll leave rather than endure it. What's more, they stay away as long as SCRAM™ is on the job.

JUST PLUG IT IN. AND CLEAR UP TO 2500 CUBIC FEET.

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SCRAM™! Drives away
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Mosquitoes Locusts
Fleas ...and many other pests

Note: In spite of some claims, studies indicate that ultrasound is not effective in controlling bats or spiders.

leading university tested it and found it absolutely safe for humans--even children--and pets. And it's harmless to the ecology. There's no mess--no traps to empty and reset, no dead vermin to dispose of. (They leave under their own power!) And SCRAM's™ ultrasonic waves will positively not have any effect on burglar alarm systems, fire or smoke detectors, garage doors, TV reception or any other electronic devices.

SCRAM™ is the perfect pest protection. It will keep pests from inhabiting and nesting in vacation homes, campers, and boats both during the summer and off-season. Use it to control pests where food is kept or stored. Commercial versions have been used for years by exterminators, restaurants, and farmers. Hard-to-seal areas, such as garages, toolsheds and farm outbuildings benefit most from SCRAM's™ ultrasonic protection.

THE PRICE MAKES IT PRACTICAL.

Until recently, prices of ultrasonic units were high--close to \$200 in some cases. Only professional pest control companies used them and demand was low. But now the secret is out. Availability of lower cost components, particularly quartz crystal speakers, resulted in lower priced units. Now clean, electronic pest control is practical for everyone. SCRAM™ costs just \$49.95 (plus \$2.85 shipping and handling) but is as effective as units costing four to five times the price!

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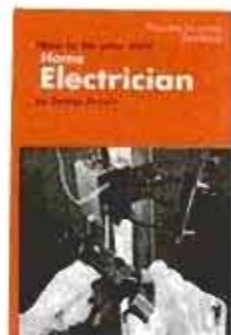
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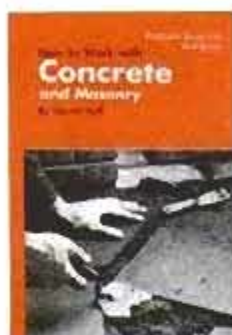
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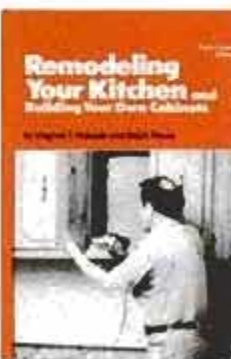
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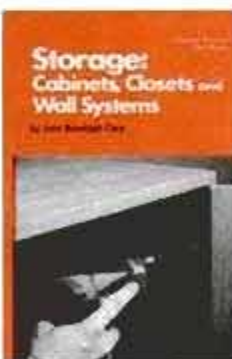
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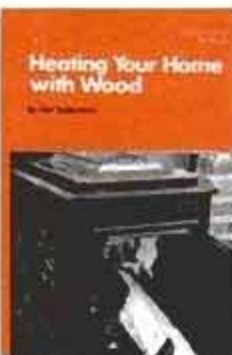
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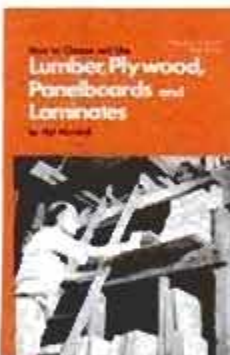
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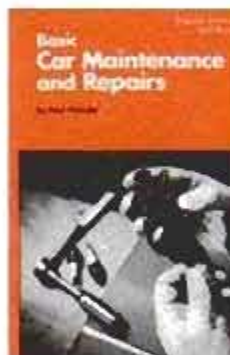
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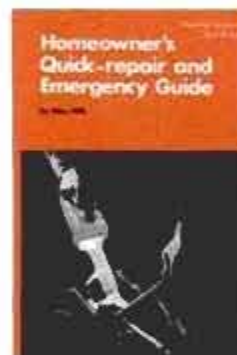
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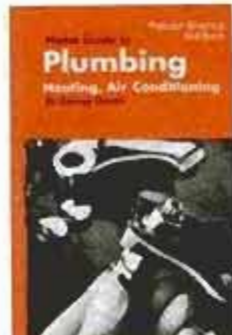
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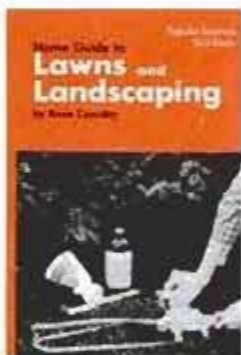
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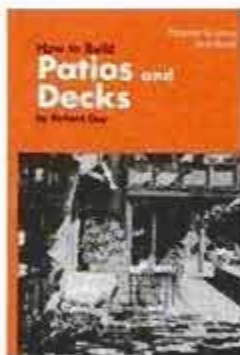
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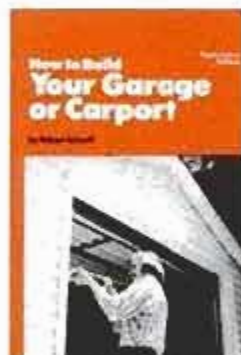
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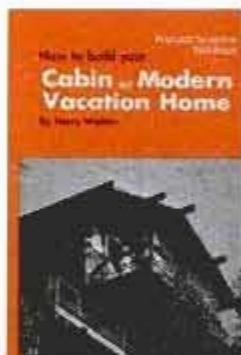
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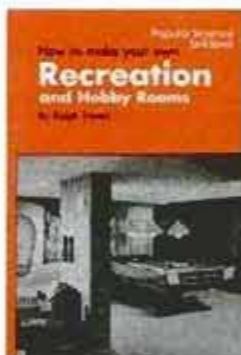
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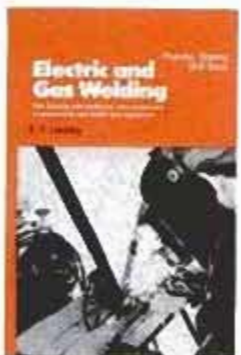
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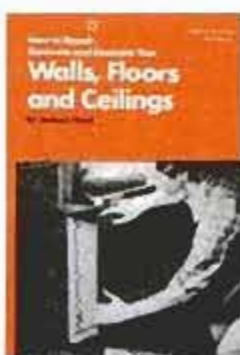
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Do-It

A YEAR OF PM OWNERS REPORTS (Continued from page 97)

what owners think about their cars—how strong their opinions are, how they rate the vehicles against their own expectations, and how well the car satisfies.

As we mentioned, the Starlet cleaned up in our 1981 Owners Report roundup. Of the 12 cars we scrutinized, no other car carried away so many honors. But others that fared well—and some that fared poorly—included the following:

The Datsun 280ZX came in for the most compliments in the area of excellence of workmanship. A total of 72.5 percent of the Z's owners gave overall workmanship a rating of *excellent*. The Starlet came in second best with an *excellent* rating of 62.0 percent.

The car with the worst workmanship rating, we're sorry to report, was the Cadillac Sedan de Ville. Everyone picks on Cad. Part of the problem with that car, though, was

due to its V8-6-4 engine which, at that early stage of the production run, was still giving owners more pain than pleasure. Nor could Cadillac dealership service personnel offer a quick cure. This, in turn, led 19.8 percent of our owners to give dealers a service rating of *poor*.



Cadillac Sedan de Ville, May '81, page 106.

Ironically, the car that owners felt got the best service was the 1981 Chrysler Imperial. Fully 60 percent gave the Imperial's service personnel an *excellent* rating. Not that Imperials needed much service, because Chrysler's Canadian assemblers, who put these coupes together,

er, must each have a minimum of 25 years of experience before they get a place on the line. Also, all the Imperial's mechanical components are hand-picked, matched, and all cars undergo real and simulated road tests before they're allowed to be shipped to a dealer.

The car with the fewest mechanical problems turned out—again—to be the Starlet. But more surprising, perhaps, is the fact that the Ford Motor Co. fared extremely well in this area, too. The Ford Escort, EXP, and especially the Granada



Chrysler Imperial, June '81, page 88.

ended up with far fewer mechanical problems than most of the others.

The Imperial took top honors in front-seat comfort, with 96 percent

(Please turn to page 132)

SUMMARY OF 1981 OWNERS REPORTS (Answers in percentages)

	AMC Eagle SX/4	Cadillac Sedan de Ville	Chrysler Imperial	Chrysler K-cars	Datsun 280ZX	Ford Escort	Ford EXP	Ford Granada	Mazda GLC	Oldsmobile Cutlass	Renault 181	Toyota Starlet
Average mpg												
City	18.0	17.7	15.8	24.0	19.2	27.9	26.3	18.4	28.4	18.6	25.2	34.7
Highway	22.7	23.0	22.4	31.6	24.9	34.1	38.0	23.3	34.8	24.1	31.9	42.5
Workmanship opinion												
Excellent	39.0	37.1	76.6	32.0	72.5	43.5	52.5	33.1	50.6	28.4	38.9	62.0
Good	44.1	37.5	18.9	43.5	25.3	43.5	40.2	44.7	41.3	40.1	49.1	31.7
Average	11.2	13.7	3.0	14.8	1.8	12.4	6.5	20.7	6.2	20.7	9.0	4.1
Poor	5.8	11.7	1.5	9.8	0.4	0.6	0.7	1.5	1.9	10.8	3.0	2.2
Mechanical problems												
Yes	60.0	46.0	40.3	42.3	43.0	35.1	34.7	23.4	32.3	50.9	64.5	17.8
No	40.0	54.0	59.7	57.7	57.0	64.9	65.3	76.6	67.6	49.1	35.5	82.2
Dealer repairs satisfactory												
Yes	51.9	55.2	78.7	72.1	64.3	66.7	72.7	78.2	58.6	55.8	53.5	64.9
No	48.1	44.8	21.3	27.9	35.3	33.3	27.3	21.8	41.4	44.2	46.5	35.1
Dealer service opinion												
Excellent	23.8	41.4	60.0	43.7	29.1	36.5	36.0	34.1	31.0	28.9	24.6	40.7
Good	34.7	29.1	28.2	34.0	38.6	41.5	36.4	39.5	38.8	37.1	36.8	34.1
Average	23.6	9.7	6.5	13.8	25.0	17.7	18.7	18.6	18.8	18.3	21.1	19.2
Poor	18.1	19.8	5.3	8.5	7.3	4.3	8.9	7.7	13.4	15.7	17.5	6.0
Comfort opinion												
Front/rear seats												
Good-excellent	92.8/15.3	87.0/84.0	96.0/60.6	84.0/74.5	98.6/20.7	96.7/80.3	96.8/—	93.5/86.8	93.4/78.7	91.4/75.5	93.6/64.9	85.0/36.1
Average-poor	7.2/84.6	13.0/15.9	4.0/30.3	15.9/25.5	1.4/79.3	3.3/10.6	3.2/—	6.5/13.2	6.6/21.2	8.6/24.5	6.4/30.1	15.0/63.9
Specific likes												
Styling	42.2	36.3	66.1	34.8	75.2	24.8	66.8	53.5	26.3	61.6	48.2	14.8
Handling	57.4	28.2	35.4	49.2	38.9	57.0	54.3	42.0	51.6	31.0	56.8	44.9
Economy	27.0	19.7	—	52.8	37.6	70.1	71.3	21.0	69.9	29.1	56.8	83.7
Comfort/ride	18.1	76.9	57.8	43.5	27.0	49.4	39.6	49.3	26.3	68.0	69.8	17.9
Other	32.7	17.1	20.8	—	34.1	—	—	—	18.0	—	—	12.5
Dislikes												
None	20.4	31.4	43.2	28.7	26.5	30.2	29.5	34.0	22.1	28.4	11.4	31.9
Low mpg	18.9	9.5	—	13.0	6.2	10.5	9.2	19.7	11.1	10.2	—	14.2
Underpowered	7.1	—	—	—	5.7	—	15.9	—	—	10.7	—	8.7
Noisy	—	—	—	9.9	5.7	7.1	—	5.9	15.8	—	—	8.7
Other	15.4	16.4	46.8	—	—	6.1	5.2	5.5	17.8	—	13.7	5.5

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"I LOST 5 INCHES OFF MY WAIST & 5 INCHES OFF MY HIPS! I am amazed at the way Shrink-Wrap works. I'll recommend it to everyone!"

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"I LOST 9 POUNDS & 4 INCHES OFF MY WAIST IN 2 WEEKS! It's just unbelievable that it took so little time and effort to produce such amazing results!"

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A YEAR OF PM OWNERS REPORTS

(Continued from page 130)

of our owners scoring that aspect plainly *excellent*. The real sleeper in the comfort department, however, turned out to be the Ford Escort, which strolled away with the rear-



Ford Escort, April '81, page 98.

seat trophy. Enthusiasm ran high as 89.3 percent of the owners we surveyed gave the Escort's rear seats a rating of *good to excellent*. Note that this doesn't mean the Escort has the biggest or necessarily the most comfortable rear seating area; it's just that Escort owners voiced their satisfaction with greater numerical forcefulness than the others.

Front seats judged least comfortable belong to Chrysler's K-cars. Part of the problem here might have

been that the Dodge Aries and Plymouth Reliant have been widely advertised as six-passenger vehicles. Owners tend to find six a snug fit.



Dodge Aries, April '81, page 99.

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And the automobile that took the booby prize in rear-seat comfort was, without a doubt, AMC's Eagle SX/4. This converted Spirit never did have much rear legroom. However, owners did praise the Eagle's four-wheel drive, mentioning it not only as a primary buying good, but as one of the best liked attributes of the car. Here, we noted the sentiment was especially strong among drivers who live in the snowbelt states.

The least liked of all features turned out to be the Ford Granada's fuel mileage. Nearly 20 percent of the drivers we surveyed had expected better, particularly with the six-cylinder engine. The Six averaged nearly two mpg lower in our Owners Report than the V8. But the big disappointment came when Granada owners compared their own mileage with that projected by the EPA. The EPA said 23/34 mpg for the four-cylinder Granada. Our respondents barely squeezed out a 20.3/25.7 mpg, average city/highway. This really isn't unique to Ford. We found owners of lots of different makes of cars voicing similar disappointments. We've often said that the EPA needs to get a more realistic test procedure, or perhaps ask owners for feedback, the way we do.

The best liked and most highly praised individual attribute of any single car was the styling of the Datsun 280ZX. No other automobile we examined last year brought out so much spontaneous praise for sheer good looks or for anything else. It's a car that sells on the basis of its appearance, yet it never seems to disappoint after the newness wears off.

The purchase least likely to be repeated was the Renault 18i. Not that anyone had terrible things to say about the Renault. But apparently the sort of buyer who chose the 18i likes to shop around. Renault workmanship and comfort come in for a good measure of praise, with 80

percent rating overall quality good to excellent. Mechanical problems, though, did crop up, and not all AMC shops were yet set up to deal with them.

In each questionnaire, we asked respondents to list changes or improvements they'd like to see. Last year, a good number of people suggested adding a turbocharger to whatever car they happened to be driving. It appeared 1981 was the



Renault 18i, September '81, page 172.

year of the turbocharger. Front-wheel drive was roundly applauded wherever it appeared and was suggested for a number of cars that didn't have it. Five-speed manual transmissions proved to be another favorite suggestion.

Overall, imported cars drew higher general praise than domestics. But that's no real indication of relative merits. Because of the hundreds of cars available, we concentrated on only an even dozen. In defense of American engineering and workmanship, the Ford Escort and EXP, the Imperial, and in some respects, the Cadillac, Granada, Eagle, and the K-cars acquitted themselves



Ford EXP, December '81, page 94.

well. In 1982, we'll see how GM's J-cars and other U.S.-made automobiles compare.

Our Owners Reports fill a need that road tests can't, and vice-versa. We'll continue to bring you these Owners Report roundups annually, and in this way we'll compare and contrast the winners and losers among the newest and most noteworthy of American and imported cars. Among those upcoming in the near future: the DeLorean, Datsun 810 Maxima, Isuzu, five-liter Mustang, Lincoln Continental and the Toyota Celica dohc. It will be an interesting automotive year. **774**

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HINTS FROM READERS

Take your pick



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Stump friends with this lock which needs no key. It's a Master lock with bail tip removed, so it won't lock. The bail is held in locked position by a removable pin that looks like a rivet, but is a common nail with rounded head and trimmed shank. I used a No. 38 bit to bore a hole for the dummy pin $\frac{1}{16}$ in. from the top of the lock back, centered on the bail, almost through the lock front.

—Harry Loudon

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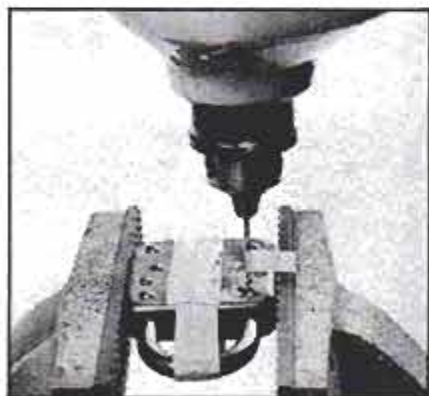
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To modify the lock, file or grind off the ball at the notch, so it won't stay locked when it's pushed in.



Tape the ball so it's almost bottoming; bore a hole through the lock back and bail. Tape flag serves as depth gauge.



Battle cruiser *Edinburgh* on convoy escort duty before her sinking in 1942. Hit first by German U-boats, then—a day later—by destroyers, she was eventually sent to the

bottom by a British torpedo. This was primarily to keep Russian gold bullion on board the crippled ship, destined for the United States, from the enemy.

HIGH-TECH TREASURE DIVERS (Continued from page 84)

the Barents Sea. A dozen divers spent as many as 40 days pressurized to a depth of 720 feet, in a successful attempt to recover gold bullion that had gone to the bottom with the warship. The ship was carrying gold bars as payment for U.S. arms sold to Russia in World War II. Some 431 of the reported 465 bars on board were recovered, worth about \$90 million.

In saturation diving, the diver is pressurized gradually to his working depth, where his body will "stay"—remain under pressure—for the duration of the dive, which may be as long as several weeks. Each diver is subjected to the maximum amount of inert gases that the body's tissues can absorb at that depth, creating a condition of equilibrium. Effectively, this means that divers can live and work at a given depth (pressure) indefinitely, without accruing incremental decompression time at the dive's conclusion in order to return to normal atmospheric pressure.

Common to both long-duration (saturation) and short-duration (bounce) diving is the problem of decompression. Normal air consists of about 80 percent nitrogen and 20 percent oxygen. Some of these gases are present in solution in a person's blood and tissues at all times, depending on the atmospheric pressure on the body. When a diver submerges, the pressure forces more of the gas in his body into solution; as he surfaces, the process is reversed.

If the pressure is reduced rapidly, the gases leave solution in the form of bubbles. The wide variety of disorders caused by bubble formation are known collectively as the "bends." It is to avoid this condition that divers are brought to the surface slowly.

A principal advantage of saturation over bounce diving is that in the former, decompression is saved for the end of the mission, instead of having to do it after extremely short

durations at bottom depth. Saturation divers remain at about the same pressure as that of the working depth and periodically are brought to the surface by a bell—always under pressure.

The *Doria* dive

The *Andrea Doria* sank on July 26, 1956, after a collision with the ship *Stockholm* some 50 miles south of Nantucket Island, Mass. It lay essentially undisturbed, despite several attempts to salvage her cache of passengers' valuables, until last August.

A professional diving contracting firm, Houston's Oceanering International, used heavy-duty commercial equipment made for work in one of the world's harshest weather areas—the North Sea—to successfully recover the ship's safe. Treasure-hunter Peter Gimbel hired Oceanering. Home base for the operation was the converted North Sea-type supply boat *Sea Level II*, leased from Sea Level International in Lafayette, La. The 190-foot vessel is designed to accommodate 16 persons in comfort, but in configuration for this mission, she carried 32 persons, an abundance of camera gear (a TV documentary of the recovery operation was being filmed) and 250 tons of diving equipment.

The *Sea Level II* carried a 1,000-foot rated saturation diving system. The deck decompression chamber included an entry or emergency lock, and an 8-foot diameter sphere with toilet and shower. It was mated to an 8-foot spherical Wilson diving bell. There were a maximum of seven divers at a time in the living chamber, according to Oceanering dive supervisor Steve Jennings.

The bottom breathing mix was 90 percent helium and 10 percent oxygen. Of some 273,000 cu. ft. of breathing gases brought along for the occasion, 250,000 cu. ft. were consumed, according to Jennings. The cost of

(Please turn to page 136)

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HIGH-TECH TREASURE DIVERS (Continued from page 135)

the breathing gas alone was \$50,000. Jennings reported that the Oceaneering divers remained at the saturation depth from August 3 to September 2. The Gimbel cameramen/divers rotated into and out of saturation at about 10 days to two weeks each. Though the saturation depth was 160 feet, the actual depth of the ship was 240 feet—this depth reached by "excursions" from the saturation holding depth.

The steel safe, weighing over two tons, was discovered by Oceaneering diver Drew Ruddy. It was moved laterally to the access hole, rigged for hoisting to the surface, and hauled aboard using an air winch. Other interesting items that came to light during the recovery included china plates and a heavy glass door, with brass corners.

The oft-forbidding weather off Cape Cod lived up to its reputation as fog, heavy seas and high winds assailed the support ship. Nevertheless, the bell was over the side of the *Sea Level II* an average of six to 18 hours per day. At a cost per day of \$25,000, the more time that could be spent on the bottom, the happier film-maker Pete Gimbel, Oceaneering's customer, seemed to be.

Deepest treasure dive

The *Edinburgh* project is the deepest manned salvage operation to date. A West German-built saturation diving system was used, including a three-man bell, two deck decompression chambers (DDC), and a pressure transfer chamber. Wharton Williams's managing director, Malcolm Williams, told PM that eight days' decompression time was required to return the divers to normal pressure after the mission.

At five minutes past midnight on the morning of September 2, a gradual pressurization of divers began. For three of the 12, saturation would be their mode of living for over 40

days. Within 41 hours, the pressure inside the deck chamber had reached the saturation holding depth of 750 feet, the pressure at which the divers planned to remain for the duration of the mission, making excursion dives from that depth to the *Edinburgh's* site at 803 feet.

On September 4, the first dive was made to the vicinity of the wreck. The groundwork had been laid five months earlier by a videotaped survey of the wreck site by Wharton Williams's remotely-operated reconnaissance vehicle *Scorpio*—made by the U.S. manufacturer Ametek-Straza. The orientation of the vessel was clear from the tapes: It was lying nearly horizontal, port side down, with a torpedo hole visible in its upturned starboard side. The torpedo hole was located some 15 feet forward of the spot known, by consulting ship's plans, to contain the ship's bullion room. To the distress of all concerned—particularly the divers—this room proved also to contain live bombs and other still-dangerous munitions.

The bullion room is located slightly off-center, closer to the more accessible starboard side of the *Edinburgh*, with its deck some 25 feet from the ship's bilge keel. To make matters more exciting, a fuel tank was located between the outside of the ship and the bullion room. Because the torpedo hole was too far forward to be of any help in making an access hole close to the bullion room, the decision was made to cut a fresh hole into the ship's side directly above the bullion room, separated from it only by the fuel tank. The tank was empty of fuel, but was littered with a huge compressor and other heavy machinery from the collapsed deck above.

Divers worked in eight-hour shifts, virtually around the clock, to cut the approximately 6 by 8-foot hole in the ship's steel hull plates,



Surface support vessel *Stephaniturm* on station in Barents Sea over the *Edinburgh* divers.

which were over 1/2-inch thick. An oxy-arc cutting torch was used, with a 200-mm supply cable (double the usual thickness) to combat potential current loss over the 800-foot length of cable run to the work site.

It took approximately two days to cut the hole in the ship's side. The operation was slowed by the fact that ship's frames lying behind the hole had to be removed.

By the end of the 13th day, the fuel tank had been traversed and a hole had been cut in the bullion room's bulkhead. Fortunately, due to the collapse of an overhead area of the surrounding part of the ship, there was a nearly two-foot gap between the bullion room's bulkhead and ceiling. That permitted the divers to feel



At left, film maker Peter Gimbel and companion, actress Elga Andersen, show off china rescued from *Andrea Doria*. Wilson diving bell was supplied by Oceaneering International. (Photos by Mark Schreyer.)

by hand whether there were any obstructions or live munitions leaning against the bulkhead before they cut through it.

Once inside the bullion room, a space measuring roughly 15 by 20 feet, a big cleanup job awaited the divers. There was a mixture of silt, fuel oil in suspension and piles of rubbish that had to be removed.

Although the first gold bar was located on September 16, one day after the bullion room was entered, it took 17 days to remove munitions and other material that hampered recovery operations. The ordnance ranged from small arms ammunition to seaplane bombs, along with 25 trolleys used for moving the heavy bombs.

But, finally, the goal was reached. Rotting wooden boxes were discovered, each containing five gold bars—each box worth at least \$1 million. The boxes crumbled when moved, so the bars had to be brought to the surface by a wire basket.

At times, the hole through the side of the ship became rather congested,

(Please turn to page 138)

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HIGH-TECH DIVERS

(Continued from page 137)

Williams told PM by telephone from his headquarters in Scotland. Going simultaneously through it were the diver's umbilical (connecting him to the diving bell), cables for lighting, TV and lifting and a water-lift hose to move the silt.

The diver's umbilical, while neutrally buoyant, contained a bundle of five components taped around a central core strength member. They included the gas hose (supplying the breathing mix of 97 percent helium and 3 percent oxygen), return line in an unusual recovery system of reusing exhaled diver gases, communications cable and hot water hose. Ambient temperature at depth was 37.4° F., but the hot water pumped into divers' suits kept their core temperatures precisely 98.6° F.

From commencement of pressurization to exit of the last diver from decompression, the mission took 41 days, six hours, 54 minutes.

Dividing the loot

Of the total value of gold recovered, 45 percent will be split by Wharton Williams and its partners and Jessop Marine Recoveries Ltd., owned by Keith Jessop, 48-year-old former diving supervisor, who found the wreck. The rest will be divided between the British and Russian governments. The United States, as it filed insurance claims and was paid for the loss, receives nothing.

The components of the Drägerwerk saturation diving system, including the saturation diving chamber (SDC) or bell, transfer pressure chamber, and two deck decompression chambers (DDC) were essential to the salvage of the gold. Its bell accommodates a maximum of three divers; it is designed for work to 1,313 feet. Total weight is 17,637 pounds, of which half is ballast weight that can be jettisoned. It is equipped with a side connection for mating to the pressure transfer chamber and a lower door for diver exit and entry. It has seven ports for visibility, and therefore can be used strictly as an observation tool, if desired. Diameter is 6 feet and height is over 7 feet. According to Drägerwerk, headquartered in Lubeck, West Germany, an emergency power supply could keep diver life-support systems functioning for a period, even if the umbilical were severed.

Also, in the event of an emergency, a four-man decompression chamber can be detached from the other chambers and lowered into the sea within a few minutes to act as an escape vehicle, or hyperbaric (high-

pressure) lifeboat for divers under pressure. Power and life support aboard the chamber are sufficient for the entire diving crew to survive at least 24 hours, according to Drägerwerk.

Future recovery operations

As useful as saturation diving may be for the specific requirements of the two salvage dives detailed here (where a great deal of fast judgment was called for when certain unexpected events occurred), the offshore oil industry relies increasingly heavily on robotic, surface-controlled vehicles for the more repetitive and predictable tasks.

Shipwrecks are among the most dangerous work sites for either divers or vehicles, with unpredictable currents always a threat to cut or entangle a life support or power umbilical. For this reason, it appears that most salvage work for recovery of sunken treasure will be accomplished by divers, working to depths of up to 2,000 feet. There is a divergence of medical opinion on the long-term physiological and neurological effects on divers working at the extremes of these depths. The deepest commercial working dive so far has been far short of 2,000 feet.

At the present time, the community of industrial undersea vehicles offers none with capabilities of doing useful work to depths like the 14,107 feet that the *Titanic* is reported to inhabit. Two U.S. Navy vehicles, the submarine *Trieste II* and submersible *Sea Cliff* (undergoing refit to extend depth capability), could get to that depth. But it is doubtful that the Navy would underwrite a commercial use for the vehicles.

Another submarine, the Reynolds six-person *Aluminant*, might be brought to bear as an observation and work platform in the region of the *Titanic's* depth, if it is incontrovertibly discovered to be at no greater than 15,000 feet. The *Aluminant*, built in 1964, has not dived since 1969, and would require overhaul. It has reportedly never dived deeper than 6,250 feet.

So, it appears for the moment that in the case of very deep wrecks such as the *Titanic* and others beyond 2,000 feet, visual inspection and video recording will be the extent of man's intrusion into the realm of sunken treasure.

Yet, there are already some new stirrings in that area, since one company is designing its own vehicle to go beyond *Titanic* depth for use in deep ocean mineral recovery. The salvage of *Titanic* may be some years away, but it is no longer considered impossible.

THE '82 FIREBIRD AND CAMARO

(Continued from page 99)

I found out in my first 60 seconds behind the wheel of the new '82 Camaro. The following week, I discovered that Pontiac's version of GM's new F-bodies—the Firebird—works equally as well, both in flat-out cornering and in tire-shredding acceleration runs.

The Popular Mechanics automotive staff spent three days at Mesa, with almost an entire day devoted to thoroughly wringing out the new Camaros in all their different versions. The following week, we journeyed on to the Laguna Seca race course in Monterey, Calif., to spend equal time with the new Pontiac Firebirds.

Ultimate in handling

We can tell you categorically that these cars are nothing short of phenomenal in cornering power and overall handling—possibly the ultimate-handling American cars in their Z28 and Trans Am versions. And the standard suspension setups allow the other new Camaros and Firebirds to acquit themselves surprisingly well, too.

For the guy who wants a little more handling on the street, but not the all-out Z28 and Trans Am versions of the car, there is an intermediate-handling suspension package available which incorporates larger front stabilizer bars, a rear bar, wider 14-inch wheels and tires, quicker steering, slightly stiffer spring rates and slightly harder shock absorbers.

Straightline performance, though strong enough to smoke rear tires at will, won't get you the top eliminator trophy at your local drag strip. That honor still goes to the '82 Mustang GT 302HO. The acceleration of these cars is deceptive. All feel pretty quick off the mark. But even the most powerful versions won't break nine seconds in 0-to-60-mph runs. That's the benchmark for a really quick car. Although we can't tell you now how much quicker the Mustang is than either the Camaro or Firebird, we will be able to next month. We're planning a smoky burnout road test of Detroit's new hot rods for our March issue. Look for it.

Meanwhile, on a handling course, the new F-cars will blow off just about anything else made. In fact, both Chevy and Pontiac engineers made a big thing about skidpad numbers and how much better the Camaro and Firebird were than, say, a Ferrari 308GTB or a Porsche 924.

While the chassis components

(Please turn to page 140)



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THE '82 FIREBIRD AND CAMARO

(Continued from page 139)

themselves are relatively common, it's the combination of rates that make these cars work so well. The front suspension is your run-of-the-mill MacPherson strut with a lower control arm. You'll also find a stabilizer bar and a separate coil spring between the control arm, and a rigid structural cross member.

The conventional solid axle in the rear is supported by coil springs and located by trailing arms, a lateral track bar and a fore-aft torque tube. The torque tube should control all wheelhop on hard acceleration. But one of the stick-shift Camaros at Mesa exhibited massive wheel hop when we dropped the clutch hard at 4,000 rpm. Automatic-transmission cars just squatted and went with no trace of axle hop at all. Later, one of the Chevrolet engineers told us that some rear suspension bushings had worked loose on that particular car.

Key to the Porsche-like handling of these cars is their extra-strong body structure, front struts, spindles and other components, which eliminate nearly all unwanted flex, and let the suspensions work as intended to keep the tires firmly planted on the road. Yet, the ride quality of all three suspension levels is much better than that of the more stiffly sprung previous-generation cars.

In a reversal of past practice, Camaro chassis-development engineers have leaned more toward ultimate cornering with their Z28 package; the Firebird designers have achieved a more supple ride/handling compromise from their optional WS6 suspension combination. Both divisions use superfast 12.7 to 1 steering and 195/60R15 Goodyear Eagle GT tires on 15x7 aluminum wheels to complete these flat-cornering, road-hugging ultimate driving packages.

Similar, yet different

Though the all-new unit-body platform, power trains and some body parts (doors, roof panels, windshield, rear hatch) are shared, the two competing studios enjoyed the luxury of near-total design freedom in exterior body shapes and details.

The Camaro, for example, has recessed dual rectangular headlamps flanking a central grille theme, while the Firebird sports hidden single lamps that pop out of narrow eyebrow slots over dual air intakes. The Camaro's front fenders rise into a smooth wedge that continues over the door's upper surface

to a flat sail panel, while the Firebird's fenders and beltline trace a subtle S-shape front to rear. The Camaro Z28 has its own look, with special body components used to give it a race-car image. The Trans Am's bright colors are set off by flat black accents. The Camaro rear spoiler is a smallish, integral decklid lip, the Firebird's a free-standing wing.

Obviously, a great deal of aerodynamic tuning went into these cars to make them slide easily through the air. Chevy claims an outstanding drag coefficient (Cd) for the Camaro of .368, as measured in GM Design Staff's new Tech Center wind tunnel at the EPA-required ride height and attitude. But with its lower nose and aerodynamically flush, flat "turbo" wheel covers, the Trans Am's Cd is a slightly slicker .323, according to Pontiac.

One interesting styling feature is the large, compound curved, all-glass hatchback, which is quite an engineering and manufacturing trick for the glass companies. Heaven help you if you have to pay to have it replaced. It's supported by gas struts and kept clean by an electric defogger and a rear washer/wiper (both optional). Under the hatchback is a carpeted cargo area for some 30 cu. ft. of luggage with the rear seat folded down. Removable T-roof hatches remain an option.

Aircraft-like look

Inside, both cars have a high-tech aircraft appearance with serious-looking gauges and switches in blacked-out instrument panels. A full-width upper panel pad, also black, helps keep reflections out of the steeply raked (62°) windshield. A wide standard console divides the cockpit from dash to rear footwell and houses radio and climate controls in its upper portion, and accessory switches on its horizontal surface. Unfortunately, the only interior storage room is in a console bin between the seats.

All but the basic cars have a full complement of gauges, the Camaro's grouped between large, round speedometer and tach faces, the Firebird's extending horizontally halfway across the dash. Exclusive to the Camaro are a double-ended speedometer needle (mph on one end, kph on the other), and a pair of protruding switch pods.

Standard seats in both cars are comfortably contoured reclining buckets with good lateral support and a full 7.5 inches of fore-aft adjustment to accommodate long and short people equally well. Camaro Berlinetta and Firebird S/E have

specific luxury buckets, the latter available in leather. The Camaro Z28 features a very special "Contour" superseat for the driver with adjustable backrest bolster, thigh support, cushion bolster, lumbar support and recliner.

A real treat

Not surprisingly, these new F-cars are even more of a treat to drive than the near-legendary Camaros and Firebirds they replace. The standard 90-hp, 2.5-liter, electronic fuel-injected Four delivers sluggish 14.5-second 0-to-60 performance and 24 mpg city, 35 highway EPA ratings with the four-speed manual transmission without airconditioning. A pleasantly raspy exhaust note adds to the fun.

The 2.8-liter, two-barrel V6 (a 102-hp longitudinal version of the X-car's 60° unit), standard in Berlinetta and S/E, gives 13.3-second performance with four-speed transmission, but less fuel economy at 20 mpg EPA city, 30 highway.

Standard in Z28 and Trans Am and optional in Berlinetta and S/E is a 140-hp, 5.0-liter, four-barrel V8 with four-speed manual, which is good for 10-second 0-to-60s and 16 mpg EPA city, 25 highway. Ultimate F-car performance (under 10 seconds 0 to 60) is provided by an optional 165-hp, high-compression (9.5 to 1) version of the 5.0-liter V8 with dual throttle-body fuel injectors on a unique crossfire intake manifold. Available only with three-speed automatic transmission for the time being, its EPA estimates are 15 city, 24 highway.

Several final-drive ratios are available so you can tailor your car for acceleration or higher mpg. If nine-second 0-to-60s still aren't quick enough, you'll have to buy a 302HO Mustang or wait until next year, when the Camaro gets the Corvette's 350 twin, fuel-injected V8 engine. That, sports fans, will be a quick piece of machinery.

Macho motoring

These GM F-cars certainly aren't perfect. They're still big and heavy compared with, say, a Volkswagen Rabbit. But they're still 500 pounds lighter and seven inches shorter than the cars they replace. And they'll eat Rabbits for breakfast, lunch, and dinner. Which is their rationale for being. If you want economy and utility, look elsewhere. On the other hand, if you want heart-stopping handling, enough power to spin the rear wheels at will, and looks that will stop nubile young things in their tracks, look no further.

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HI-FI CARTRIDGE TEST

(Continued from page 80)

coloration to the sound. Some cartridges sound bright and brilliant, others more mellow. Speakers and cartridges are alike in this respect—and for the same reason: Both are so-called transducers.

Transducers are middlemen between separate provinces of nature—the mechanical and the electrical. Whereas the speaker transduces electrical energy into mechanical motion, the cartridge does the opposite: It changes the mechanical motion of the stylus into electrical energy. This translates the musical waveforms, molded into the record

groove, into corresponding variations of electrical voltage. The accuracy of this translation determines the fidelity of the reproduced sound.

There are four different ways of generating the signal in a high-fidelity cartridge. They are: 1. moving magnet; 2. moving coil; 3. moving iron; and 4. electret. Think of the cartridge as a miniature power plant, generating a voltage through the motion of magnets and coils. In a moving-magnet design, the magnet is linked to the moving stylus and wiggles inside a coil. In a moving-coil design, it's exactly the other way around: the coil wiggles while the magnet stays out.

In moving-iron cartridges, a tiny iron piece, attached to the stylus, moves between two magnet poles. This changes the magnetic flux—and hence the electric signal—in keeping with the musical waveform.

Finally, at least one maverick manufacturer uses a so-called electret. This is a small slab of a semiconductor substance that emits an electric charge when twisted by the stylus motion, thereby generating the audio signal. One aim of PM's test was to determine if there were any audible differences among these four cartridge types.

We picked nine cartridges that

(Please turn to page 144)

How PM tests hi-fi cartridges

Using a series of special test records provided by CBS Laboratories, each cartridge was tracked at the midpoint of the recommended range of tracking pressures specified by the manufacturer. In each case, the following performance factors were measured using state-of-the-art equipment: 1. Stereo channel balance. This is the maximum deviation of one stereo channel from the other, measured over the entire frequency range, expressed in decibels (dB). 2. Output voltage, measured in millivolts from a standard reference groove. 3. Channel separation, measured in decibels at a mid-frequency point of 1 kHz. 4. Harmonic distortion, expressed as a percentage of total output. Both second and third harmonics were measured.

We also conducted tests to show the relative transient response of each cartridge. This measures how well a cartridge responds to sudden sounds, such as drumbeats, cymbal crashes or pistol shots. These results were derived from oscilloscope traces, which were rated either good (G) or very good (VG). We didn't find any bad ones in our sampling.

Finally, we measured frequency response over the entire audible spectrum—from dips to peaks—including any other major deviations that would produce harsh and ragged sound. There were slight differences in response level at the uppermost highs above 12,000 Hz, which also showed up in the listening tests. These are discussed in the listening evaluations.

HI-FI CARTRIDGES—TEST RESULTS

	Type	Channel balance*	Output voltage†	1 kHz L/R separation	Distortion HD ² , HD ³	Transient response	List price
AKG P10ED/L	moving iron	3 dB	4.2 mV	21/27 dB	1.3/2%	VG	\$115
Audio-Technica AT 30E	moving coil	0.5 dB	5.0 mV	22/22 dB	1.4/25%	VG	\$125
Bang & Olufsen MMC 10E-C	moving iron	1.3 dB	2.7 mV	22/26 dB	.9/14%	G	\$55
Empire 200E	moving iron	1.0 dB	5.8 mV	21/31 dB	1.3/1%	VG	\$60
Micro-Acoustics 100-e	electret	1.7 dB	4.1 mV	24/26 dB	.8/3%	VG	\$99
Pickering V-15 Micro IV	moving magnet	1.0 dB	5.0 mV	22/26 dB	1.3/05%	VG	\$65
Shure M75HE	moving magnet	1.3 dB	6.4 mV	20/27 dB	.8/00%	G	\$92
Shure M95HE	moving magnet	1.0 dB	5.4 mV	20/20 dB	2.2/05%	G	\$112
Stanton 680EE	moving iron	1.0 dB	3.6 mV	22/28 dB	.8/12%	G	\$106

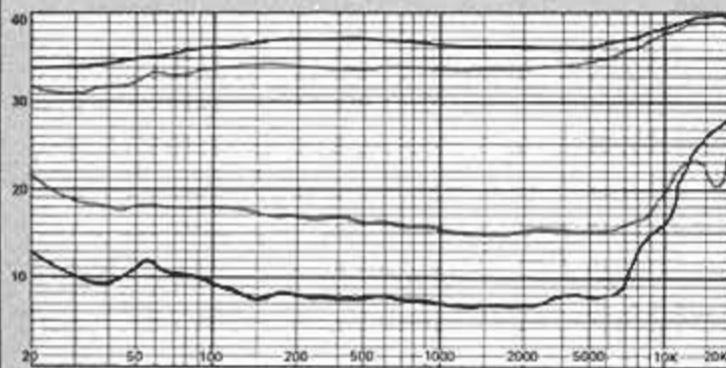
*Worst case: 20 to 15 kHz. †Standard reference: 3.54 mV.

The numerical data are summarized in our table. To interpret these figures, keep in mind that variations in output voltage have no effect on sound quality. A cartridge with high output, however, requires less amplifier gain to reach a given volume. Consequently, you don't have to turn up the volume control very much to get loud sounds and are, therefore, less likely to get hum.

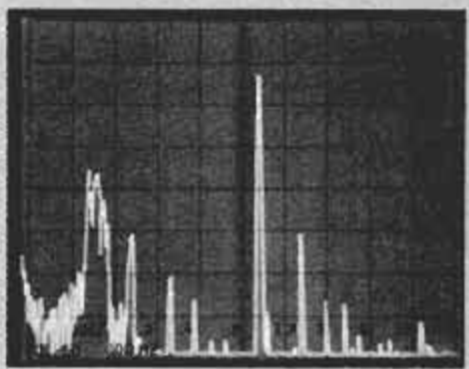
As for channel separation, 20 dB is usually considered sufficient. All the cartridges we tested reached or surpassed that figure. In the case of channel balance, the less deviation the better. The AKG cartridge proved

clearly inferior in this respect, although it was excellent in all others. When we told the company that we measured as much as 3-dB difference between the outputs of left and right channels, a spokesman said that the sample must be defective. Unfortunately, we couldn't repeat the test with another sample before press time.

As for distortion measurements, the lower figures are naturally preferable. However, within the measured range of 0.2- to 2.2-percent second harmonic distortion, the statistical difference was not noticeable to the ear.



The strip chart (left) shows frequency response of cartridges. Top and bottom pairs of traces show response and crosstalk (in decibels) of two stereo channels. A spectrum analyzer at right shows cartridge output level from 0 to 20,000 Hz.





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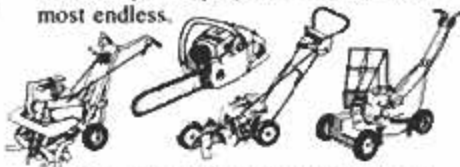
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Because the small engine industry has grown so quickly, an acute shortage of qualified Small Engine Professionals exists throughout the country. In fact, it's not unusual for a good small engine man to be three to four weeks behind in the summer and at least a week behind in the winter. 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 \$17.50 for a simple tune-up that takes less than an hour!

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PM'S TEST OF 9 NEW HI-FI CARTRIDGES (Continued from page 142)

retail for \$60 to \$125 (many of these are available for much less). In our experience, cartridge quality rises roughly in proportion to price, up to about \$125. Beyond that point, improvement is slight—and usually very expensive.

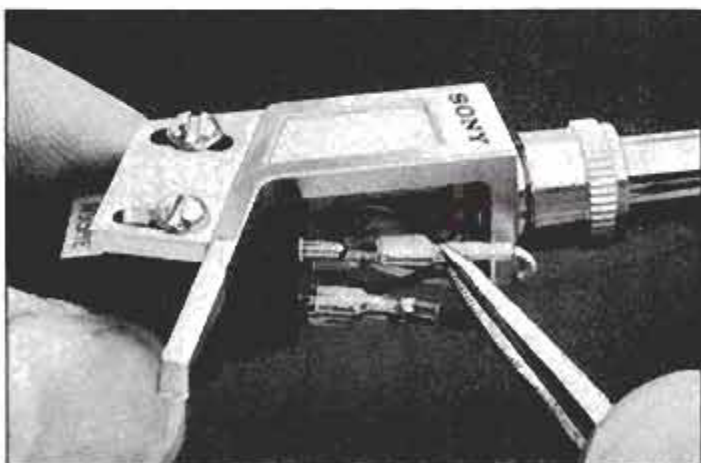
For our listening tests, we used a Dual 607 turntable, which is typical of the equipment found in good home-stereo systems. Our amplifier was a Sansui Model AY-D11, with a spectacular distortion rating of just 0.005. A pair of Bose 901 Series IV speakers rounded out our equipment.

We listened to each cartridge play-

Olufsen was exactly the opposite—warm and mellow, with plenty of bottom, but every sonic detail well defined.

Both Shure models sounded superb, combining silk-smooth highs with a solid mid-range and good bass impact. We heard heavy orchestrations with astounding clarity, and a nice, gutsy feeling from the plucked strings of the Spanish guitar came through without any false, metallic plink.

Oddly enough, the M75HE measured even better in the uppermost range than the more expensive M95HE, though the ear could detect



When changing hi-fi cartridges, be very careful! The wires should be connected and disconnected with a tweezers. Grasp the lead by the metal, sliding connection—never by the wire itself. And be sure that you follow the color codes as given in the instructions for your turntable and your cartridge.

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ing different kinds of music, ranging from massive symphonic scores to the detailed, subtle sounds of a string quartet, and from soft vocals to hard rock.

To our surprise, the differences in sound showed no correlation to the differences in design principles. Our tests revealed no basic advantage of moving-coil cartridges over moving-magnet types, or of moving iron or electret as compared to any of the others. What we learned is that—within the limits of our sample—the tonal character of a cartridge is a function of its individual design, not of its operating principle.

On the whole, the nine cartridges we tested were more notable for their similarities than for their differences. They all sounded remarkably clear and transparent. This isn't surprising, since their response in the vital part of the frequency range (from about 100 to 12,000 Hz) is very similar and substantially flat (see *How PM Tests Hi-fi Cartridges*, page 142). Above and below that range, there are response differences that give each cartridge its particular tonal flavor.

For example, the Micro-Acoustics was notably bright and brilliant and a little weak in the bass. The Bang &

virtually no difference between the two.

The Audio-Technica and Empire sounded so similar that we couldn't tell them apart. Both were clear, smooth, and pleasantly bright, but the lows were unmistakably present.

Stanton's entry had plenty of "presence." It puts the sound right out front. As one listener observed, "It makes the musicians jump out of the speaker"—fine for rock and pop, but a bit flashy for symphonic music. Though the Pickering cartridge is made by the same company, it seemed a little more subdued in the highs, its balance better suited for all kinds of music.

As for the AKG, it was most notable for its superbly defined transients. This helped us tell the instruments apart and made the sound texture strikingly transparent. This kind of clarity benefits all kinds of music, making it lively and real. But rock fans may find the AKG a bit cool in character, since it lacks oomph at the bottom.

Here, then, is the cream of the mid-price cartridge crop. Despite the small differences described here, they all deserve high marks. We'd be happy to live with any of them. **PM**

TECH LINES

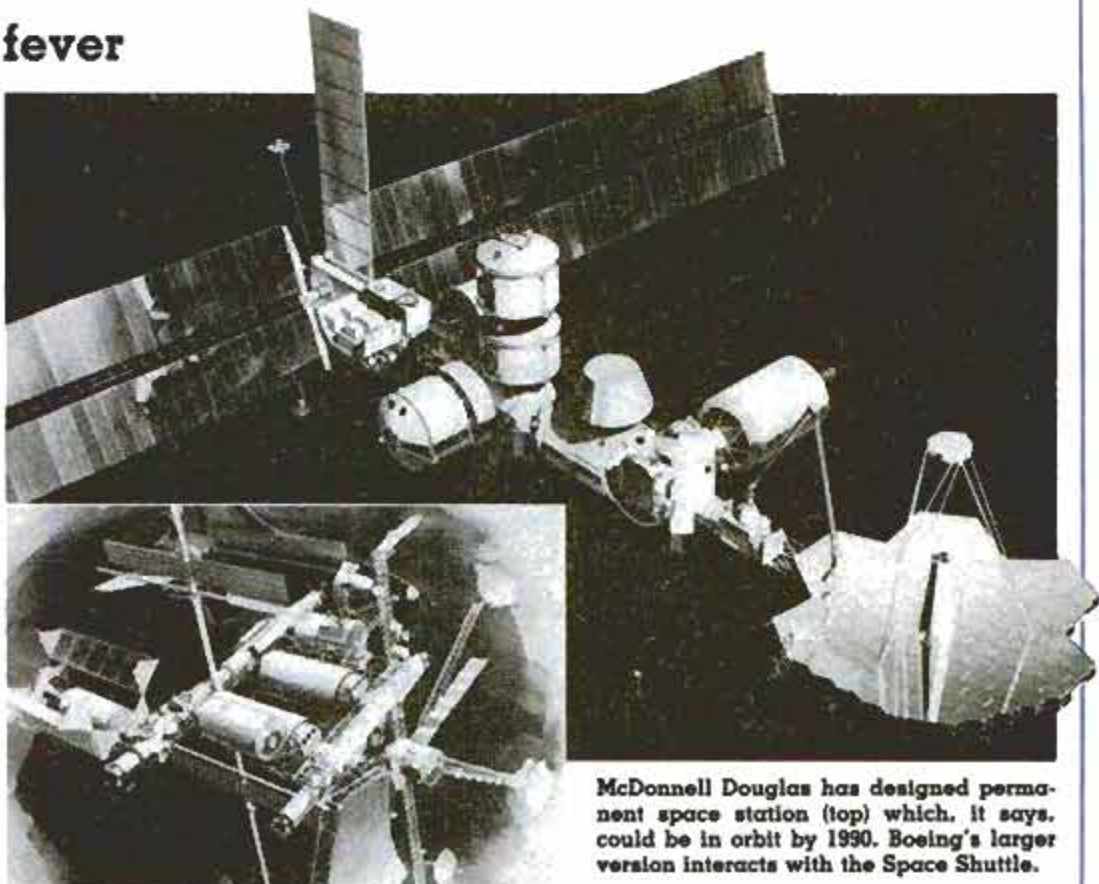
Space-station fever

Aerospace

Even though there are a number of questions to be answered over the course of the ongoing Space Shuttle program, NASA's contractors—especially McDonnell Douglas and Boeing—are already selling the idea of a permanent, manned orbital station.

McDonnell Douglas's studies promote the simpler version (above, at right) of a manned station, which, the company claims, could be in place by the end of this decade. Boeing's more elaborate concept would test, among other things, the interaction of the Space Shuttle with the platform—the effect of its docked mass on the center of gravity, and use of its external tank for spacecraft storage.

Between four and eight men would crew the platforms. McDonnell Douglas has provisions for an emer-



McDonnell Douglas has designed permanent space station (top) which, it says, could be in orbit by 1990. Boeing's larger version interacts with the Space Shuttle.

gency re-entry pod (lifeboat) in its study. Boeing's design could assemble and move heavy payloads to other orbits.

Testing of systems for the manufacture of pharmaceuticals, electronic crystal and metallurgical products is cited as a prime

factor by both companies. Military applications are doubtless a consideration, if not headliners in the publicity releases.

Automotive

Future dash is here

In *The Computerized Car of Tomorrow* (page 144, May '81) PM conjured up what we thought was some very advanced dashboard instrumentation. On a recent trip to Unterturkheim, headquarters of Mercedes-Benz, we saw how quickly that dashboard is becoming reality. MB has an operational, high-tech dash on its advanced product-research vehicle.

Conventional instruments on the central pod have been replaced by four tiny display screens. Besides calling up information on engine functions, fluid-level warnings and failure indications, you can program a route anywhere in Germany and an

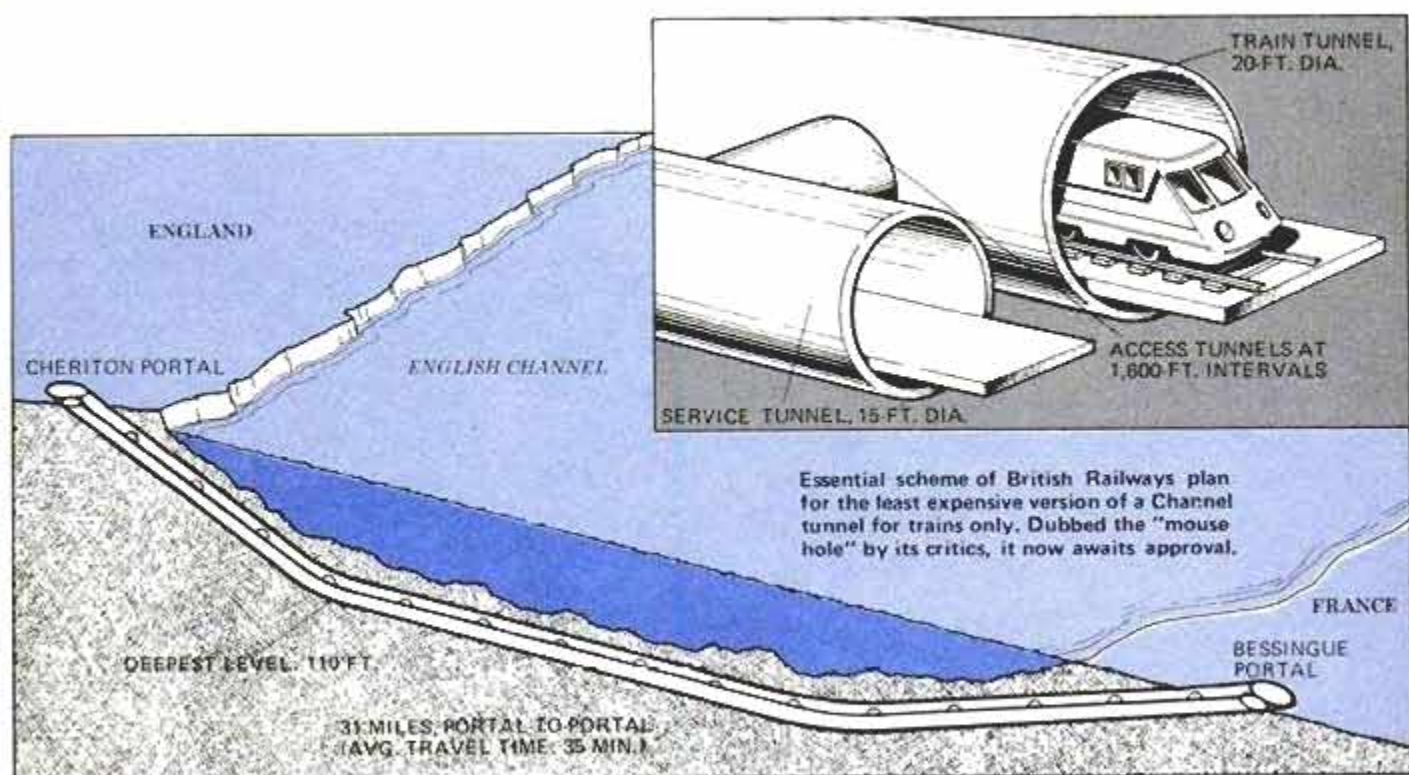


on-board computer will plot the quickest course. (Every major German roadway, entrance and exit is

stored in the computer.) The dash will also predict your travel time and alert you to traffic, weather and construction delays. This is possible because Germany has a radio network which broadcasts only traffic data. The on-board receiver processes this and alerts you to delays.



MB's new dashboard has four information panels operated through a keyboard on steering wheel. In addition to monitoring the engine, it supplies navigational data.



Essential scheme of British Railways plan for the least expensive version of a Channel tunnel for trains only. Dubbed the "mouse hole" by its critics, it now awaits approval.

Engineering

Channel tunnel, again

Sometime early this year, British Transport Minister David Howell has indicated he will approve construction of a tunnel beneath the English Channel to link England and France.

You say you've heard all this before? Maybe you have. The dream of a Channel tunnel is said to have originated with Napoleon. A tunnel was actually started in the 1840s, but the British military, still fearing Napoleon, forced its abandonment. They were worried that an invading force would troop through, disguised as tourists. In 1974, with great fanfare, Britain and France started construction of a "rolling motorway" to transport cars and trucks under the Channel on double-decked rail flatcars. To the ire of the French, the British pulled out after 300 meters had been completed. Escalating costs, labor protests about possible loss of seamen's jobs and environmentalist outcry that new highways and rail lines would savage the pastoral landscape prompted the withdrawal.

Since then, Britain has become even more closely tied to the European Common Market; traffic on existing ferries and hovercraft has more

than doubled in the past decade. Accordingly, seven proposals have been made for a "cross-Channel link": Howell will choose among them. Most are far more daring and dramatic than the stripped-down, economy-style tunnel expected to receive approval. Two construction consortia have suggested road bridges across the 21-mile-wide waterway, one of them utilizing unprecedented two-mile single spans.

British Steel Corp. has proposed a combination bridge and tunnel. This would require construction of two artificial islands, five miles off either shore, to be linked to France and Britain by bridge and joined to each other by a 12-mile undersea tunnel. The project is estimated to cost six times as much as a tunnel.

"Why try something new when a tunnel has been thoroughly tested?" asks David Williams, project coordinator for the front-running project, advanced by the British Railways Board. This proposal is regarded as simple, uncomplicated and cheap: It calls for a one-way, single-bore, rail-only tunnel without passing places, a mere 6.0 meters (about 20 feet) in diameter—just barely large enough to accommodate current railway rolling stock. Critics call it a "mouse hole." The tunnel would begin at Cheriton, near Folkestone, behind the famous white-chalk cliffs of Dover, and emerge near Bessingue,

near Calais. Total length would be 30.6 miles, 23.2 under the sea. The tunnel would begin with a steep gradient on the British side, dip to a maximum of 110 feet beneath the sea bed, then rise gradually to the level of the less precipitous French shore.

Both freight and passenger trains would travel through the tunnel in convoy—10 in succession in each direction, followed by 10 in the opposite direction. Multiple-aspect signals spaced a kilometer apart would allow the trains to operate on two minutes' headway at a continuous speed of 120 mph. A mandatory stop system would halt traffic in the event of a breakdown. The trains would be pulled by dual-voltage locomotives, which could switch from the 25,000-volt-a.c. overhead-catenary system used in Britain to the French 750-volt-d.c. hookup. The continuously welded track would accommodate existing freight and passenger cars, although Brit-Rail has already begun design on new luxury passenger cars.

The main tunnel would be flanked by a parallel, 4.5-meter (about 15-foot) service tunnel, connected to the main tunnel at 500-meter (1,640-foot) intervals. The service tunnel would allow for maintenance and provide an escape route in event of breakdown. Negative-pressure doors on each passageway would seal off the

parallel tunnels from each other.

If governmental formalities proceed on schedule, rotary boring machines could be churning through the chalky sea bed by the end of 1983. Utilizing the latest technology, the boring machine will follow a laser beam, projected ahead to keep the tunnel on line and level and to investigate the texture of the rock ahead.

Probably no bit of real estate on earth has undergone so many test borings. More than 60 samples from the 1970s project have given engineers nearly a foot-by-foot picture of the sea bed. "The chalk is almost ideal tunneling material," one of the engineers says. "It's like going through a bit of cheese." The chalk is solid enough, however, that no supports will be needed. In fact, the unsupported 1840s Beaumont Tunnel is still intact (filled with surface runoff, not with seepage from the sea).

Working from either side, British

and French should link up in seven years. As each section is dug, a pre-fabricated concrete liner will be moved into place.

Why build such a small tunnel when cross-Channel traffic is increasing so rapidly? That question was also asked last year by a select committee of the British House of Commons. They voted for a 7.8-meter, one-way rail tunnel, large enough for double-decker car ferries, so voters could "drive" their cars to Europe. The larger tunnel would be insurance against future demand, the committee said, whereas it would be impossible to enlarge the "mouse hole" once dug. Howell has indicated that he will also consider the larger version, while noting that it would increase the cost by an estimated 25 percent.

By 1980 estimates, the small-tunnel bill would be 765 million pounds (about \$1.5 billion) to be divided

roughly equally between the two countries. Terminals and track improvements would cost another 83 million pounds. Prime Minister Margaret Thatcher's austerity government has made clear that Britain's share must come from private financing, which would be recouped from the tunnel tolls.

Still stung by Britain's 1975 withdrawal, France has not publicly agreed to start again. But the matter was discussed at a recent meeting between Thatcher and French President François Mitterand, who hinted afterward that he favored the project.

According to Williams, fares on the new service would be competitive with aircraft; and trains will use only one-fourth as much energy per passenger as a plane. He estimates that about six million passengers would switch to trains when the first express starts rolling in 1990.

Electronics

Thinks small

Panasonic's new handheld computer (HHC) offers a number of formerly big-machine features and sports a blend of sophisticated electronics and miniaturization that make it stand out, even in the growing legions of carry-along computers.

Panasonic plans on including more than just a BASIC language for this machine. It has developed a

new language, called SNAP, which is based on the FORTH computer language. While SNAP may be somewhat more difficult to learn than BASIC, it will better utilize the HHC's built-in program memory of 4K (about 4,000 memory "locations").

The HHC's liquid-crystal display can be supplemented by connecting its video output to your own TV set through an adapter. On a TV, it will feature a multiline display. Other features include a special circuit that keeps programs in the HHC's memory from vanishing when the power is turned off.

Panasonic intends to support this new computer with a wide range of peripherals and add-ons. Probably the most important add-ons are a *modem* and a printer interface. The modem permits you to connect the HHC to a phone line to access other computers. The interface lets you work in conjunction with any large-machine-oriented hard-copy printer.



Panasonic's new HHC, a miniature handheld computer, can put real big-machine capability literally in the palm of your hand.

Additional memory modules can bring the HHC up to 48K of memory, which is on a par with most conventional-size home or personal computers.

The pricing of the unit could be its only drawback. About \$600 for a 4K main unit (keyboard/computer combo) seems right.

But 8K memory modules go for \$330 apiece and the TV adapter is \$349. This hefty pricing takes the HHC out of a competitive situation, relative to most personal computers—but this one fits in your briefcase.

Editor: Robin Nelson
Contributors: Tony Assenza, Shel Gallagher, Edwin Keester Jr., Neil Shapiro



Memory modules, printer interfaces, modems and more all attach to the computer.

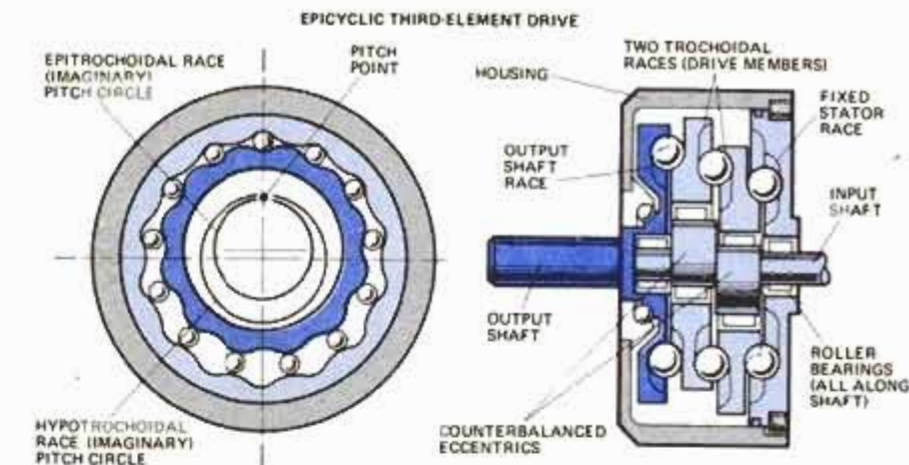
Inventions

Born toothless

It's rare that anything totally new comes along that's also wholly mechanical in its operation. But a Boulder, Colo., firm called Advanced Energy Technology is selling a drive (reduction/step-up) concept that appears to fill the bill.

It looks hopelessly complicated, but the epicyclic (planetary) motions followed by the ball bearings that replace gear teeth as driving elements in the system have been observed in nature and defined precisely since before Newton. It's being marketed under the proprietary name of Anti-Friction Drive, but can be termed either a third-element drive or an angular thrust bearing. The basic mechanical efficiency of the system—its power-density ratio—plus quietness and lack of wear, offer an amazing advantage over conventional gearing systems.

In high-rpm applications, for instance, the system would cut the weight of the requisite gearbox significantly. Turbine engines need not



Eccentric thrust coming off the input shaft is converted into rotary motion by ball bearings in epicyclic (planetary) grooves machined into one or more drive members.

be hitched to transmissions that nearly outweigh them. Much of the gasoline mileage lost through automotive differentials could be recovered, and the basic unit could be streamlined, as well. Beyond that, front-wheel-drive transaxles incorporating an integral clutch and a range of speeds of up to two dozen or more are feasible. And the constant-speed engine—a fuel-economy ideal—operating through a computer-controlled transmission, is possible.

The length of opposing trochoidal

(wiggly) races which guide the ball bearings determines the drive ratio; there is no optimum range, although the efficiency advantages over conventional worm or spur-gear systems are more pronounced at high ratios. Since all the balls exert some force all the time—as opposed to one tooth in a spur gear—there is no backlash or slippage, which opens up precise computer and robotics applications.

The possible catch? Manufacturing economics. If they pan out, however, there could be epitrochoidal implications in the near future.

Recreation

Reborn BD-5: It almost flies

It looks like an airplane—and almost is. With a claimed speed in excess of 100 mph, the BD-200 "auto-cycle" is the latest in recreational road vehicles, combining racy performance

with a fuel economy that's hard to believe.

Its sleek aircraft look is no accident—it's the work of aircraft designer Jim Bede, whose spectacular BD-5 sports plane was grounded by financial woes. Incorporating the same slick streamlining, the BD-200 is built on a stretched Honda motorcycle chassis, putting its two



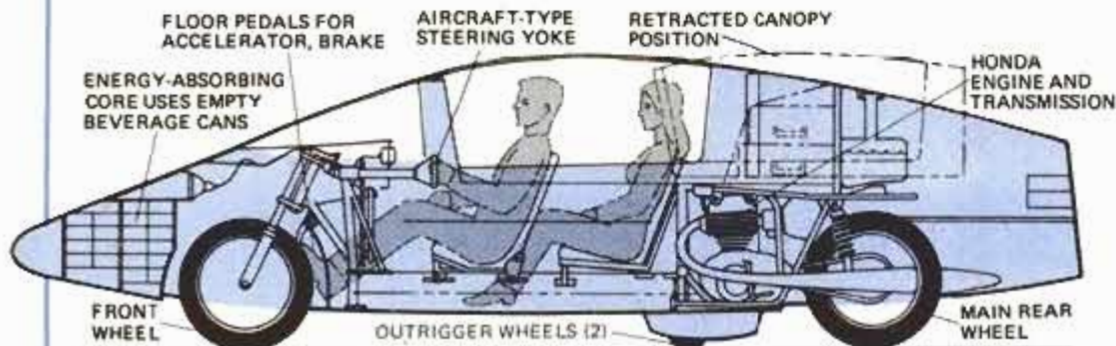
Sleek, aircraft-type styling is patterned after BD-5 fuselage.

tandem-seated occupants close to the ground for low drag. At 55 mph, the vehi-

cle is said to get 100 mpg—and at 100 mph, an incredible 70 mpg.

Small outrigger wheels give stability on turns, and aircraft-type speed brakes pop out of the "fuselage" for use on wet or icy roads.

The BD-200 will be sold in complete form for about \$3,995 and as a retrofit kit, for those who already own a motorcycle, for \$2,150. Plans for a homebuilt version will also be available for \$20 from Bede Design, 901 Orchard St., Mundelein, Ill. 60060.



Tandem seating, slide-back canopy, yoke-type steering wheel all echo BD-200's aircraft heritage.

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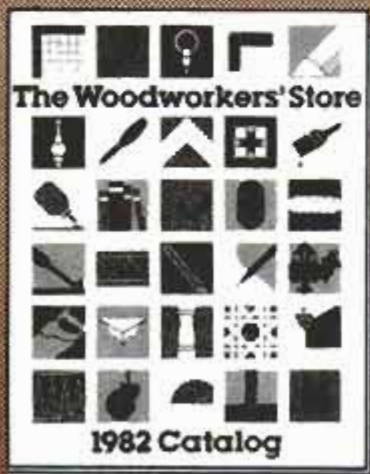
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CHRYSLER'S K-CAR CONVERTIBLE

(Continued from page 82)

vertible a hit in the marketplace.

Unzip the flexible plastic rear window, reach for the console-mounted switch, then watch and listen to a hydraulic mechanism fold the three-ply fabric roof back over your head and into a neat pile in its recessed compartment. Walk around and tuck in the corners, snap down the tailored vinyl boot and take a ride down Memory Lane. Even the wide white sidewalls are echoes of an earlier age.

With its thrifty 2.2-liter, four-cylinder engine, front-wheel drive, MacPherson-strut front and coil-spring rear suspension, rack-and-pinion power steering, power front disc and rear drum brakes and just-right exterior size, it doesn't drive much like the old freeway cruisers of our youth. But it looks the part, and it sure *feels* as good. No, it feels better.

The performance is more docile, but the braking and steering are far better and the handling more willing and agile. Most importantly, the wind in the hair is still there; that adventuresome feeling, the freedom, the devil-may-care spirit that used to excite us before cars became government-approved transportation boxes. It makes you want to pose for a picture, crash a Hollywood opening, take a drive just for fun.

Filling a void

Why did Chrysler decide to bring back the convertible this spring? Mostly because no one else has. At least no domestic maker. And Chrysler can use some exciting and unique new products to enhance its image and attract showroom traffic. VW's German-built Rabbit ragtop has fared well with fun-starved buyers, and independent conversion companies have sprung up like weeds in springtime to provide what Detroit would not.

"The convertible has held a special attraction for car lovers," says Chrysler sales and marketing vice president John B. Naughton. "We think that the time has come for convertibles to reappear. The interest they generate is fantastic. People want them. We're not sure how large the market is, but we're planning a low-volume offering with the capacity to build up to several thousand units."

Each of the 10,000 or so convertibles Chrysler hopes to sell this year will begin life as an ordinary Chrysler LeBaron/Dodge 400 body shell on the company's St. Louis assembly line. It will get a unique wishbone-

shaped floor pan, torque tube and other structural reinforcements before being shipped, with bare metal roof, to Cars and Concepts Inc. in Brighton, Mich. The contractor will then snip off the roof and trim 1½ inches from the windshield frame, add more reinforcements, install the shorter windshield glass and the convertible frame, top and mechanism, and return it to the dealer distribution pipeline.

Exquisite engineering

It's important to note here that the structural reinforcements necessary to replace body strength lost to the roof removal have been carefully engineered and tested, not just randomly thrown together with "boilerplate" here and there. Computerized, finite-element analysis was used to design the beefed-up structure, while extensive lab, road and crush tests served to refine and verify the package for ride and handling stiffness, as well as for crash safety.

Dimensionally, the convertibles are your basic LeBaron and 400 coupes except for 1½ inches less height and about 62 pounds additional weight. Surprisingly, though, headroom is a couple of tenths more than in the tin-tops because all that's there is the ragtop's black, rubberized inner layer, which is trimmed to the transverse bows to minimize ballooning in the wind. To avoid profanity and broken fingernails, the convertible boot has quick-attachment, post-type fasteners. Allowing space for the folded top reduces trunk capacity to 13 cu. ft. compared to the coupe's 15; the three-point safety harnesses loop over the seatbacks and are anchored inside the rear quarters (because there are no center pillars).

Otherwise, they're the same well-equipped, K-based, luxury compacts we met last fall, equipped with standard three-speed automatic transmission, AM radio, electronic digital clock, tinted glass, body-color remote outside mirrors, color-keyed bumper rub strips and body side moldings, wheel covers, reclining low-back bucket seats, center console and armrest and steel-belted, 14-inch white-sidewall radials. Options include the usual airconditioning (it helps, even with the top down), power windows, door locks and deck release, cruise control, tilt steering column, leather-wrapped steering wheel, cast aluminum wheels or (ugh!) wire wheel covers, halogen lamps, intermittent wipers, a light gauge alert group, the 2.6-liter Mitsubishi Silent Shaft engine

(Please turn to page 154)

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SEA EAGLE

CHRYSLER'S K-CAR CONVERTIBLE

(Continued from page 152)

and various entertainment systems.

For the country-club set, there's a LeBaron Medallion version. In addition to all of the comfort, convenience, performance and appearance stuff listed above (and a lot more we haven't room to list), it features a Mark Cross designer leather interior in mahogany and saddle and 20-ounce cut-pile carpeting. In fact, it's marketed like the Imperial—just one price. The only buyer choices are color (mahogany or white with matching tops and orange pinstripes), seek-and-scan AM/FM or AM/FM cassette stereo, and standard or heavy-duty suspension.

We were happy to find the ride as smooth, the structure nearly as stiff and the interior only slightly noisier (top up) than the LeBaron/400 coupes.

We were pleasantly surprised to see that the rear seat of the K-car was kept and none of the space for rear-seat passengers was compromised. Often, a convertible conversion will do away with a good bit of rear-seat space to accommodate all the mechanicals of the power top.

We didn't appreciate the top's claustrophobic rear quarters, though. They create enormous blind spots, which make the otherwise finely crafted convertibles look like run-of-the-mill conversions (which routinely eliminate quarter windows to save work and money), and to our eyes seem out of proportion and out of fashion. The coupes suffer from outdated, fixed opera windows, but at least you can see out of them.

Finally, these are luxury cars, and people who like luxury cars are not necessarily the same ones who like convertibles. And at an easy \$15,000 (the LeBaron starts at \$13,900), they'll be out of reach of most of the younger, less affluent folks who should be the prime candidates for open-air motoring. This time, maybe Ford has a better idea with its soon-to-come Mustang ragtop. We asked some Chrysler people why, in addition, they didn't do cheaper Reliant and Aries versions, which could list for under \$9,000; they said the basic K-cars had structural differences that made converting them more difficult and less practical. We'll bet they could do it if they tried.

Dodge Rampage

Also new at mid-year are a revival of the old Town and Country concept, with a wood-sided LeBaron wagon, five-door hatchback models

of the excellent Mitsubishi-built Champ and Colt fwd subcompacts, and very nice 4wd versions of the Mitsubishi Arrow and D-50 minipickups. But most interesting is Chrysler's first homebuilt baby truck, the Dodge Rampage.

Like VW of America, Chrysler has taken an economical fwd subcompact, sawed it off aft of the front seats, and added a pickup box on a tube-axle, progressive-rate, leaf-spring rear suspension. But Chrysler has chosen its TC3/024 fwd sporty coupe as a base instead of the ho-hum Horizon/Omni sedan, and in many ways the execution is better.

Good space and performance

Primarily, there's plenty of stretch room inside the cabin, the lack of which is the VW pickup's major weakness. The basic 024 has been stretched 7.6 inches in wheelbase to 104.2 inches and 9.6 inches in length to 183.6, giving a very useable 63.7 inch-long by 52.2-inch-wide box (41.8 inches between wheelhouses) with a cargo payload of 1,138 pounds. The box is double-wall welded steel, and the tailgate has easy-operating, positive-lock caliper latches operated by a bell crank through a release lever.

Rampage's performance is downright sprightly because the 2.2-liter engine puts out an improved 84 eager horses at 4,800 rpm and 111 foot-pounds of torque at 2,400 rpm, thanks mostly to redesigned valves and intake manifold. Standard transaxle is a four-speed manual with a 2.69 to 1 final-drive ratio, while the striped, two-toned and larger-tired Sport model gets a shorter 3.13 ratio. Power front disc, rear drum brakes, tinted glass, left-hand remote mirror, sport steering wheel, AM radio, rally-styled wheels and a load-sensitive rear brake proportioning valve are standard; the Sport truck also boasts contoured cloth bucket seats with adjustable backrests, a shift-lever console, tachometer and a quartz clock.

At first exposure, we like the Rampage a lot. It looks good, goes and handles like an agile, small car, suffers little in ride (unloaded) compared to the 024 it's based on, and should be a fairly useful light cargo carrier despite its sporty "El Camino" styling and small size. Our only complaints are lack of a five-speed (maybe next year) and Chrysler's ridiculous pedal placement that makes proper performance downshifting ("heel-and-toeing") an impossibility. Otherwise, it's a real fine product that should sell like nickel beer in the growing tiny-truck market.

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How to get great pictures without being there

by Tom Sahagian



Full length of USS Yorktown museum in Charleston, S.C., is captured by Luther Hux's airborne camera mounted in a model airplane and remotely controlled by radio.

Use remote control to get those "impossible" shots.

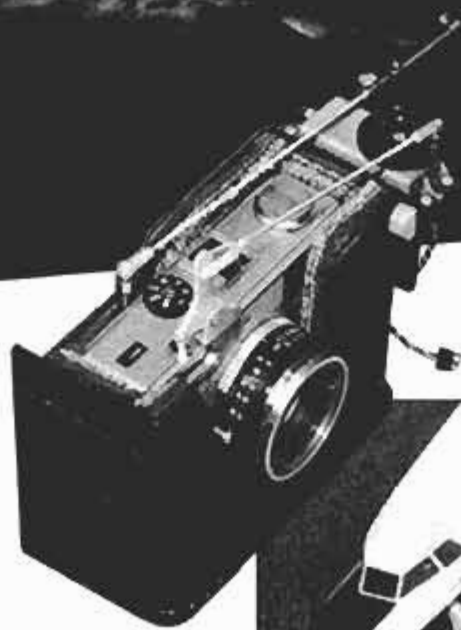
Remote-control photography may sound difficult and expensive—like taking pictures of Jupiter. But a number of earthbound tinkers seem to have circumvented both problems, and opened up a new world of picture taking.

Remote control makes it possible to take photographs from the top of a ship's mast or the tail of an in-flight airplane. The photographer can be in the picture or a great distance away. Best of all, certain techniques make possible shots that couldn't be taken any other way.

One of the oldest forms of "remote" control is a camera's self-timer. While it's a useful device, its versatility is limited. The same can be said for squeeze-bulb air releases.

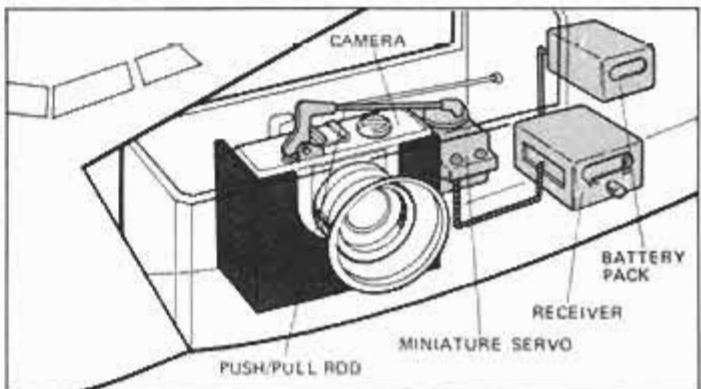
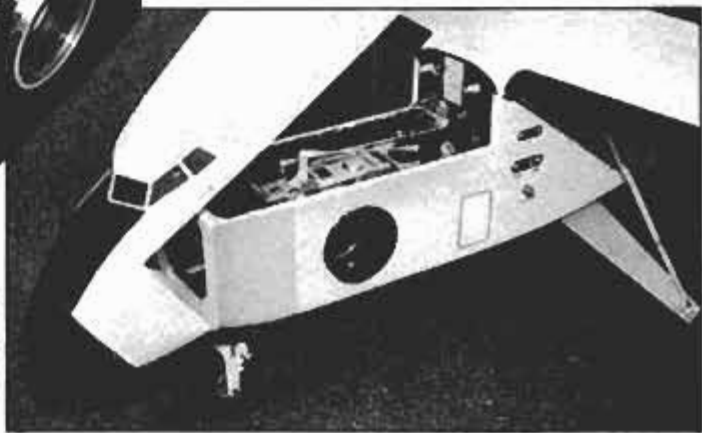
Other old standbys include trip wires (to photograph small animals in mid-run) and light-beam triggers. Similar in concept to a trip wire, a light-beam trigger is less obtrusive,

(Please turn to page 158)



Model airplane's fuselage was modified to hold photographic and remote units. Nose swings open like car hood for access.

Inside the plane's fuselage, the camera sits so that its lens points out through the body of the craft. Servo motors control push/pull rods attached to the camera's controls. The servos are, in turn, controlled by ground commands which are received on an on-board module that is battery-powered.



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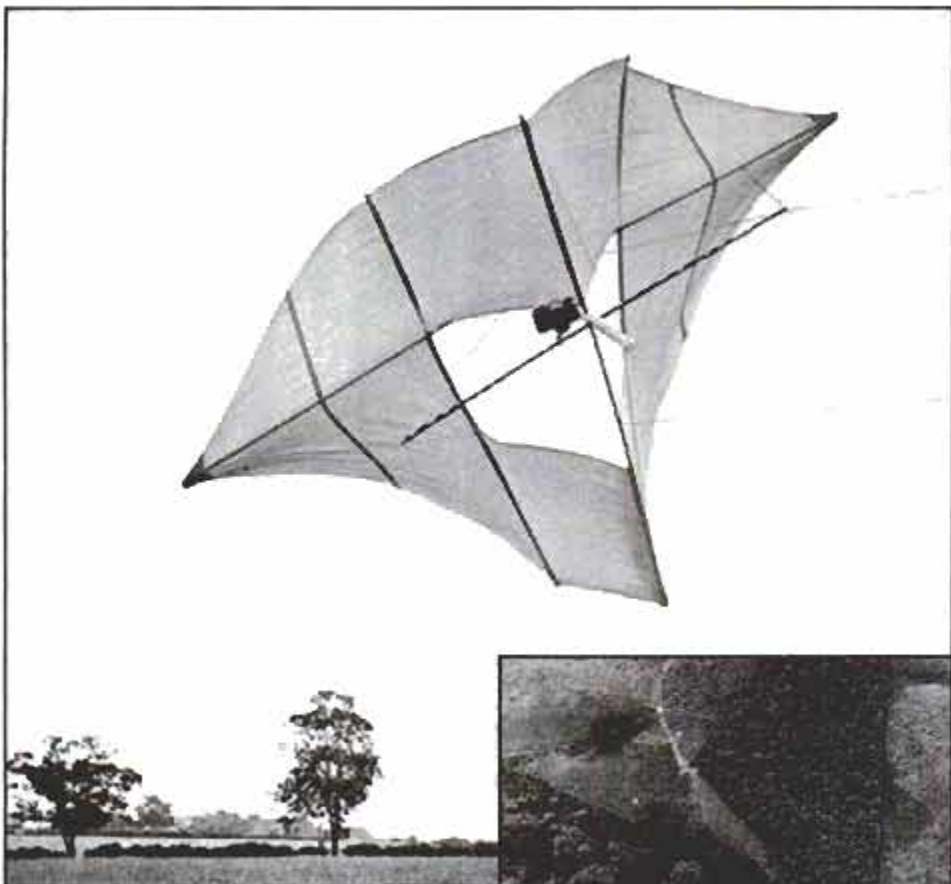
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Camera-toting kite rises quickly in the wind and resists plummeting when wind falls. R/C can be used to take high-altitude shots (right) or—maker claims—kite rises fast enough so you just set self-timer.

but more complicated. It can usually be cobbled together from parts that are available from science-supply houses.

Another option is a photoelectric trigger. These fire a remote "slave" flash unit when struck by light from a "master" unit mounted near the camera. They are inexpensive and widely available.

A related device is the sound trigger. The sound of impact, such as a tennis racket on a ball, will activate the camera or, more usually, a flash unit. (See *How Pros Take Those 'Impossible' Photos*, page 120, Apr. '80.)

Another interesting gadget, more remote than controlled, is a camera that mounts on a model rocket—the Astrocam 110, made by Estes Industries. The Astrocam is activated by the separation of the rocket's final stage from the booster. Camera height and angle can be adjusted somewhat by varying the power of the rocket charge. As the name implies, the Astrocam uses 110 cartridge film.

Radio control most versatile

Most spectacular remote-control photography is being done with radio control (R/C). The problem is,



R/C camera equipment has always been prohibitively expensive for the average photographer. Fortunately, there are several affordable alternatives.

Canon and Yashica make low-cost (about \$150 to \$175 retail) R/C units, and others can be found advertised in the back pages of photography magazines. They require a motor drive or a power winder to advance the film and fire the shutter. While such systems work, their range is limited.

The Yashica unit, which uses infrared instead of radio, has a claimed range of 65 feet. The Canon LC-1 claims 150 feet. And with little or no improvisation, they can be made to work with cameras from various other manufacturers.

One company, New Ideas Inc., plans to introduce a unit with a claimed range of half a mile and a

list price under \$100. It will have its own programmable signal code, like some garage-door openers.

Modelers to the rescue

Those with more ingenuity than money may want to capitalize on the equipment used by R/C modelers. Here's why:

- It's not expensive. A two-channel transmitter, receiver, two servos and assorted hardware cost about \$100.
- It's easy to use. And there are lots of people around who know how to use it if you have trouble.
- It has good range: A half-mile to a mile is common.

Camera in the sky

One man who has become an expert at adapting model R/C gear to photography is Luther Hux of Annapdale, Va. He controls not only the camera with R/C, but also the model plane that carries it around. He's taken scores of impressive photos (like the one on page 156) with a relatively modest camera and a lot of patience and practice.

Hux stuffed a 35-mm rangefinder camera in the nose of an R/C plane.



Astrocam 110 takes pictures from 300 to 500 feet high. The engine size sets altitude.

The camera had automatic exposure control, but no automatic film advance. With a remote-control servo and some hardware, he devised a mechanism to advance the film winder when the servo turned counterclockwise and press the shutter button when the servo turned clockwise. The camera is housed in a padded box to reduce vibration and protect it in a crash (there have been no crashes—so far). The lens points out the side of the plane, parallel to

(Please turn to page 160)



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GET GREAT PICTURES WITHOUT BEING THERE (Continued from page 158)

the wing, as an aerial aiming guide. It's important to fly the model as smoothly as a real plane; tight turns or a bouncy ride play havoc with the auto-exposure meter needle and introduce blur.

While many of Hux's shots are ground views taken from the air, he also takes air-to-air shots of other model planes. Frank Heppner, a zoology professor at the University of Rhode Island, goes one better and uses an R/C plane to take movies of geese in flight.

Equipment for aerial photos

Hux settled on a rangefinder camera for financial reasons, but it's by no means the only type suited to R/C photography. Small, light SLRs with auto winders eliminate the need for a lot of the tricky servo hardware, and offer a wide selection of lenses. They require a more powerful airplane, however. Where a rangefinder might weigh 15 ounces, even the Konica FS-1 with built-in winder weighs 27.5 ounces. One of Hux's objectives was to keep the project simple and affordable (plane, controls, camera and extras came to about \$550).

Don't forget 110 cameras, either. They are lightweight and some have built-in advance. Their small negatives may make disappointing blowups, though.

SLRs aren't the size limit, by any means. Some modelers have sent up 8-mm or even 16-mm movie cameras. A scientific group studying underwater archaeology around the world uses an 8-foot-wingspan model plane to loft a motorized Rolleiflex 2 1/4 x 2 1/4 camera with a 100-frame film back.

The group's use of R/C photography was a first in the history of underwater archaeology. With it, they've been able to locate shipwrecks and artifacts as far as three miles offshore.

The Rolleiflex isn't an auto-exposure unit, by the way. Exposure is set according to the instruction sheet that comes with the film package.

Robert F. Marx, a member of the underwater archaeology group, says the R/C plane has become a serious scientific tool. He's been on many expeditions, both on land and at sea, that were so remote that full-sized airplanes were unavailable or prohibitively expensive. And in some mountain valleys, real planes can't fit, making models the only alternative.

Other researchers are using R/C models for purposes like plotting

flood lines and mapping. Peter Miller, a British archaeologist, is trying to develop a technique to spot traces of underground building remains from the air. The theory is that during hot, dry weather, the grass above a sunken building dries up first, causing a faint yellowing that is not obvious from the ground. From above, however, the building's outline should be fairly easy to detect, especially with appropriate filters to enhance the color difference.

Model planes aren't the only way to fly with R/C. A helium balloon or a parafoil will lift a camera. Kites are another option—not the flimsy kind found at the drugstore, but large, sturdy ones. A British company, Cochranes of Oxford Ltd., makes a kite specifically designed for photography. It claims that if the wind drops suddenly, the kite will float gently to the ground without jarring the camera.

Of course, there's no reason remote-control photos need to be taken from the air. Wildlife lovers can use R/C to be safely or unobtrusively away from their subjects. Cameras have been mounted all over cars, boats, airplanes, hang gliders, bobsleds, surfboards, skateboards, skis and even people's heads.

If you plan to use modelers' R/C gear, make sure your transmitter frequency won't interfere with others in the area. Using airplane frequencies for ground-based operations could send a nearby model plane spinning dangerously out of control. Also, only use as much power as you need; keep your antenna as short as possible.

Remote-control photography can be as simple as cocking the self-timer on your camera or as complex as a multichannel commercial radio system with a three-mile range and a mega-price tag. The more gadgetry, the more difficult shots you can take.

Low-budget rig

But, as with so many other endeavors, fancy equipment is no substitute for imagination. Julian Whitteley, for instance, who makes balloons for archaeological photography and has access to the finest remote-control equipment, designed a "shutter release." He ties a string or thread around a matchstick, cocks the camera's self-timer and jams the matchstick between timer lever and camera body. At the proper time, the thread is pulled, the timer goes off and the shutter is tripped. Total cost: three cents.

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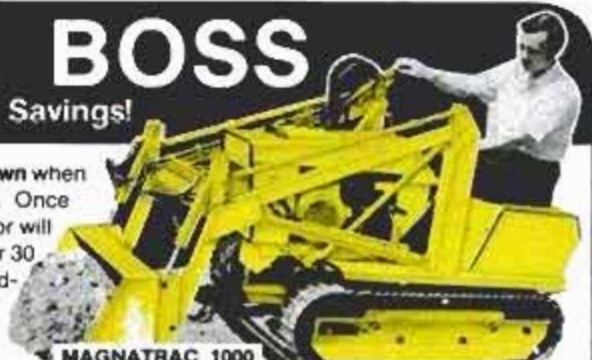
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WORK OF ART IN WOOD

(Continued from page 60)

grade (or head for the scrap bin). Select a "useless" pitchy piece of pine with large knots. However, the knots should be solid, because they will be sawed into thin $\frac{1}{16}$ x $2\frac{1}{2}$ -in. slats. Loose knots will fall out.

Use the drawing (page 165) as a guide for selecting and cutting wood. It suggests spots for positioning knots, slat size and wood type. The minimum thickness of the boards to be sliced is $\frac{1}{4}$ in. I find that the first and last slices are usually waste. This leaves the two center slats for use. Keep the slat pairs together after you cut them.



When you cut the wing slats, place the fence to the left of the blade for greater control. As stock passes the blade, pull the slat with your left hand. (Saw guide is removed to improve clarity of the photo.)

To make my butterflies more visually exciting, I use different, often contrasting woods on the lower wing slats. Redwood has become a standard because it's attractive and easy to cut and sand. I also use aromatic cedar because of its large, beautiful knots. Sugar pine, however, can be just as interesting.

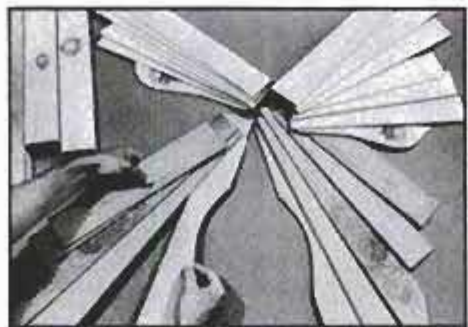
Setting up the saw for slicing requires some thought. Although the rip fence on a table saw is commonly placed on the right side of the saw blade, I find that for sawing thin slats, I have more control if the fence is on the left side. However, with some saws, this isn't possible.

If you can set up the rip fence to the left of the blade, hold the wood

against the fence with your left hand and use a notched push stick in your right hand. As the slat comes through the saw, retrieve it with your left hand to prevent the slat from jumping backward. Remember to wear eye protection when you work and stand to the side of the fence, not in line with the blade.

Important: If the slot in your table-saw insert is so large that a cut

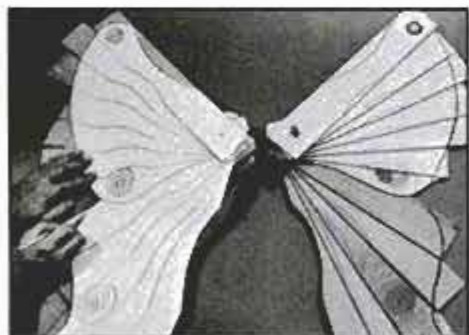
The butterfly's designer has granted PM readers permission to make a butterfly for themselves, or as a gift. However, the butterflies cannot be made for sale. Or, you can purchase a completely constructed butterfly by sending \$110, postpaid, to Briggs Bugs & Butterflies, 17 Dalton St., Newburyport, Mass. 01950. After December 1982, write for the price.



Separate the pairs of slats beginning with slat L. Move the top slat of the pair onto the left wing arrangement as if you are opening a book. The other slat is for the right wing. Pairs are mirror images.



Stack the slats of one wing. Align the slat ends that will rest nearer the butterfly body. Then bore a $\frac{1}{16}$ -in.-dia. hole, centered 2 in. from the ends of the slats.



After bolting and fanning out wing slats, trace the full-size pattern on the wings. Then cut out the wing outline on a band saw, following the pencil lines.



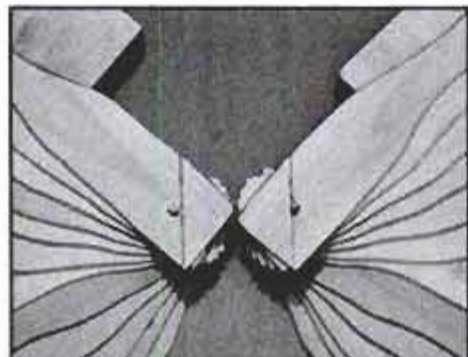
To make interior cuts, loosen, but don't remove, the bolt; collapse the wings. Swing each slat forward to cut it on a band saw.



After respacing and lightly marking the wings, join slats together with white glue. Secure seams with 3-in. spring clamps.



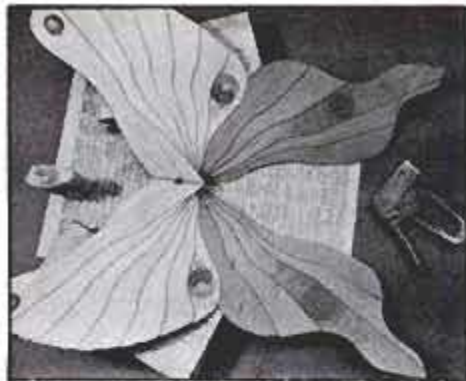
After gluing dowels in the wing holes, place the wings on 2x4 blocks with the top corners of the top slats touching. Place the wing adjustment board between the wings and move them until board is centered.



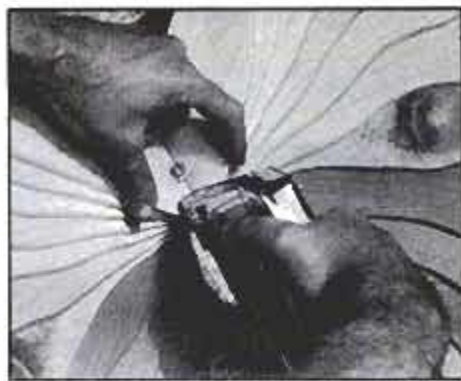
After the wing-adjustment board is centered, draw a pencil line on the top slats on both sides of the board. The lines are bases of triangles that are cut off.



Cut the right wing, using the jig as shown. When cutting the left wing, reverse wing position so that bottom slat L is leading.



To join the wings, rest two wood blocks under each slat G, so that the wings align perfectly at the joint. Apply glue to one wing and press the two together.



Insert four 1/2-in.-long staples across the freshly glued seam. Turn the wings over and staple twice across the seam. Then, put them back on the blocks to dry.



After cutting the body to rough shape on a band saw, round and shape it on a table sander; or use a drum rasp in a drill.



The antennas are a 32-in. length of No. 10 solid copper electrical ground wire bent in two. Bore two 3/16-in.-dia. holes in the body and insert the wire ends inside the butterfly body, going outward.



Notch the top wing slats to accommodate the butterfly body and then test-fit parts.



Use a hot-melt glue gun and plenty of glue to attach body to wings. Hold body while the glue bonds—about 60 seconds.

slat would fall between insert and blade, make a plywood insert with a thinner slot.

I use a hollow-ground planer blade to reduce the amount of sanding required. Although a planer blade is not designed to rip, it will work well if you keep it very sharp and push the work through it at a slow feed rate.

If your table saw can't cut a 2 1/2-in. thickness, cut partly through one side, then flop the board and finish the cut. The slats should be thicker than 3/16 in. to allow for extra surface sanding if you must make two cuts to slice the slats.

Before you arrange the slats into wings, draw the butterfly pattern full size.

You can do this by making a grid of 1-in. squares on cardboard and drawing in the butterfly. Then cut out the pattern.

After you've cut a large selection of slats, select pairs with knots similarly placed to those on slats G, J and L of the pattern. Then, you cut these slats to shape, using a band saw.

Arranging slats into wings

Following the pattern, separate the pairs of slats and lay them out into two wing shapes on a work

table. (See the second photo on page 162).

Begin with slats L. Move the top slat as if you're opening a book and place it on the left wing arrangement. The other slat of the pair goes into the right wing, face upward. In this way, the wings should be mirror images.

After you've made the wing arrangements, stack the slats in order in two piles and secure each stack with a rubber band. Mark the left and right wing stacks in pencil.

Sand the top side of each slat with a 120-grit sanding belt on a stationary belt sander. As an alternative, use a belt sander or sand the pieces by hand. Be sure to keep the slats in order.

Turn one of the piles upside down on the work table. Align the slat ends nearest the body of the butterfly and bore a 3/16-in.-dia. hole, 2 in. from these ends in the center of the slats. Insert a 3/16 x 3-in. bolt with two washers through the hole; se-

HOW TO ORDER A BUTTERFLY PATTERN

You can order a full-size pattern of the butterfly. Send check or money order for \$4.50, payable to Popular Mechanics, to Dept. BT, Box 1014, Radio City Station, New York, N.Y. 10101. Allow three to four weeks for third-class mail delivery. For faster, first-class mail, add 50 cents.

cure the stack with a wingnut. Fan out the pile again and space the slats evenly. Then tighten the wingnut to hold the slats in place. Repeat the process on the second pile of slats. Be sure that the second wing arrangement is a mirror image of the first.

Place the full-size pattern over the left wing arrangement. Use a soft lead pencil to outline the pattern on each wing. Turn the pattern over to do the right wing. You can pencil the interior curves freehand. However, you may want to revise the design by making other interior cuts to reveal knots or interesting marks on the wood.

After marking the wood for all cuts, use pliers to tighten the wingnuts on each wing stack while it is still fanned out. Cut the wing outline on a band saw. To cut the interior curves, loosen, but don't remove, the wingnuts and collapse the wings. Swing each slat out of arrangement and cut its curve on the band saw.

I like to finish-sand all of the curved edges by machine, leaving a slight bevel on each edge. This makes the lines of the butterfly more flowing. You can also obtain a beveled effect by hand. Carefully bevel the inside curved edges with a

(Please turn to page 165)

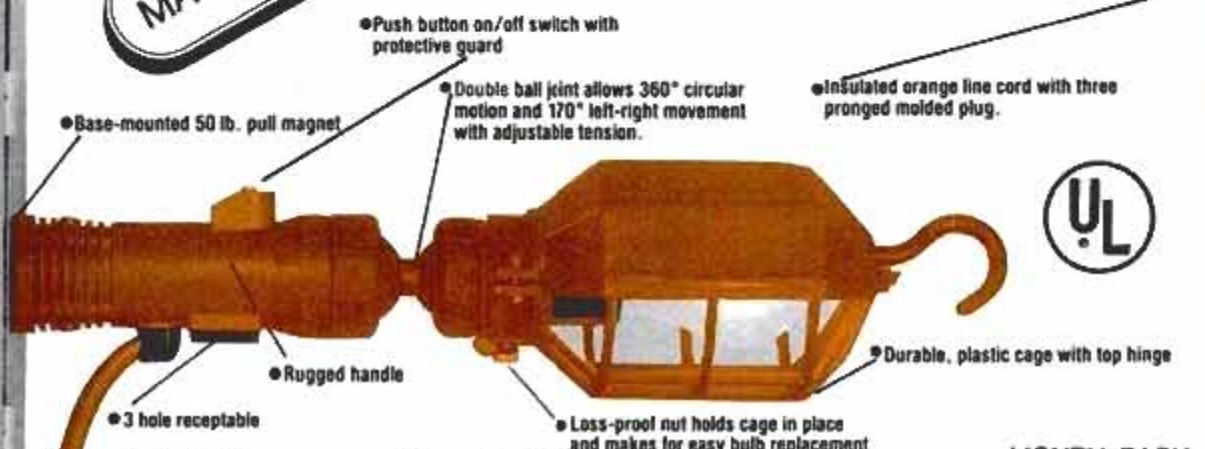
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WORK OF ART IN WOOD

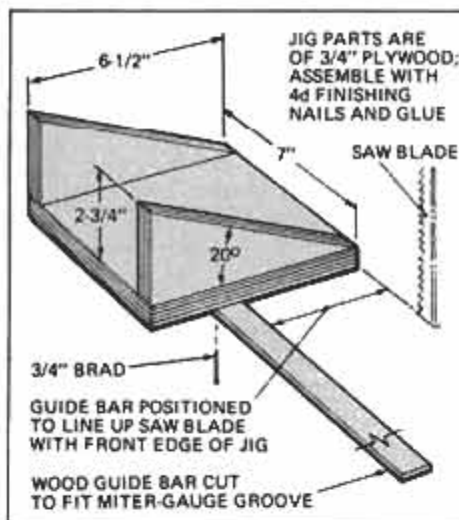
(Continued from page 163)

whittler's knife; then sand by hand. Bevel the outer end of each slat with a sanding block.

Gluing the wings

To glue the wings, fan out the slats. When the wings are symmetrical, retighten the wingnuts. With a sharp pencil, draw lines very lightly along the curved edges of each slat onto the slat below.

Loosen the wingnuts and separate the slats. I use a pump oilcan to place a continuous bead of general-purpose white glue along each slat. (A new container of white glue with a twist-off cap also lays a fairly clean glue bead.) Run a thin line of glue just behind the pencil line on slat L of one wing. Position slat K over it and secure with a 3-in. spring clamp. In most cases, one clamp will bridge two seams. Continue this process and retighten the wingnut of a finished wing with slip-joint pliers.



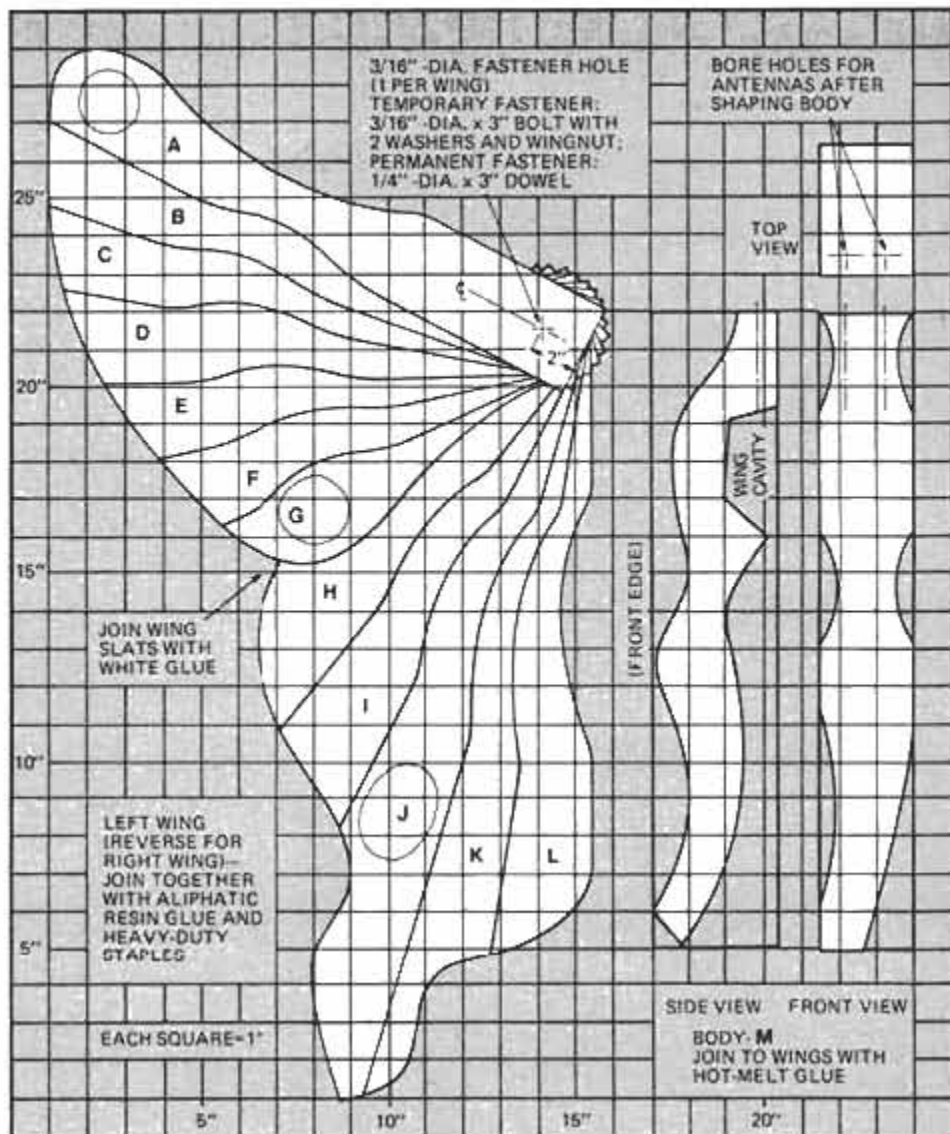
Jig holds a wing at the proper angle for making a cut where it joins the other wings.

Then apply glue to the remaining wings.

When the glue has dried thoroughly, remove the clamps. Remove the bolts and rebore the holes with a 1/4-in.-dia. bit. Glue a 1/4 x 3-in. wood dowel in each hole; cut the ends flush with the wing surfaces. Arrange the wings on four 2x4 wood blocks with the centers of the wings touching. Center a 3/4 x 3 1/4 x 18-in. board between the wings. Adjust the wings as needed and draw a pencil line on the top slat along both sides of the board.

The band-saw jig shown aids in making the angled cut on each wing at its attachment point. Don't try to cut these angles on your table saw, because the wings are too fragile.

To use the jig, lay slat L of the



TOOLS AND EQUIPMENT

You'll need a 10-in. table saw with 10-in. hollow-ground planer blade; stationary belt sander with 60-, 80-, 100- and 120-grit belts; ruler; band saw with 1/4-in. blade, four teeth per inch; portable drill with 3/16-, 1/4-in.-dia. bits and 1-in.-dia. drum rasp; slip-joint pliers; whittler's knife; 1/2-in.-deep gouge; finger-pump oilcan (for white glue); sixteen 3-in.-wide spring clamps; tape measure; heavy-duty staple gun and 1/2-in. long staples; pneumatic drum sander (if available); propane torch; ball-peen hammer; anvil or substitute; hot-glue gun; bristle-brush duster; hammer; sandpaper in 120, 220 and 400 grits.

right wing on the front triangle of the jig; center slats on the back triangle. Line up the pencil line on the top slat with the band-saw blade. Hold the bottom slat firmly against the jig and guide the wing arrangement past the saw blade.

When sawing the left wing, feed the bottom slat L into the blade first. Hold the center slats on the front triangle.

Glue the two wings together at the angled cuts you've just made. To do so, position each wing on the 2x4 blocks and align the parts. Lift one wing and apply carpenter's glue along the joint line. Press the wings together.

Insert four 1/2-in.-long staples

MATERIALS LIST—BUTTERFLY

Key	No.	Size and description (use)
A	2	3/8 x 2 1/2 x 17" pine (wing slat) with 2" knot about 1 1/2" from end
B	2	3/8 x 2 1/2 x 16" pine (wing slat)
C	2	3/8 x 2 1/2 x 16" pine (wing slat)
D	2	3/8 x 2 1/2 x 15" pine (wing slat)
E	2	3/8 x 2 1/2 x 15" pine (wing slat)
F	2	3/8 x 2 1/2 x 13" pine (wing slat)
G	2	3/8 x 2 1/2 x 12" pine (wing slat) with 2" knot about 1 1/2" from end
H	2	3/8 x 2 1/2 x 14" redwood (wing slat)
I	2	3/8 x 2 1/2 x 16" redwood (wing slat)
J	2	3/8 x 2 1/2 x 24" aromatic cedar (wing slat) with 2" knot about 8" from end
K	2	3/8 x 2 1/2 x 22" redwood (wing slat)
L	2	3/8 x 2 1/2 x 18" redwood (wing slat)
M	1	2 1/2 x 3 1/4 x 17" pine (body)

Misc.: 32', No. 10 solid-copper electrical ground wire (antennas); two 3/16"-dia. x 3" bolts with four washers and two wingnuts (temporary wing fasteners); two 1/4"-dia. x 3" dowels (permanent wing fasteners); four 2 x 4 x 12" pine (support blocks); 3/4 x 3 1/4 x 18" pine (wing-adjustment board); white glue; carpenter's glue; three sticks hot-melt glue; varnish; 1/2"-long staples.

across the freshly glued seam. Hold the wing together where the back lower slats meet and turn them over. Insert two staples across the seam on the back side. Replace the wings on the 2x4 blocks; let them dry.

Making the butterfly body

The body of the butterfly is a 2 1/2 x 3 1/4 x 17-in. piece of solid, pitch-free pine. Draw the side view shown on

(Please turn to page 166)

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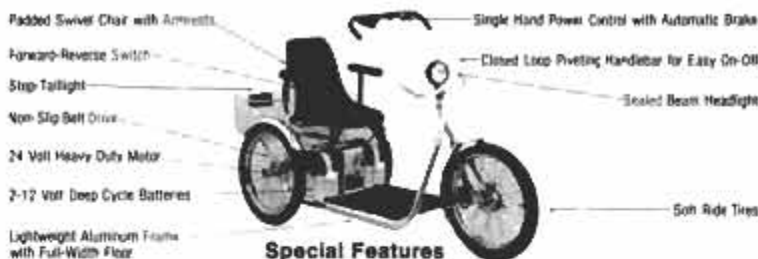
Ray D. McMullen, 70, Eugene, OR

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Paul Fuhrman, 67, Beaver Springs, PA

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Maria Weigand, 13, Lebanon, NJ



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WORK OF ART IN WOOD

(Continued from page 165)

the 3/4-in. side of the block and cut out on the band saw. Next, draw the front view on the 2 1/4-in. surface and rough-cut it on the band saw.

Shape the body on a stationary belt sander. (Or rough-shape with a large-size drum rasp in a portable drill; then finish by hand.) Turn the body back and forth against a moving 40-grit belt using your right hand; control the stock removal with your left hand.

Shape the head and back of the body with the belt coming toward the workpiece; rotate the work to shape the top and underside of the tail.

Once you have arrived at the basic shape, change to a 120-grit sanding belt and repeat the process. Finish sanding by hand. If you have a pneumatic drum sander, do the finishing sanding on it. Otherwise, sand the parts by hand, using 150-grit sandpaper.

The antennas are shaped from a single 32-in. length of No. 10 solid copper electrical ground wire, bent in two. Bore two 1/16-in.-dia. holes in the top of the body and insert the wire ends from inside the body through the holes. Curl the wire ends outward until they form nearly complete circles. Heat the curls with a propane torch until they're red hot, then flatten them with a ball-peen hammer over an anvil or a heavy, metal substitute.

The wings are mortised to fit the body. In the center of the wings where the slats come together, carve the same angle as the one on the inside of the body. Chisel a notch in the top slats of both wings to accommodate the body. Use a hot-glue gun to attach the body to the wings. It will bond in 60 seconds while you hold the body firmly in place. Use plenty of glue.

Finishing the project

Remove all exposed glue with a razor-sharp knife. Hand-sand all surfaces with 220-grit abrasive. Dust the butterfly thoroughly with a clean bristle brush. Apply a coat of interior varnish to all surfaces with a bristle brush—keep rechecking to make sure you leave no drips (sags). Let the piece dry overnight; then sand the front of the butterfly wings and the body with 400-grit sandpaper. Dust thoroughly and apply a second coat of varnish to these sanded areas.

To hang the finished butterfly, simply drive a nail into the wall. Set the V at the wing joint onto the nail-head.

PM

Quick and easy front-door replacement



Before installation, read instruction booklet and make a complete parts check. Door comes complete with a frame (jamb), including stops, weatherstripping and a strike plate.

Installing a new front door is usually a job for a professional carpenter. But the Stanley Works, best known for its popular line of hand tools, recently began offering steel replacement entry doors which are engineered to fit existing wood jambs. Both frame and door are steel, with the latter having a foam

core, plus both magnetic-strip and compression-type weatherstripping for improved insulation.

PM's test installation of a replacement door took approximately six hours, not including installation of new interior trim and final painting of both door and trim. Since the

(Please turn to page 168)



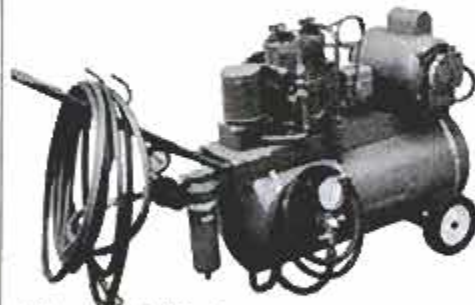
1 Take care when removing interior trim so you can reinstall it over metal door frame. Otherwise, install new moldings.



2 Remove and discard old threshold. A new one comes with door frame. Make cut through so you can remove the threshold.

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FRONT-DOOR REPLACEMENT

(Continued from page 167)

house is over 40 years old, the jamb had become distorted through settling and overpainting. Refitting such jambs is necessary, using a Surform tool or plane and shims supplied with the door. This may add approximately one hour to the time



3 Use a Surform tool or plane to remove irregularities in old door jamb that might hold new door frame away from the wall.

the door installation might normally require in a newer house.

The photos on these pages show the basic steps for installing a replacement door system.

The step shown in photo No. 5 requires the most care. As the door jamb must be square, use a level to check the vertical jamb members for plumb. Use shims to bring the sides



4 Nail furring strips to an unrabbeted jamb. The outside edge of the new door frame then abuts these strips (stops).



5 Use shims between jamb and frame to ensure a snug fit and to bring the jamb plumb. Nail shims over the mortises.



6 After all fitting adjustments are made, lay a zigzag bead of caulk across the sill. Then, permanently install the frame.



7 Nail the door frame to the jamb, using 1½-in. nails provided in the kit. Predrilled holes make this an easy step.



8 Retainer brackets hold unit firm for installation. Remove bracket screws. If the frame is square, door opens easily.

to plumb, as explained in the instruction booklet. Some shimming may also be required of the header



9 Install 11 screws in the sides and top of the door frame. If the screws are overtightened, the frame could be distorted.



10 Nail weatherstripped stops (provided in kit) over furring strips with stripping compressed against door face, as shown.



11 Weatherstripping should expand as door is opened if it's installed while sufficiently compressed to make a tight seal.

and sill in order to make these planes level.

All shimming must be done with the final checks made on the door frame itself, with a spirit level, before you begin to do any of the frame nailing.

Stanley offers the replacement door in two sizes: 2 ft., 8 in. by 6 ft., 8 in. and 3 ft. by 6 ft., 8 in. The doors are sold by Stanley Door Systems, 1225 East Maple Rd., Troy, Mich. 48084.

Retail prices start at about \$189 for the basic, unornamented styles and range up to \$389 for leaded-glass doors.

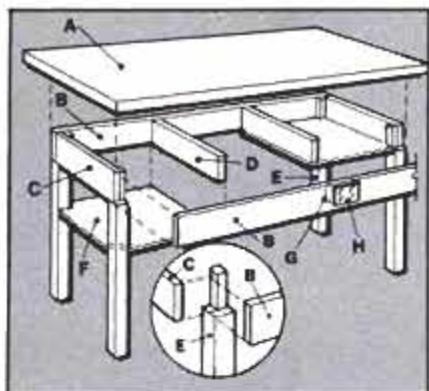
All doors are precut for standard lock and deadbolt hardware (not included in price).—Robin Nelson

HINTS FROM READERS

On-the-job bench

This light, portable bench does away with any extension cords, yet it has four outlets so you don't have to unplug one tool to use another. To build the bench, cut the parts, notching the legs to accept the side and end boards and notching the drawer bottoms to fit around the legs. Make the cutout for the electrical box. Join wood members with white glue and 1/4-in. No. 8 flathead wood screws. Turn the bench upside down, prebore and attach drawer bottoms with glue and screws. The top remains loose.

A double-duplex mounting box and cover with two grounded duplex receptacles is wired to a three-wire, grounded extension cord. Run the cord to nearby power. When you're done using the bench on a project, remove the loose top, step inside the bench and haul it off.—Robert Udesen



MATERIALS LIST—BENCH

Key	No.	Size and description (use)
A	1	1 3/4 x 24 x 60" door (bench top)
B	2	3/4 x 5 3/4 x 58 1/2" plywood (sides)
C	2	3/4 x 5 3/4 x 21" plywood (ends)
D	2	3/4 x 5 3/4 x 21" plywood (partitions)
E	4	1 1/2 x 1 1/2 x 22 5/8" pine (legs)
F	2	1/4 x 22 1/2 x 24" hardboard (drawer bottoms)
G	1	Double duplex mounting box with cover
H	1	Double duplex receptacle

Misc.: Heavy-duty, three-wire grounded extension cord, strain relief for cord.

Note: Ground all outlets according to NEC.

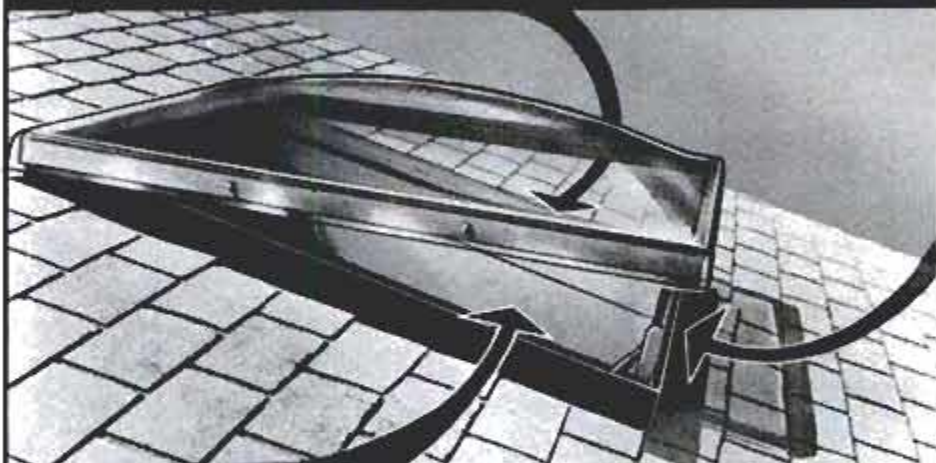
Removing linoleum

To remove old linoleum held to a floor by adhesive, place damp towels over a section of the floor. Iron over the towels with a steam iron set at medium heat. Iron until the towels are almost dry and the treated section will come loose; cut and remove it. Scoop up adhesive remaining on the floor with a broad-blade putty knife.

—Irwin Ross, M.D.



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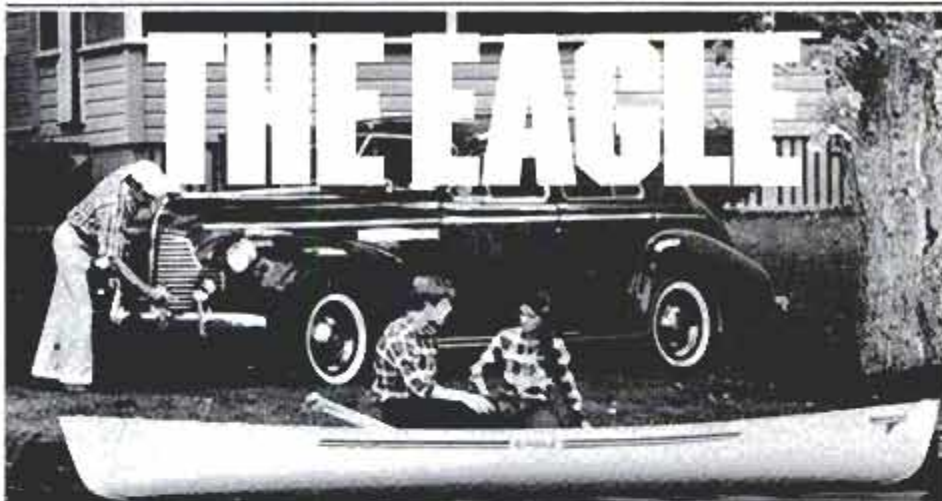
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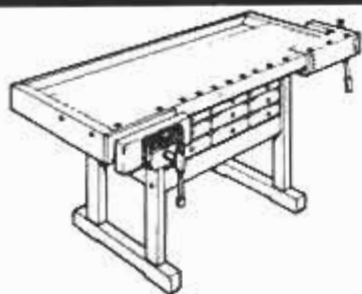
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