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Popular Mechanics

1½ MILLION-MILE REPORT
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"Quality's Great!"



Jimmy Carter: How To Handcraft Country Chairs The Old-Fashioned Way

COMING: Cheap Cars From Korea

PLANS: 5 Home Phone Centers For All That New Gear

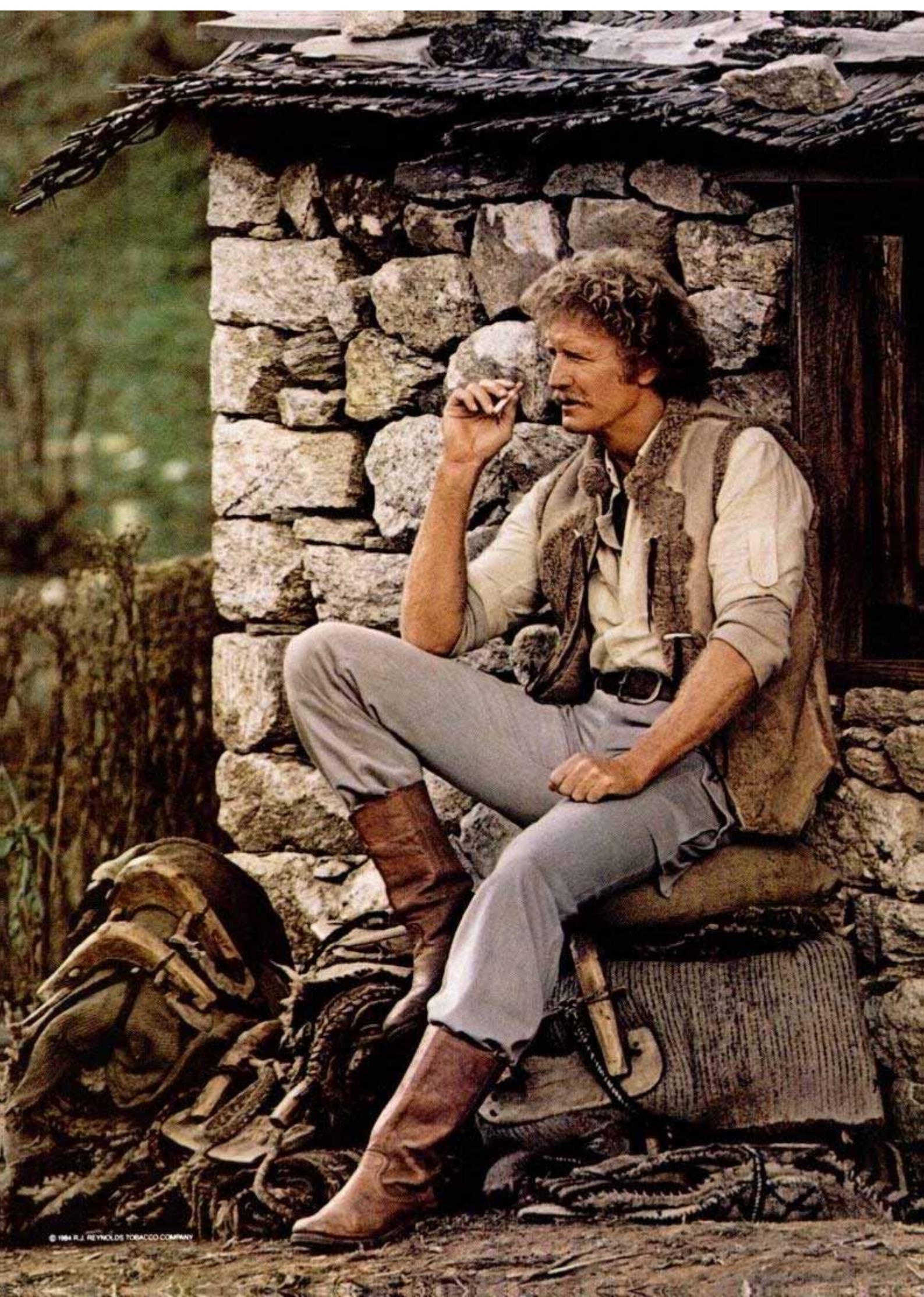
CAR STEREO: Best Systems In 3 Price Ranges

STEP-BY-STEP: 5 Charming Garden Pools You Can Make

MAN-MADE ISLANDS: How We'll Build Them And Live On Them

Ex-President Carter shapes chairs from hickory grown on his own farm.

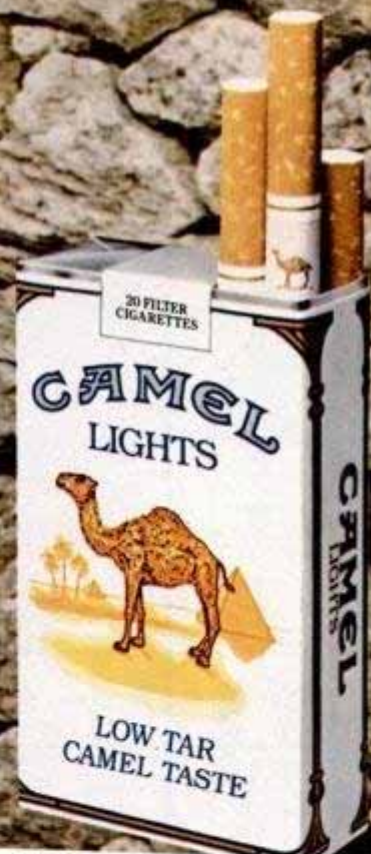




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ON THE COVER

Former President Jimmy Carter hand-shapes a piece of hickory on his farm in Plains, Ga. Read the fascinating account of his little-known skills as a first-rate furniture-making craftsman. Story begins on page 73.

—Photo by
Rosalynn Carter



Popular Mechanics

VOLUME 161 NO. 8

AUGUST 1984

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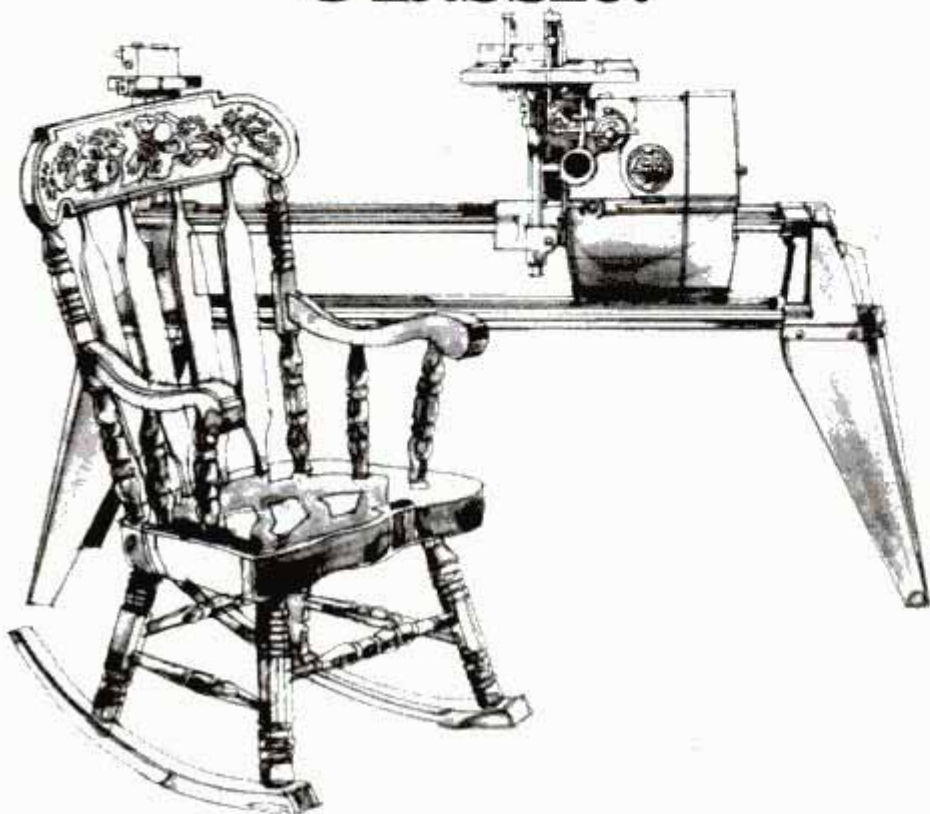
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Editorial Production: Peter Francesconi, chief; John Bostonian Jr., art; Rebecca Harth, assistant
Design Director: Ira Herrick

Art: John Johaneck, director; Alan Andresen, Ann Bennett, assistants

Special Publications: Clifford B. Hicks

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Reader Service Department: John Ginsberg, manager; 224 West 57th St., New York, N.Y. 10019; (212) 262-4292

Advertising Director: Gil Alfano

Advertising Offices:

New York: 224 West 57th St., New York, N.Y. 10019; (212) 262-8824

Chicago: 520 North Michigan Ave., Chicago, Ill. 60611; (312) 527-2400

Detroit: 377 Fisher Rd., Grosse Pointe, Mich. 48230; (313) 881-3520

Cleveland: PDC Building, 3659 Green Rd., Cleveland, Ohio 44122; (216) 292-7334

Los Angeles: 460 East Carson Plaza Dr., Carson, Calif. 90746; (213) 532-8101

Director of Marketing: Edward Vaquero

Production Manager: Alan Biedeman

Advertising Production: Patricia Woods; (212) 262-4800

Classified Sales Manager: Sophie Gronowicz; (212) 262-4825

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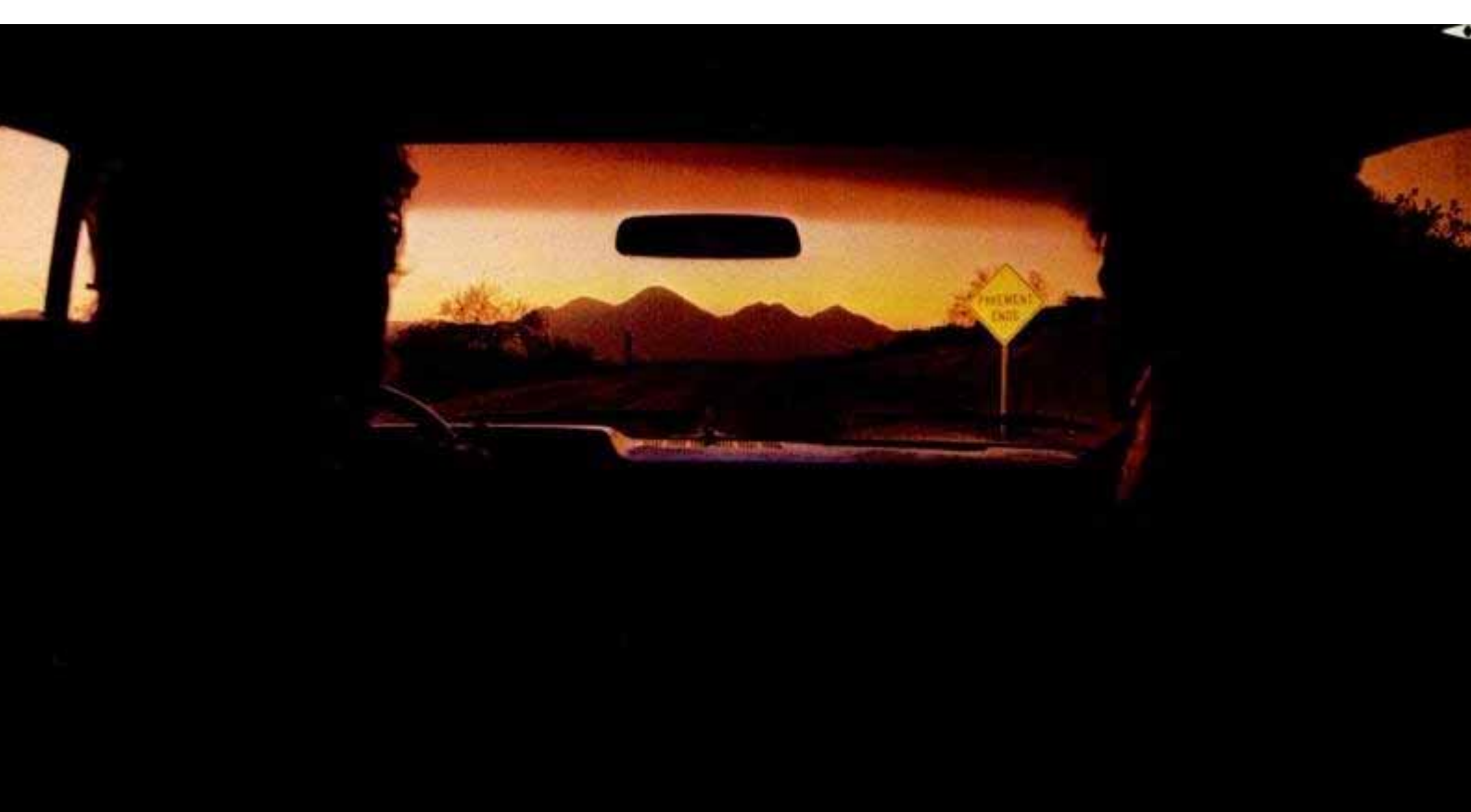
President, Magazines Division: Gilbert C. Maurer

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EDITOR'S NOTES

When we read that former President Jimmy Carter had made four chairs that sold for \$41,000—that's \$10,250 apiece—we figured he knew something we didn't. Especially since we sometimes have a tough time giving away homemade things. As it turned out, the \$41,000 was paid at a benefit auction. It may be worth that much to say your chairs were made by a former president of the United States. President Carter,



Once you cut down a tree and start making chairs, you might as well make a lot of them. This stack of parts awaits assembly by Jimmy Carter.

we learned, has been a woodworker from the time he was a boy on the family farm. He's still a "down-home" type, affirms Science Editor Dennis Eskow, who says that the ex-president answers his own phone (if you know the number to call). He builds well, too. In the living room of their Plains, Ga., home, the Carters still use a couch he made 30 years ago. Without the burdens of the White House, Mr. Carter now finds time to turn out a veritable assembly line of chairs. After all, if you cut a tree in your back yard, you might as well use all the wood. For instructions on handcrafting a hickory chair in the Carter manner, see *Jimmy Carter, Craftsman* (page 73). . . . **At some future time**, when we're up to our necks in neighbors and there's no uninhabited island to escape to, we'll thank Frank P. Davidson for his vision of *Life On Artificial Islands* (page 76). Davidson thinks big. Macro, you might say. He's the author of the new book *Macro: A Clear Vision Of How Science And Technology Will Shape Our Future* (William Morrow, \$17.95). A book review in *The Wall Street Journal* pretty well summed it up: "In Praise of Building Big." Man-made islands are just one of the large-scale public works—or macro-engineering enterprises—that he feels are praiseworthy endeavors. When he last dropped by our office, he was on the way to a conference about moon bases built by NASA. That's macro-thinking. . . . **Those new cellular phones**—the kind you carry around in your car—have reached a new state of miniaturization. There's one now that can be carried in your hand (just as the man is doing in the photo), enabling you to have telephone



PM's new art director (second from left) casts a quizzical eye at the newest model of go-anywhere cellular telephones.

conversations anywhere the cellular system exists. For an update on mobile phones, see *Phones On The Go* (page 92). PM's new art director, John Johaneck, took advantage of the telephone photo session to be introduced to PM readers. John came to PM from *New Shelter*, where he was art director. He's a graduate of the Kendall School of Design in Grand Rapids, Mich.

John A. Lillietter



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LETTERS TO THE EDITOR



Another lost-in-ice mystery

I was fascinated by your story about the World War II fighters buried in Greenland's icecap (*The Lost Squadron*, page 78, May '84). It reminded me of another lost-in-ice mystery that you may know something about.

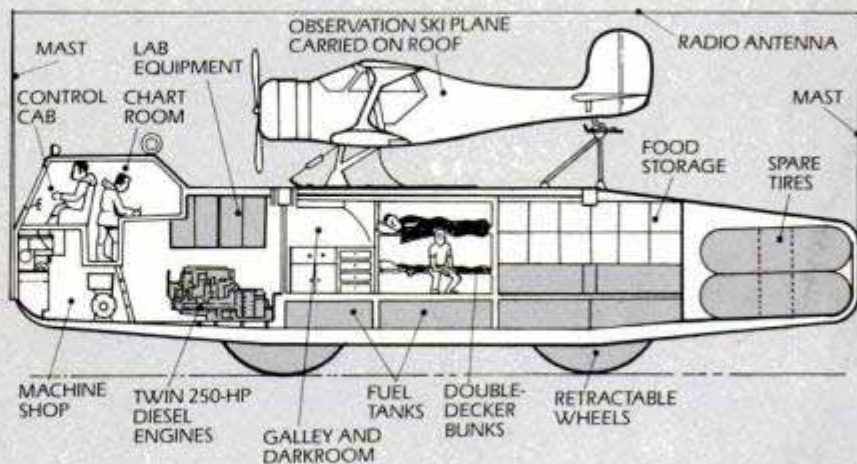
Whatever became of the mammoth vehicle that was built to accompany Admiral Byrd's expedition to Antarctica in 1940?

It was called the Snow Cruiser and was supposed to be a giant mobile research laboratory able to roam over the ice for thousands of miles, carrying scientists in comfort.

If they can dig planes out of the ice in Greenland, is there any chance they'll ever find the Snow Cruiser?

KAY PROBST
JEFFERSON, WIS.

According to the Goodyear Tire & Rubber Co., which made the huge 10-foot-diameter tires for the vehicle, it was abandoned in Antarctica at the start of World War II and is still there. In 1969, Dr. Thomas Poulter, designer of



the Snow Cruiser, reported having located it near Byrd's Little America base camp under what was then 12 feet of

ice. So far as is known today, however, no recovery attempt has been made or is planned.

Automated gate

Some time ago a friend of mine wrote to you about his use of a modified garage-door opener to operate a sliding gate (*Letters*, page 6, June '82). He was swamped with requests for information on how to do it.

For those who are interested, we now have plans available that show how to make the modification. They're \$10 postpaid from E. T. Horizons, Box 1323, Lancaster, Calif. 93534.

EUGENE L. TIEDE
LANCASTER, CALIF.

That was no Trans Am

Your otherwise excellent story *New Life For Your Old Car* (page 106, May '84) contained a glaring error. The red convertible identified as a '69 Trans Am is neither a Trans Am nor a '69. It's a '68 Firebird 400.

PAUL DAVID
CLARKSTON, MICH.

If that convertible really were a '69 Trans Am, it would be worth big bucks

today. In 1969, there were 11,657 Firebird convertibles built, but only eight of them were Trans Ams!

J. W. SMITH
AKRON, OHIO

All '69 Trans Ams were white with blue trim. That's how you can spot them. Only three are known to exist.

MICHAEL M. TKACH
WILKES-BARRE, PA.

The car is, indeed, a '68 Firebird 400. It must have been wishful thinking that led our caption writer to mistake it for a '69 Trans Am.

Strikeout

Your article *Science Goes To Bat* (page 71, May '84) mentioned the rehabilitation of Jim Bibby and Don Robinson of the Pittsburgh Pirates, but incorrectly credited the facility where these players were treated. They were operated on by Dr. Jack Failla, Medical Director of the North Hills Sportsmedicine Center in Pittsburgh. After surgery, they

underwent rehabilitation under my care as Director of Sportsmedicine.

STEVEN A. DICKOFF, LPT, ATC, MS
NORTH HILLS SPORTSMEDICINE CENTER
PITTSBURGH

Defying gravity?

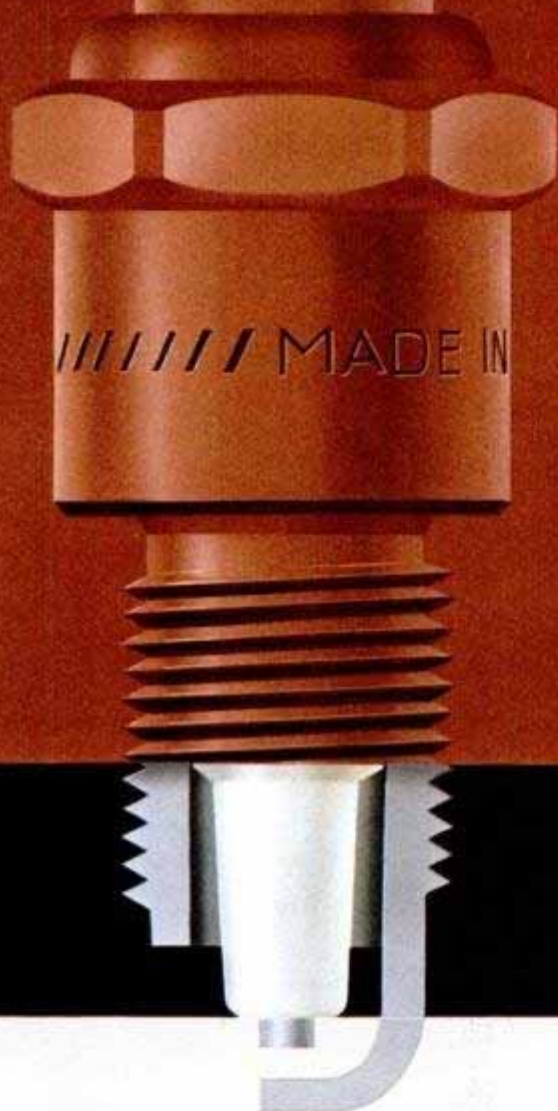
I don't quite understand what holds up your "gravity" bookshelves (*4 Handy Home Accessories*, page 102, Apr. '84). I realize that weight on the shelves keeps the uprights pressed against the wall, but what keeps the uprights from shifting sideways?

The shelves look like a house of cards about to topple. And what happens if an earthquake strikes?

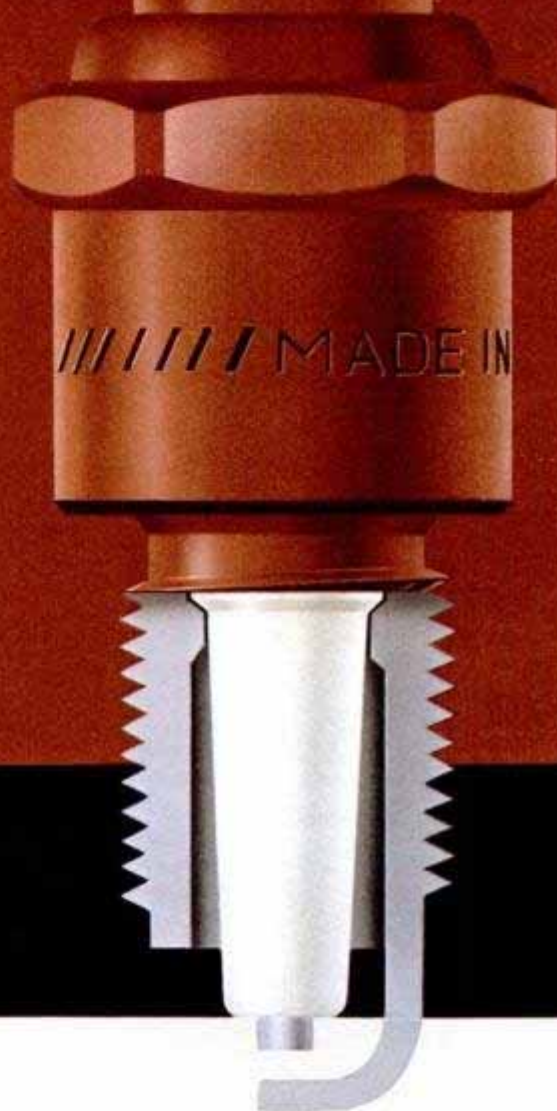
F. H. CARROLL
HERNDON, VA.

The shelves are notched to fit around the upright posts, locking them into a rigid structure that can't shift sideways. In earthquake-prone areas, the tops of the uprights should be fastened to the wall or conventional bookcase construction should be used instead. FM

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Le Car nouveau



The second-generation Renault Le Car: The new Laureate has a tough act to follow.

One of the most successful cars ever made is about to be replaced. After 12 glorious years as the No. 1 model sold in France, the Renault 5, as it's known there, will become the Laureate and will be completely reworked. The four-cylinder engine will finally get an east-west installation, ending the quirky intrusion of the longitudinal arrange-

ment between driver and passenger. The new body, a lot more contemporary, will be 1.2 in. longer than the 5, and 3.5 in. wider. When the 5 came here in 1975 (see *Driving The Renault 5*, page 124, Jan. '76), before it got the Le Car name, we were charmed by its high Personality Quotient. We're anxious to see if the Laureate has it, too.

Corvette under the skin

This Bertone design is too new to be included in *World Cars 1984*, but it'll certainly get prominent display next year. The Italian coachbuilder's Ramarro idea car is done on a Corvette

chassis, but is not a Chevrolet project and can be said to bear no resemblance to the Vette. Wheelbase is the same, but overall length is 13 in. shorter.

Three ideas are explored in the design: doors that slide forward on tracks



Ramarro is built on Corvette chassis.

Bimmer vs. Benz

Ford and Chevy owners don't go at it much anymore. That type of allegiance is a thing of the past, as car buyers open their minds to a whole range of choices, both foreign and domestic. In Germany, however, where driving is a passion and choice of car a solemn vow, one great rivalry is very much alive: Mercedes-Benz vs. Bayerische Motoren Werke. Both manufacturers have recently had sizzling performers for R&D and racetrack —M-B with the C-111

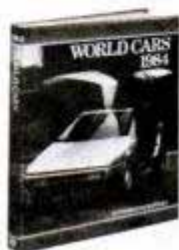
and BMW with the M-1—but the face-off in early '85 will be on the street. A new car in the 5-Series, the M535i, will be ready, BMW hopes, to keep the faithful who may have been tempted by the 16-valve Mercedes 190. The power struggle will be waged on two fronts: from standing start to 60 mph and top speed.



BMW M535i will soon face M-B 190 E 2.3-16.

Cars of the world

No wonder the Gabbiano was chosen to be shown on the cover of *World Cars 1984*. The Renault-inspired, Ital Design, gull-wing prototype is one of the most striking cars to come along in quite awhile. You'll see more of it in the "Special Bodies" section of *World Cars*, along with other designs from studios like Bertone, Ghia, Pininfarina and Zagato. Other special sections in this 439-page reference include a wrap-up of the '83 Grand Prix season, reports on world auto production and —always the heart of the big annual—a country-by-country (35 in all) compilation of more than 1,000 current models. *World Cars 1984* can be ordered from Herald Books, Box 17, Pelham, N.Y. 10803.



World Cars is \$41.75.



Ramarro's doors open by sliding forward.

(hinged doors on two-door coupes have to be wide and are especially clumsy in parking lots), a one-piece, spiderlike front seat for driver and passenger and an automatic transmission switch on the dash for selecting your gears. It's unlikely it'll ever be produced, but with its sliding doors, the Ramarro is the car I would want to park next to at the supermarket.

The competitors will hit 60 in about 7 seconds, and top out between 140 and 150 mph. Stand back. **PM**



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HOMEOWNERS' CLINIC



Static electricity a shocking problem

Static electricity is a problem at our house. My wife tries to use additives in the washing machine and dryer to control it, but it doesn't help. Every time I put on a sweater and take it off—especially the latter—I can hear crackling. The problem is the worst in the bedroom upstairs. Just walking across the carpeting, I can pick up static electricity in my socks. It even seems to be in the air, floating or hanging there. What can be done about this?—Alan Siegel, East Greenbush, N.Y.

Static electricity in the house is usually more of a problem in the winter, when the relative humidity is very low,

than in the summer when the humidity is high. This is a clue to how you can minimize the problem.

Static electricity is the buildup of an electrical charge brought about by rubbing two dissimilar nonconducting materials together. Moist air is a better conductor than dry air and, as such, helps dissipate the charge before it becomes noticeable.

According to a Scandinavian new-technology magazine—in an article on Danish heating, ventilating, air conditioning and energy technology—studies have shown that in order to prevent static shock in rooms with carpets of

wool, nylon, and some other synthetic fibers, the relative humidity should be higher than 40 or 50 percent. For carpets of cotton and sisal, the relative humidity should be higher than 30 or 35 percent.

Some manufacturers have introduced conducting fibers in the carpet to minimize the problem. One such example is Monsanto's Ultron line. In addition, there are products on the market such as Static Guard from the Alberto Culver Co., Melrose Park, Ill., which can be sprayed onto a sweater or other article of clothing to eliminate static cling. Static Guard is available at your local supermarket. A 6-oz. spray can costs about \$2.50.

Moss on roofs

Our house, covered by asphalt shingles, is shaded by three large oak trees. In the winter rainy season, moss appears between the separations in the adjacent shingles. A very thick growth of moss appears on the north and west sides of the roof. During a rain, moisture oozes up under the shingles lifted by the moss and leaks down into the house. Last summer I scraped off all the moss and glued the edges of the shingles down with roofing cement. However, this winter the moss quickly reformed and the roof is leaking again. Is there any way to keep the moss from

reforming? I certainly do not want to cut down three beautiful old oak trees. If the house is reroofed, will the problem recur?—M. Frank Collen, Walnut Creek, Calif.

If moss exists as a thin layer on the shingles, it can be removed by wetting down the shingles with a copper sulfate solution (1/4 to 1/2 ounce per 10 gallons of water) or a zinc chloride solution (10-percent zinc chloride and 90-percent water). Copper sulfate has a good residual effect.

The chemical can damage shrubbery and is corrosive to metal. Therefore, be careful with the overflow and make sure that gutters and downspouts are clean before you start. After treatment, flush them thoroughly. When moss exists in clusters, it should be scraped off by hand, then treated as described above.

Numerous chemical solutions are available in nurseries and garden supply stores for use on roofs to kill moss. One such product, called De-Moss, is made by Safer Agro-Chem Inc., 728 Center St., Box 550, Lewiston, N.Y. 14092. It comes in a 32-oz. container, costs about \$13 and covers a 500-sq.-ft. area. Regardless of which chemical you use, follow directions carefully.

According to the Washington State Cooperative Extension, copper or galvanized ridges on a roof are often effective in keeping moss under control for about 10 ft. down from the ridge. If a copper wire is stretched horizontally across a roof, the corrosive leaching of the copper should also provide moss control for about 4 to 6 ft. down. The

Cooperative Extension publishes an excellent brochure about moss on roofs. Write King County Cooperative Extension, 312 Smith Tower, Seattle, Wash. 98104, for KCH-1 Moss On Roofs.

Removing graffiti

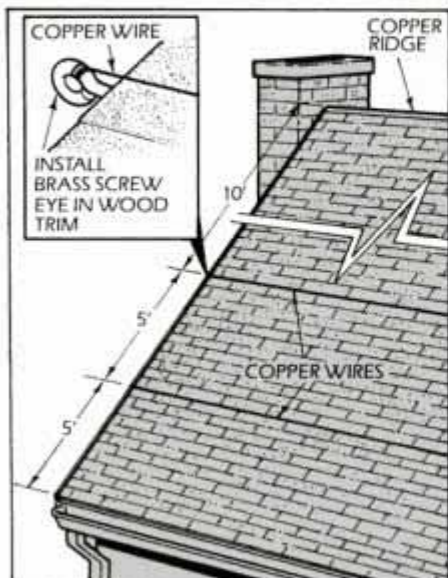
Louie Labasse, Luling, La., writes to inquire if we have heard of a certain graffiti remover for cement and brick.

Louie, I haven't heard of that one, but you can send a stamped, self-addressed envelope to Indiana Limestone Institute of America Inc., Suite 400, Stone City Bank Bldg., Bedford, Ind. 47421. They'll send you *ILI Technote*, "Graffiti Resistant Coatings" and *ILI Technote II*, "Graffiti Removers."

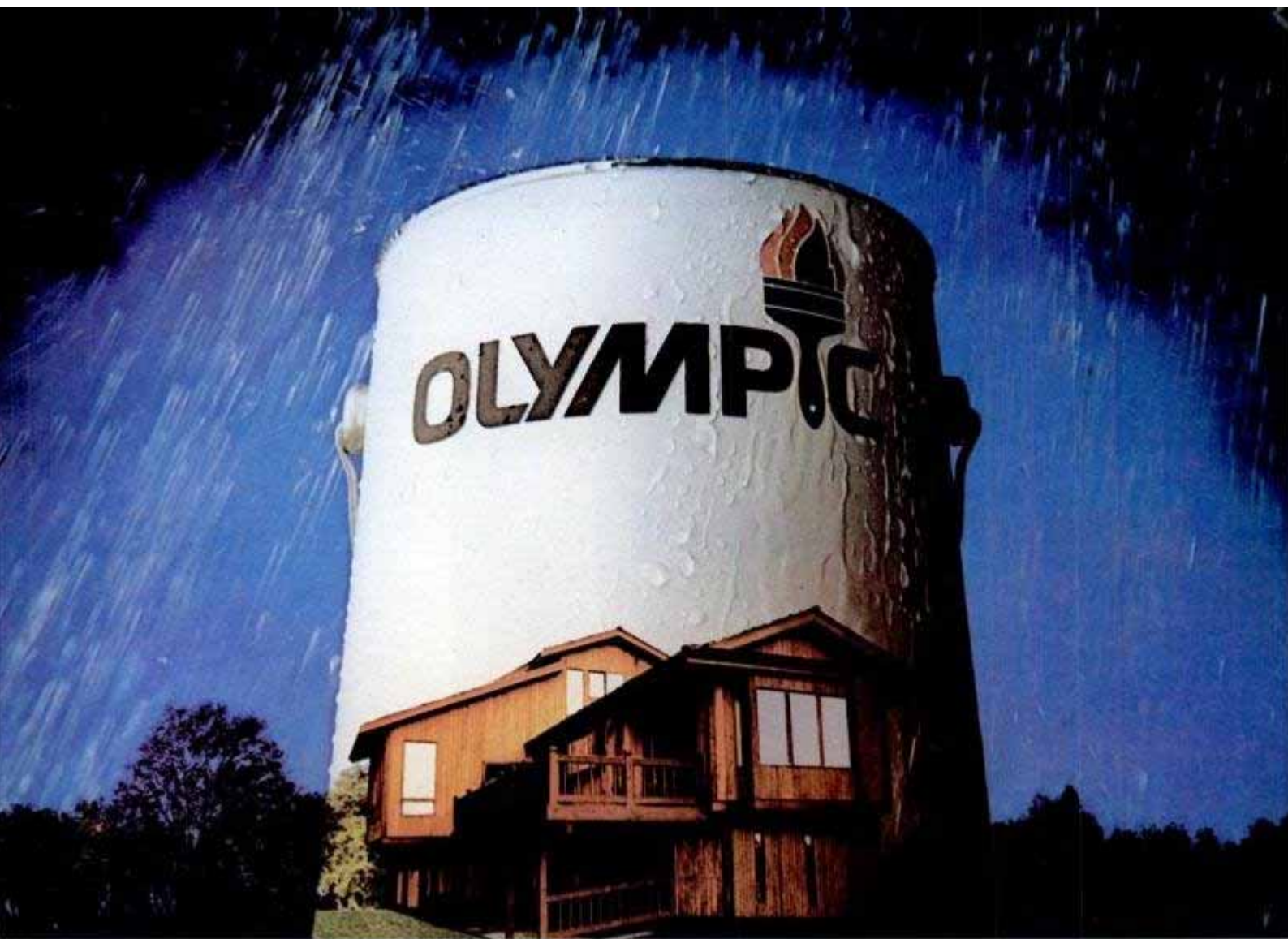
Aluminum siding update

In "Cleaning Aluminum Siding" (*Homeowner's Clinic*, page 32, May '84), we inadvertently suggested that cleaning aluminum siding should proceed from top to bottom. Heavily soiled walls should be cleaned from the bottom up. This keeps hard-to-remove dirty streaks from running down the wall. Soilax, a cleanser for use on walls, not siding, was also misidentified. **PM**

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 the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.



The corrosive leaching of copper wires stretched horizontally across a roof at intervals should provide some moss control.



Weather Screen[™] gives your home extra protection because it screens out the weather.



Weather Screen actually repels water

Olympic Weather Screen Oil Stain has linseed oil and additives that penetrate wood and actually repel water.

So your home gets the protection it needs against the ravages of the weather.



Weather Screen helps preserve the beauty of wood. Because extra-protection Weather Screen screens out the weather.

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ALL OUTDOORS

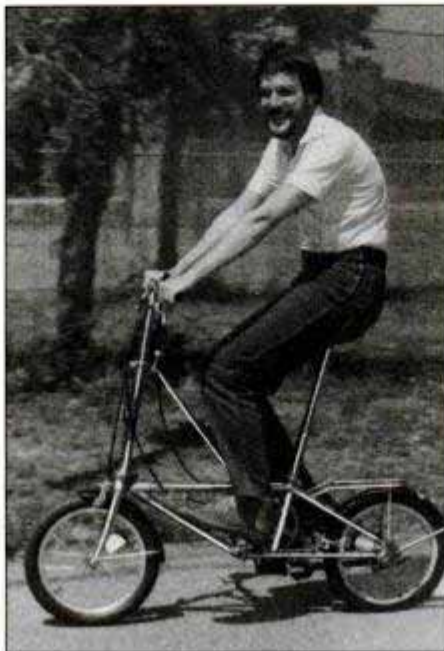


The take-it-with-you bike

Folding bicycles have been around almost as long as the bicycle itself. But the Hon Convertible folds down into a 9 x 18 x 28-inch, 28-pound package and even slips into a nylon zipper bag. That's the smallest compact folding bike yet. You can pack up or set up the bike in about one minute using quick-release fasteners that stay attached to the bike so you can't lose them.

Riding and braking characteristics on this three-speeder are very good for a foldaway, with no evidence of wobbling or instability. The adjustable handlebars and seat accommodate riders from 4-foot, 6-inches to 6-foot-6. The Hon Convertible comes with a luggage rack and a flip-up caster wheel that provides stability during setup or for wheeling the bike around in its folded-up mode.

Price of the bike is \$350, plus another \$24.95 for the optional carry bag. The manufacturer is Hon Corp. International, 1526 West Winton Ave., Hayward, Calif. 94545, (415) 887-8759.



Even though it's foldable, the Hon bicycle is stable and comfortable to ride.

No-buttons walkie-talkie

Now it's the walkie-talkie's turn to be caught up in the electronic revolution. No longer the bulky piece of equipment that brought in reinforcements to beleaguered troops in World War II movies, and a lot more sophisticated than the toy quality models around, the newest units are typified by General Electric's



GE walkie-talkie is a voice-actuated unit.

Voice 1 model, which costs \$39.95.

The GE voice-actuated walkie-talkie comes with a headset and attached boom-type mike for hands-free communication—perfect for activities such as bike riding. The lightweight power-

pack clips to your belt or fits in a shirt pocket. You can override the voice actuation with a manual push-to-talk button if you want to call for reinforcements the way John Wayne did.

Row your board

Row your sailboard? Well it's more work than using wind power, but think of the exercise and fun you can have. The Onboard Sliding Feet Rower is a 20-pound rowing system that attaches to your sailboard in minutes without any tools, and without any alterations. Because the \$400 conversion retains all the advantages of the sailboard, it's stable and easily rightable. Used with 9-foot, 9-inch sculls, which aren't included, you can row at speeds to 7 knots. It's from Onboard Products, 959 Main St. Amesbury, Mass. 01913.



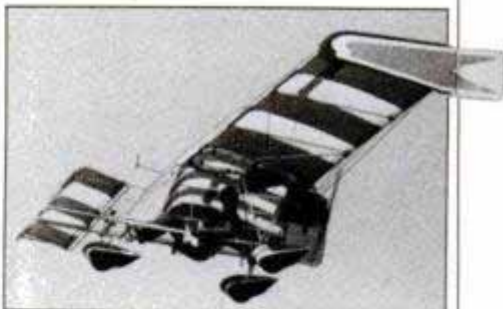
Rowing conversion uses standard-size oars.

Catamaran racing

When Robert Benchley said that watching a sailboat race was like watching grass grow, he wasn't talking about fast catamarans that can rip through water at a very respectable clip. If you'd like to see a catamaran race, you'll have ample opportunity in the coming months. The Canadian National Championships will be on Lake Winnipeg July 29 to 31; the Hobie 18 U.S. Nationals at Corpus Christi, Tex., Sept. 18 to 24; the 16's at St. Petersburg Beach, Fla., Oct. 2 to 8. Closing the championship season will be the Hobie 14 Nationals in Ventura, Calif., Oct. 31 to Nov. 4. For a list of events, write the World Hobie Class Assn., 4925 East Ocean-side Blvd., Oceanside, Calif. 92056.

New ultralight

The Ultra-Aire by Pinaire Engineering offers a standard canard configuration along with some interesting innovations. Most apparent is the sealed wing fin design used to mount the rudders and increase lift by blocking vortex generation over the tips. The fin also improves handling in crosswinds.



Ultra-Aire is a canard with a twist.

The main landing gear tube uses axially aligned fiberglass, which is stronger and more resilient than fiberglass inserts or crosshatch cloth composite. The tube- and Dacron-constructed craft uses a 35-hp Cuyuna pusher engine with a 1.96-to-1 belt-driven speed reduction. Setting up and tearing down is a one-man operation that takes 20 minutes.

The Ultra-Aire is available ready to fly for \$7,950. A complete kit costs \$5,985. Separately, the basic components cost \$3,875. Contact Pinaire Engineering Inc., Box 8232, Evansville, Ind., 47715, or call (812) 477-9818. **PM**

Let's give Liberty a helping hand.



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POWER TOOLS

For 99 years she's extended her torch of freedom to those who needed it most. But age, climate, and the wear and tear of billions of footsteps have weakened her. Now it's our turn to stretch out a helping hand.

Black & Decker has joined with millions of Americans to fund the restoration of the Statue of Liberty. But money isn't all we're giving. As a leading manufacturer of power tools, we're also donating our time, experience, and a whole line of tools to keep Miss Liberty strong.

You can help. For each selected Black & Decker professional tool you buy through September 1984, we'll add \$5 to the restoration fund in your name. See your local Black & Decker distributor or dealer for the details. Give this great lady the helping hand she needs. Get the tools built to give you the helping hand you need.

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Electric fuel pump stumper

My 1983 Ford LTD Crown Victoria is on its second electric fuel pump and now it, too, is making noise. If you're outside the car, it sounds like hissing. On the inside, it's an annoying buzz.

The original pump was quiet for about a week. The replacement was quiet for several weeks. Must I put up with this noise? The dealer and district rep don't know what to do.—Ronald Retherford, no address given

They should know what to do be-

cause the solution to this problem is in a service bulletin—83-12-11, to be exact. The noise develops because the boot, which is clamped to the pump and is supposed to dampen noise, absorbs gasoline and swells enough to contact the bottom of the fuel tank. As the pump operates, noise is transmitted through the boot to the tank and into the car. The service bulletin suggests installing a noise-reduction service kit (part No. E3VZ-9B357A).

Too hot to handle

The headlight switch shaft of my 1979 Buick Riviera gets too hot to touch when the instrument lights are set to half-brightness. The dealer says other GM cars have the same problem and there's no cure. What's going on?—James Stone, Marion, Iowa

The dimmer you set those instrument lights, the greater the resistance in the switch rheostat. As resistance increases, heat increases. If you want to get rid of the hot shaft without turning the instrument lights off, keep them on full brightness.

To my knowledge, heat generated by the GM switch has not caused the switch to fail, or any other problem. A new switch may generate less heat, but GM won't guarantee it. Just to be sure, double check the black ground wire from the headlight switch to be certain it has a solid connection at the ground junction block located in the lower firewall area.

A couple of swingers

Can you tell me why the temperature and fuel gauges in my 1980 Ford Mustang suddenly swing to "Hot" and "Full," respectively, stay there for one to three minutes and then return to normal? The engine isn't overheating and my fuel tank isn't full. The dealer can't duplicate the trouble, so he says he can't fix it.—Albert D. Brown, no address given

The common denominator is the instrument voltage regulator, which controls both gauges. This is a bimetal device that works like a set of thermostat points in a toaster. The points pulsate so that 5 1/2 volts are supplied to

the gauges. In your case, the points may be sticking together momentarily, sending a full 12 volts to the gauges. This can cause the swing.

Replacing the instrument voltage regulator will probably solve your problem. However, unless points stick together for long periods, no harm will occur. But if the situation becomes more acute, a gauge can burn out or become decalibrated.

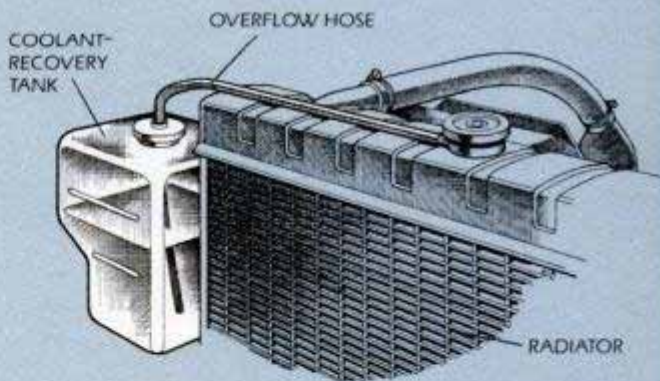
Bumped off

Have others complained about front bumpers of 1980 Chrysler Newports? The chrome on mine is blistering. Has Chrysler made provisions to replace this part? Where can I find out if the company has responsibility for this?—Irv Banka, Overland Park, Kan.

Others have not written about this, and questioning dealers and body shops in my area leads me to believe that this is not a widespread problem. The cause may be poor plating. I've found that auto manufacturers are liberal in their allowances even after warranties expire when defects, such as poor plating, result because of errors during production.

Therefore, contact the Chrysler Zone Office and ask them to send a technician to examine the bumper. The address of the office near you is 6901 West 63rd St., Box 2258, Overland Park, Kan. 66202 (telephone number: (913) 831-1600). If the decision goes against you, you can appeal in writing

(Please turn to page 20)



Discovery of recovery

William Grussinger of Glen Head, N.Y., believes that removing the coolant recovery tank from a vehicle, or keeping it dry, eventually causes corrosion that plugs the radiator. I agree with him. Here's the way Bill tells it:

"A year ago, I drained the recovery tank dry because it was cracked and losing coolant. The other day, I removed the radiator cap for the first time since then to drain and clean the cooling system. I found the radiator filled with corrosion.

"Fearing a severe blockage, I added a can of radiator flush and drove the car for

two days. It didn't do any good. The coolant was literally stagnant. As a last resort, I filled the recovery tank with water and drove the car hard for a mile or two. Then I flushed the cooling system, filled and flushed it again. That did it. The system unplugged.

Bill concludes: "I figure that a properly functioning coolant recovery system keeps air from entering the radiator, thus reducing the chance of corrosion. It also creates pressure that will promote coolant circulation—instead of stagnation—in the vehicle's radiator."

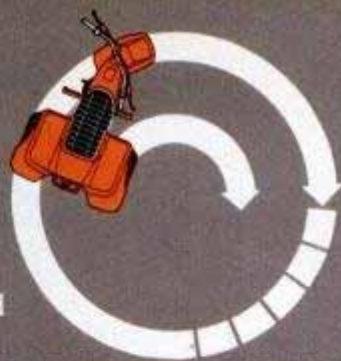
These powerful KLTs really earn their keep...they're truck tough, more versatile than a tractor and more economical than both.

With a KLT200C or KLT250 Prairie[®], you get a rugged 4-stroke engine with electric starting, a 5-speed transmission, and Kawasaki's exclusive Dual-Mode Differential. The Prairie's also got oversize radial tires and heavy-duty racks for carrying big payloads.

You know a KLT works hard, but wait till you see it play. Kawasaki power flattens rough terrain. The deep-padded seat keeps you comfortable. And those front and rear racks carry just as much hunting, fishing and camping equipment as working gear. Kawasaki's also got mud flaps, cargo bins, floor boards, covers, an engine guard, a power sprayer...just about every optional accessory for 3-wheeled work or play.

So, come see the KLT200C or KLT250 Prairie at your Kawasaki dealer today. They're hot off our assembly line in Lincoln, Nebraska. When people ask why you're always riding the 3-wheeler, you can smile and say, "I'm just takin' care of business."

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Let the good times roll.



Lock in the exclusive Dual-Mode Differential for maximum traction and pulling power. Unlock it for tighter and easier turns.



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NEVER TOO TIRED TO WORK. ALWAYS READY TO PLAY.



For off-road use only. Specifications subject to change without notice. Check local laws before you ride. Availability may be limited. Kawasaki believes in riding safely. Member AMA, MSF and SVTA.

CAR CLINIC

(Continued from page 18)

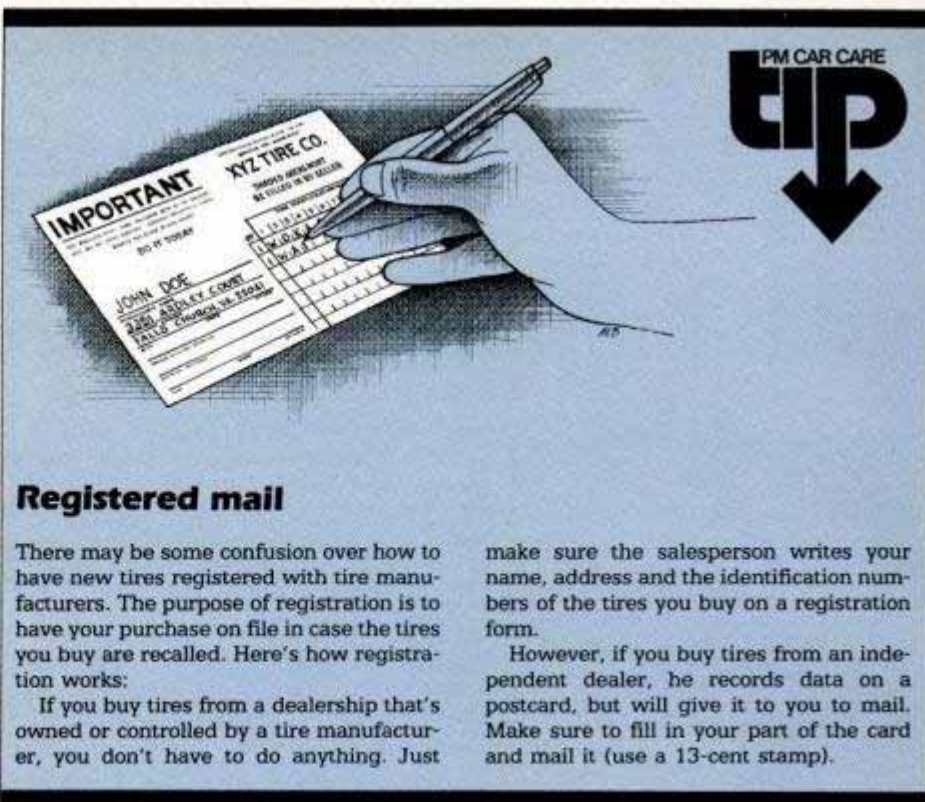
to John Personette, Manager of Owner Relations, Chrysler Corp., 26001 Lawrence Ave., Centerline, Mich. 48015. If the final answer is no, I'm afraid it's the end of the line. But if you decide to go ahead on your own and have the bumper replated (it's anodized aluminum) by a body shop, the cost will be about \$250. A new bumper costs \$350.

Water torture

At 52,000 miles, the tubes of the pulse valve assembly in my 1981 Pontiac T1000 rusted through. When I took the valve off the engine, I found it filled with water. Two dealers I've spoken with don't know what causes water to build up in the valve. Do you? A new assembly cost me \$123. I'd like to protect my investment.—Don Williams, Cleveland

For those who aren't familiar with the GM pulse air system, it's used on many four- and six-cylinder engines to inject air into exhaust ports, so gases are burned in the exhaust manifold before they enter the exhaust pipe. This reduces levels of hydrocarbons and carbon monoxide.

The pulse air system—its complete name is pulse air injection reactor sys-



Registered mail

There may be some confusion over how to have new tires registered with tire manufacturers. The purpose of registration is to have your purchase on file in case the tires you buy are recalled. Here's how registration works:

If you buy tires from a dealership that's owned or controlled by a tire manufacturer, you don't have to do anything. Just

make sure the salesperson writes your name, address and the identification numbers of the tires you buy on a registration form.

However, if you buy tires from an independent dealer, he records data on a postcard, but will give it to you to mail. Make sure to fill in your part of the card and mail it (use a 13-cent stamp).

tem (PAIR)—has a main valve which contains four check valves. One check valve is connected by a tube to each exhaust port. These are the tubes that rusted.

As the engine fires, it creates a pulsating pressure in the exhaust ports. When the exhaust valve is closed, pressure is negative in that port, and fresh air is drawn through the check valve

How to Tow With Today's Car and save up to \$15 at Hitch World



New cars are built lighter to save gas. So when you tow, you want added protection. Here are a few tips to follow:

1. THE RIGHT HITCH.

Hitches differ. The wrong one can cause body damage, or tear out. Hitch World provides the hitch to fit your towing needs, using top brands like Draw-Tite and Reese. Each hitch has a nationwide warranty, good as long as you own your tow vehicle.

2. A TRANSMISSION COOLER.

Towing with a downsized car causes heat build-up in the transmission. That can burn the transmission's fluid and shorten its life. Hitch World selects and installs a transmission cooler, like Hayden, that extends the transmission's life by releasing the towing-caused heat.

3. A TOWING SUSPENSION.

A standard suspension is basically made to carry passengers. Frequent trailer towing can reduce the life of your springs and shocks. Hitch World installs air lifts or air shocks, such as Monroe and Hellwig, that give your tow vehicle added frame support, and reduce suspension and tire wear.

NOW SAVE UP TO \$15

This ad is good for \$5 off the price of a hitch, a transmission cooler, and a suspension system (\$15 maximum discount, offer expires 12/31/84). It's all at your nearest Hitch World. Look in the White Pages under U-Haul Centers. Write for a FREE HITCH GUIDE: HITCH WORLD, Dept PM, P.O. Box 21503, Phoenix, AZ 85306



at your **U-HAUL** Center

into the exhaust port, where it mixes with the hot exhaust gases to permit oxidation.

What causes water buildup inside the PAIR valve? The interaction of hot and cold that results in condensation. This water drips into the tubes as the check valves operate and causes the tubes to rust. I bet if you took the PAIR valve apart, you'd find rusted check valves, too.

Originally, valves and tubes were made of regular steel. The newer PAIR valve and tubes are stainless. Although water will still collect, the parts won't rust.

The warranty period for replacing rusted PAIR parts is five years or 50,000 miles. Although you exceed this by 2,000 miles, Don, get in touch with the local GM Zone Office (see your owner's manual) and present your case. There's a chance you'll get your \$123 back.

Race car

It currently takes five minutes, winter or summer, for my 1981 Chevy Citation four-cylinder engine to idle down after it's started first thing in the morning, or at other times when the engine's cold. A dealer has told me it's characteristic for this car. Is he right?—J.C. Hare, Narrows, Va.

The Citation engine—indeed, any engine—will race as it warms up if one

or more adjustments are off-base. These are fast idle, choke coil lever, fast-idle cam and choke-rod relation, and vacuum break. Before checking any adjustments, buy a can of carburetor cleaner and give the choke shaft and linkage a thorough washing. A toothbrush saturated with cleaner does wonders when you apply it to those parts.

If a thorough cleaning of the choke and fast-idle mechanism does not solve the problem, inspect the carb to make sure all vacuum hoses are connected and in good condition. Make sure the vacuum break shaft is fully extended with the engine off and retracts when

the engine is started. If it fails to perform this way, replace the vacuum break.

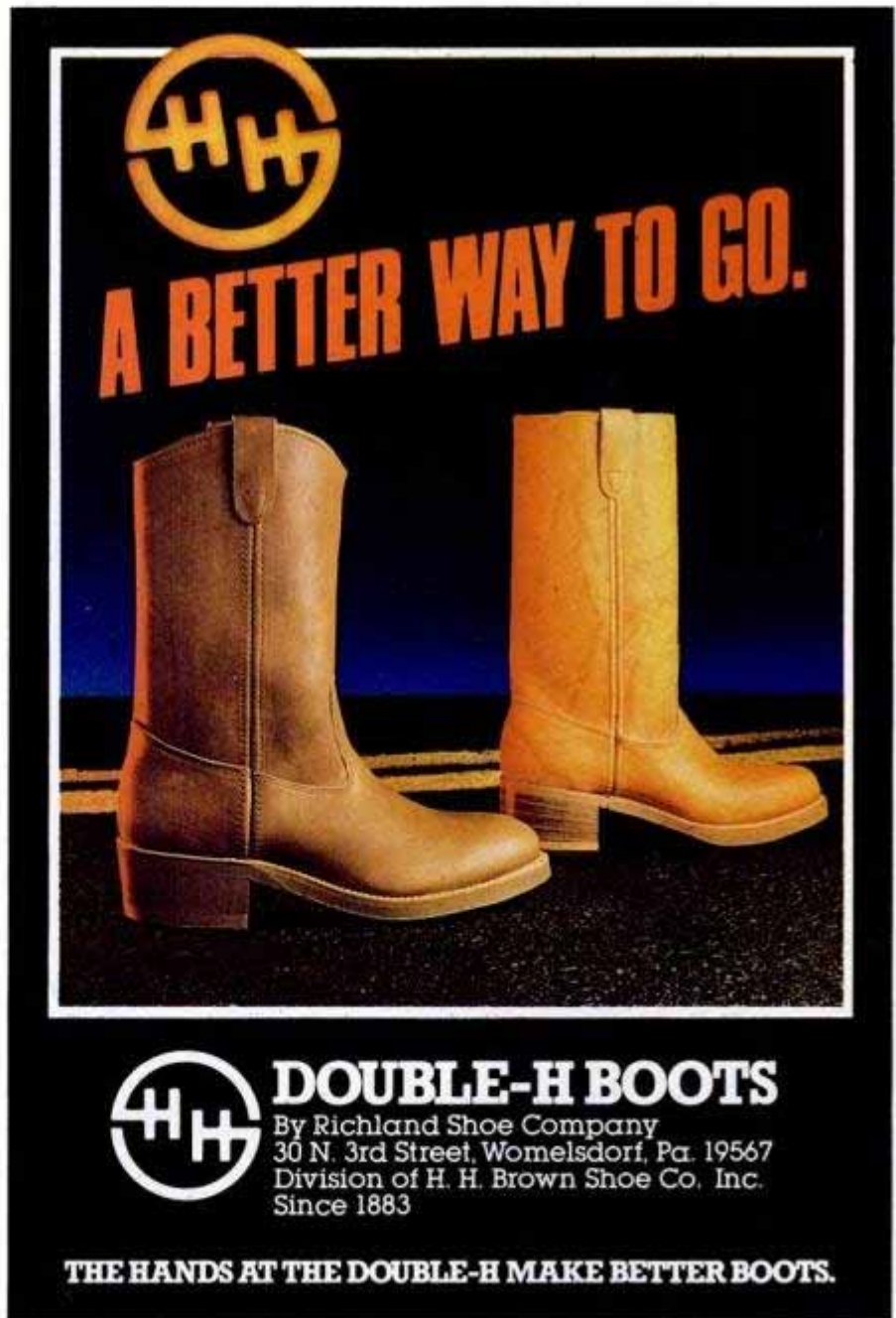
If the vacuum break checks out okay, you'll have to check the previously mentioned adjustments. A choke valve angle gauge and a service manual are needed for these somewhat complicated adjustments. If you don't have these, find a mechanic who does. **PM**

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS


- Owners of Chrysler-built 1984 Conquests with limited-slip differentials should note that the lubricant recommended in the owner's and service manuals may not be available. If this is the case, use Mopar Hypoid Lubricant (part No. 4318058) to fill the gear case, then add a 4-ounce container of Mopar Hypoid Gear Additive (No. 4318060).
- Loose nylon screens on the undersides of rear speakers in 1983-'84 Honda Preludes and 1984 Accords can cause buzzing. Take off the speaker covers and remove the screens.
- Some 1984 Ford Escorts and Lynxes with power doorlocks built early in the production run may be difficult to unlock using the key or may be stubborn when using the power switch. A dealer can tell you if the car needs a redesigned door latch actuator (part No. E4FZ-74218A-42B for the right-hand side; No. E4FZ-74218A43-A for the left-hand side).
- If your 1960-'84 GM vehicle is equipped with a Chevrolet-made small block V8 or 90° V6 (200- or 229-cu-in.) engine and it has a rocker cover oil leak you can't stop, here's encouraging news. Newly released Viton rocker cover gaskets and hardware that GM assures us will do the job are available. Use part No. 14082319 to order your new gaskets for a 90° V6. For a V8, use No. 14082322. To clamp the cover tightly into place, get a reinforcement bracket (No. 14082321) and hold-down bolt (No. 9439930).



DOUBLE-H BOOTS
By Richland Shoe Company
30 N. 3rd Street, Womelsdorf, Pa. 19567
Division of H. H. Brown Shoe Co., Inc.
Since 1883

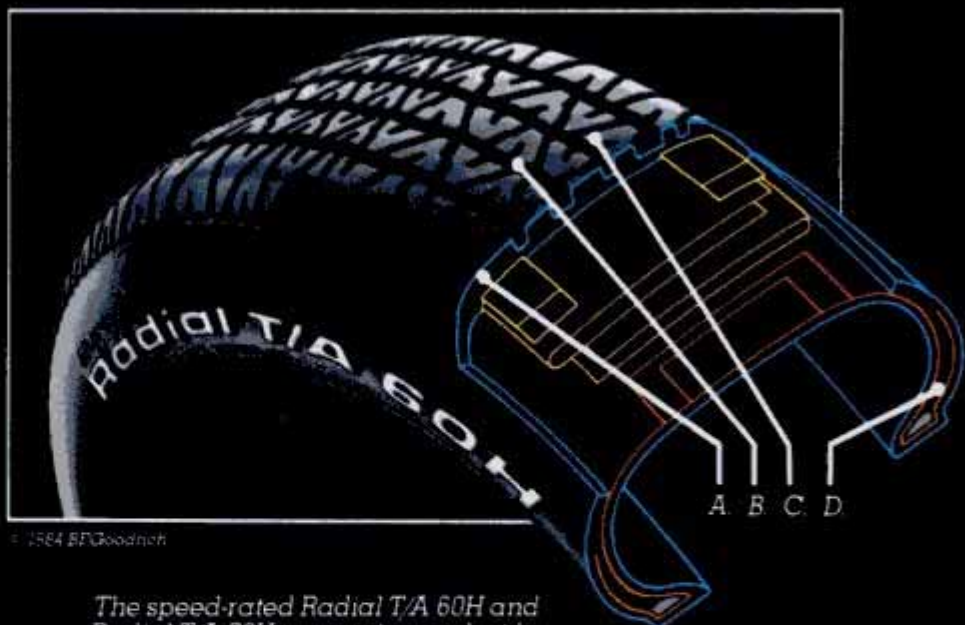
THE HANDS AT THE DOUBLE-H MAKE BETTER BOOTS.

**HOW BF GOODRICH
MAKES SPORTS COUPES PERFORM:
THE INNOVATIVE RADIAL T/A 60H.**



The Radial T/A[®] 60H—and Radial T/A[®] 70H—were designed specifically for outstanding car performance. Professional test drivers recently tested the Radial T/A 60H on an unmodified foreign sports coupe. The result: improved overall performance.

BF GOODRICH **T/A[®] HIGH TECH[®]**
RADIALS



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- The speed-rated Radial T/A 60H and Radial T/A 70H are engineered with advanced materials and technology:
- A. Special tread rubber compound promotes outstanding traction.
 - B. High void-to-rubber ratio reduces hydroplaning for superb wet traction.
 - C. Computer-optimized tread design offers excellent handling.
 - D. High-modulus bead fillers help generate quick steering response.

When equipped with the Radial T/A 60H, the test vehicle generated as much as 0.798 g's during lateral acceleration under dry road conditions. 60 to 0 mph dry stopping distance was as low as 147.3 feet. And the test car averaged 1:29.53 seconds to complete a difficult 2.0 mile, 9-turn road course: an impressive lap time attributable to the predictability and control of the Radial T/A 60H at the limit of adhesion.

The BFGoodrich Radial T/A 60H and Radial T/A 70H—a combination of advanced handling characteristics derived from the world-recognized Comp T/A*, raised white letter styling, and the European H speed-rating. These unique tires are designed to make sports coupes perform.

WE MAKE CARS PERFORM

DETROIT LISTENING POST



C'mon in—the water's great!

The first amphibious vehicle since the Amphicar will find its way into the United States via ASC (formerly American Sunroof Corp.) and *Rheinauer Maschinen-und Armaturenbau GmbH* (RMA). The four-seat aluminum Amphi-Ranger 2800 SR is pictured here. ASC, perhaps the nation's foremost aftermarket design and fabrication house, has turned out projects like the Mustang convertible and much of the original design of the Cadillac Eldorado Biarritz.

The Amphi-Ranger is an outgrowth of the German *Trippelschen SG6* swimmer of World War II vintage. RMA claims the Amphi-Ranger can hit the water with no decrease in road speed. The propeller shaft extends from a cavity in the body by an electric motor and, in aquatic duty, the driver can run through the gears just like on land. The underside, or hull, is a seamless aluminum sheet enclosing the complete underbody, eliminating the need for off-road skid plates or sealing mechanicals from exposure to water. RMA claims the vehicle is water-, mud-, sandstorm- and insect-proof.

U.S. versions will be powered by a

Ford 2.8-liter V6 with a twin-choke carburetor pumping premium unleaded fuel, producing 135 hp at 5,200 rpm. It should reach the RMA-claimed 75 mph on *terra firma* since its estimated GVW is just over 1,000 pounds.

Power is transmitted to the 5.5×16-inch road wheels via a manual gearbox, with four forward gears and one reverse each for on-road and off. Steering is rack and pinion, brakes four-corner disc, and suspension fully independent.

Watch future issues for a complete Firsthand Report.



Aluminum-body Amphi-Ranger dashes from pavement to pond without a slowdown.

Ford ad flap

Seen the Ford ads claiming that their Thunderbird Turbo Coupe is faster around a handling course than BMW's twice-as-costly 633CSI? If not, you better look quickly, because Ford has withdrawn the campaign. In an out-of-court settlement, Ford promised to stop the ads and thereby not offend the folks who also happen to supply Turbodiesel Sixes for the Continental Mark VII.

The controversy began when Ford publicized the results of a comparison test conducted by the editors of *Car and Driver* magazine at the request of Ford. Ford termed the T-bird as "the winner" on the basis of 1.0-second-per-lap quicker time through their one-mile closed-handling course. "Nicht so," said BMW and threatened to sue, contending that the comparison, performed at Ford's Dearborn test facility, may have been unfair. BMW did not deny that the Turbo-Bird beat the Bimmer around Ford's private test track, but objected to the ad's contention that the T-Bird could "outhandle" a BMW.

Hidden costs

You buy a turbocharged car because it gives big engine performance with small displacement economy, right? That axiom may hold true for fuel consumption, but overall costs are higher for turbo cars. That's the findings of the people at Runzheimer and Co. Inc., a Wisconsin-based consulting firm.

Take a 3.8-liter V6-equipped Buick Regal, for instance. Their study shows that the pressurized version costs an extra \$517 to own each year due primarily to higher purchase price, license, insurance and depreciation costs over a three-year/60,000-mile ownership period. Higher operating expenses (maintenance, fuel and oil costs) make up only a quarter of the extra price of turbo ownership.

Dodge's 600 model fared better at a mere \$175 cost differential. Still, the extra oomph and complexity of a forced-induction car definitely has its price, and now we know exactly what that price is.

Domestics for export

Never mind that boatloads of cars built offshore are brought to the United States each year. At least two Detroit automakers aren't letting any grass grow under their export wheels.

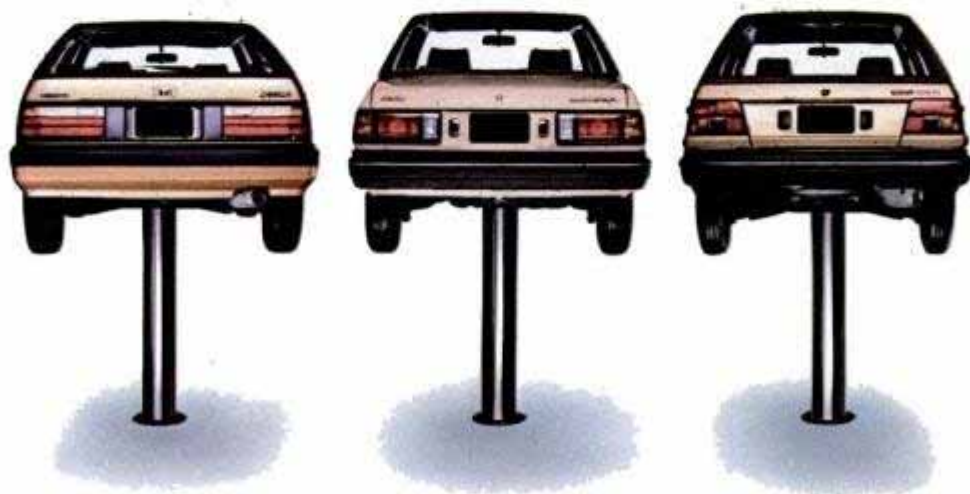
AMC/Jeep begins production this month of the ECE (Economic Commission for Europe) Cherokees, primarily for sale in Europe. Changes include Euro-spec headlights, taillights, glass and a significant absence of emissions gear. At least, emissions gear as we know it, since the ECE model needs only to meet routine European emissions standards. The Jeep will be sold in France and other countries with the GM-supplied 2.8-liter V6 or the Renault-supplied four-cylinder turbodiesel.

The ECE Cherokee won't be cheap due to the exchange rate between U.S. dollars and foreign currency. It'll sell for several thousand dollars more there than it does here.

Chevrolet has introduced its new

(Please turn to page 28)

Ford Escort spends less time in the air than these Japanese imports.



Ford Escort has been carefully engineered to help lower your cost of ownership by reducing required scheduled maintenance operations.

Number of Scheduled Maintenance Operations Required*

Honda Accord	58
Nissan Sentra	54
Toyota Tercel	37
Ford Escort	20

The chart above shows just how well it stacks up against the leading Japanese imports.

Escort's efficient CVH engine will also do its

part to help keep your operating costs way down. **37** EPA Est. MPG, 56 Est. HWY.**

So enjoy Ford Escort's economy and front-wheel drive. The smooth ride of its four-wheel independent suspension. The surprising room of its comfortable interior. And spend more time on the road, and less time up on the hoist.

The Best-Built American Cars.

Based on a consumer survey, Ford makes the

best-built American cars. The survey measured owner-reported problems during the first three months of ownership of 1983 cars designed and built in the U.S.

Plus a Lifetime Service Guarantee.

Participating Ford Dealers stand behind their work in writing with a free Lifetime Service Guarantee. No other car companies' dealers, foreign or domestic, offer this kind of security. Nobody. See your participating Ford Dealer for details.

*For five years or 50,000 miles. Scheduled maintenance performed at regular intervals is, of course, essential. But don't forget that other vehicle checks (fluid levels, tire pressure, headlight alignment, etc.) also should be performed periodically by you or a qualified technician. Vehicles in severe use require additional maintenance.

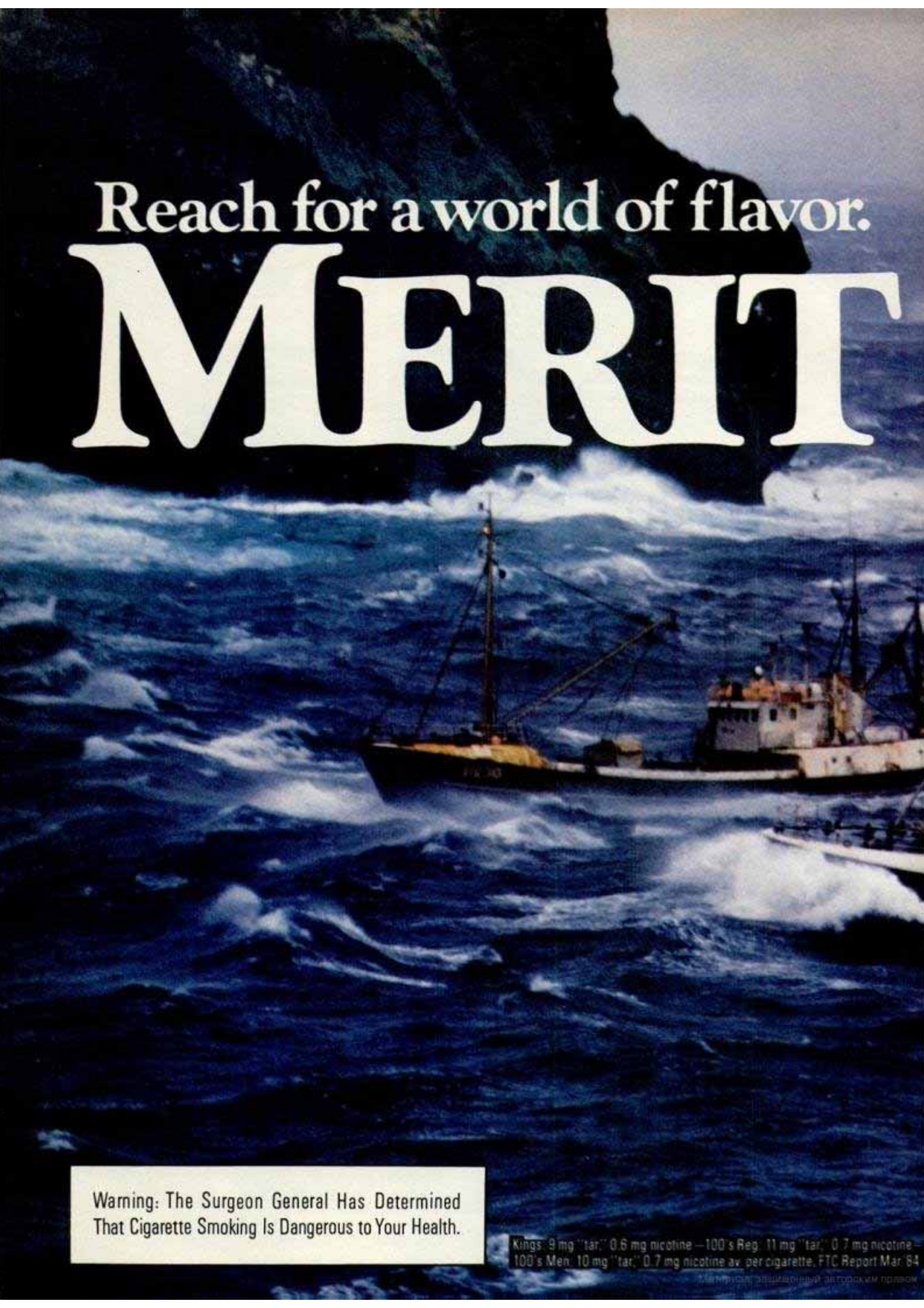
**For comparison. Your mileage may vary depending on speed, trip length, weather. Actual highway mileage lower. Escort mileage applicable to sedans with FS engine and without power steering and A/C. Not available in California.

Have you driven a Ford... lately?



Get it together —
Buckle up.





Reach for a world of flavor.

MERIT

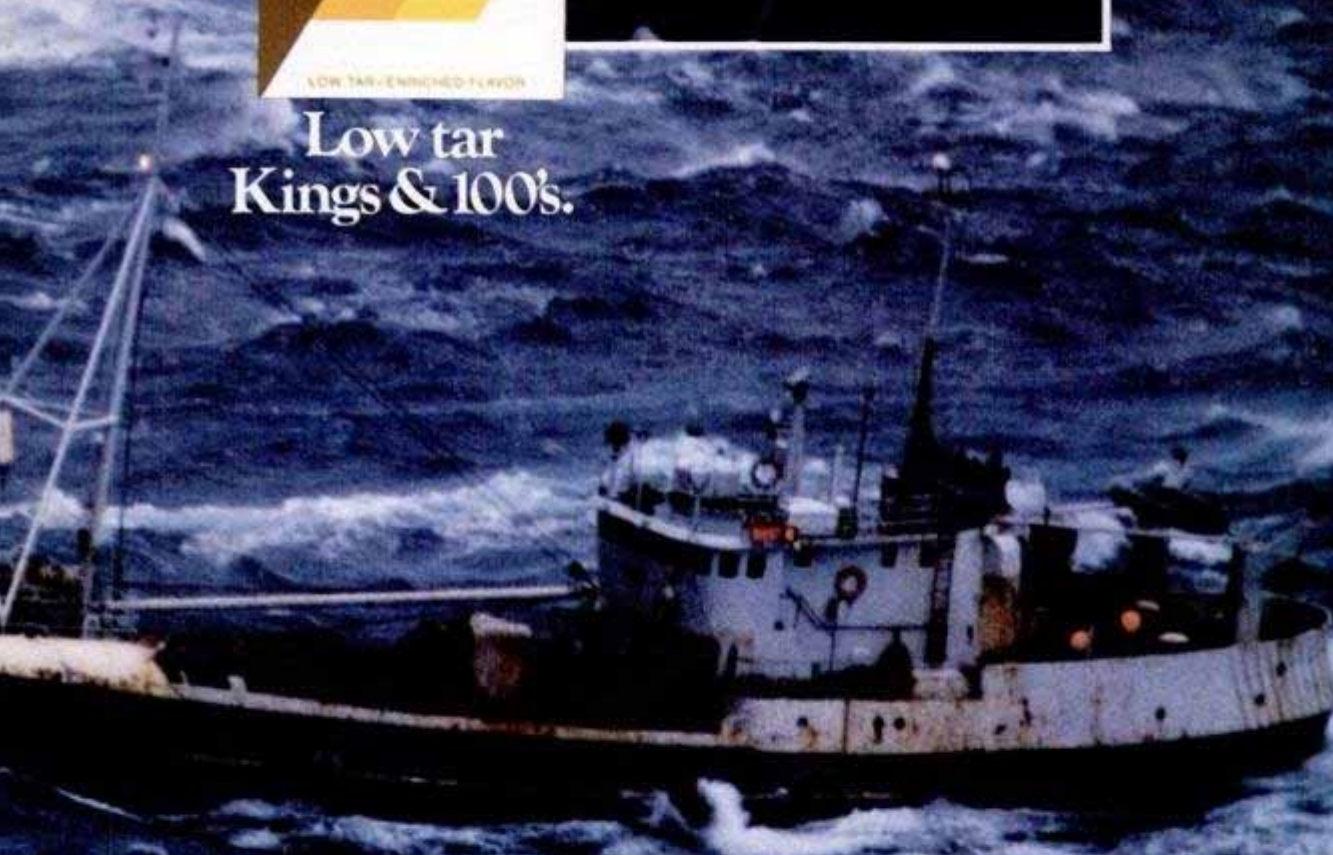
Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Kings: 9 mg "tar," 0.6 mg nicotine — 100's Reg: 11 mg "tar," 0.7 mg nicotine —
100's Men: 10 mg "tar," 0.7 mg nicotine av. per cigarette. FTC Report Mar. '84

© 1984 Philip Morris Inc. All rights reserved.



Low tar
Kings & 100's.



Corvette to the Euro market, too. Changes were made to the All-American sports car's rear end to facilitate European license plates. New glass, lights, radios and mirrors were installed for continental customers. The Corvette gets an "open-loop" version of its standard engine (less emissions equipment and perhaps more horsepower).

Never-to-be T-bird GT

Languishing in a garage somewhere in Dearborn is one red-hot Ford we're

never likely to see in production. It's a Thunderbird with the Turbo Coupe chassis and the 205-hp 302 V8 from the Mustang GT. The PR guys admit that everyone has asked for a package like this, but the decision not to build it goes right to the top levels of Ford Motor Co.

It seems that this particular corporate bigwig has the Mustang cast as the sole V8 muscle car for Ford, and sees the T-bird as a Euro-type technology leader. His plan? Develop a 2.5-liter double overhead cam fuel-injected Four to install. Not enough power you

say? How about if we top it off with a supercharger? Yes, how about it? Still, we'd like a drive in the V8 version.

Ford Aerostar delayed

The downsized Ford Aerostar minivan (*Detroit Listening Post*, page 14, May '84) won't see the showroom floor as planned. We originally thought the 2.3-liter seven-seater would debut late this year, but now sources at Ford say it won't be ready until perhaps April of 1985.

Ford's St. Louis assembly plant is being converted to produce the first pilot vehicles in December '84. Ford is planning a spring introduction, noting that some press reports peg April 17 as Ford's historically successful intro date. The Mustang and other Ford success stories debuted on that date.

Ear to the ground

Plastic engine to race: Amoco Chemicals Corp. is supplying Turlon, a graphite-reinforced, injection-molded plastic, to Polimotor Research Inc. for use in an experimental 168-pound plastic racing engine, only 68 pounds of which are metal parts. The engine will power a Lola T616 in at least five, and perhaps as many as seven, IMSA races this year.

Short drives: Buick Century T Type is a nice execution of the sporty sedan theme, with good V6 power underfoot and Buick quality all-around. It could use stiffer suspension but remains a good city/country tourer.

Pontiac 2000 Sunbird Convertible is a hot one at 150 hp, right at the edge of what this turbocharged 1.8-liter Four J-chassis can handle. Although it has gobs of power, there's altogether too much torque steer. Yup, there are normal convertible rattles, but you sure don't notice 'em when the top's down.

Chevrolet Sprint: This truly is the Littlest Samurai, Chevy's bow-tie logo notwithstanding. This '85 built by Suzuki was optioned up with radio and A/C, but it's said to see retail beginning at as little as \$4,949! That's \$41 less than the cheapest Chevette Scooter. Its perky 1.0-liter, three-cylinder gave yeoman service through a five-speed manual, but was buzzy at higher rpms. The car's quality was good, but retains the low-buck plastic-hinge look and feel.

Cadillac Sedan DeVille: The brand-new front-drive Cadillac joins the Buick Electra T Type as the best examples of the GM C-car exercise. Though handling is vague and ride soft, it's a traditional Cadillac in a downsized, attractive package, perfectly suited to its audience. Big options, big price, big impact. Folks point at this car. **PM**

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We invented this style of plier. Improved it with patented can't-slip adjustment. Improved it again with our patented stress resisting flange. And still again with our new PERMALOCK fastener. All of which is why tongue and groove pliers by any other name can't match CHANNELLOCK. Be sure that name is on the pliers you buy. Send for free catalog. Channellock, Inc., Meadville, Pa. 16335

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"I'm tellin' you... I figured they could never make a work boot that was light and tough, no way! Tough always had to be heavy... you know? Like the boots I used to have: sure, they were tough, but it was like wearin' lead weights! These Work Lites, though, they're somethin' else... like I said, they're light, they're comfortable, and they've got guts... man, they're the greatest boots I ever went to work in!"

America goes to work in
WOLVERINE
Boots & Shoes



THE PM GARAGE



Driveway dreams: A portable lift!

What better way to keep the family car away from your teenagers than to put it 6 feet in the air? Mobilehoist 4400 will do the job safely, and give you a handy movable lift for every kind of auto servicing.

The Mobilehoist will lift a 4,400-pound vehicle to 6½ feet and needs only 110-volt a.c. power. Its Lamborghini-built hydraulic pump has a preset bypass valve to prevent lifting more than the hoist's capacity. Safety features include a dual spring-loaded lockpin system to prevent the carriage from dropping in case the hydraulic system fails.

Mobilehoist is supplied with a crane attachment for doing engine swaps or even unloading pallets from a truck. Wheels at each corner let you move the hoist and its load easily. The Mobilehoist 4400 sells for \$3,695, complete



The portable Mobilehoist 4400 can lift your car 6 feet up for easier maintenance.

with a four-year parts and labor warranty and four adjustable jackstands. Tell your friends to contact Mobilehoist

Eurocalifornia Inc., 3350 Sports Arena Blvd., San Diego, Calif. 92110, in time for your birthday.—W.H.

Spring squeezer

Changing a MacPherson strut isn't difficult, but you do have to compress a big coil spring. To do that safely you should use the right tool. A new compressor I tried has a push-type safety latch to keep it locked in place (shown unlatched below).

The spring hook has a tapered grip to follow the angle of the coil spring, which also contributes to security. The tool showed no signs of slippage as I tightened it. List is only \$66 for two compressor screws, \$95 for three. (Three compressors are recommended

for large springs such as GM's X- and A-bodies and all Chrysler front-drives except Omni and Horizon). The spring compressors are marketed by Grand Performance Tools, 501 Phillips Ave., Toledo, Ohio 43612, and Owatonna Tool Co., Owatonna, Minn. 55060.

—Pete Warren



Push-type safety latches lock spring securely.

Seal puller

Removing a stuck valve stem oil seal on an overhead cam engine with recessed valve springs can be a real struggle. A new split-collet slide hammer tool I tried not only fit in easily but enabled me to pop out the seal in a few seconds.



Slide hammer oil seal puller as ideal tool for recessed valve stems of ohc heads.

Just push the tool down to force the collet onto the seal, then push on a knurled sleeve that squeezes the jaws of the collet together, locking it in place. Operate the slide hammer and the seal comes right up.

At \$36.50, this tool isn't pocket change, but it's something to remember if you're stuck in the middle of a job. The slide hammer is No. 57900, the collet No. 57920 and the combo is made by Lisle Corp., Clarinda, Iowa 51632, and sold in auto parts stores.

—Pete Warren

Shaped hoses



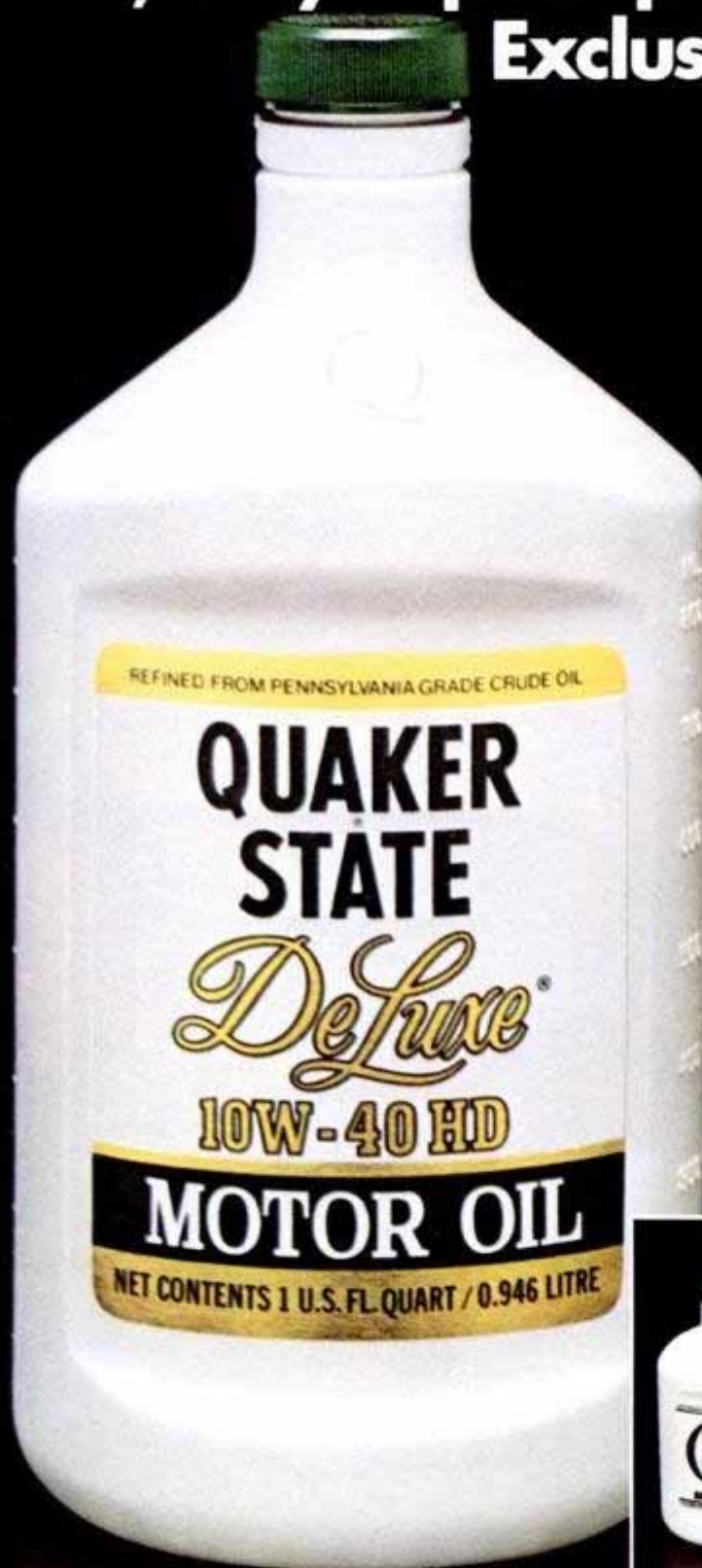
The Moldable Shape N Fit hose uses a wire reinforcement to hold any shape desired.

Neat and orderly is how I like to see the engine compartment of my car. The Gates Rubber Co. can help with its Shape N Fit heater hose, designed for custom installations or as an alternative to molded hoses.

Made in ½-, 5/8-, and ¾-in. I.D. sizes, Shape N Fit has a built-in heavy-gauge spine wire that holds any contour it's bent to. A spiral wire reinforcement lets you make small radius bends without putting any kinks in the hose.

Check your auto parts store for Shape N Fit. Or you can contact Gates Rubber Co., Box 5887, Denver, Colo. 80217.—N.S.M.

**Now, Quaker State comes
in clean, easy to pour plastic bottles.
Exclusively.**



That Quaker State quality America has trusted for over 70 years now comes in the most convenient containers you can buy. They're a cinch to open, pour and reseal. That means if your oil is less than a quart low you can top it off and save the rest for later.

Quaker State's leading motor oils are refined from 100% Pennsylvania Grade Crude. So now you get 100% Penn-Grade protection. And 0% mess.

Best of all, it's made to cost you nothing extra.

And if the new bottle isn't in your store now, it'll be there soon.



Today you need an oil this good in a package this good.

WE BUILD OUR STOVES WITHOUT COMPROMISE.



When considering a stove or fireplace insert, it's difficult to know what features are important. At Consolidated Dutchwest, our approach to your concerns and questions is very straightforward. We build our stoves without compromise. All the important features are built-in so they will be there when you need them. And we start with safety. Each unit exceeds all safety requirements. Clean-burning catalytic models are available to meet the expected safety and pollution control requirements of the 1990's now. To very safe operation we add efficiency in an airtight design with precision controlled combustion. Using our stoves, customers consistently report fuel savings of 50%, 70%, even 90% when they converted from conventional heating. You can expect exceptional savings too.

WOOD & COAL BURNING CAPABILITIES

To safety and efficiency we add wood and coal capabilities, because fuel flexibility is as invaluable as are the coal-related features — even if you never burn coal. An ashpan, ashbin and shaker grate are essential for burning coal. With wood they are just plain useful — for quick fire starting and easy, clean ash removal. Most stoves burn wood or coal and require costly additional parts and time-consuming steps to convert from one fuel to the other. Our conversion takes 30 seconds. Our most popular models provide both radiant and convection (circulating) heating. Heat is egalitarian. It radiates in all directions, including the less productive ones — bottom and back. Our convection systems channel warm air from bottom, back, and top through unobtrusive vents on the stove front.

HAND CAST, AIRTIGHT CONSTRUCTION

Our stoves are made entirely from cast-iron, hand cast and assembled from pure, virgin grey iron. They are airtight to the point that even our smallest stoves can hold a fire through the night. Our larger units, lit at daybreak, will still be heating your home well after sunset on a single loading of wood. With coal, the burning times are even longer. All models, including inserts, have polished cooking tops. Most load from front or side. Ceramic glass windows are standard, as is a screen for open-hearth burning.

FEDERAL PERIOD STYLING

While concentrating on function, we haven't compromised on appearance either. We've employed the simple clear lines of Federal period architecture (1810-1830), as elegant today as it was then, to create a unique and beautiful pattern of raised lines and arches. Our distinctive pebble finish and solid brass trim highlight the classic styling. We know our stoves will frequently be sited in living rooms and we've gone to great lengths to assure they belong there. Those of you who eventually own a Consolidated Dutchwest stove will find our trademark pebble finish is not only beautiful, but also increases our stoves' radiant surfaces by over one-third. Even while stressing appearance we never forget performance.

A COMPLETE UNIT

We don't believe in options. Too often they mask essential features which must be pur-

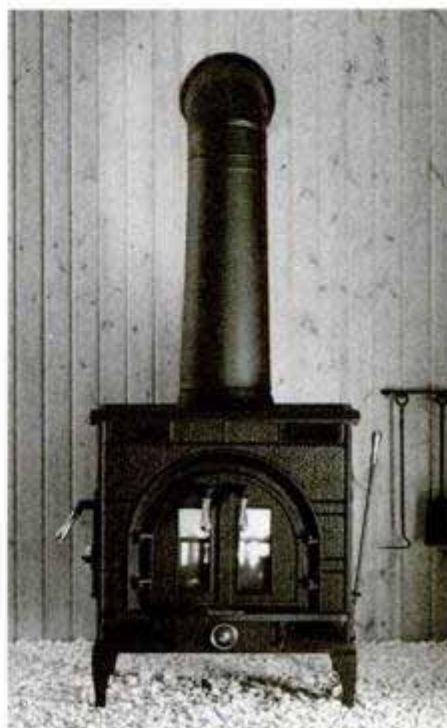
chased to make a stove useable. Our list of options makes quick reading. A Corning Catalytic Combustor to reduce both creosote build-up and pollution (as much as 90%) and increase combustion efficiency (up to 50%). A 100 cfm dual-speed fan (standard on inserts) enhances convection airflow fivefold. A flue adapter facilitates mounting pipe in tight quarters. A decorative brass rail and mitten rack complete the stove options. All else is standard, including a 30-day money-back guarantee, 3-year warranty and delivery to your door.

FREE CATALYTIC COMBUSTOR THIS FALL

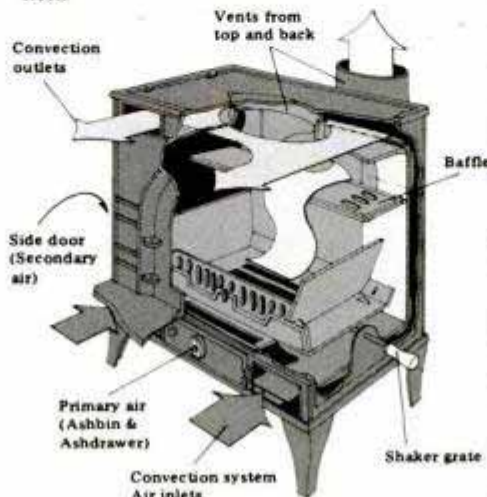
To introduce our line of all-catalytic adaptable stoves, we will be giving away a Corning Catalytic Combustor absolutely free with each stove purchased this fall. This year we re-engineered every one of our stoves so that they would be capable of catalytic combustion by the simple addition of a catalytic element. We feel the astounding results achieved by the Corning Combustor, in terms of improved efficiency, cleaner air, and stove safety, warrant everyone having a catalytic stove now. To help make this attainable for everyone, and encourage use of the safest, cleanest stoves ever made, we will be including a catalytic combustor free with every Consolidated Dutchwest stove purchased this fall. Write or call us today for details.

WRITE, OR CALL TOLL-FREE
1-800-225-8277
(IN MASS. 617-747-1963)

BUILT WITHOUT COMPROMISE SO YOU WON'T HAVE TO.



Left: The Federal Convection can be converted from use with wood to coal in less than a minute.
Center: An ashbin and tray provide for easy removal of ash.
Right: Palladium-coated combustor in the Catalytic Federal Convection increases combustion efficiency while providing for cleaner, smoke-free burning of wood.



SEND FOR YOUR FREE INFORMATION PACKAGE

Please send me your FREE 5-part information package, including 48-page color catalogue, "Stovebuyer's Guide," pricing, and details of your free Corning Catalytic Combustor offer.

I plan on purchasing a stove:
 for use within the next 60 days
 for use this season uncertain

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Or, you may call (toll free) for your free catalogue, 1-800-225-8277 or 1-800-722-5556 (in Mass. 617-747-1963)



Box 1019, Dept. 4PM8, Plymouth, Mass. 02360

THE PM WORKBENCH



Top-of-the-line hacksaw

It isn't often that a manufacturer improves a simple handtool enough to merit attention, but that is exactly what Nicholson has done with the hacksaw. The result of the company's efforts is the Nicholson Model 12P (\$19) high-tension hacksaw.

The saw houses an adjustable spring-loaded mechanism in the handle that provides superior blade tension, which means straighter cuts and longer blade life.

Additional features include an enclosed handgrip, in-frame spare blade storage and permanently mounted



The all-steel saw frame offers comfort with easy operation (above). Hollow upper frame stores spare blades and converts easily to a jab saw (top, left) whenever you need to reach tight spots. When you change blades, you just have to release the spring-loaded catch in the hacksaw handle (left).

blade pins that can't fall out—a common problem with most hacksaws.

Also, the 12-in. blade can be mounted at 45° and extended from the upper

frame for use as a jab saw. For further details and information, you should contact Nicholson, Box 728, Apex, N.C. 27502.—J.T.

Finding the lost arc



High-Intensity lamp mounted atop welding helmet enables the welder to see the work and electrode clearly before striking an arc.

The Vu-Light welding system by Conray Inc., 105 W. Church Ave., Clinton, Tenn. 37716, employs a high-intensity lamp mounted on a welding helmet for viewing the workpiece and electrode through the protective shade. The extra illumination increases eye safety dramatically, especially for novice welders, since there's no need to hold the welding rod close to the work before flipping the helmet down. This prevents the possibility of seeing inadvertent arc flashes. A power transformer reduces standard 110 v.a.c. to 14.5 volts for extra protection from shock. It's available for \$99.50 postpaid.—J.T.

Electronic sabre saw

Sears has incorporated the precision and reliability of solid-state electronics into the Craftsman Model 1840 electronic sabre saw (\$99). The saw features a speed-indicator with 20 settings for selecting blade speeds up to 3,000 strokes per minute. Electronic feedback maintains selected speed under load.

Other features include an auto-scrolling mechanism which rotates the saw blade 360 degrees, a reversible base with a second, smaller blade opening for splinter-free cuts and a blade clamp that accepts broken blades. It's available at larger Sears stores and through their Power and Hand Tools catalog. For details contact Sears, Roebuck and Co., Sears Tower, Dept. PM703, Chicago, Ill. 60684.—J.T.



With analog electronic feedback, sabre saw maintains the selected speed, even under loaded conditions.

Info for homeowners



Free catalog offers publications which cover all phases of home building, financing and remodeling and energy saving ideas.

While visiting many of the 700 exhibits on display at the 40th annual National Association of Home Builders (NAHB) convention in Houston earlier this year, I discovered a valuable source of information for homeowners—the NAHB bookstore. The NAHB offers more than 70 publications (ranging in price from \$2 to \$67) under such headings as Construction and Design, Energy and Solar, Land Use and Development and Remodeling and Rehabilitation.

For a free catalog (while supplies last) of the publications currently available, write to: Publications, NAHB, 15th and M Sts. N.W., Washington, D.C. 20005.—J.T.

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.

ONLY NISSAN HAULS A TON.



NISSAN HEAVY-DUTY LONG BED.

Meet the weightlifting champ of the compact class. This tough hunk hefts a bigger payload than any other compact and many full-size pickups: 2,050 pounds of cargo and passengers.

Plus:

• Nearly 7½ feet of cargo bed wrapped in double walls of steel.

- Most powerful standard engine of any compact truck.
- 5-speed overdrive and ventilated power front disc brakes, standard.
- 3-across seating, with more legroom than Toyota.
- Power steering with tilt column, standard.

• Tailgate lowers 90°/180°; removes

Pick your hunk from a whole line of Nissan workhorses, including the only Cab & Chassis in the class with factory-installed dual wheels.

Now that's Major Motion.

AT YOUR DATSUN DEALER.

COME ALIVE, COME AND DRIVE

LONG BED

MAJOR MOTION
FROM NISSAN





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

5 mg. "tar", 0.4 mg. nicotine av. per cigarette. FTC Report FEB. '84

THE TASTE OF SUCCESS



ULTRA LIGHTS

VANTAGE

*Great Taste with Ultra Low Tar.
That's Success!*

SCIENCE WORLDWIDE



New railroad barriers break sound



Calmzone barriers are being tested at commuter railroad tracks near Los Angeles (left). The structures (right) stand less than four feet high. Made of synthetic resin, the tapered and ribbed barriers are designed to damp and reflect sound waves.

Damping noise near railroad tracks and highways is a difficult task. The most practical solution is to erect a very tall absorbent barrier. But people who live near the barriers object because they block out the sun and spoil landscapes. Now, Bridgestone has created a sound barrier system made of synthetic resin that does the job of a tall barrier but stands less than four feet high. The "Calmzone" wall is tapered and ribbed to collect sound waves and reflect them outward after damping. The combined action sharply reduces noise. The Federal Transportation Department is testing new barriers along commuter lines near Los Angeles this summer.

Wood research yields secrets of dry rot

A great enemy of wood exposed to the elements is dry rot. Its onset often goes undetected until the wood is so badly damaged that large parts of the structure have to be rebuilt. But new research in Britain, reported in the journal *New Scientist*, may provide some answers. Dry rot is caused by a fungus called *Serpula lacrymans*. The British

researchers say these spores multiply faster than rabbits—a reproducing sample of the fungus can produce 50 million serpulæ per minute for several days. The offspring in turn multiply as fast. Thus, once dry rot begins, it can spread at lightning speeds.

Preventive measures include applying generous helpings of laundry

bleach to the wood several times a year—at least once each season. Spraying fungicides around the edges and corners of the wood will also stave off the fungus. Wood, the researchers say, should be inspected regularly. At the first sign of dry rot, the affected wood should be cut away and the entire structure sprayed with a fungicide.

Engineering help

If you're planning to remodel or retrofit your home to take advantage of solar energy, the Federal Energy Department wants to help you. FED engineers will answer your questions and make suggestions if you call them toll-free at 1-800-428-2525. In Montana call 1-800-428-1718. Consultations are free.

large numbers of prehistoric animals. The star, according to the latest theory, no longer poses a threat to earth.

Alcohol as medicine

Patients suffering from multiple sclerosis or other degenerative nerve diseases may soon be given a couple of

shots of whiskey each day to reduce tremors. Two Loyola University School of Medicine researchers gave 25 middle-aged male patients intravenous feedings of ethyl alcohol each day. The feedings were about the equivalent of a glass of wine. The patients showed no sign of tremors for several hours after each feeding.

Is sun's twin gone?

Several astrophysicists, working independently, have proposed that our sun once had a twin that either fell apart or was flung out of the solar system into the middle of the Milky Way galaxy. The twin star wouldn't be unusual. Most stars have at least one, and often two or three companions.

The scientists from Lawrence Livermore Labs, Lawrence Berkeley Labs, Princeton University and the University of Chicago propose that the twin star passed through a breeding ground for comets near Pluto every 26 million years. The pass caused a shower of comets to hit the earth and wipe out

Advanced robots in the laboratory

Pennsylvania State University engineers hoping to develop advanced ro-



Penn State's unique minirobot has telescoping arms and lifts a 10-pound object.

bots for industrial use have built a lab filled with miniature robots. "Unlike other systems which use plastic or nonrigid metal models that are subject to breakdowns and inaccuracies, ours will use industrial-grade components to build actual tabletop manufacturing systems," says Paul Cohen, Penn State engineering professor.

Among the unique pieces of equipment in the lab is a robot whose arms telescope out to three feet. It can lift a 10-pound payload and will be used to assist engineers in their design of machines intended for heavy equipment assembly lines.

PM

MONROE GAS-MATIC.[®]

THE SHOCK THAT SHOULD'VE BEEN ON YOUR CAR IN THE FIRST PLACE.

Now there's a replacement shock that's so superior, so advanced, you'll wonder why it didn't come on your car in the first place. Monroe Gas-Matic. The most advanced shock we've ever made.

ADVANCED DESIGN.

Gas-Matic features a nitrogen gas charge (1), and a Teflon/steel priming valve (2), that drastically reduce aeration for less shock fade. This advanced technology allowed us to open up the valves (3) for reduced ride harshness.



The results are dramatic.

In comparison testing to conventional shocks, Gas-Matic handles better. Rides better. And gives you greater control without sacrificing comfort.

The conventional shocks didn't even come close.

Consider this: Gas-Matic improves handling by reducing body roll as much as 14%. It reduces shock fade up to 43%. And reduces ride roughness and vibration up to 63%.

SO SUPERIOR, GAS-MATIC IS PREFERRED 3 TO 1 ON ALL ROAD SURFACES.

We built Gas-Matic to be the best. On every type of road surface. In a recent

consumer ride test that included potholes, washboard bumps, railroad tracks, curves and a slalom course, Gas-Matic was preferred 3 to 1 over conventional shocks.

GUARANTEED TO GIVE YOU THE BEST RIDE EVER.


The best shock we've ever built deserves the best ride guarantee in the business. And that's what we gave it.

"If in 60 days you don't agree Gas-Matic shocks or struts give you the best ride ever, we'll replace them—at no charge—with any comparably priced shocks or struts."*

So if you want a better riding, better handling car, get the shock that should've been on it in the first place.

Get a set of Monroe Gas-Matic shocks or struts.

*See retailer for details.

Monroe Auto Equipment 
Division of Tenneco Automotive



GAS-MATIC.[®]

THE MOST ADVANCED SHOCKS AND STRUTS
MONROE HAS EVER MADE.

IT PULLS MORE THAN ITS OWN WEIGHT.



A Kubota tractor has lots of pull. It pulls a rotary tiller, disc harrow, front loader, box scraper, mower, cultivator, plow and more than 40 other matching tools.

Of course, not every Kubota tractor pulls every one of these implements. But with the widest selection of tractors under 40 hp and matching implements, you're sure to find the combination you need.



Whatever that is, Kubota tractors and implements are made for each other.

And our implements work even harder because of the special features built into our tractors. Like a fuel-efficient diesel engine. Four-wheel drive. Power steering. Three-point hitch with position and draft control.



On some models, shuttle-shift.

Stop by your Kubota dealer. He can tell you all the reasons why Kubota tractors and implements pull ahead every time.



Tractor Models	HP	CYL	Choice of Transmission
B5100	12*	2	Standard
B5200	13*	3	Standard
B6200	15*	3	Standard
B7200	17*	3	or
B8200	19*	3	Hydrostatic
PTO HP			
L235	19	3	Mechanical shuttle-shift
L245 HC	21*	3	Standard
L275	23	3	Mechanical shuttle-shift
L305	26	3	Standard
L345	29	4	Standard
L355 SS	29*	4	Hydraulic shuttle-shift
L3750	36*	5	8 x 8 or
L4150	40*	5	Hydraulic shuttle-shift

*Manufacturer estimate

 **KUBOTA**

Nothing like it on earth.™

APPLIANCE CLINIC



Disposer won't run due to food buildup

I have a Frigidaire garbage disposer, Model FDF-2, serial No. 3177826. We close up the house for three months in the summer and go to Maine. The problem with the disposer is that it seizes up over any extended period of time and it's a rough job breaking the seal loose upon our return. Most disposers have the same "seal" principle so I am looking for an answer to lubricating the appliance in order to avoid this problem.—(Name Withheld)

I don't think you have a seal problem.

The trouble may be due to not allowing sufficient water to run through the disposer after it has completed grinding.

After the disposer stops, there still can be a soft composition of foodstuff left in the disposer. If this food is not flushed with water and is left to stand for an extended period of time, the composition becomes hard like a rock. It freezes the turntable to the grinding ring, preventing the motor shaft from turning.

Sometimes this problem will occur if a dishwasher is hooked up to a disposer. The dishwasher discharges soft food into the disposer. If the disposer unit is not used for a long period, the hardened food can cause it to seize.

To prevent food hardening in the unit after you have been using the disposer and grinding the entire load, shut off the unit. Then run a good stream of water through the disposer for 30 seconds or more. This should rid the disposer of the buildup.

Dryer doesn't stop

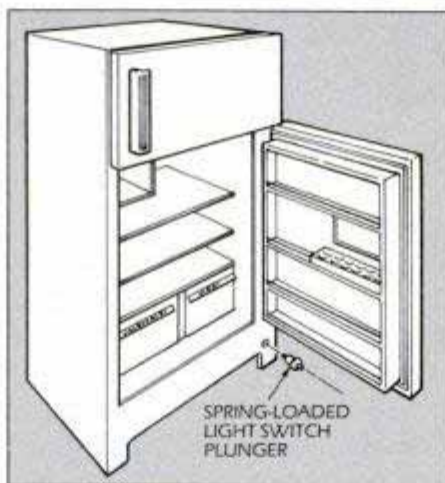
My problem is with my Kenmore gas Heavy-Duty Plus dryer with a solid-state automatic sensor, model No. 110-87181100, serial No. F11705179. The dryer doesn't shut off automatically as it should. In the "timed" position, the timer doesn't move. Also, in the "cotton/sturdy" position, the timer knob doesn't move toward the off position; hence there is no buzzer sound to indicate that the clothes are dry. The buzzer does work when I rotate the timer knob manually. Although I suspect the timer, I'm not sure that there might not be something wrong with the sensor or the solid-state board.—Jim Tucker, Boston, Pa.

I go along with your diagnosis. When you set the timer knob on your model dryer to the timed position, the automatic electronic sensors are out of the circuit. The timer should run for the time you choose, then advance and shut off automatically. When the timer doesn't advance, this will usually mean that the timer motor or the mechanism in the timer is defective and should be replaced. Or possibly a wire has become disconnected from the motor.

Refrigerator switch repair

I have a Westinghouse Frost-Free/18 refrigerator, serial No. RJ204478, model No. RJJ87LT9. The spring-loaded plunger light switch is damaged and I would like to know how to replace it.—Gilbert Luedke, Greenfield, Wis.

The first thing to do is to get the replacement switch, which is Westinghouse part No. 0-71027. It costs about



The spring-loaded plunger light switch on this Westinghouse refrigerator is removed by pulling it straight out with pliers.

\$7.50 plus tax. You can buy it at any White Westinghouse Service Co. or at an appliance parts distributor.

Once you get the switch, unplug the refrigerator and open the refrigerator door, then grab the old switch plunger with pliers (see drawing). Pull the plastic plunger straight toward you. The switch should come in one piece. The switch connector and wires should stay in the foam insulation. If the plunger is broken off, you will have to use a putty knife to pry behind the switch and work it out gently.

To install the new switch, look into the hole with a flashlight. Notice the location of the connectors. Push the new switch in the hole, making sure the connectors line up with the switch. Plug the refrigerator back into its power source and try the door.

Strange odor

I have a 13-year-old Tappan gas range, model No. 36-1049-00, with a continuous clean Modern Miracle oven lining. Lately I have noticed an odor coming from the oven vent. When I turn the oven on to heat, the odor gets very strong and burns the eyes and nostrils. The pilot is on constantly so I can smell the odor through the oven vent all the time. Could you tell me what is causing this? I have never used any abrasive cleaners on the liners. No repairman has been able to determine the cause.—Mrs. E. R. Gust, Kenmore, N.Y.

Whenever you get an eye-burning sensation out of a gas range, the first thing to look at is the oven burner flame. It should be blue and have a sharp cone shape at the end of the flame. If the flame is yellow and rolls lazily around the burner, this means that the burner is starving for air. If you suspect the burner flame is causing the problem, ask your local gas company to adjust the burner and check the orifice adjustment.

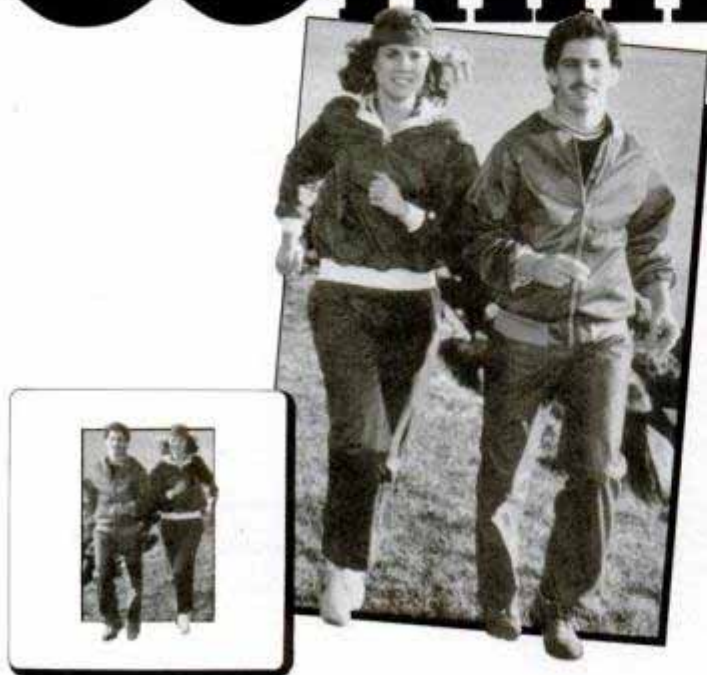
If the flame is okay, check the insulation around the oven. Something may have spilled over in the oven or on top and worked its way into the insulation.

There's a remote possibility that a rodent has climbed into the insulation and made its home there. To check this, remove the range body sides and inspect the insulation carefully. **PM**

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

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PM ELECTRONICS MONITOR

Apple's latest seedling

In a bid to make its widespread Apple II computers a permanent fixture in the world, Apple has just introduced the IIc, a portable version with no expansion slots, but lots of goodies inside the case. The keyboard is basically the same as the earlier II, except that it's more shallow, so it makes the package thinner. Big design surprise: a switch that changes the keyboard from standard QWERTY to the Dvorak, a key layout supposed to be much faster to use unless you're already an experienced touch-typist.

Inside is a 65C02 microprocessor, a low power consumption and faster version of the old standby 6502. There's 128K of RAM packed in, and on the right side is a slot for inserting regular



Apple IIc can be purchased with a monitor. The unit is compatible with 95 percent of Apple software.

5 $\frac{1}{4}$ -inch floppy diskettes. The disk controller is built into a new large-scale integrated circuit on the motherboard, and will handle a second disk drive plugged into a connector in the back.

The machine is said to be compatible with about 95 percent of the existing

Apple II software, and will run games as well as more serious programs. A fold-down flat-panel screen will be available for the slim machine soon. In the meantime, a weird-looking monochrome monitor is available for \$199. Or you can plug the IIc into any standard TV with the external TV modulator/adaptor supplied.

Many features are standard equipment in the streamlined IIc, including an 80/40-column display circuit and a mouse/joystick port. One shortcoming: Because there are no expansion slots, people using CP/M business software on their IIe computers won't find the IIc compatible. But inevitably, someone will come out with a plug-in CP/M adapter soon. What it will do to the IIc's portability is another matter. The basic IIc is \$1,295.

VCR made simple

In spite of the wide acceptance and popularity of VCRs, there still are folks who won't buy one because they believe that you have to be an electronics engineer or a B-52 pilot to operate one—especially if it is one of the programmable video cassette recorders. To combat this programming paranoia, the General Electric Co. has just introduced the Visual Programmer VCR.

You control the entire programming process with just four buttons—UP, DOWN, LEFT and RIGHT. As you program



The Visual Programmer feature is available on two new GE VCRs. Four buttons control all of the programming functions.

days, times and channels—you can do up to eight events 21 days in advance—all the information appears on a digital display. If you make a mistake while programming, you don't have to reset

the entire program. You can correct the mistake and the rest of the program remains intact. This is a good idea and one that should go a long way toward helping many people overcome their fear of VCRs.

GE's policy of not setting manufacturer's suggested list prices for any of their products precludes us from telling you what the two GE VCRs (models 1VCR5018X and 1VCR5014X) that have the new programmer list for. But you will probably find them at a local dealer for about \$1,000.

Big bass

Most bookshelf speaker systems fail to deliver that deep, satisfying bass response because their small enclosures give them a relatively high (70 to 100Hz) resonance. With the use of conventional acoustic suspension speakers, frequencies below resonance roll off sharply.

Acoustic Design Group's Triad 70 speaker system uses a new concept that delivers a low end down to 24Hz \pm 3dB from a woofer unit that measures only 8 $\frac{1}{2}$ \times 8 \times 13 inches. Working with two satellite speakers that handle highs and midrange, the separate woofer with its own 70-watt amplifier is designed to operate in the

frequency area below its resonance.

The speaker's secret is a special proprietary circuit in the amp that analyzes the incoming signal and adjusts



The Triad 70 system produces bass response that belies the enclosure's size. It's better than many of the larger units.

the low frequency cutoff point of the amp to prevent amp clipping and excessive cone travel, which could damage the woofer. You get frequencies down to 24Hz most of the time. But when you crank up the volume, the variable cutoff circuit raises the lower limit of the woofer to a safe operational level.

We've heard the Triad 70 system and the sound truly belies the size of the speaker enclosures. In fact, the Triad 70 system can hold its own and even surpass the performance of many speakers on the market with much larger size enclosures. We think it's a real breakthrough system. Price is \$575. **PM**

NEW ADVANCED



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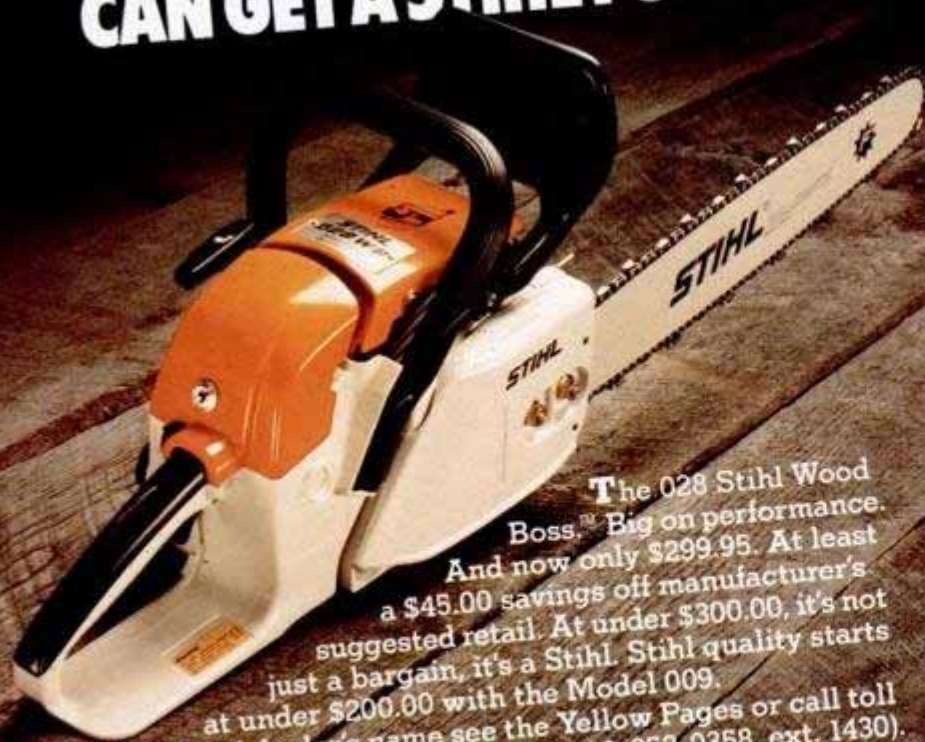


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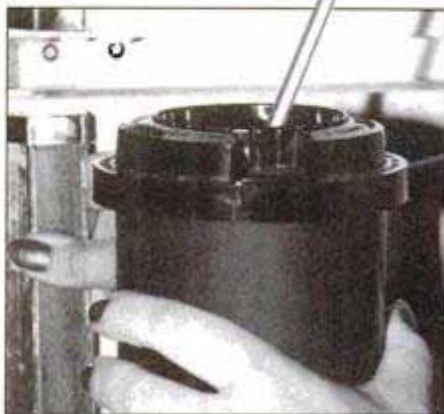


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PM PHOTO HINTS

Hot weather developing



On very hot days, if your darkroom isn't air conditioned, you can keep your developing chemicals cool enough for use by storing them briefly in the refrigerator. Small developing tanks that hold a thermometer are handy for this.

If room temperature is around 80° F., leave the chemicals in for one hour. This will lower their temperature to between 60° and 65° F., giving you enough time to develop two rolls of film before their temperature rises again to an unsafe level. For other ambient temperatures, determine cooling times by experimentation.—Bob Grewell

Simple 'mounting' trick



Here's how you can give your prize prints an attractive "mounted" look without the work of mounting them. Simply use larger paper than your image size. Printing a 5x7 image on 8x10 paper, or an 8x10 image on 11x14 paper, produces a wide natural border, as shown at right above. Use an appropriate size mask to leave the edges of the paper unexposed. The technique is especially useful when you want to submit prints to photo contests that specify unmounted entries only.

—A. Weber



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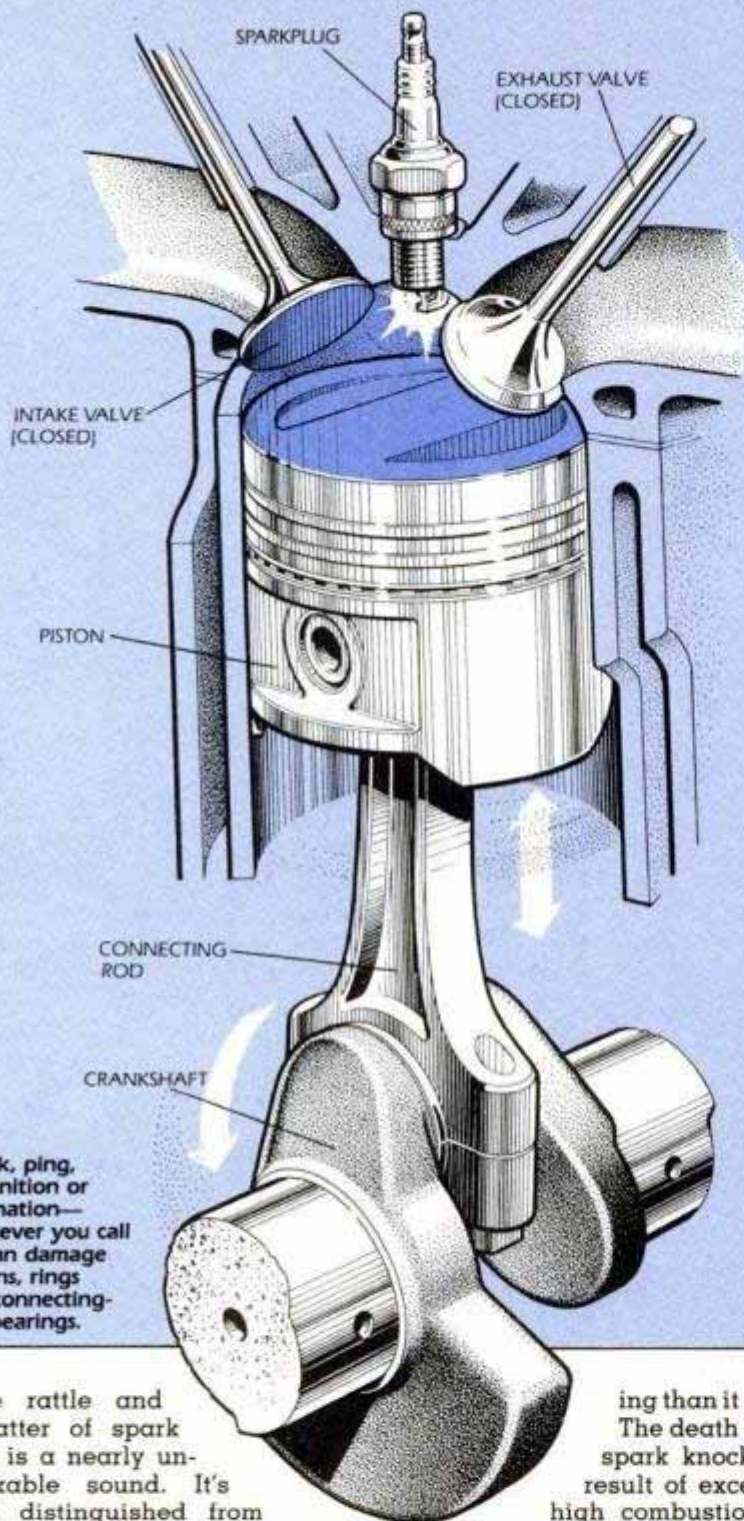
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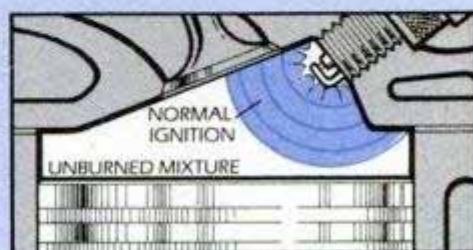
11 mg. "tar", 0.7 mg. nicotine av. per cigarette by FTC method.

Silencing Spark Knock

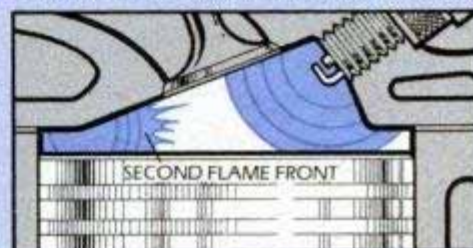
BY PAUL STENQUIST



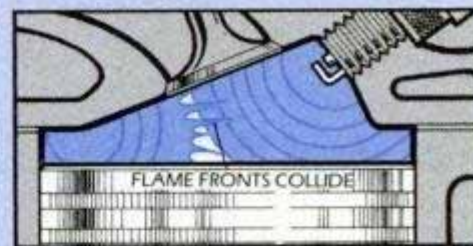
Knock, ping, preignition or detonation—whatever you call it—can damage pistons, rings and connecting-rod bearings.



In normal combustion, spark ignites the mixture, which burns evenly across chamber.



Hot deposits or compression ignition of low-octane gas may start another flame front.



When the two flame fronts collide, high pressures and temperatures are generated.

The rattle and clatter of spark knock is a nearly unmistakable sound. It's easily distinguished from mechanical noises because it isn't rhythmic like a ticking lifter or noisy bearing. "Marbles in the hub-caps" is a fairly good description, but it obviously comes from the engine.

However you describe it, the sound of spark knock is so distinctive that it's simple to recognize—but it can be a lot more difficult to eliminate.

And it's quite necessary that you work to cure a spark-knock problem just as soon as it becomes apparent, since it's a great deal more damag-

ing than it sounds. The death rattle of spark knock is the result of excessively high combustion pressure pounding the pistons.

The term "spark knock" isn't a very good one, because the condition is not always related to spark or spark timing. Sometimes it's called "detonation," but spark knock can occur without detonation taking place (as you'll see in a moment). At any rate, it's a serious problem and shouldn't be ignored.

Spark knock is usually the result of detonation. This occurs when a second flame front is ignited in the com-

bustion chamber some time after normal ignition has occurred. This means that the air/fuel mixture is burning on both sides of the chamber, creating tremendous heat and pressure between the two flame fronts. At some point this heat and pressure cause the remaining gases to explode violently—usually when the piston is close to top dead center (TDC). This violent explosion pounds the top of the piston, opening up the ring lands, damaging rings and hammering connecting rod bearings.

Preignition

Detonation can sometimes result from a condition called preignition.

CENTRIFUGAL
ADVANCE WEIGHTS



1. Check distributor advance weights for sticking caused by corrosion, lack of lubrication, or weak return springs.

This occurs when a hot, glowing spot on the sparkplug or in the combustion chamber causes the mixture to ignite before the spark occurs. Because the chamber heat builds up too soon, the compression squeeze may cause more of the mixture to ignite in another part of the chamber, causing detonation. Or the normal spark ignition may start a second flame front, again causing detonation.

The high cylinder pressures that result from preignition can cause a spark-knock noise even if detonation doesn't occur. This is particularly true if the preignition takes place well before the piston reaches TDC. The premature combustion creates a situation where the piston slams into a veritable wall of high pressure.

However you define spark knock, the result is the same: engine damage. And although some domestic carmakers called spark knock "the

sound of economy and efficiency" when they couldn't eliminate it from their engines, it's a serious problem.

Fortunately, a completely clear understanding of the causes is not necessary in effecting a cure. Spark knock is undeniably the result of either preignition or excessive chamber heat, and steps can be taken to eliminate both.

Begin by checking your sparkplugs to make sure they're the correct heat range. An excessively hot plug can cause preignition. Use a plug recommended by the manufacturer, but check an up-to-date listing to make sure the recommendation has not changed. Switching to a colder plug might help cure preignition, but may cause other driveability problems. Usually, if the correct plug runs hot enough to cause preignition, something else is not working properly and the resulting plug heat is a symptom, not a cause.

Once you're sure the correct heat range sparkplug is installed, check ignition timing. If timing is too far advanced, heat and pressure will build up too soon and detonation will result. You should be able to run as much spark advance as the manufacturer specifies, but don't exceed the factory recommendation.

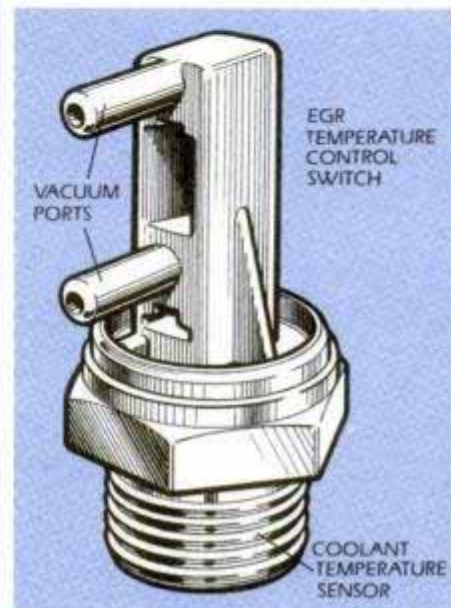
Retarding the spark from the maker's specs may eliminate knock, but this should be done only when all else fails. Retarding the ignition too far could cause valve damage, loss of power, increased fuel consumption and high emissions.

If you find that ignition timing is okay, check the centrifugal advance weights for corrosion and binding if

the engine is so equipped. These spring-loaded weights are located inside the distributor, usually underneath the rotor (Fig. 1).

Overheated engine

If ignition timing is not the source of your problem, it may be due to overheating. If you haven't serviced your cooling system once a year, do a thorough flush and a pressure test. Then refill the system with a 70



3. Temperature control switch in some systems should block flow of vacuum to EGR valve only when engine coolant is cold.

percent solution of new antifreeze.

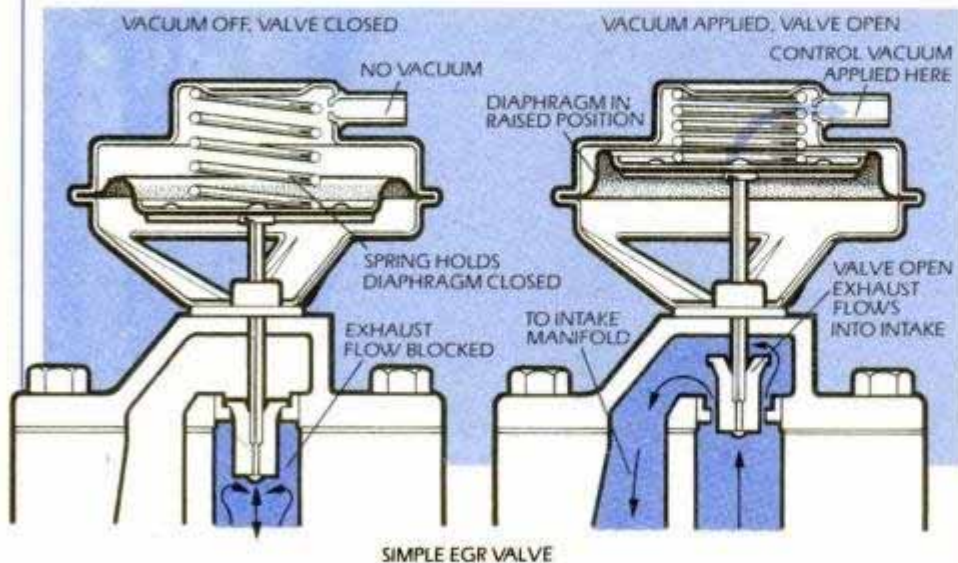
If your car has a temperature gauge, check fully warmed engine temperature and compare it to manufacturer's specs. If there's no gauge, you can install one. Simply replace the coolant warning light probe with the temp-gauge probe and mount the gauge under your dash.

If engine operating temperature exceeds manufacturer's specs, it must be lowered. The cause could be a defective or incorrect thermostat, slipping fan belt, bad water pump, collapsing hose, defective fan clutch or cooling system blockage.

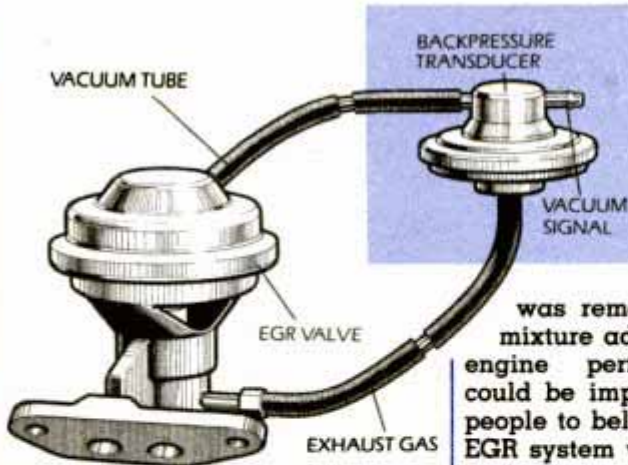
When you suspect overheating problems, begin by checking the fan belt. If the sides are glazed or the belt is more than four years old, replace it. Make sure the belt (old or new) is properly tensioned. Have a mechanic adjust it with a belt tension gauge if possible.

A thermostat can be tested by suspending it in a pan of water with a thermometer. Heat the pan on the stove and note where the thermostat opens.

Bad water pumps and collapsed



2. Simple EGR valve is operated by vacuum from the carburetor. At engine speeds of 2,000 rpm, you should be able to feel the vacuum in the hose and see the valve movement.



4. Exhaust modifications (removing catalyst, installing free-flow muffler) can affect EGR on cars with backpressure transducers.

hoses can sometimes be diagnosed by watching the coolant flow through the open neck of the radiator. Once the thermostat is open, coolant should move vigorously through the radiator.

A fan clutch is a bit tougher to diagnose, but you can get a general idea of its condition by watching the fan spin when you shut off the engine. If the engine is cold, the fan should continue to spin; with a hot engine, the engaged clutch should stop the fan when you turn the ignition off.

Severe blockage in the engine sometimes is indicated by a pounding sound that comes from the affected area. Radiator blockage can sometimes be detected by checking for cool spots on the radiator core while the engine is running. Fan position and grillwork often make this impossible. The best way to check a radiator is to have it removed, flow-tested and cleaned.

A power backflush with chemical cleaners may eliminate blockage without removing the radiator. Most garages are equipped for this, but make sure a shop has a power backflush machine before you sign for the work.

Defective EGR system

If you determine that neither engine operating temperature nor ignition timing are the cause of the spark-knock problem, it may be the result of a defective exhaust gas recirculation (EGR) system. EGR failure is probably the single most common cause of spark knock.

The EGR device routes a predetermined amount of exhaust gas back to the intake system to help lower combustion chamber temperature (Fig. 2).

The reduced temperature lowers NOx emissions and prevents spark-knock problems. In the early days of emission controls, EGR systems were basically add-on devices. If the valve was removed and the air/fuel mixture adjusted to compensate, engine performance sometimes could be improved. This led some people to believe that disabling an EGR system would *always* improve performance, but nothing could be further from the truth. Engines of the last seven years or so are calibrated around the EGR system. Removing or disabling it is usually a disaster, but some people still do it. They usually get a spark knock, and then must retard ignition timing to stop it. Performance and fuel economy end up worse than before the tinkering began.

Today's informed power plant mechanic makes EGR testing part of every tune-up or engine diagnosis. He makes sure that (1) the EGR control vacuum is present and at spec; (2) the EGR valve opens when control vacuum is supplied; (3) a flow of exhaust gas actually passes through the EGR valve when it opens.

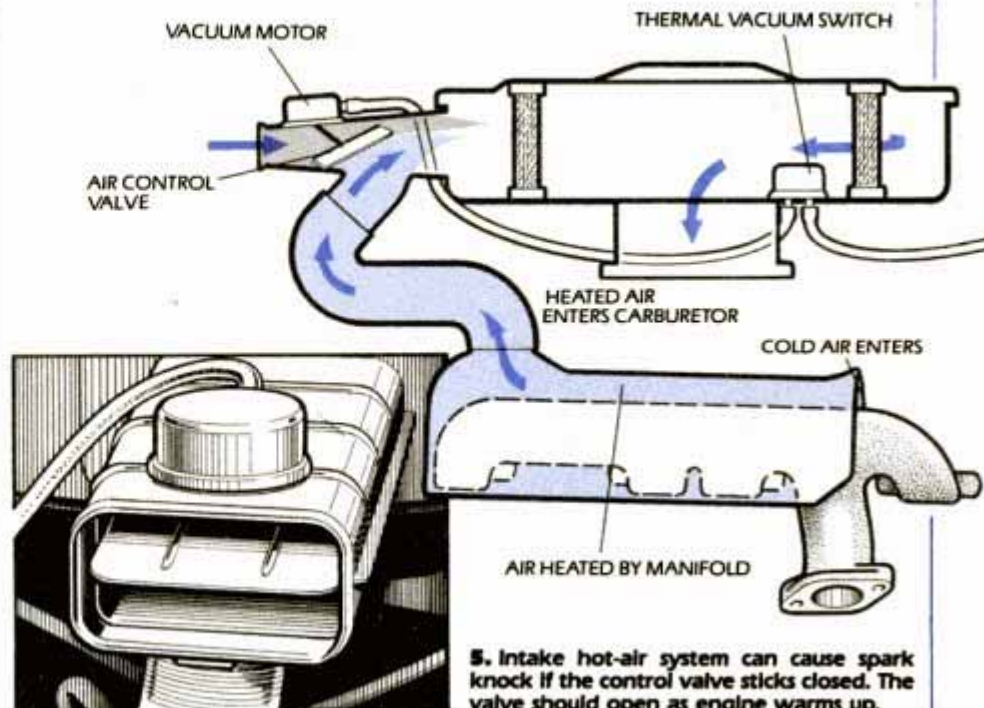
Procedures for these steps vary greatly from engine to engine, depending on the type of EGR control used. The manufacturer's service manual for your car should include complete directions. Some general

auto repair manuals, particularly the professional editions, include this information. Do-it-yourself manuals frequently gloss over or ignore this important diagnosis.

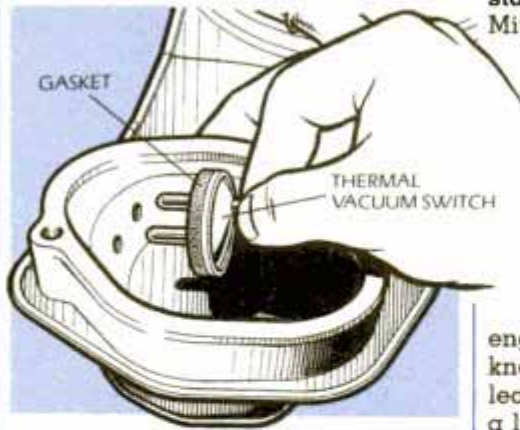
The simplest EGR valves use a vacuum signal—taken from just above the carburetor throttle plates—to open the valve. Called ported vacuum, this signal is not present at idle. A temperature control switch in the vacuum line prevents exhaust gas from being recirculated until the engine warms up (Fig. 3).

To check this EGR system, make sure that control vacuum is present when the engine is warm and running about 2,000 rpm. To verify valve opening and exhaust flow, apply vacuum to the EGR valve with a hand vacuum pump while the engine idles. The EGR flow should cause the engine to stumble, or even stall. If there is no change in performance, the valve is defective or the exhaust flow is blocked. Feel the underside of the valve diaphragm while vacuum is applied (wear gloves if the engine is warm.) If it doesn't move, the valve is defective. If the valve appears to be opening but there is no change in idle when the valve is opened with the vacuum pump, the exhaust recirculation passages are plugged.

Other EGR valves won't open when vacuum is applied. They are regulated in respect to exhaust backpressure and vacuum (Fig. 4). Specific tests vary. Some Ford backpressure valves can be tested quite easily by revving the engine in NEUTRAL.



5. Intake hot-air system can cause spark knock if the control valve sticks closed. The valve should open as engine warms up.



6. Switch inside air-cleaner housing should shut off vacuum supply to vacuum motor as intake air warms. If not, replace switch.

Other Ford valves can be tested only after the exhaust is restricted with a socket. Some GM backpressure valves must be removed from the car for testing.

Various EGR systems

Backpressure EGR systems used on a majority of late-model Ford and GM vehicles are sensitive to changes. Some won't open if the catalytic converter is removed or burned out. Others may be affected if the muffler is replaced with one that does not meet original equipment backpressure specs. Today's cars rely on the interaction of many different systems. Tampering with emission-control components can be bad news.

There are many other systems: Some computerized vehicles use a solenoid in the EGR vacuum line for control. The computer can eliminate EGR by switching the solenoid. Others use a more sophisticated dithering solenoid to modulate EGR flow. Sometimes they are used with backpressure valves.

Some Fords and Chryslers make use of a venturi-vacuum signal to trigger EGR. This signal is strengthened by a vacuum amplifier, since it is too weak to move the diaphragm of the EGR valve on its own.

Many Chrysler products use an EGR timer that prevents EGR flow for a specific amount of time after the engine has been

started. Chrysler products with the Mitsubishi 2.6-liter four-cylinder have a complex, three-stage EGR system. Unless your car obviously has a simple ported vacuum EGR, you'll need a factory service manual for troubleshooting directions.

Vacuum leak

If you determine that your EGR system, spark timing and engine temperature are okay, spark knock may be caused by a vacuum leak. This is usually accompanied by a lean misfire.

Tiny vacuum leaks are tough to pinpoint. Try applying carb cleaner to gaskets and vacuum hose connections while the engine is idling. If idle speed increases perceptibly when the solvent is applied, you've found a vacuum leak.

A mechanic with an emissions analyzer can find leaks by closing off lines with a hose pliers while watching for a drop in emissions.

An excessively lean fuel mixture can also cause spark knock, usually accompanied by hesitation, surge or misfire. Again, an emissions analyzer helps pinpoint problems.

Excessive preheating of air or the intake manifold can also cause detonation because the incoming mixture is too near the flash point. This can occur if either the intake hot-air

system or the early fuel evaporation (EFE) system fails.

The intake hot-air system draws air from a stove surrounding the exhaust manifold (Fig. 5). On most cars it's controlled by a vacuum motor. Vacuum supply for the motor is turned on and off by a thermal switch in the air cleaner (Fig. 6). When the intake air is cold the motor closes a door in the air cleaner, forcing the carburetor to draw its supply from the stove. As intake air warms, the switch should shut off the supply of control vacuum, and the door should return to the heat-off position.

If the door remains in the heat-on position, check for vacuum at the vacuum motor when the engine is warm. If you find vacuum, the thermal switch is defective. If you don't have vacuum, the door is stuck.

EFE or manifold heat systems supply heat at the base of the intake manifold to aid in fuel vaporization when the engine is cold. Most use exhaust heat to warm the manifold. Some late models use an electrically heated grid under the carb (Fig. 7). If either system fails to shut off the heat as the engine warms, spark knock can result.

Carbon accumulation

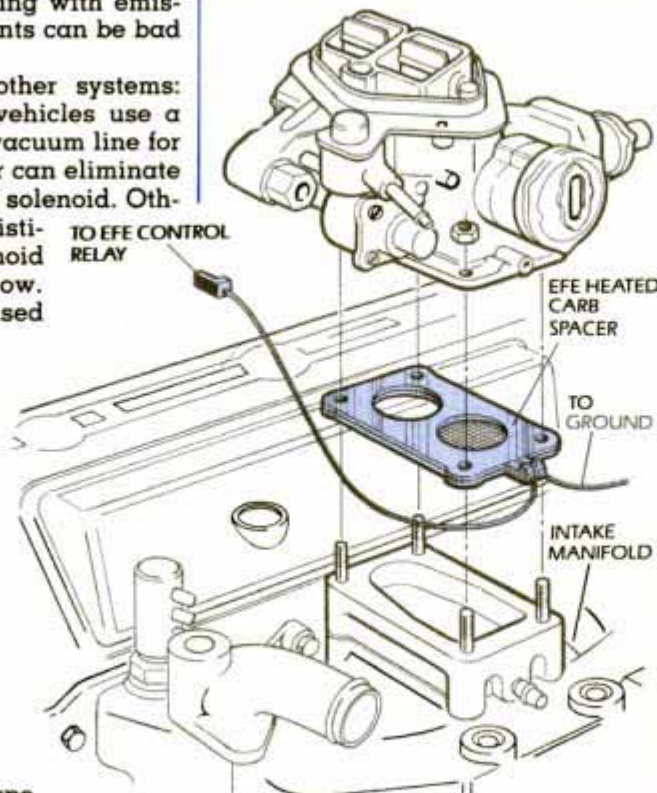
Carbon accumulation in the combustion chambers can cause detonation, due to the resulting increase in compression ratio, or preignition because of hot spots in the carbon.

GM sells a top-engine cleaner/solvent that will remove carbon from combustion chambers and pistons.

If you have eliminated all possible mechanical solutions to a spark-knock problem, a change in fuel is in order. Premium unleaded gasolines provide considerably more anti-knock protection than regular grades. Octane boosting additives may be equally effective.

In extreme cases where both mechanical solutions and fuel-switching fail, a thicker head gasket can be installed on the engine—a far better solution than retarding the spark because it won't cause other damage. This is, of course, expensive and difficult. The thick gasket may cause some loss of power and fuel efficiency, because it lowers the compression ratio. But the engine may end up being more efficient if it was constantly detonating.

The death rattle of spark knock is a warning. Don't ignore it or you'll be looking for your piston rings in the bottom of your oil pan. **PM**



7. New cars use electrically heated grid to warm cold intake air. System must shut off when engine warms up.

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We'll give you tomorrow.

(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

A MEMORABLE QUALITY.

Ford's EEC-IV* is the most advanced on-board automotive computer in the world. Here are some of the things it remembers to do for you.



1984 Mercury Topaz

Get it together—buckle up.

With the capacity to make a quarter of a million operations every second, Ford's EEC-IV can:

1. Save fuel, by making sure that your engine has the precise air-fuel mixture it needs for optimum performance. No more, no less.
2. Help your engine run better, by instantly measuring and adjusting for such external conditions as altitude, temperature, and engine load.
3. Get you off to a better start in the morning, by helping to prevent stall-

outs and reduce warm-up time.

4. Help your service technician at maintenance intervals, by keeping an electronic "diary" of your engine's performance history.
5. Perform one final quality control check on itself before the car leaves the factory, to make sure everything is working together properly.

For obvious reasons, other car companies would like to offer an on-board computer with the memory, speed and accuracy of Ford's EEC-IV. But so

far, there's no such animal.

And yet, EEC-IV is just a small part of our commitment to build the best cars and trucks we possibly can.

Come find out more about all our 1984 models, and get the details on the Lifetime Service Guarantee.**

We think a few minutes with your Ford or Lincoln-Mercury dealer will convince you of one very important thing: that Ford is, indeed, a car company to remember.

You're going to love the quality.



Quality is Job 1.

*EEC-IV not available with all engine/transmission combinations.
**Offered by participating dealers.

FORD • LINCOLN • MERCURY •
FORD TRUCKS • FORD TRACTORS

Programmable table saw

An electronic, 10-in. table saw is now available from Sears, Roebuck and Co. The 1-hp saw features programmable power-blade elevation and bevel settings which eliminate the need for crank handles. A digital display reads out the blade elevation to .005 of an inch as the saw automatically raises or lowers the blade to the programmed height. Bevel angles are displayed to $1/10^{\text{th}}$ of a degree. An elevation jog button allows you to adjust the blade .005 of an inch with each touch of the button. It's available through the Sears general catalog and at larger Sears stores for \$699. For details, write Sears, Roebuck and Co., Sears Tower, Dept. PM703, Chicago, Ill. 60684.



Electronic table saw has a touch-control panel (above) for programming blade height.



Instant hot water dispenser

The convenience of instant hot water is now available for every home kitchen thanks to the In-Sink-Erator hot water dispenser (Model H-330). A $1/3$ -gallon tank delivers 40 cups of 190° water per hour for the preparation of food and beverages.

To install the unit, first remove the sink-spray nozzle and hose (or bore a hole in the sink rim), then slip the dispenser in from beneath and anchor it with the threaded mounting nut. Attach the copper tube to the cold water pipe and plug in the power cord. It's available at hardware stores and home centers for approximately \$60. For more details, contact In-Sink-Erator, 4700 21st St., Racine, Wis. 53406.



Superior drywall tape

Manco self-adhesive fiberglass drywall joint tape is easy to apply, needs no prepping and works with new quick-drying compounds that often cause paper tape to bubble. It comes in 2-in. x 36-ft. (\$3), 180-ft. (\$9) and 300-ft. (\$13) rolls. Contact Manco, 2040 West 110th St., Cleveland, Ohio 44102.



Two new bright ideas

Two new cordless, rechargeable lights for home and shop use are offered by Black & Decker, 515 Glebe Rd., Easton, Md. 21601.

The Clamp-Light (\$25) is the first cordless, portable worklight that clamps in place leaving both hands free. The padded jaws attach to any object up to $1\frac{3}{4}$ in. thick and the lamp pivots 360° . According to the maker, the batteries sustain a charge for one hour. The Space-Light (\$20) offers up to two hours of continuous light in unwired areas such as a closet, attic, storage shed or staircase. To recharge, remove light from the wall-mounted bracket and plug it into an electrical outlet. Both lights are available at hardware stores and home centers.



Scrubbable wall paint

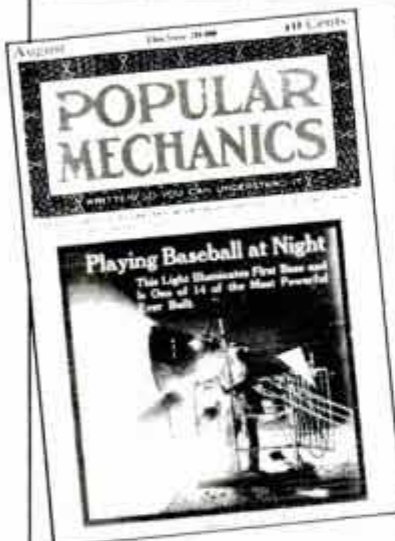
Pittsburgh Paints claims its new Wall-hide latex flat wall paint (priced at \$14 per gallon) is twice as durable as other premium flat wall paints. The Wall-hide paint line boasts easy stain removal, resistance to water spotting, surface uniformity and maximum washability without surface paint damage. It's available at home centers and all Pittsburgh Paint dealers.

For details, write PPG Industries, 1 PPG Pl., Pittsburgh, Pa. 15272. **PPG**



PM'S TIME MACHINE

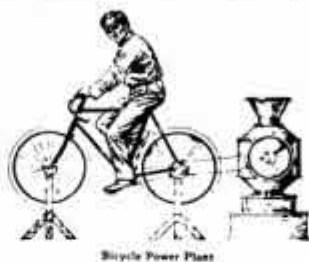
75 YEARS AGO: August 1909



Cincinnati gets night baseball.

Night baseball

A small-size fortune has been expended in Cincinnati in the construction of a remarkable illumination scheme for the National League baseball park of that city. The plant which converts night into day is composed of 14 powerful carbon lamps, fed by a 250-hp dynamo installed on the ground. The lamps encircle the field, arranged in such a way that the glare does not blind. Ten lights are arranged on five towers, and four are operated from the grandstand and bleachers.



Bicycle Power Plant

Coffee anyone?

A Kansas City grocer has an ingenious arrangement by which he grinds coffee for his customers and gets healthy exercise. He props his bicycle up, connects his rear wheel by pulley to the grinder and treads slowly.

Time measurement

Time, as a separate entity, has not yet been defined in language. Definitions will be found to be merely explanations of the sense in which we use the word in matters of practical life. No human being can tell how long a minute is; only that it is longer than a second and shorter than an hour. . . . In time measures we strive for a uniform motion of something and this implies equal spaces in equal times; so we here assume just what we cannot explain, for space is as difficult to define as time.

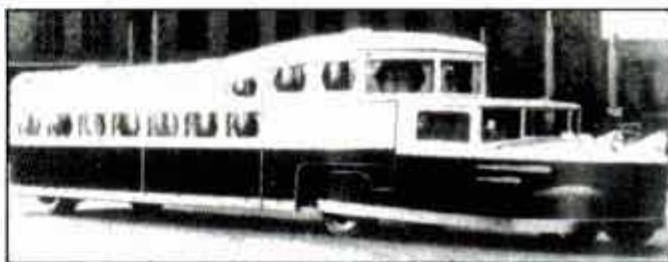
50 YEARS AGO: August 1934



Sunken treasure is discovered.

Treasure hunters

Would you like to go sea hunting for treasure this summer? An old Spanish galleon lying deep in some quiet harbor, ducats of gold, fat doubloons, pieces of eight and precious jewels trickling through its rotting sides may be calling out to you. If you have the cash to finance such a trip, you might induce Lt. Harry E. Riesenbergh of Washington, D.C., to start you off on a jaunt that would give you the thrill of a lifetime. Riesenbergh has charted caches of more sunken treasures than any other man.



A quiet coach

Engine vibration is eliminated from the passenger compartment of the articulated motor coach (above)—two units streamlined to have the appearance of a single vehicle. The convex front fits in the concave back.

Earthquake on film

The script of a recent motion picture called for an earthquake. Sets were placed on rollers and tied to the floor with heavy springs. Walls were constructed with prepared but concealed cracks.

25 YEARS AGO: August 1959



Who will reach the moon first?

Racing to the moon

The race is on. Someday soon we will hear an announcement that a spaceship, bearing men, is on the way to the moon. How soon? Will the men be Americans? Russians? Men will go simply because the Age of Space has come. The United States is preparing a kind of lob into space—a large airplane releasing a piloted smaller one (the X-15) which will zoom 100 miles up. This project and others are considered necessary probings before the moon journey.



Commercial copter

Twenty-four passengers can be seated in a new commercial helicopter that promises to make intercity travel even faster. The Vertol 107 twin-turbine craft has traveled 82 miles from New York to Philadelphia in 37 minutes.

Call for help

Shipwreck victims and downed aviators may be saved by a radio beacon life preserver that sends a preset code signal the moment it touches water. The one-watt transmitter can call rescue ships within a range of 20 miles. **PM**

Pall Mall A Step Ahead

*Step up in taste,
step down in tar*



9 mg. tar
0.8 mg. nic.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Mar. '84.

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



In Japan, where high-tech electronics are a way of life, they pay \$714.93 for an American-made radar detector

(You can get the same one for considerably less)

Even we were a little surprised. All we did was build the best radar detector we knew how. We shipped our first ESCORT in 1978, and since then we've shipped over 600,000. Along the way the ESCORT has earned quite a reputation—among its owners, and also in several automotive magazines.

Credentials

Over the past five years, *Car and Driver* magazine has performed four radar detector comparison tests. Escort has been rated number one in each. Their most recent test concluded "The Escort radar detector is clearly the leader in the field in value, customer service, and performance..." We think that's quite an endorsement.

Our Responsibility

One of the reasons for our reputation is our attention to detail. If we don't feel we can do something very well, we simply won't do it. That's why we sell Escorts directly from the factory to you. Not only can we assure the quality of the ESCORT, but we can also make sure that the salesperson you speak to is knowledgeable. And if an ESCORT ever needs service, it will be done quickly. And it will be done right.

50 States Only

And that's the reason we don't presently sell ESCORTs outside of the United States. Even in the countries that use identical radar (Japan and Australia, to name two) we know that we couldn't provide the kind of customer service that ESCORT owners expect. So we pass up the additional sales rather than risk our reputation.

"Dear Sir..."

So we'll admit we were surprised when a letter from one of our customers included an advertisement from a Japanese automotive magazine. The ad pictured an ESCORT, and the price was 158,000 yen. Our customer was kind enough to convert that to U.S. dollars. Using that day's rate of exchange, an American-made ESCORT was worth \$714.93 in Japan. Further translation revealed the phrase "The real thing is here!" and warned against imitations.



This 1/2 page ad was a total surprise.

Econ 101

Needless to say, we were flattered. We knew that ESCORT had an impressive reputation, but we never expected to see it "bootlegged" into other countries and sold at such a premium. But the laws of supply and demand are not so easy to ignore. When there is a strong need for a product, there is an equally strong incentive for an enterprising capitalist to fill that need. And apparently, that's just what happened.

The Moral

We still don't sell out of the country. And the price in this country is still \$245. The price we've had for the last five years.

Quite a deal for what the Japanese must think is the best radar detector in the world.

Try ESCORT at no risk

Take the first 30 days with ESCORT as a test. If you're not completely satisfied return it for a full refund. You can't lose.

ESCORT is also backed with a one year warranty on both parts and labor. ESCORT \$245 (Ohio res. add \$13.48 tax)

TOLL FREE 800-543-1608
IN OHIO 800-582-2696



By mail send to address below. Credit cards, money orders, bank checks, certified checks, wire transfers processed immediately. Personal or company checks require 18 days.

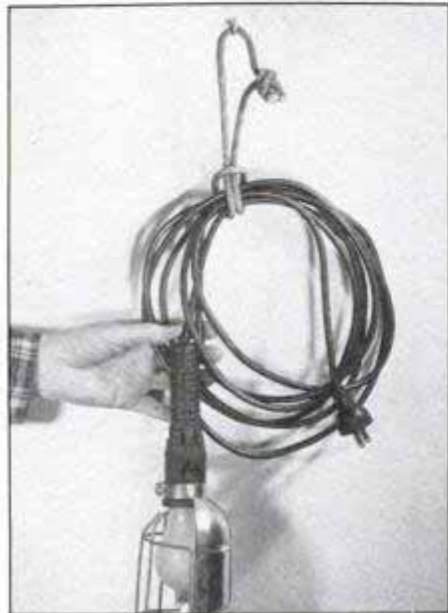
ESCORT

RADAR WARNING RECEIVER

Cincinnati Microwave
Department 100-868
One Microwave Plaza
Cincinnati, Ohio 45296-0100

HINTS FROM READERS

Hanging extension cords



To keep trouble lights and extension cords coiled when not in use, secure them with a loop of rope or twine and hang them on a hook.—*Charles F. Radtke and Walter E. Burton*

Easier sawing



A piece of paraffin wax can add muscle to your hand sawing. Use it to wax both sides of the saw in the areas that will move in the cut. The wax acts as a lubricant to reduce friction and therefore the force necessary to move the saw back and forth. Repeat the waxing whenever the saw requires more push. A chunk of wax from a glass of homemade jelly is shown being used on a crosscut saw.—*Walter E. Burton*

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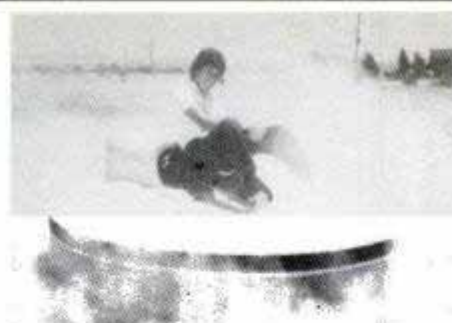


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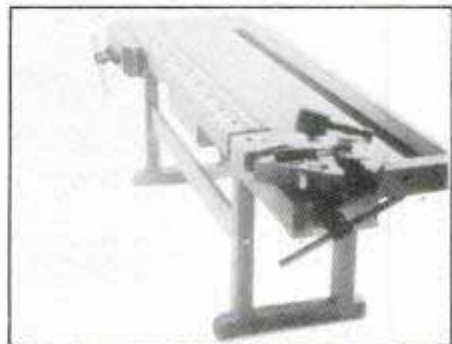
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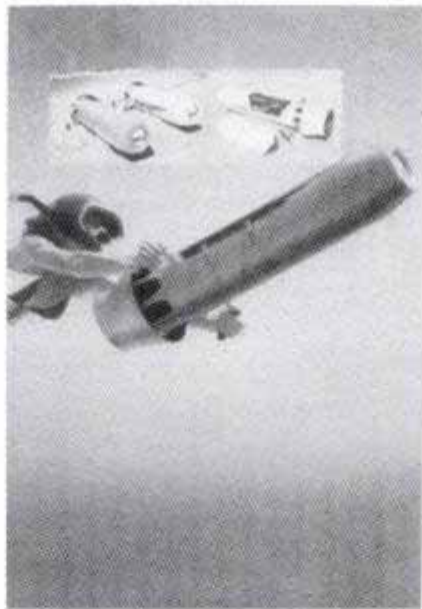
Send your name and address with check or money order payable to POPULAR MECHANICS. Mail to: Popular Mechanics, Box 1014 Radio City Station, New York, N.Y. 10101



Pegasus—Float above the ground on a 7' dia craft designed for flying. Built from plywood, this lawn mower engine powered hovercraft will run for 3 hours on a gallon of regular gas. Cruise on air. Complete plans and photo illustrated instruction booklet. (PL-1800-\$9.95)



Classic Workbench—Build this classic European workbench for half the price of the factory version. Dovetail joints give the drawer super resistance to racking. Our drawings will show you how to make these joints. In addition you get detailed plans, instructions and material list. (PL-1748-\$5.95)

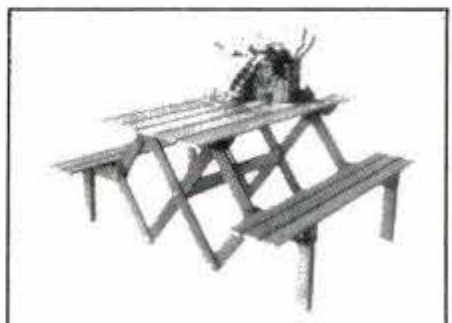


Scuba Tow Set—Leisurely explore beneath the sea behind the single engine scuba tow. Glide underwater at about 3 mph using scuba gear or just a snorkel. Complete plan includes full size cutting patterns and an illustrated instruction manual. (PL-1747-\$10.95)

Popular Mechanics is a Publication of Hearst Magazines a Division of The Hearst Corporation.

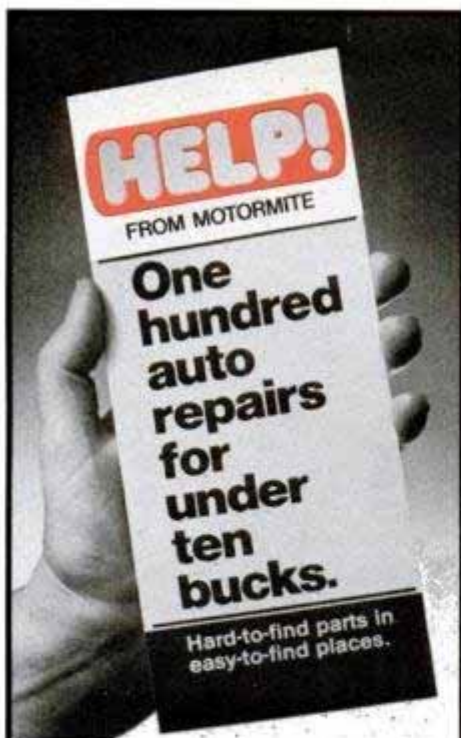


Adirondack Lawn Furniture This traditional Adirondack furniture is durable and attractive. Crafted of hardwood, each piece is carefully sanded, then assembled with water-resistant glue, sealed with wood preservative and painted—all to make it stand the rigors of outdoor use. Illustrated plans and material list available. (PL-1751-\$5.95)



Stowaway Picnic Table is clever one-piece design that folds like scissors for easy storage when not in use. Easy to build. (PL-1716-\$3.95)

COMING NEXT MONTH



Go ahead
HELP!
yourself.

Even if you've never done any work on your car yourself, HELP! makes it easy to take care of those pesky little repair jobs. Like broken window-crank handles, loose arm rests or noisy starters, to name a few of hundreds for which HELP! has answers. No more weekends hunting parts in auto junkyards.

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President Ronald Reagan tells how we'll launch a manned space station as early as 1992—the first step in a bold plan to open new frontiers in space.

HOTTER DETROIT CARS FOR '85

Chrysler and Dodge field a 150-hp turbo sports sedan that rivals Audis and BMWs in performance.

IS YOUR HOUSE LEAKING HEAT?

Here's a survey of likely heat-loss spots, plus tips on making the most of an energy audit.

PM'S GUIDE TO HOME INSULATION

Our comprehensive chart helps you choose the best insulation and the right amount for sure protection.

HIGH ADVENTURE IN BRAZIL

Detroit Editor Dan Ross takes you on a wild ride by Land-Rover through the jungles of Brazil.

HOT NEW MOTOR SCOOTERS

Japanese imports are reviving the scooter craze with flashy models that sport digital dashboards, pop-up headlights and even heaters.

MAKE YOUR OWN BUTCHER BLOCK

Here are easy ways to make handsome butcher block tops, plus a handy roll-around cart.

CARS YOU CAN'T BUY HERE

Unusual imports, sold only in Canada, include economy compacts selling for \$4,000 to \$5,000.



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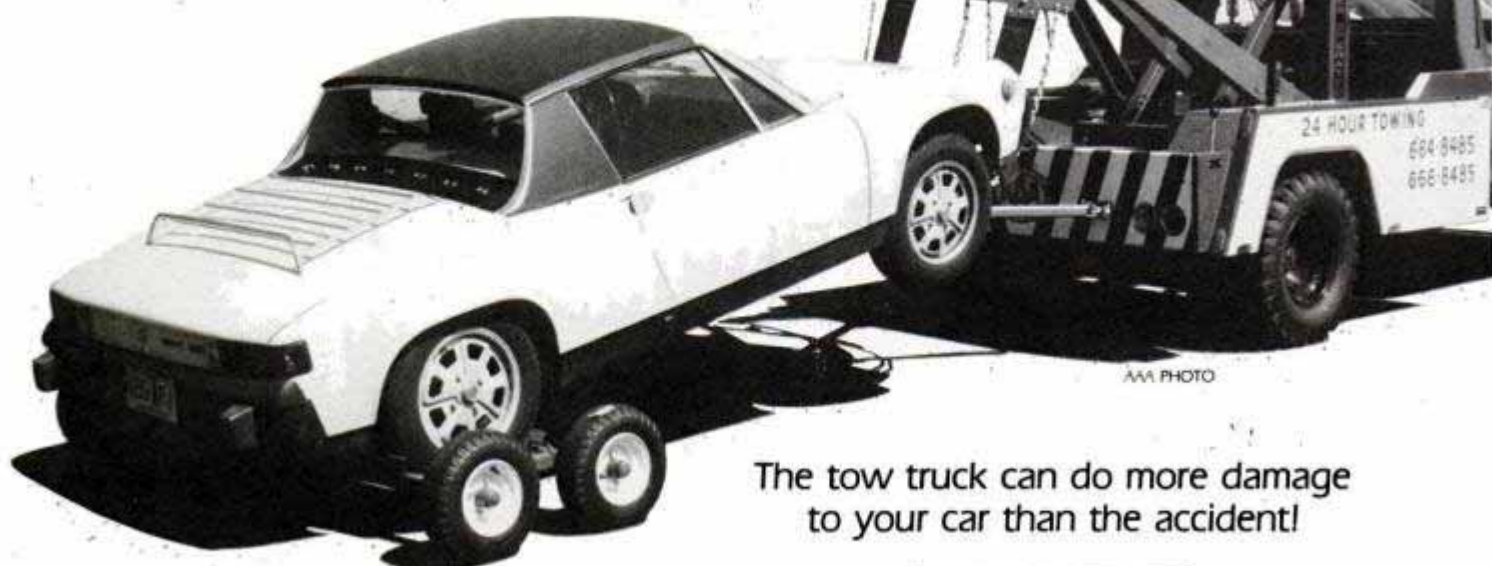
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What To Know BEFORE They Tow Your Car

Dolly protects drive train when a car must be towed on its drive wheels. Mid-engine or front-drive cars with transaxles often need a dolly.



AAA PHOTO

The tow truck can do more damage to your car than the accident!

BY MORT SCHULTZ

Unless you're a member of a motor club, such as the American Automobile Assn. (AAA), you may be putting your vehicle on the line when you have it towed. A motor club usually protects members by holding recommended towing outfits accountable for damage they cause. But, whether or not you're a club member, you can save yourself time, trouble and money if you know the proper way to tow your particular car. You have the right to tell a tow-truck operator how to do the job, if you

happen to know he's doing it wrong.

If you want your car or truck towed to your dealer or mechanic, see if he'll come and get the vehicle before you call a towing outfit. Dealing with someone you know is best.

If you're a member of a motor club and you have to use a local towing company, check the instructions provided by your club. If you aren't a member, look under "Towing" in the classified pages for a company that's affiliated with one or more auto clubs. As a last

alternative, ask the police to recommend a reliable operator.

Once you've got a towing company on the phone, make sure to discuss the following:

- The make, model and year of the vehicle.
- If the transmission or differential is inoperable; if the vehicle has special equipment like fog lights, air dam, extra-wide tires or spoilers. On a truck, tell them if it's got a camper body, full-

(Please turn to page 68)

Tote That Dodge, And Other Tough Tows

Some vehicles are easy to tow; some are almost impossible. Here are the '84 models the AAA considers the easiest (plus a few honorable mentions) and the hardest (plus a few dishonorable mentions).

The Easiest

- VW Jetta, Scirocco, Quantum.
- Jeep CJ7, Scrambler.
- Ford LTD Crown Victoria, Mercury Grand Marquis, Lincoln Town Car.
- GM G-Body Cars (Chevy Malibu and Monte Carlo, Pontiac Bonneville and Grand Prix, Olds Cutlass Supreme, Buick Regal).
- GM B-, C- and E-Body cars (Chevy Impala and Caprice Classic; Pontiac Parisienne; Olds Delta 88, 98 and Toronado; Buick LeSabre, Electra and Riviera; Cadillac Fleetwood, DeVille, Eldorado, Seville).
- Toyota Tercel

Honorable mention: VW Rabbit, Toyota

Cressida, Ford LTD, Mercury Marquis, Ford Bronco.

The Hardest

- Exotic foreign types (Aston Martin, Ferrari, Porsche)—Not designed for towing with a sling; too low to be picked up with wheel-lift or to be winched onto a flat-bed without possible damage.
- Rolls-Royce, Bentley—Heavy; overloads common towing equipment.
- Chevrolet Corvette—Requires several pieces of lumber to prevent damage; needs dolly under ground wheels; top must be on to prevent damage as chassis flexes; too low for wheel-lift or flatbed.
- Pontiac Firebird with aerodynamic "ground effects" package—Can't be towed from front with sling equipment; too low for wheel-lift or flatbed equipment.
- Honda Prelude—Can't use sling front or rear; plastic bumpers can be damaged.
- Mitsubishi Starion—Can't use sling

front or rear since air dam, gas tank, or exhaust system may be damaged; wheel-lift or flatbed equipment should be used.

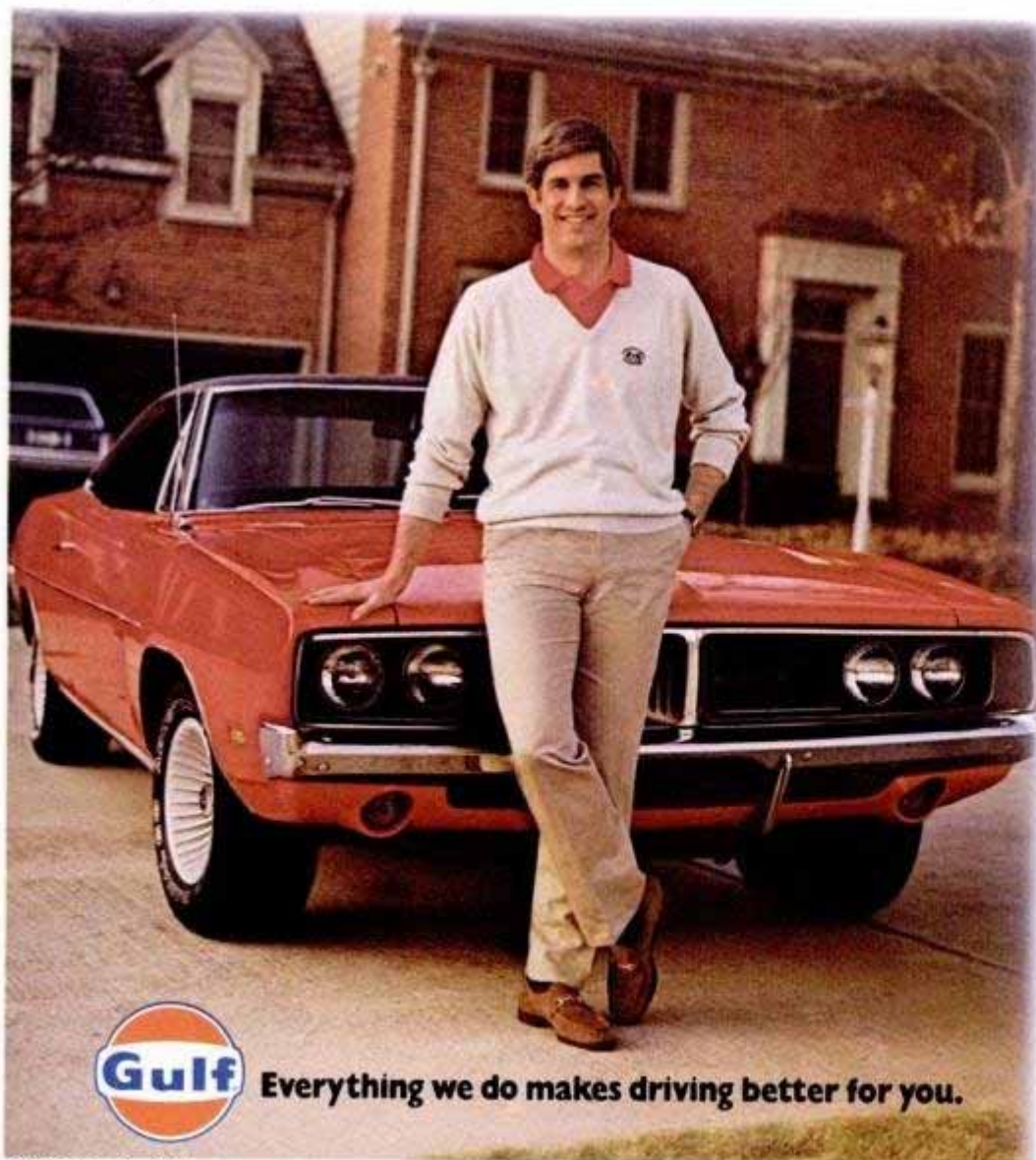
- BMW 318i/325e—Can't use sling front or rear since air dam, brake lines or exhaust system may be damaged; wheel-lift or flatbed equipment should be used.
- Mazda GLC sedan—Can't use sling up front since valance panel may be damaged; sling in rear may be used, but front wheels must be placed on dolly.
- Honda Civic—Can't use sling up front; sling in rear may be used, but front wheels must be placed on dolly.
- Pininfarina Azzurra—Can't use sling in rear; to tow vehicle from front, spoiler must be removed and 4 × 4 spacer blocks placed exactly to avoid damage.

Dishonorable mention: Alfa Romeo Spider, All Chrysler rear-wheel drive sedans, Peugeot 505 sedan, Jaguar XJ-S coupe, Isuzu Impulse.

Senior year, Dad lent me the money for this car.

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Find us in the white pages under U-Haul Center.



BEFORE THEY TOW YOUR CAR

(Continued from page 66)

load or a trailer. Providing these facts will help the company send the right equipment.

- If you have passengers with you, make arrangements for a taxi.
- Where the vehicle is located and where you want it towed.
- Price and method of payment (some firms only take cash). Find out the kind of tow vehicle the company intends to provide—sling, wheel-lift or flatbed.

Don't rely on someone else to deal with the tow truck operator. It's your vehicle—be there.

Before the tow truck arrives, know the proper towing procedures for your vehicle. Chrysler and Ford service manuals explain how to tow their cars. GM publishes a separate towing manual. Some imports may have towing information in the owner's manual. The AAA publishes a *Towing Manual* annually that you can get for \$8.95 from its Credit and Order Dept., 8111 Gatehouse Rd., Falls Church, Va. 22047. Be sure to mention the year and model of your car (you need a 1982 manual for an '82 Chevy, for example). It's a good idea to keep a photocopy of your car's towing instructions in the glove compartment at all times.

Size up the towing equipment when it arrives. The most common wrecker is the sling type. Auxiliary equipment such as a 4×4-inch crossbeam, spacer blocks or a wheel dolly must often be used with this kind of truck to prevent



AAA PHOTO

Proper sling attachment often requires a 4×4 and spacers. Each car is different.



FELIXSON WRECKER ACCESSORIES

Wheel-lift supports car by its suspension, instead of axle, bumper, undercarriage.

damage to bumpers, radiator, suspension parts, unibody frames or the transmission.

Some cars can't be lifted by a sling without being damaged, even with auxiliary load spreaders. Others can be lifted easily, but they can't be pulled at more than 5 to 10 mph without damage. The AAA manual has all this information.

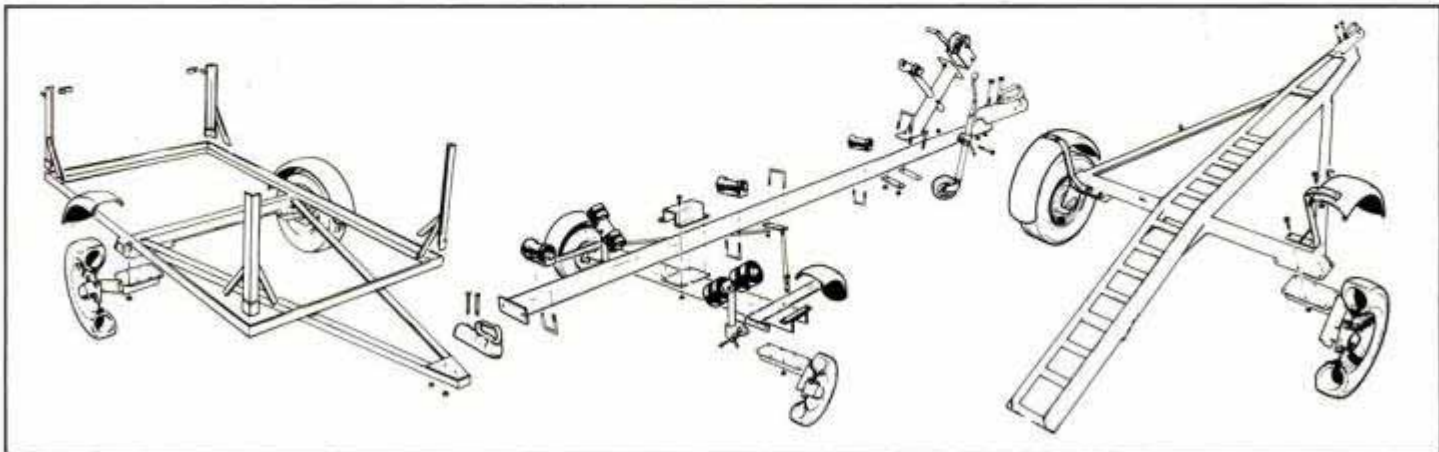
Wheel-lift and flatbed equipment is generally safer to use than a sling-type wrecker, especially for front-drive vehicles. This equipment is more expensive than a sling-type truck. If you hire a flatbed, it should have a gross vehicle weight (GVW) capacity of at least 18,000 pounds. The Ford F600 and Chevrolet C60 fall into this class.

Before the hookup, walk around your vehicle with the tow truck operator and make two lists of existing damage—one for you and one for him. Have him sign yours—you sign his.

When possible, a vehicle should be towed with its drive wheels off the ground. The transmission should always be placed in NEUTRAL and the parking brake released. (During a tow, raised wheels may hit the road; they should be free to rotate to prevent damage to the vehicle.)

If your vehicle has to be towed on its
(Please turn to page 70)

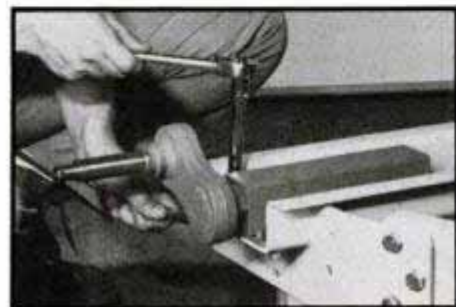
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BEFORE THEY TOW YOUR CAR

(Continued from page 68)

drive wheels and the drive train is inoperable, the drive wheels must be put on a dolly or the driveshaft of a rear-drive vehicle disconnected. If your vehicle is going to be towed on the drive wheels, make sure the tow operator knows the towing speed and distance limits recommended by the manufacturer.

If the vehicle is going to be towed on its front wheels, the steering wheel must be unlocked and secured with a special clamping device, not the ignition lock, which may break.

Sling-type equipment should not be used if a vehicle's GVW exceeds 6,000 pounds. Frame rails of pickups can flex enough when loaded to let the cab and body come into contact, causing dam-



CHEVRON INC. PHOTO

Flatbed trailer uses a winch to haul car up onto its tilt bed. No wheels touch road.

age. The operator should always tow a loaded pickup from the front, or use wheel-lift equipment.

The operator should always attach safety chains that are completely independent of lifting and towing equipment. Chains should be installed so they won't hit against lights, bumpers, painted surfaces, or other parts likely to be damaged.

The lifted wheels of the towed vehicle should clear the ground by more than 6 inches, but not be so high that the bumper on the other end hits the ground on bumps.

During and after towing

Ride in the tow truck with the operator. Make sure he observes speed and distance restrictions for your vehicle, and that he doesn't exceed 50 mph for any reason.

When you reach your destination, repeat the walk-around inspection to see if your vehicle suffered damage during the tow. If it did, stipulate in writing what damage occurred and have the operator sign the document.

When you pay for the tow, see that the operator's name is on the receipt, as well as the name, address, and phone number of the tow company. **PM**

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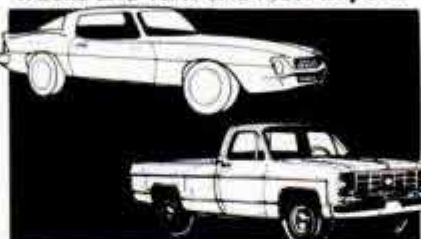
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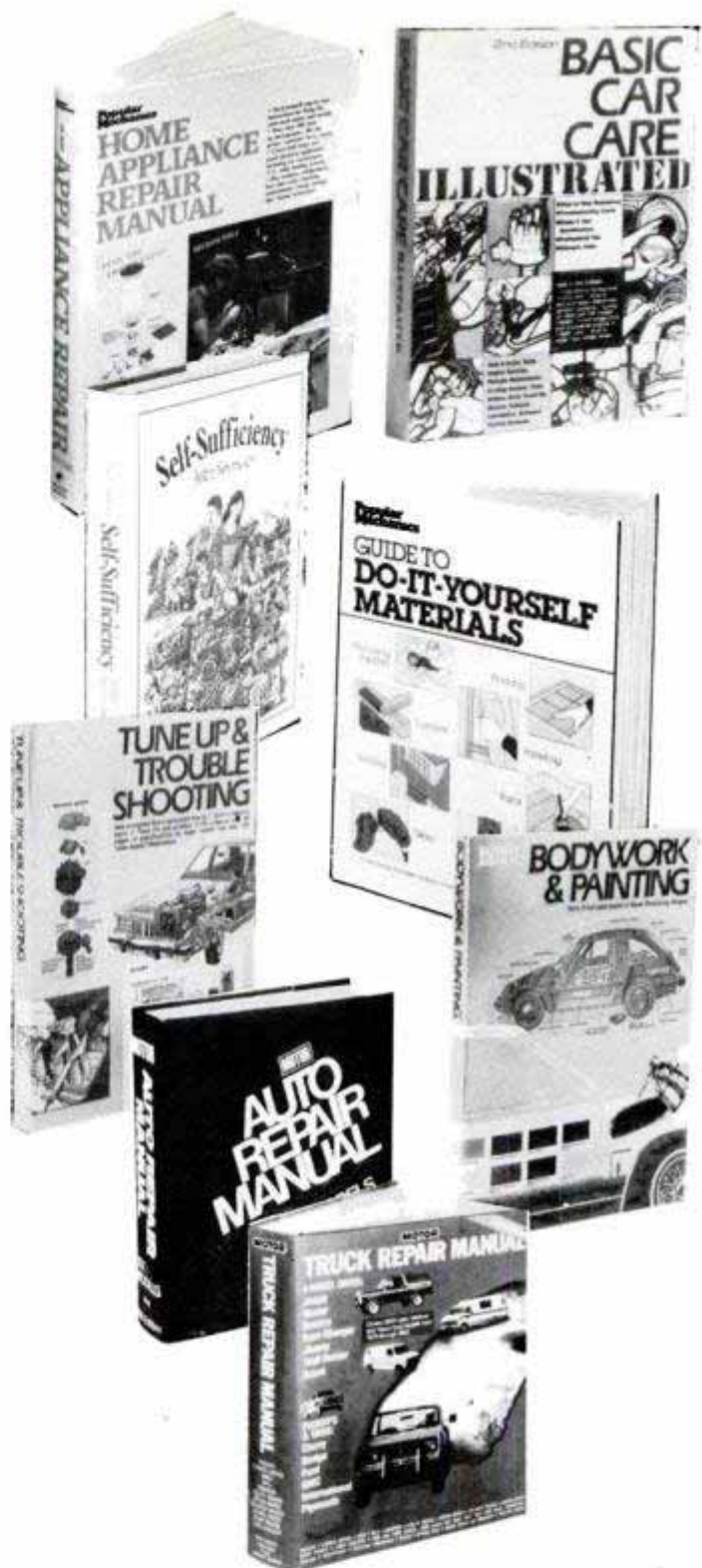
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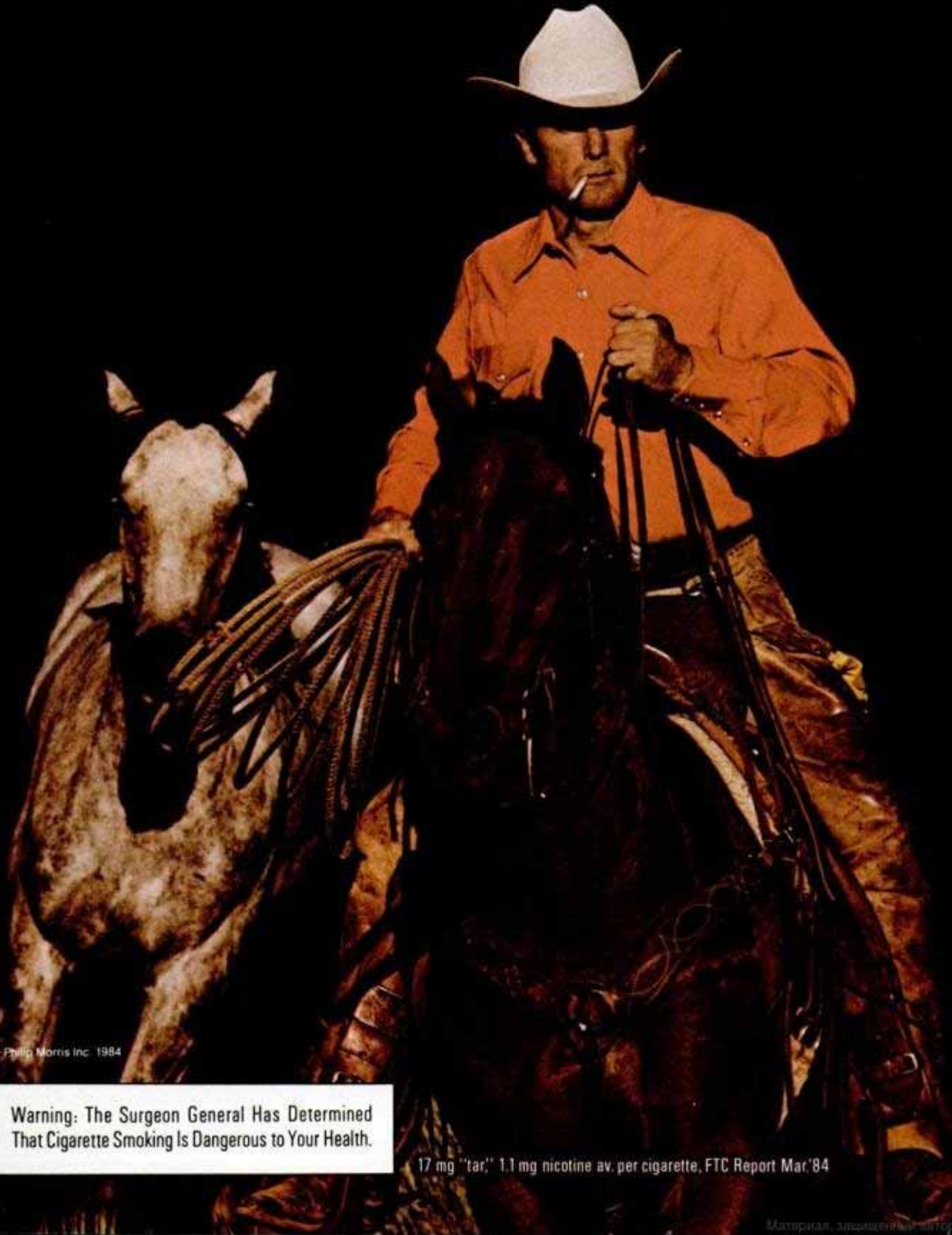
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Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Mar '84

Материал, защищенный авторскими правами

Jimmy Carter, Craftsman

'Behind our house is a fairly good stand of hickory. Hickory has straight grain, so I've made a number of good chairs from it.'

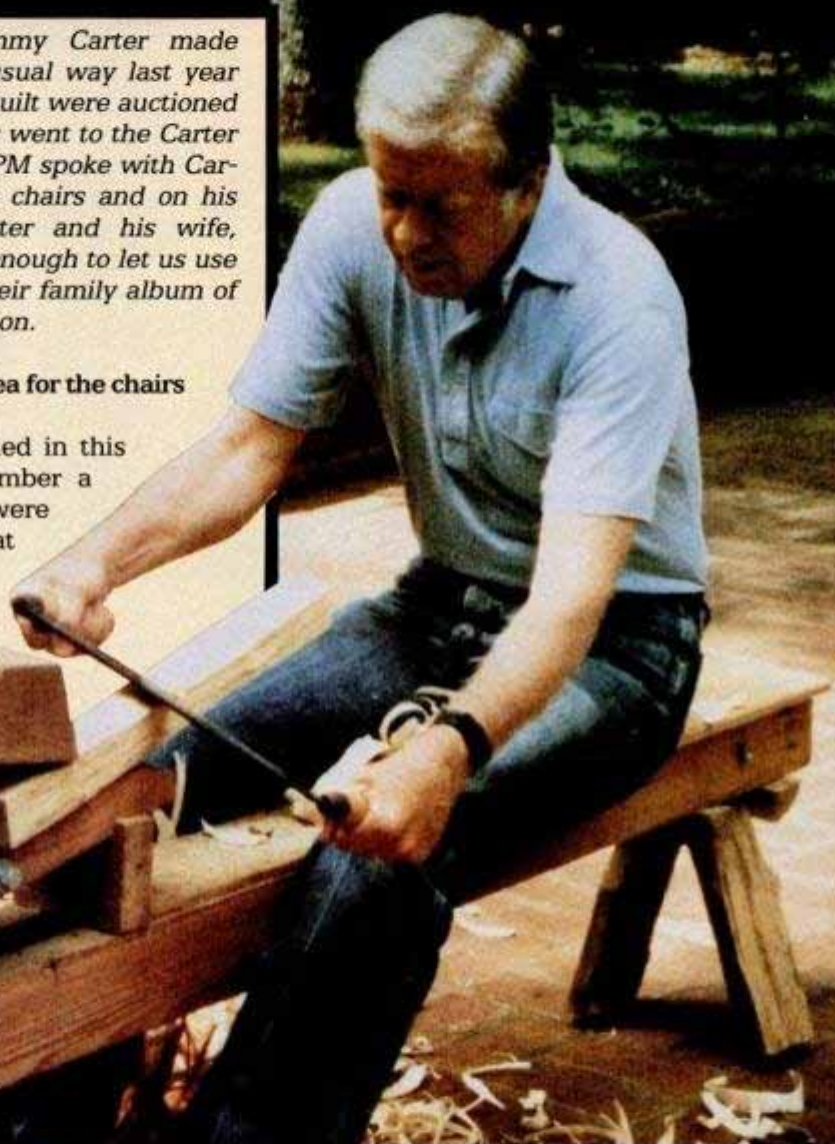
Former President Jimmy Carter made headlines in an unusual way last year when four chairs he built were auctioned in New York. The proceeds went to the Carter Presidential Library fund. PM spoke with Carter on the building of the chairs and on his woodworking hobby. Carter and his wife, Rosalynn, were also good enough to let us use the photos they took for their family album of the chairs under construction.

■ Where did you get the idea for the chairs you made?

Well, our ancestors settled in this area in 1893 and I remember a couple of chairs that were owned by my wife's great grandfather that were made out of green hickory or oak.

■ Did you have plans to work to?

No. I've never really seen any-



On a shaving bench (top), Carter shapes leg. He and Rosalynn wove the seats for his chairs.



Carter removes rough, dry bark with a draw knife. He says it's a tough chore.



After rough bark is removed, the white bark that's left is scribed with a knife.



White bark strips off after scribing. It's saved for use in weaving the seats.



With a froe, the tree trunk is cut into sections. Sizes can be varied to any length desired.

thing exactly like the ones with the vertical slats.

■ **Is it true you cut your own tree to get wood for the chairs?**

Yes. I live on a farm that we own on the edge of Plains. It's about 160 acres, and behind our house is a fairly good stand of hickory. Hickory has straight grain, so I've made a number of good chairs from it. I cut down about a 12-inch-diameter hickory and made six chairs and four stools. In the last project, the tree was a little bit smaller, and I made the four chairs for the library auction.

■ **How did you treat the wood after cutting?**

Well, you don't do anything to the wood after you get the tree cut down. You just take a draw knife and remove all the rough, dry bark. It's quite a chore. You have to cut the tree down between April and August when the sap is rising so you can get the bark off the tree. After you get the rough bark removed with a draw knife, you take a pocket knife and scribe the length of white bark left on the tree. Then that bark strips right off the tree, providing the sap is rising. You remove those

strips and save them. The bark is the last thing you are going to use, to weave the seats.

■ **So now you have a bare tree trunk.**

That's right. You cut the tree trunk in lengths that you're going to need for the chair backs and the rungs. Some pieces

'You just take a draw knife and remove the rough, dry bark.'

I used are 17 inches; some of them are 14 inches. The slats for the chair back are 15½ inches. You cut the tree trunk into sections to give you the proper lengths. Then you use wedges and a froe and split the tree trunk into proper sizes. For the rungs, you want a 1 × 1 cross section. Then you take a shaving bench and draw knife and shape the rungs, slats and chair legs—two short front ones and two long back ones.

■ **How long can you wait to start the project after cutting the tree?**

I like to do this before the wood dries out because you've got to bend the wood. You just figure out approximately how much you want to bend it.

■ **What exactly do you bend?**

The two things you have to bend are your back legs and the slats that go in the back of the chair. You can either steam those or boil them in water. I've devised a little steam outfit I use. You make those pieces pliable and bend them and put them on forms to hold them, and I generally leave them for about a week. They dry and stay in that curved shape.

The rungs of the chair you want to be quite dry. You can either dry them over a fire on a rack or, if the weather's good, you can keep them out in the sunshine where the air can get around them.

■ **Is this where the chair comes together?**

Yes. You make sure that your chair legs in which you drill holes are not too dry, but your rungs should be extremely dry. I use 5/8 inch at the end of my rungs. I cut the ends down to a uniform 5/8 inch in diameter with a dowel cutter I made. Then I take a 5/8-inch drill bit and grind about a 64th off each edge, which



Carter bends a back leg for one of the chairs. The legs and slats are bent by hand after wood is steamed soft.



Rungs are hammered in after the ends are trimmed to give them a tight fit.



Carter devised a "little steam outfit"—a bucket placed over a fire—to soften the wood to make it easier to bend the legs and slats for his chairs.



Using dried hickory strips, Carter weaves the seat for a chair.

makes it about $\frac{1}{32}$ inch smaller so that the holes in the chair legs are about a 32nd smaller than the rungs. So that you won't split the leg when you drive it in, you shave off a little of the rung on each side, but not on top and bottom.

■ **How do you do the shaving?**

With a knife. Then you drive your rungs into the legs of the chair, and you have to use a lot of force on them. You think its going to split but it doesn't. And once it goes in, of course, then it locks fairly tightly. I use a little white glue, too, just as a safety precaution. You do the front and the back, then the next thing you do, of course, is to put your side rungs in from the back to the front. Then your chair frame is pretty well fixed except for the back slats.

I mortise and put the slats in. You can bend the top of the chair aside enough to slip them in easily. On my vertical-spoke chair, I put five spokes between the top and bottom curved slats. You don't glue any of this. But when you put in your top horizontal slat you take a clamp or put a rope across the top and twist it and bring it together. Then you drill a $\frac{1}{4}$ -inch hole through the back legs into the ends of the top horizontal

slat. Then I take a piece of hickory, taper it at the end and drive it into those holes, which locks your top slat in. Now the back of your chair can't spread.

■ **Is that a sturdy piece of work?**

Oh, yes. The whole chair is locked together.

'Then you weave the seat with a standard herringbone weave.'

■ **So now you have a green-wood chair.**

Yes. You're through with the chair, basically—except for weaving the seat with those hickory strips. Some other bark is probably better—white oak splints might be just as good—but I just prefer to make the whole chair out of the same tree.

You soak the bark for an hour or so to make it flexible, because by now it's as hard as a rock. Then you weave the seat with a standard herringbone weave and

keep all your joints on the bottom, of course. Once that's all done, you level your chair: Cut a little bit off one or two legs if you have to, to make sure the chair sits steady on the ground. I put a couple of coats of clear Watco oil on the hickory, just to keep dirt or handprints from showing up.

■ **Sounds like a very time-consuming project.**

The actual working time is not all that great, but you have to wait while your rungs dry out, and you have to wait while your bent pieces dry out. It takes a long enough time. The fewest chairs I've ever made at once is four. I make from four to 10 chairs at a time.

■ **Do you find hickory easy to work with?**

I'd say hickory is very easy to work with when it's green. But it's very tough when it gets dry. So you'd want to do all the shaping you can when it's green.

■ **I gather that you keep those chairs around the house, right?**

I sold four at the auction, and the others we have in a mountain cabin in north Georgia. We built a log cabin up there, and I made all the furniture for

(Please turn to page 113)

ON THE HORIZON

Life On Artificial Islands


BY FRANK P. DAVIDSON
Illustration by John Berkey



The 21st century man-made island shown in this artist's conception would be built 200 miles off the Atlantic Coast. The outer rim of the island would provide space for farming and solar collectors. A nuclear power plant could provide electricity at a distance from the island. Inland, a huge mall would house offices, apartment complexes and warehouse areas. The island would have a supertanker port, a heliport and an airport for small jets and V/STOL aircraft.

ABOUT THE AUTHOR

Frank P. Davidson, co-author of the best-selling book *MACRO* (William Morrow, \$17.95), is chairman of the System Dynamics Steering Committee at the Alfred P. Sloan School of Management at Massachusetts Institute of Technology. He also worked with British and French agencies in the planning of an English Channel tunnel.



Using 1980s technologies, we're on the verge of building our own livable off-coast lands.

Unexpectedly, like a mythological monster, the island rises out of the sea against the disappearing horizon. It appears on no maps. Indeed, just two years ago it didn't exist. A miracle of engineering, some would say. The grand real estate deal, according to others. The 21st century has barely begun and mankind, finding travel to distant lands commonplace, has now gone a step beyond and built new lands. Artificial islands.

We can look ahead to this bold accomplishment of macro-engineering—the building of huge projects—because the technology is already at hand in 1984. Mammoth artificial islands sit in Chesapeake Bay off the Maryland coast and in Japan's Osaka harbor. Scores of ultralarge oil platforms break the horizons of Prudhoe

Bay, Alaska, the Texas Gulf and the Gulf of Arabia. We're building and planning islands at a quickening pace to meet the demands for pristine air, more living space, deep-water ports and oil exploration. New York State is exploring the possibility of building an off-shore tanker port near New York City. Japan has already set aside funding for an island airport in Tokyo Bay, beneath which would coexist offices, apartments, tanker docks and warehouses.

Why not look ahead to the 21st century and an even greater leap in man-made land construction? The island sits 200 miles offshore, far from the smog and traffic of the city and benefiting from the favorable tax treatment of a "free port." Here, new industry can grow at an orderly pace without getting tied down to

ARTIFICIAL ISLANDS

bureaucracy and excessive taxes. Here, the environment can be controlled from the sea bed up. We'll call it Liberty Island.

Connected to the mainland by a multitubed tunnel, the island's mass-transit system brings it closer to the rest of the world than a midtown bus. State-of-the-art roughing pumps keep the tubes virtually air-free. That allows a maglev train system to race above its magnetic track at supersonic speeds. The idea is based on a demonstration in 1982 by Yoshihiro Kyotani of the Japan National Railways. He and his team succeeded in running a full-scale, electromagnetically levitated maglev train 300 mph on a test track. It was just a small leap of the imagination to the supersonic train. Having escaped the friction of a track through levitation, it now also escapes air friction by virtue of the tunnel's roughing pumps.

Laying the transportation tube at varying depths down to 3,000 feet allows the transit system to follow the contour of the ocean bottom, sitting on rock ledges or man-made piers that bob imperceptibly above their anchors. This idea also originated in the 20th century. Submarine engineer J. Vincent Harrington even identified an attractive North Atlantic route for a proposed pipeline.

Liberty Island rises on piers that float and are anchored hundreds of feet beneath the base. Ships can literally pass beneath the island. On one side of the irregularly shaped land mass, a rock ledge beneath the sea permits part of the mass to be supported by polders, large prestressed concrete walls of the type used for Holland's major dikes.



Artificial Island of Chesapeake Bridge-Tunnel is seen during construction.



COURTESY MITSUI ENGINEERING



Japanese concept art shows Technoport Osaka (top) as it will look when completed in the next decade. Aerial photo (above) shows portion of the 9-sq.-mi. island already built.



COURTESY SOHIO ALASKA PETROLEUM

Oil-drilling islands such as the Sohio gravel construction in Harrison Bay, Alaska, are the forerunners of large-scale man-made islands. The island, which is made of 1.25 million cu. ft. of gravel, is 350 ft. across. It's built for calm seas.

On one side of Liberty Island sits the world's largest supertanker port. It can accommodate scores of tankers that couldn't get into New York Harbor or Chesapeake Bay. This section is patterned after "Europort," a series of artificial islands linked together off the North Sea. The Europeans began building it island-by-island shortly after World War II.

Like the older Europort, our futuristic Liberty Island brings the ships inside protective walls that keep away the driving sea and fierce winds of occasional storms.

The 21st century island is composed largely of solid wastes from the cities it serves. Safe containment walls of lightweight steel and other advanced materials are used to contain the waste.

Liquid waste, chemically treated at sea, is pumped into Liberty Island's soil as fertilizer, now that its deadly chemical components have been incinerated. On a level just above the shipping, the liquid wastes and the salt air of the sea help farmers grow a bumper crop of legumes.

Near the outer edge of the farmland, close to the shore, a fishery, facing incoming ocean currents, uses cranes and nets to farm the carefully husbanded local sea. Indeed, Neil Ruzic's 1980s experiments with man-made reefs in the Caribbean lay the perfect groundwork for such fisheries.

On the next level up, angled away from the farm country to allow maximum sunshine, the real city begins. High-rise office buildings take up a



Mitsui Engineering concept of Tokyo Harbor Airport Island is based partly on early work of Buckminster Fuller. The island will stand on prestressed concrete pillars sitting on concrete pads that act as "shock absorbers" to keep the structure standing in an earthquake. Because the island will be raised above sea level, boats will be able to pass underneath.

considerable part of the outer periphery. Farther inland, a giant contained city—a super mall of the future—contains stores, apartments, offices, research facilities and a heliport. Atop the entire affair is an airport, where small jets, V/STOL craft and prop-driven planes can land. (Such an airport is part of the plan being funded by the Japan Institute for Infrastructure Development in Tokyo Bay. The Japanese government in 1983 appointed an engineering team to begin designing the island for completion in the 1990s.)

An old idea

Man has been building small artificial islands, or adding on to existing islands, for eons. In Aztec cities of ancient Mexico, causeways and small landfills were the forerunners of the 20th century landfill islands and deep-sea oil rigs.

With the advent of improved construction materials such as high-tech metals and ceramics, and with 20th century overcrowding, man finally had the tools and the drive to go to large-scale artificial lands.

One of the world's most impressive systems of artificial islands sits off the Maryland coast in the Chesapeake Bay. Completed in 1964, the Chesapeake Bay Bridge-Tunnel system was built in three years by Raymond International Builders. The \$200 million island chain links the Delmarva Peninsula with Nor-

folk, Va. Most of the nearly 20 miles of the Chesapeake structure is taken up by bridge trestle structures or tunnels.

Four man-made islands, each eight acres in area, sit in waters 30 to 45 feet deep. The islands rise up to 30 feet above the mean water level so that only the fiercest of storms will carry large amounts of water over the surface. It took 1.5 million tons of sand and 300,000 tons of rock to build each island. Today, they provide approach ramps to the tunnels and service areas located along the lengthy road system. Garages, emergency equipment and tunnel ventilation buildings are on each Raymond island.

As if preparing for the advent of bigger man-made islands, Raymond constructed specially designed low-level trestles of precast, prestressed concrete at a plant built especially for the Chesapeake project. Since then, Raymond has used the plant to build components for seaboard highways. The trestles used on the Chesapeake project have withstood pounding salt water and ravaging winds for 20 years without a substantial sign of damage. Such material is the basis for the polders used to hold up the landward side of our imaginary Liberty Island.

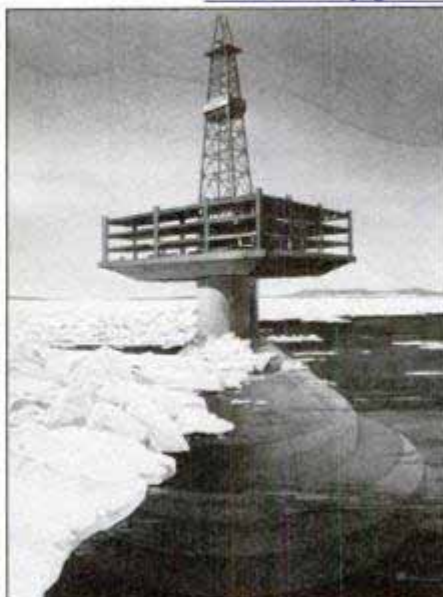
Oil platform experience

The futuristic island will need more than polders to keep it from breaking apart of floating away. On the seaward

side, ocean currents, winds and storms present a tremendous engineering challenge. This is where the oil platform technologies will come into play. Today's oil platforms face challenges from nature such as wind and water damage and risks from the drilling itself. The engineering job is to construct a stable platform that will remain stable even as oil is removed, causing increasing give in the earth holding up the structure.

Oil companies have developed a wide range of platforms for different environ-

(Please turn to page 117)



Concept art shows an oil platform on a conical tower to deflect ice chunks.

COURTESY AMERICAN PETROLEUM INSTITUTE

SAILIN' SMALL!

Mini replicas of America's Cup racers offer safety and simplicity for the novice and a real challenge for old salts.

BY CLIFF GROMER

At first glance they look like oversized radio-controlled models, slicing through the water with deliberate slowness. The oversized human head poking up out of the cockpit appears placed there as a prank. But these boats are no toys. Called Miniature Twelve Meters, the roughly 1/3-scale versions (about 12 to 15 feet) of the 12-meter America's Cup racers are sophisticated sailing machines.

The concept for these minis originated three years ago in England, where they were series-produced under the Illusion name. The boats now are also produced in Florida to one-design rules—strict parameters that make up the Illusion Class of racing. Application has even been made to the international Yacht Racing Union for full international status of the class.

Single-seat versions (the predominant configuration) of the minis are intended primarily for match racing—one-on-one around a 14 1/3-mile triangular course, as opposed to any number of boats running various handicaps and

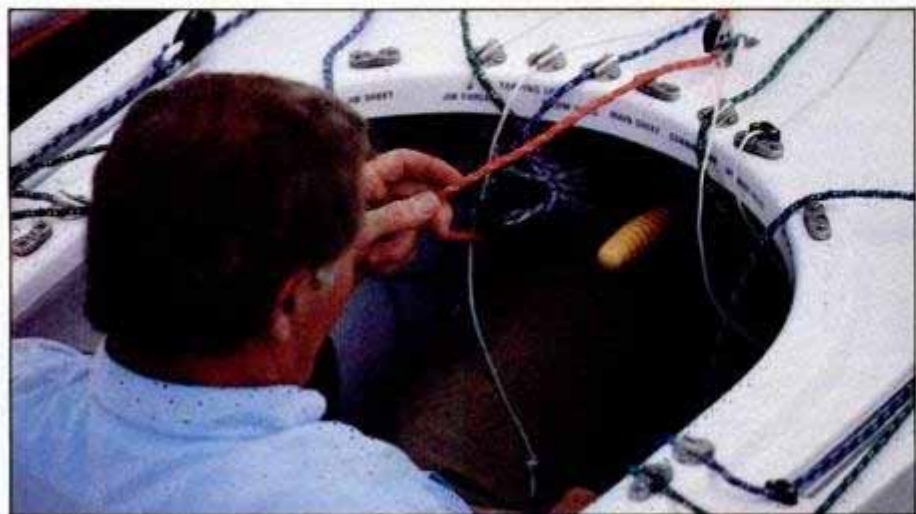
competing free-for-all style. But two-place models are available, too.

Unlike a conventional sailboat where you hike out or sit on a rail as you ride the line of excitement between water and wind, the minis offer a more civilized, albeit less adventurous, sailing style. You sit, or rather recline, deep in the cockpit with legs stretched out.

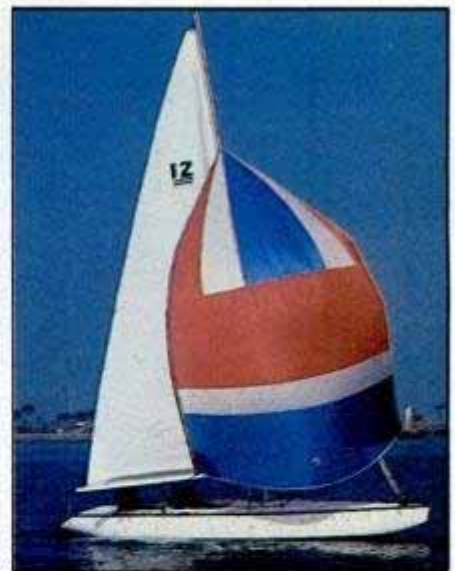
Where's the wheel or tiller, you ask? There is none. You steer with a bar that's controlled by your feet. Arrayed around you are about a dozen labeled lines that attach to the various sheets and sails. Even raising the spinnaker is a simple one-man operation from your seated position. Just tug on the right line and the spinnaker pole is raised out of its foredeck compartment. The topping lift and foreguy are attached and the inboard end is clipped to the 13-foot mast that towers over you. Controls are adjustable so seating position accommodates all sailors, from tall adults to small children.

No need to worry if you're an inexperienced sailor. With built-in flotation

Cockpit accommodates even tall adults and is laid out so all lines are easy to reach.



Sleek mini looks like a real 12-meter yacht—until you notice the skipper, who appears to be walking on the bottom. The drawing at right shows the helmsman's position in the cockpit, with his feet on the steering bar.



Two-place 12-meter minis can be raced, but also are fun for recreational sailing.

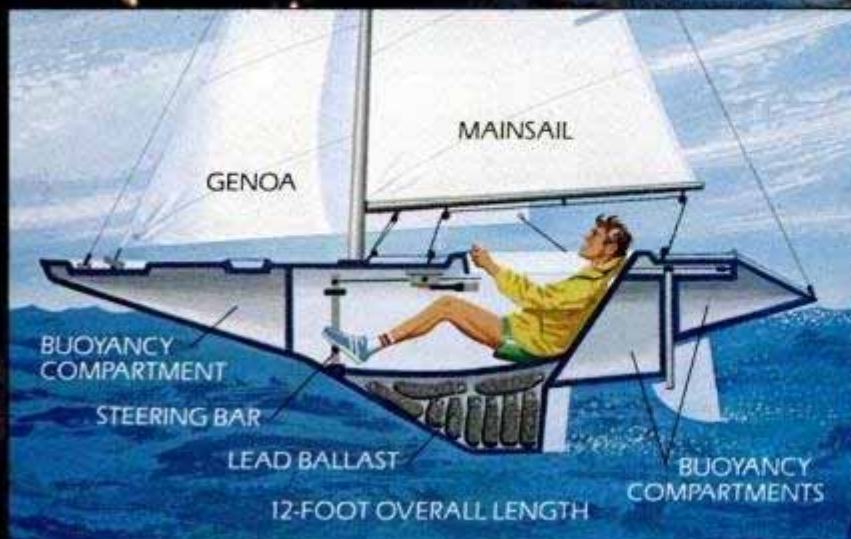
chambers and removable bags of lead ballast in the keel, the minis can't sink or capsize.

You can simplify your sailing by operating with just the mainsheet. Then, as you become more experienced, you can grow with the boat by employing the other sails, including the spinnaker.

With the lead ballast removed, the minis can be launched easily and even car-topped. And while they may not be incredibly fast in the water, the minis give you the same feel as the full-size 12 meters. All you need is a little imagination and you can win back the America's Cup. **PM**

MANUFACTURERS— 12-METER MINIATURES

L&I Yachts, 34511 Calle Monte, Capistrano Beach, Calif. 92624
 Davis & Oberg Boatbuilder Inc., 500 Wood St., Bristol, R.I. 02809
 Illusion Yachts U.S.A., 4501 Ulmerton Rd., Clearwater, Fla. 33520
 Milli-Meter Marine, Box 898, San Rafael, Calif. 94915
 Quantum Yachts, 7730 Adams St., Fairmont, Calif. 90723
 Enterprise Yachts, 314 First St., Menominee, Wis. 49858

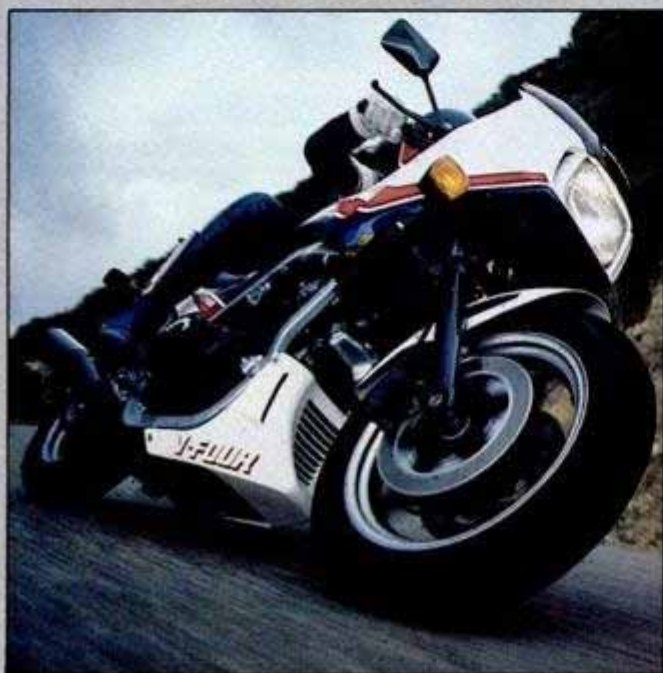


Minis are roughly 1/5-scale models of 12-meter racing boats. The 12- to 16-foot-long craft feature the same snubbed bow, heavy displacement sections and small keel design of the America's Cup racers. Minis are untippable and unsinkable.

NEW SUPERBIKES

Today's Technology Destined For Tomorrow's Cars

BY NORMAN MAYERSOHN
Illustrated by Pat Ruggero



Superbike defined: High G-force cornering and 100+ horsepower.

Just when you might have thought motorcycles reached their absolute performance peak, they started getting even better. Two-wheelers have become more powerful and better handling even as cars began to get bloated with luxury features and choked by smog controls.

The good news is that you don't have to be a motorcyclist to share in the motorcycle's technological advances. Especially in Japan, mechanical innovations start out on two-wheeled road warriors and, when proven reliable, are adapted for passenger-car use. Want some recent examples? Four-valve, double-overhead-cam heads; linerless aluminum cylinder bores; breakerless ignitions; adjustable damping suspensions; antivibration counterbalancing systems; and tubing exhaust systems have all been popularized by, if not invented for, modern superbikes.

Take a look at the current state-of-the-superbike art. There are 100-plus hp 1-liter engines, and versatile chassis designs to keep up with the 140-mph potential. If we're lucky, we might just see some of these features on the four-wheelers now being sketched on drawing boards worldwide.

UPPER FAIRING SECTION:
More than a simple windshield, the racing-style cowling integrates headlight and radiator openings, sets a style carmakers ought to strive for.

AERODYNAMIC FRONT FENDER:
Deflects rushing air around chassis components. The equivalent of automotive bellypans already seen on advanced models.

ANTIDIVE FRONT BRAKES:
Disc caliper action shuts off front suspension downtravel under braking for better ground clearance and stability.

STEEL/ALUMINUM COMPOSITE WHEELS:
Forged steel spokes for bump absorption, cast aluminum rim for light weight. They're one cure for stiff-riding sports cars.



Liquid-Cooled 90° V4 Engine

The V4 engine is ideal for a motorcycle. Only two cylinders wide, it's narrow enough to mount low in the frame and still give optimum ground clearance. Overheating problems that might plague the rear cylinders are averted by liquid cooling. Biggest plus, and one that might make buzzy minicars more bearable: The 90° V4 has perfect primary balance, which allows solid mounting on the frame, using the engine case to strengthen the chassis.

Aerodynamic Bodywork

Aerodynamics are even more important to a cycle than to a car. Typical two-wheelers have drag coefficients in the .70 range, far worse than cars, because of all their exposed hardware. Upper fairing sections mimic tried-and-true road race designs. A lower "chin" spoiler conceals an oil radiator. Engines run cooler be-

SQUARE TUBE FRAME MEMBERS:
Fabricated in aluminum for racing bikes, this design would add rigidity, without a weight penalty, to future cars.

cause of better ducting, and riders benefit from less wind blasting. Yamaha's faired front fender design takes a little of the front fork legs out of the wind and hugs the tire closely to minimize air turbulence. The profile is also designed to direct cooling wind into the engine.

Composite Wheels

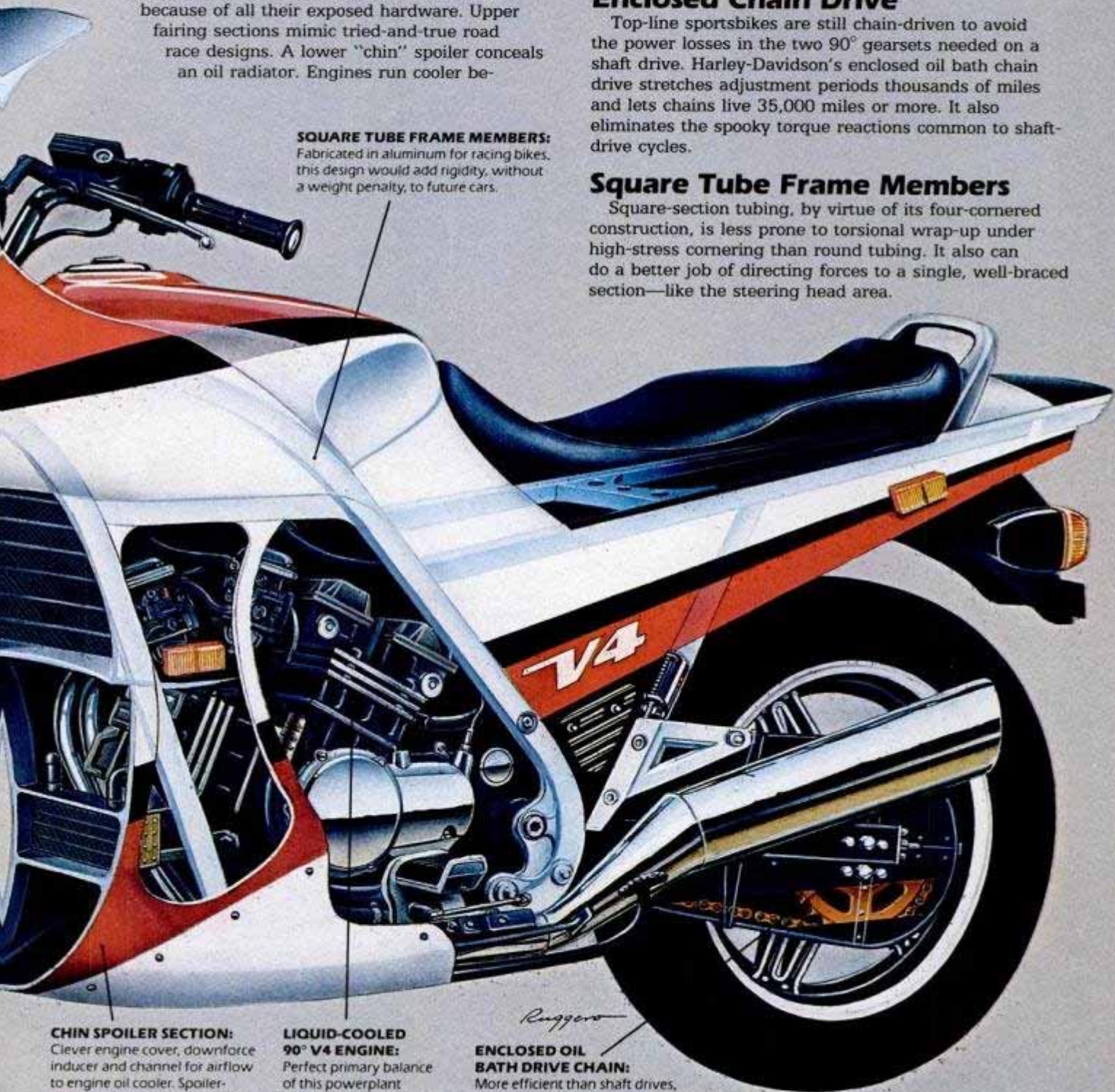
Composite construction wheels offer great strength with light weight. Forged steel "spokes" have some of the flex and bump-absorbing qualities of traditional wire wheels. The aluminum rim keeps weight down and allows mounting of tubeless tires. Stiffly sprung sports cars could benefit from this construction technique.

Enclosed Chain Drive

Top-line sportbikes are still chain-driven to avoid the power losses in the two 90° gearsets needed on a shaft drive. Harley-Davidson's enclosed oil bath chain drive stretches adjustment periods thousands of miles and lets chains live 35,000 miles or more. It also eliminates the spooky torque reactions common to shaft-drive cycles.

Square Tube Frame Members

Square-section tubing, by virtue of its four-cornered construction, is less prone to torsional wrap-up under high-stress cornering than round tubing. It also can do a better job of directing forces to a single, well-braced section—like the steering head area.



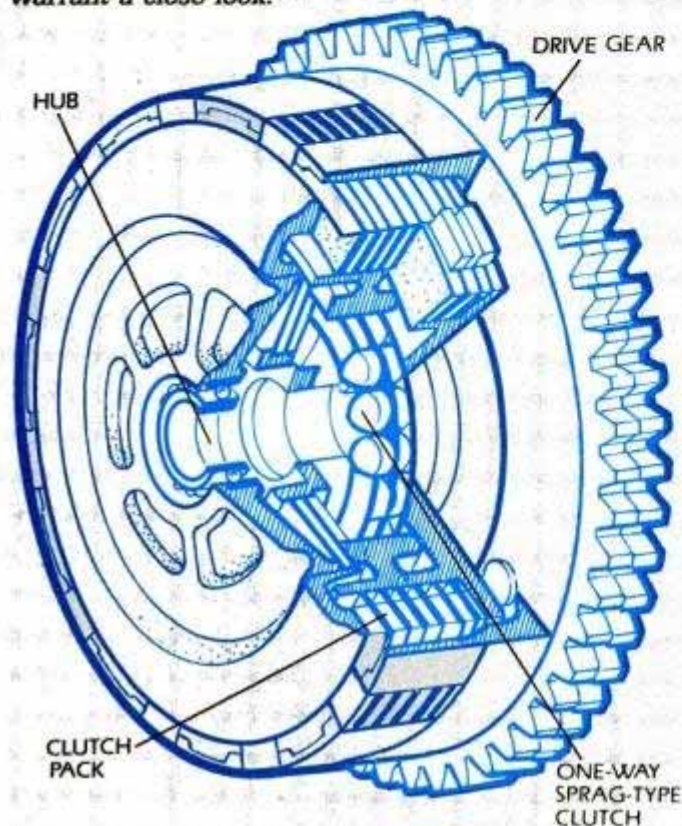
CHIN SPOILER SECTION:
Clever engine cover, downforce inducer and channel for airflow to engine oil cooler. Spoiler-mounted radiators would tidy up a minicar's engine compartment, cool more efficiently.

LIQUID-COOLED 90° V4 ENGINE:
Perfect primary balance of this powerplant layout would be an ideal vibration fix for econocars.

ENCLOSED OIL BATH DRIVE CHAIN:
More efficient than shaft drives, and similar technology soon to come in constantly variable ratio transmissions for cars.

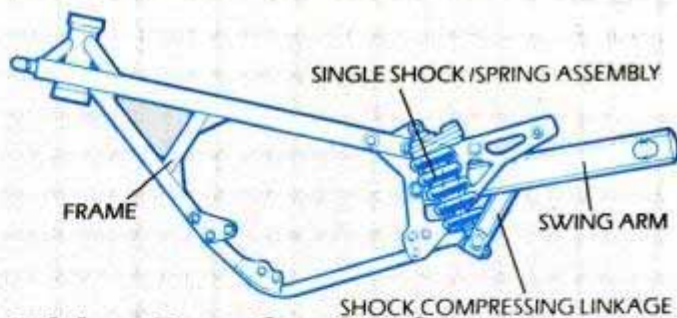
SUPERBIKES

Some of the best features of today's motorcycles are hidden from view, deep within the dark recesses of the machine. Though they're not as obvious as the items already mentioned, they do warrant a close look.



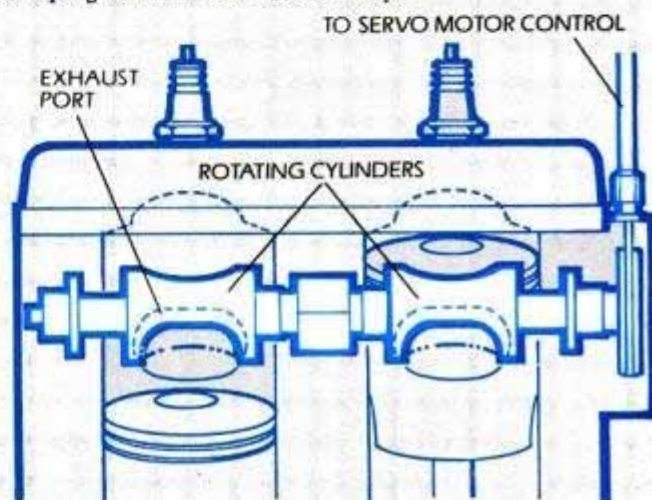
One-Way Clutch

High-output engines are a delight when the throttle is wide open. But when the gas is shut off and there's little flywheel effect to smooth the deceleration, they can lurch hard enough to make the rear wheel momentarily lock up. Honda solved the problem by splitting their one-way clutch hub in half vertically, connecting its outer section to the transmission mainshaft with an internal overriding sprag. Under severe engine braking the outboard half will freewheel, preventing rear-wheel lockup while retaining the desirable effects of compression braking.



Rising-Rate Suspension

Single-shock rear suspensions are in vogue now. Though the idea is old, the execution is new. By locating the shock vertically behind the engine and compressing it with levers linked to the swing arm, the suspension can be tuned for rising-rate characteristics: It's soft when the bumps are small but gets harder to compress as the wheel travels farther. Multiple adjustments for bounce and rebound stiffness, ride height, spring preload and air pressure charge allow riders to tailor damping to their own size and style.



Variable Exhaust Port

Two-cycle engines are still the most powerful for a given displacement, but they can suffer from very narrow power bands. Intake and exhaust timing has always been fixed by the piston movement opening and closing off ports—until Yamaha developed its electronically controlled power valve system. A flat-sided rotating cylinder is positioned in the exhaust port, and effectively varies port size and timing by turning as commanded by an electric servo motor. More ponies at the low end, free breathing at peak revs... just what the two-stroke fans always wanted.



Suzuki GS1150ESE is the dean of the superbike school, with conventional transverse Four and multiaadjustable suspension.



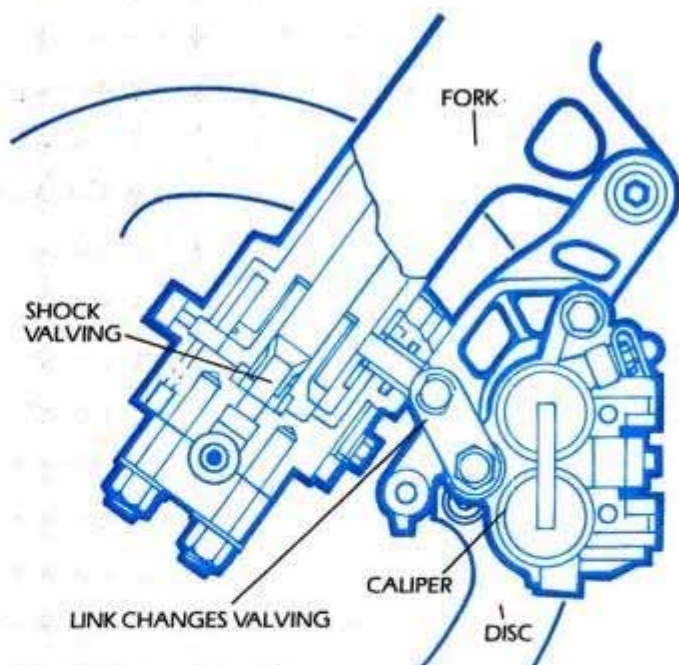
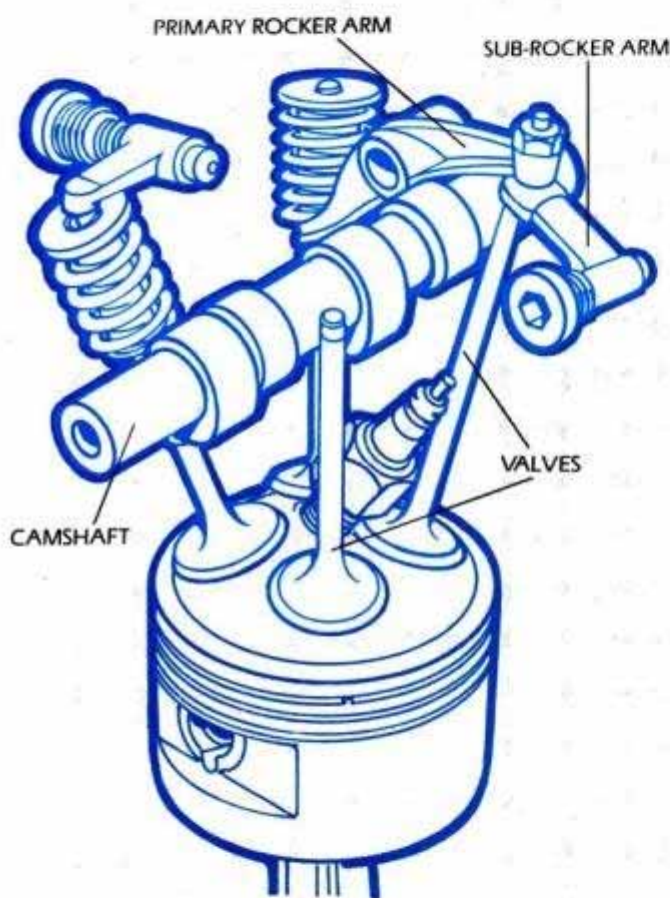
Kawasaki Ninja [translates to assassin] has new water-cooled Four, equals others' performance with just 900-cc displacement.

Radial Four-Valve Head

The hemispherical design of Honda's radial four-valve combustion chamber is extra-efficient for several reasons. It loses less combustion energy to the atmosphere and contains no corners to trap unburned gases, a leading cause of detonation. Higher compression ratios can be used, and the sparkplug is ideally located in the center of the action.

With the valve stems diverging radially from the center of the cylinder, no two stems are parallel. That makes valve actuation a knotty problem, as a conventional valve gear would place too much side load on the valve guides.

Honda's solution: A wicked arrangement of primary rocker arms and subrocker assemblies. The worthwhile result is improved volumetric efficiency, which is due to large valve sizes and free breathing. Reciprocating weight is held down by mounting subrockers directly to the head. Might we see this trickery on the 1990 Civic CRX?



Antidive Brakes

Antidive brakes cancel the front-end plunge that commonly occurs when a superbike's powerful twin discs are activated. The principle is quite direct—shut off the suspension travel of the front forks when the brakes are applied. Honda does it with a torque-reactive system; others use a hydraulic actuator coupled to the brake caliper. Either way, ground clearance is preserved and suspension geometry stabilized for a hard-braking turn. Automotive engineers sometimes specify front-end geometry that has built-in antidive characteristics, but motorcycles are way ahead in this department.

Will we see all this leading-edge technology on next year's cars? Probably not. Bit by bit, though, the motorcycle test beds yield valuable on-the-road experience for automotive engineers to adopt. Some concepts proven on two-wheelers—from fuel injection and turbocharging hardware to nondistributor ignition systems and gas-charged shock absorbers—have already become commonplace on modern cars. Some of these innovations even originated in the automotive universe, but they were largely tested and perfected on the new generation of ultra-high-performance superbikes.

For a preview of what might be coming your way in up-to-the-minute car designs, look at what today's crop of motorcycles has to offer.

PM



Honda's V4 Interceptor was bred for production-class road racing. You can take your choice of 500-, 750- or 1,000-cc variants.



Yamaha RD500 two-stroke isn't for sale in the U.S., but many Americans would love to try the power-valve-equipped V4 rocket.



The Daewoo Maepsy-na has a 1.5-liter four-cylinder engine, a rear drive and a \$3,300 price tag. Its Opel-like appearance is no accident: Daewoo Motors is owned 50 percent by General Motors, and Opel is GM's German branch.



Hyundai Pony (left) is a basic front-engine/rear-drive four-door hatchback that sells for \$4,530 in Canada. Top-of-the-line model costs only \$5,233. Contemporary styling, inside and out, is by Ital Design. The 1.4-liter, overhead-cam, four-cylinder engine (right) is built under license from Mitsubishi.



COMING: CARS FROM KOREA

Low wages and foreign investment will help the Koreans mount a U.S. offensive.

BY MICHAEL LAMM, West Coast Editor

If you think Detroit ought to worry more about the Japanese, forget it. Detroit and Japan both better start worrying about the South Koreans, because 10 years from now, the Korean auto industry should be where the Japanese are now.

That's because the average Korean autoworker earns about \$2.75 an hour, or a quarter of what a Japanese assembler makes (\$10 to \$11 an hour), which is not even in the ballpark with their \$20-an-hour Detroit counterparts (these figures include the value of fringe benefits). This huge wage gap gives the Korean auto industry a tremendous leg-up on the world's other automakers.

American car manufacturers are very much aware of the Korean advantage—so much so that the *Wall Street Journal* recently quoted Lee Iacocca as saying that he doubts the Japanese will be able to compete much longer in the minicar field, now that Korea has entered. In fact, Chrysler has sent scouts to talk with the Koreans.

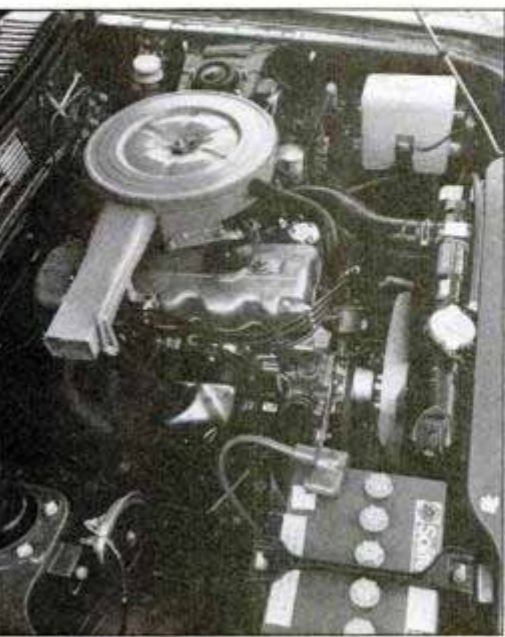
Ford, meanwhile, has been working with Korea's biggest automaker, Hyundai (pronounced *hoon-dye*), since 1967.

Hyundai currently assembles European Ford Granadas for the Far East market. Hyundai also builds two models of its own: the Pony, on a 96.6-in. wheelbase, and the 101.6-in. Stellar. Both are solid four-cylinder, rear-drive cars, but Hyundai hopes to get a front-drive subcompact into production by the end of this decade, and that model is destined for our shores. Right now, Hyundai ranks 41st among non-U.S. world businesses and is planning a huge plant expansion in its home city of Ulsan—Korea's "Detroit."

The other big Korean automaker, Daewoo Motors, is already half-owned by General Motors. Daewoo, along with GM's German Opel subsidiary, are designing a fwd replacement for the T-car (Chevette). This car is also destined for export to the United States, probably under the Pontiac nameplate.

That's significant because, as U.S. trade quotas restrict the importation of more Japanese cars by American automakers, Detroit begins looking toward Korea as a second source. GM dealers, for example, could sell more Suzuki Sprints and Isuzu Spectrums in 1985.

(Please turn to page 112)



Daewoo Royale is an Opel Rekord lookalike with a 102-hp, 1.9-liter four-cylinder engine.



Hyundai's big car is the Stellar. It has a 102-in. wheelbase and a 100-hp, 1.6-liter Four.

3 SOUND INVESTMENTS FOR YOUR CAR

We mix and match some top-notch components to assemble three stereo rigs for living-room listening on wheels.

BY CHRISTOPHER GREENLEAF: Photos by Bill Ashe

A good car stereo—like a turbo under your hood—has to give you the punch when you need it. Without stumble or hesitation, it must deliver the power to overcome road noise, and to match the sound system you're used to at home.

When we set out to assemble three high-performance sound systems—good, better and best—we trusted our ears to select the components that put the music first.

(Please turn to page 114)



1 This dream system, assembled with off-the-shelf components, lets the music play with all the fidelity of home stereo equipment.

1. Heart of the system is Nakamishi's TD-800, a remarkable AM/FM digital tuner and tape player. It features Dolby B and Dolby C, and simple but sophisticated controls on the front panel. With its remote tape head alignment control [2], the \$890 Nakamishi is the ultimate music source for a car-based stereo.

3 to 7. Components are part of Audio-mobile's 1600 integrated system of three loudspeaker pairs, amplifier and front-to-rear fader control (\$1,090). The amplifier [3] is out of the way, since it's installed in your trunk. It pumps out a total of 160 watts RMS and adjusts for bass level. The front satellite speakers [4] normally go at shin level on the side kick panels and complement the rear satellites [5], which are designed for corner mounting on the rear deck panel. The subwoofers [6], two awesomely muscular speakers for deep

bass, go under the rear deck. The fader knob [7] fits anywhere you want to put it and subtly balances front and rear stereo.

8. Alpine's 3015, a seven-band computerized graphic equalizer and automatic level control, is an add-on for fine-tuning car acoustics and compensating for road noise. It's \$400.

Before installation, our dream system, which blends very refined control over your music with elegant design, totals \$2,380.



4



3



1



2

2 Excellent sound on the go is provided by this grouping of components with the emphasis on FM reception.

1. Audia's revolutionary DTX-1000 is one of the first tuners to incorporate FM diversity tuning, which uses two antennas for the cleanest FM signal reception possible. The \$625 Audia also lets you switch to tuner reception while the tape player is on fast forward or rewind.

2. Power amplification is needed with the Audia for each pair of speakers you use and our selection is the ADS P120. The \$329 power amplifier will provide 60 watts per channel to one pair of speakers.

A pair of P120s, one for front speakers and the other for rear, can be mounted in your trunk.

3. B + W LM-1 speakers for the rear deck are panel-mounts and are \$450 a pair.

4. ADS 300i panel-mount speakers for the front doors or kick panels are \$269 a pair.

Our FM buff's mobile sound system, which adds up to \$2,000, is perfect for the city driver who is tired of skyscrapers interfering with his reception.



2



1



3

3 When you demand good sound, you pick good components and don't assemble a budget system. With this selection, you can get started with a basic car stereo setup and add to it later.

1. Proton 212 is an uncluttered receiver/tape machine with integrated amplifier. The \$390 unit will drive front and rear pairs of speakers.

2. Genesis AM 135 is a panel-mount front speaker system priced at \$200 a pair.

3. Canton AC 200 self-powered amplifier/speaker combination for your rear deck can be added later to Proton and Genesis components.

If you're flexible, you can start this system at \$590 and top it off for \$940.

And I Thought I Was A GOOD DRIVER!

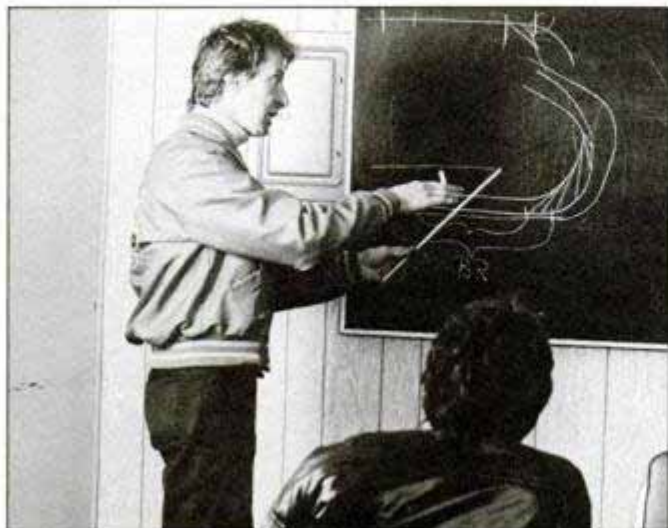
BY GARY WITZENBURG

Ask yourself an important question: Do you *really* know how to react in a sudden highway emergency? Most of us consider ourselves excellent drivers. I know I did. But most of us are wrong. Natural ability provides a head start, but expert driving is an art. As in acting or athletics, we need expert coaching. Without it, we learn by trial and error—so long as we survive our errors.

It's bad enough that most of us already plying the highways have little formal training, other than the sign-reading and parking lessons we received while practicing for our first licensing test. Think about how many totally inexperienced teen-agers we turn loose every year with shiny new licenses. Do we really know how to react in a sudden emergency or how to handle an unexpected skid? Do they?

I had my first and—so far—only serious auto accident not long after my 21st birthday. But I can think of numerous occasions before that when I narrowly missed destroying myself in a car—two particularly scary ones by the time I reached the tender age of 17. I learned a lot and somehow survived those early years. Would I want my kids out there learning the way I did? Would you? There must be a better way.

There is. It's called a professional driving school. It teaches advanced highway driving, high-performance driving, even competition driving. I don't mean some guy in a classroom telling you to "turn into a skid." I'm talking about serious, behind-the-wheel training by highly qualified instructors on a racetrack, skidpad or another place where you can actually *practice* all those



Road/rally/ice racing champion Bertil Roos gives chalk talks.

crucial, potentially lifesaving skills, that you only *hear* about in an ordinary driving "school."

Professional schools I've known

Of the five major North American schools I've attended, the largest, best-known and most versatile is the Bob Bondurant School of High Performance Driving at Sears Point Raceway near Sonoma, Calif., northeast of San Francisco. A former top-ranked international racer, Bondurant offers one-, two- and three-day highway schools (in your car or theirs) as well as competition and other specialized courses. His method includes substantial dual instruction—the instructor rides with you to see how and what you're doing and you ride with him so he can demonstrate.

All Bondurant courses begin with a terrific "ground school" on basics like proper seating position and use of the controls, understeer (front-wheel skid), oversteer (rear-wheel



Car control is what you learn. Here, Bob Bondurant demonstrates the ragged edge.



Some schools let you use your own car, which is the least expensive way to learn.

Professional driving schools may be expensive, but they really teach you how to react to a highway emergency.

skid), shifting, cornering, braking and emergency maneuvers. You then progress through a trio of driving exercises—a two-turn oval, a greased-down skidpad and an Accident Simulator.

The oval, with a hairpin turn at one end and a faster sweeper at the other, gives repetitive braking, shifting and cornering practice. The icelike skidpad provides excellent skid-control training at low speeds as the instructor demonstrates and you practice various skids and spins. Skid correction is one of those things—like riding a bicycle—that you have to experience to master. Theory alone won't do the job.

The Accident Simulator—sort of a pylon freeway with traffic lights over each of its three lanes—teaches you how to drive around a sudden obstruction instead of locking up the brakes and skidding into it. Here's how it works:

As I approach the pylons at low speed (about 20 mph), the instructor turns two of the lights red. My task is to dodge quickly into the "unobstructed" (green) lane without touching the brakes or any pylons. It's easy at first, but gets tougher as I repeat the exercise at progressively higher speeds up to 40 mph. Then, on one run, all three lights suddenly go red—the road is completely blocked. I try to stop in time—which usually can't be done—effectively demonstrating how much distance is required to stop a car even at moderate speeds.

All but the one-day course also include some time on the very challenging Sears Point racetrack, a genuinely thrilling experience that will give you a new perspective on what real racers are up against out there.

Another good bet for highway training is the

(Please turn to page 128)



Slide Cars at the Bertil Roos School let you practice skid control.

Phones ON THE GO

The cellular system for fast and clear mobile phone service in your car is spreading from city to city—and now there's even a handheld portable.

BY MARC STERN; Color photo by Mark Koslowski



It's technology's latest magic show. Just take the telephone out of your pocket, dial the other side of the world—or a number around the corner—and a crisp, clear phone connection is yours. The handheld, self-contained phone will also start ringing in your pocket when someone gives you a buzz. So don't be fooled by the looks—it's not a walkie-talkie and not a cord-

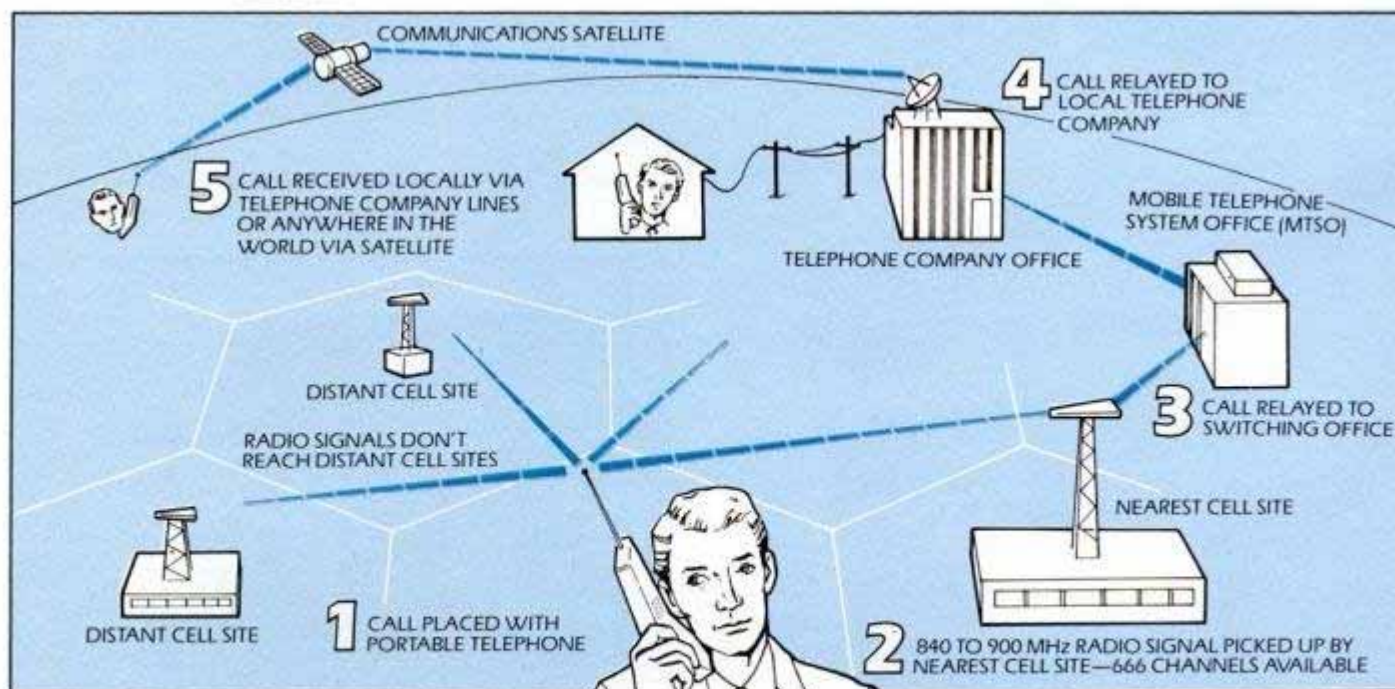
less telephone for your back yard.

The breakthrough phone is the Motorola handheld DYNA T.A.C. 8000X Cellular Portable Telephone, a communications industry first.

The 28-ounce 8000X is the smallest mobile phone in the world, but has powerful features, such as storage and recall of up to 30 phone numbers—including international listings. Using the latest microprocessor and display technology, this programmable unit can be used anywhere within an area covered by a cellular phone system. (We'll update the latest developments in cellular installations later in this story. The

Completely self-contained portable telephone from Motorola, shown here and in use on facing page, gives you total mobility in a city with a cellular system (below).

PHOTO BY LAYMAN/NEWMAN



Cellular system allows a caller with a portable telephone—either a handheld unit like the Motorola pictured above, or a mobile version installed in a car—to connect with his telephone company office without using telephone lines. When a caller dials a number, a radio transmission

with power as low as 1 watt reaches the nearest cell site. The call is relayed to the Mobile Telephone Switching Office and then to the local telephone company, where it's completed in the traditional way: by telephone lines or communications satellite. A call made to someone

carrying a portable is transmitted to the cell sites. Then the site nearest the portable phone causes it to ring and establishes the connection. If the portable phone is a mobile unit in a car, the call is automatically handed off from one cell site to another to maintain the connection.



first city set up for cellular was Chicago. See *New Mobile Phone System*, page 32H, July '81.)

Totally synthesized—special circuitry allows it to work on any of the 666 radio channels in its range—the 8000X has such features as three-way call capability and call-transfer. It can be programmed to use any of the alternate long-distance services, such as MCI, Sprint or AT&T. And, thanks to the power-stingy Liquid Crystal Display, you can see the number you are dialing. This type of display is easy on the unit's batteries.

With this much capability, you might worry about unauthorized use, but Motorola has taken security into consideration. You can program it so it will automatically lock and turn off the power. And, if you suspect someone might know the code you used to lock up the unit, you can instantly reprogram the locking code.

A versatile system

Adding to the versatility of this system are a couple of options that change the 8000X into a more conventional, vehicle-mounted mobile phone.

Motorola offers a special vehicle adapter into which you fit the handheld unit. This unit comes with an externally mounted antenna. The adapter also offers one-hour battery recharging.

When it's mounted in a car, the 8000X nearly becomes a standard mobile phone, much like its bigger brother, the premier 6000X mobile cellular phone. The key difference between the two systems is that where the 8000X is a low-powered (about 1-watt of output at the antenna), all-in-one unit, the 6000X consists of two separate units: the phone control head that sits under the dash and the transceiver electronics which sit in the trunk. The mobile unit also puts out much more power—up to 25 watts.

Like the 8000X, the 6000X features state-of-the-art microprocessor technology with features like speed-dialing and on-hook call processing. It has a highly readable 14-digit fluorescent display and can store and recall up to 99 numbers.

The-cellular concept

Motorola's transceivers fit in well with the cellular phone concept, which

is the key to having a phone that goes with you. Such a system just became available in the New York metropolitan area, and it will soon be available in many cities across the country. Nynex Mobile Communication was formed after the AT&T phone divestiture last January. Its cellular system uses equipment manufactured by Oki Advanced Communications and is the culmination of experimentation and research carried out in Chicago during the 1970s, when the cellular system was known as AMPS, or the Advanced Mobile Phone System.

Thanks to the Federal Communications Commission's allocation of a wide band of frequency space from about 840 MHz to about 900 MHz, the cellular phone system can offer 666 channels for duplex communications. Duplex communication is what we are used to when we use phones. This type of operation allows two-way conversations with both parties speaking at the same time, if they choose to. Normal mobile phone operation is simplex, meaning that one person can talk while the other listens. Duplex operation usu-

(Please turn to page 115)

A SPECIAL DELIGHT:



Your Own Garden Pool

Experience the beauty that a pool brings to your garden. Here are five ways to build your own.

A garden pool can be a very appealing addition to your landscape. Planted with colorful flowers and stocked with fish, the garden pool takes on a vitality of its own. Waterfalls and fountains add to the visual interest and introduce a pleasing sound.

One of the first steps in water gardening is to select the type and shape of pool you want. From the five pools shown on these pages you're sure to see one you'd like in your garden.

A simple tub pool requires no construction and is the easiest water garden to tend. A pool lined with flexible PVC sheet can be designed to any free-form shape. A rigid fiberglass pool is easily installed in an excavated area. A masonry pool, whether of concrete or concrete topped with brick, offers a look of permanence to the surroundings.

Planning a garden pool

There are several considerations in planning a garden pool. First, select a sunny site where water flowers will thrive. Second, plan to situate your garden pool away from shrubs that will shed into the pool.

Third, the minimum depth for fish and many water plants is 1½ to 2 ft. If you plan to use the pool for shallow-

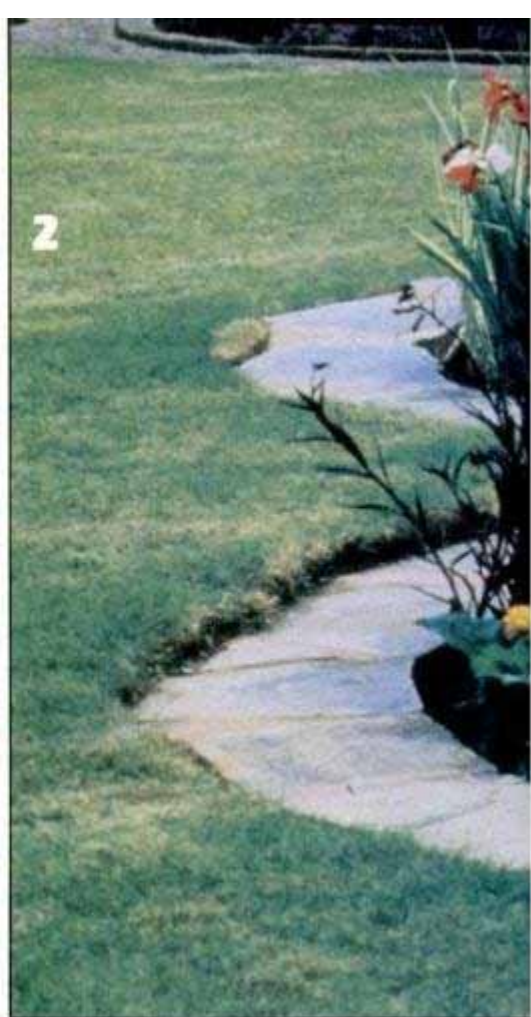
water plantings or only as a reflecting pool, the depth can be less. At any rate, check your area ordinances, as some require that pools of a specified depth be fenced.

If you plan on having pumps or lighting in the pool, consider the nearest source of electricity. All electrical pool equipment must be grounded with three-prong outlets.

1 Tub gardens

Caring for a tub garden—whether a wine barrel, clawfoot bathtub or simple plastic tub—is a good introduction into water gardening. The same techniques of keeping the water clear, or balancing it, can be used in larger pools. The container should be able to hold at least 4 gals. and be completely sealed. To seal the tub, line it with a PVC liner and use heavy-duty staples to secure the liner at the edges.

Both plants and animals work together to keep the water acceptably clear of algae and well balanced. Oxygenating grasses replenish evaporating oxygen, and absorb carbon dioxide, making life difficult for algae. Water lilies partially cover the surface of the water to minimize oxygen loss and keep the water



cooler. Snails eat algae and consume decaying matter on which algae feed. Fish eat algae and other pests.

Water garden suppliers can suggest appropriate plants and fish for a tub garden and the other garden pools shown here. Van Ness Gardens, Upland, Calif., suggests that for each square yard of surface the pool contain the following: two bunches oxygenating grasses, one medium to large water lily, 12 water snails and two 4 to 5-in fish. See the supplier list at the end of the story.

2 PVC-lined pool

A flexible liner of PVC allows you to design a pool of any shape. The liners



are also a good repair for leaking pools of other materials. To determine the size liner you need, add twice the depth of the pool to the total width; add twice the pool depth to the total length.

With a rope or garden hose outline the pool shape on the ground. Excavate the area within the outline, leaving shallow water planting shelves if needed, 9 in. wide and 9 in. below the water level. Also remove soil to accommodate edging material.

It is important to level the top edge of the pool, so the liner won't show at the high points. First use a spirit level around the perimeter, then level the width and length by placing the level on a board long enough to bridge the excavation in both directions.

Remove any sharp stones or roots that might puncture the liner. Then install a 1/2-in. cushion of damp sand along the bottom and worked into the sides. If the soil is particularly rocky, consider installing an underlayment of building grade polyethylene.

Drape the pool liner over the hole and anchor it along the edges with stones or bricks. Then place a garden hose in the center of the pool and begin filling it. As the pool fills the liner will settle. Ease off the weights to allow the liner to settle.

Let the liner settle for one week. Then cut the excess liner leaving a 6-in. lip. Secure the liner to the ground with 20d nails.

Edge the pool with precast paving,

1 Easily adapted to a small space, a tub garden can rest on a balcony or deck. To plant a tub it should be sealed and able to hold 4 gals.

2 This pool was excavated and then lined with a flexible PVC liner. By using a PVC liner you can design a freeform pool of virtually any size.

3 This crescent-shaped, rigid fiberglass pool looks perfectly natural after being edged with stones and planted with water grasses and water lilies.

4 Forms are required to pour this concrete pool with chamfered lip to shape. Pool with water lilies is a contrast to the colorful garden border.

5 This concrete pool topped with brick edging is a graceful outgrowth that adds a central point of interest to a brick retaining wall.

broken slabs, stones or brick laid in a mortar bed of 3 parts sand to 1 part cement. Be careful not to get mortar into the water as the lime in it is toxic to fish and plants.

3 Fiberglass pool

To excavate for a fiberglass pool, lay the pool top side up, and scribe its outline with a stick or other sharp object. Dig the hole 6 in. wider on all sides. You can backfill later.



Make sure that the top edge of the PVC-lined pool is level (top), so that the liner will not show. While the pool is being filled (above), remove the liner weights.

Remove any sharp rocks and roots that may damage the pool. Then line the bottom with 1 in. of sand.

Set the pool in place. Add 1 gallon of water and use it as a level for properly positioning the pool. Check that the pool is level with a spirit level resting on a board that spans pool width and length.

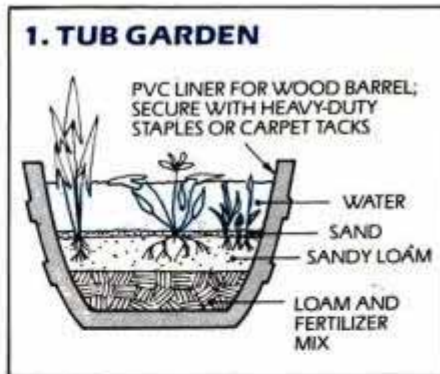
Continue to fill the pool with water as you backfill the hole. Edge the pool with stones, brick, or mix 5 parts topsoil to 1 part dry cement, pat the mix into place while making sure that none of it slips into the pool, and then dampen the mixture. The topsoil mix will accept plantings.

You can plant the pool when the temperature of the water arrives at air temperature and the water is dechlorinated. Chemicals available at garden

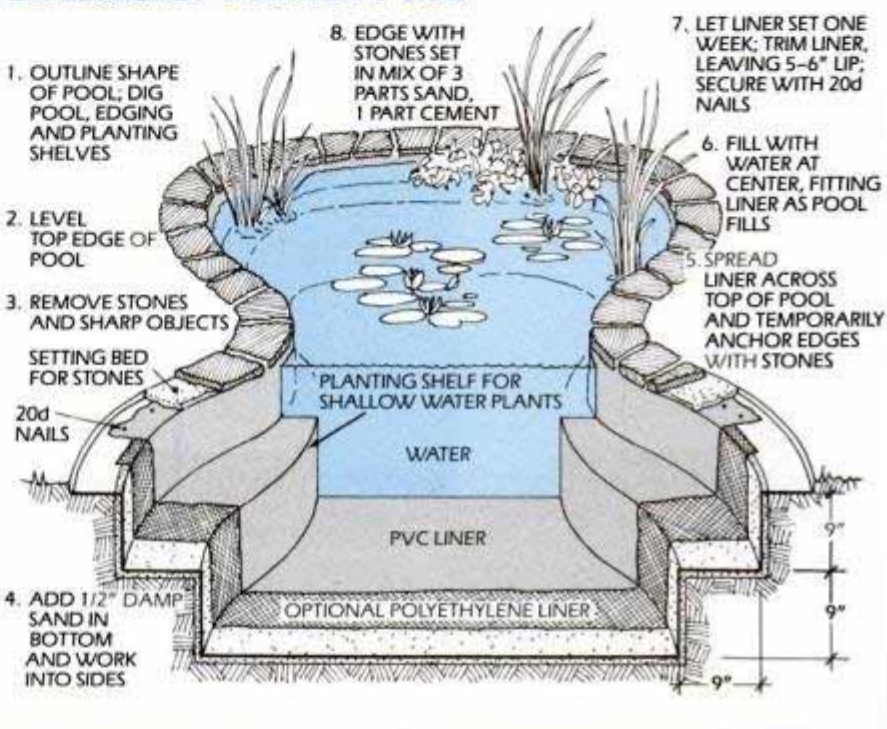
pool suppliers can speed up the removal of chlorine.

4 Concrete pool

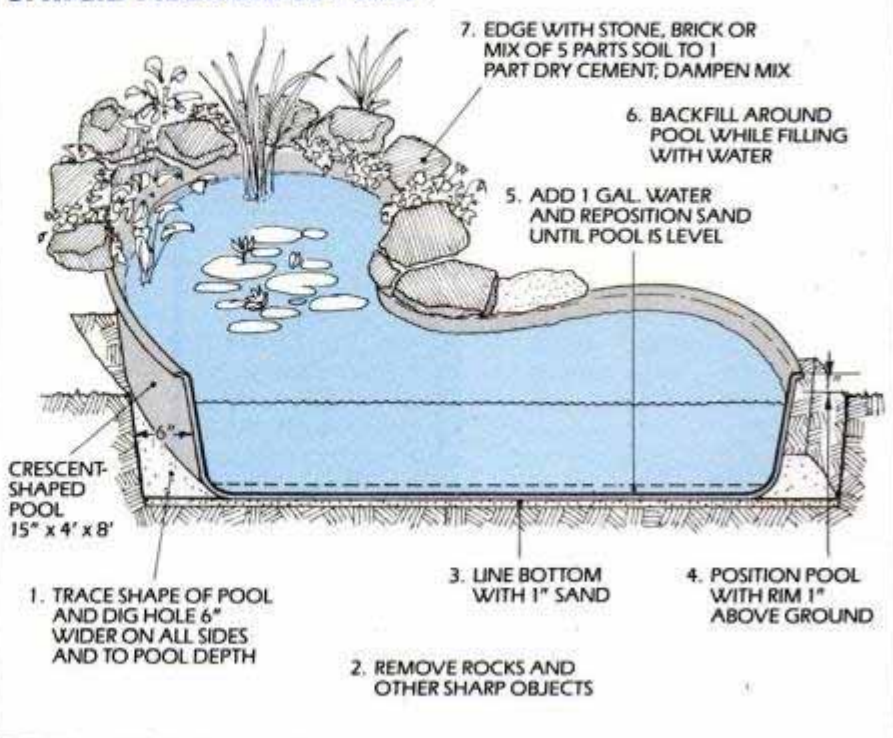
To construct a square or rectangular concrete pool lay out the pool corners using a mason's line and stakes. To make sure each corner is square, measure 3 ft. from a stake along one line and 4 ft. from the stake along the other line. The distance between these points should be 5 ft.; adjust it as needed.



2. FLEXIBLE PVC-LINED POOL



3. RIGID FIBERGLASS POOL

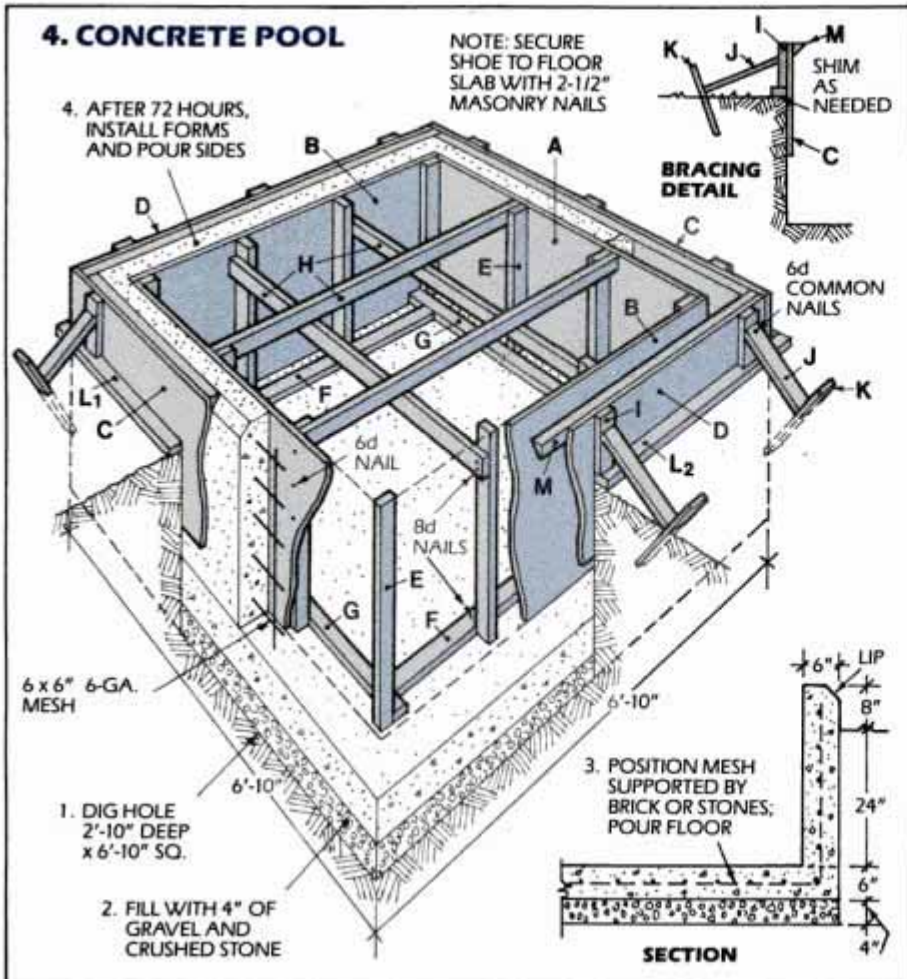


Text: Penelope A. Spangler, Assistant Home and Shop Editor

Photo No. 1: Derek Fell; No. 2: Stapeley Lilypons Water Gardens; No. 3: Lilypons Water Gardens; Nos. 4 and 5: Pamela Harper

Resource for illustration No. 1: Van Ness Gardens Illustrations: Dyck Fledderus

4. CONCRETE POOL



MATERIALS LIST— CONCRETE POOL FORMS

Key No.	Size and description (use)
A	2 3/4" x 2'-8" x 5'8 1/2" exterior plywood (inside form sides)
B	2 3/4" x 2'-8" x 5'-10" exterior plywood (inside form sides)
C	2 3/4" x 1'-8" x 6'-11" exterior plywood (outside form sides)
D	2 3/4" x 1'-8" x 6'-10" exterior plywood (outside form sides)
E	12 1 1/2" x 3 1/2" x 2'-8" pine (inside ribs)
F	2 1 1/2" x 3 1/2" x 4'-6 1/2" pine (inside shoes)
G	2 1 1/2" x 3 1/2" x 5'-8 1/2" pine (inside shoes)
H	4 1 1/2" x 3 1/2" x 5'-8 1/2" pine (top braces)
I	12 3/4" x 2 1/2" x 6 1/2" pine (outside cleats)
J	12 3/4" x 2 1/2" x to fit pine (outside braces)
K	12 3/4" x 2 1/2" x 12" pine (stakes)
L1	2 1 1/2" x 3 1/2" x 6'-11 1/2" pine (outside shoes)
L2	2 1 1/2" x 3 1/2" x 7'-5" pine (outside shoes)
M	4 1 1/2" x 1 1/2" x to fit pine (chamfer strips) (ripped at 45°)

Misc: 6d, 8d common nails; 2 1/2" masonry nails

Next, set batter boards of three 2x2 stakes joined by horizontal 1x6s so the assembly duplicates the right corner angle of the slab area. Set the batter boards about 4 ft. outside each corner for use as reference points. Transfer the mason's lines from the slab corners to the batter boards.

Dig the area to a 2-ft. 10-in. depth or as planned. Then fill the area with 4 in. of gravel and crushed stone.

Lay 6 x 6 in.—6-gauge mesh on the ground supported by brick or stones so the concrete will encompass the mesh. Line the walls with mesh.

To pour the floor use a mixture of three parts sand to one part cement; or use 90-lb. bags of ready-mixed concrete. Use a spade to spread the concrete. Level the slab with a screed. With a 2x4 board make an indentation along the perimeter of the floor where the walls join, to key the parts together. Keep the slab wet by sprinkling it with water and covering it with polyethylene.

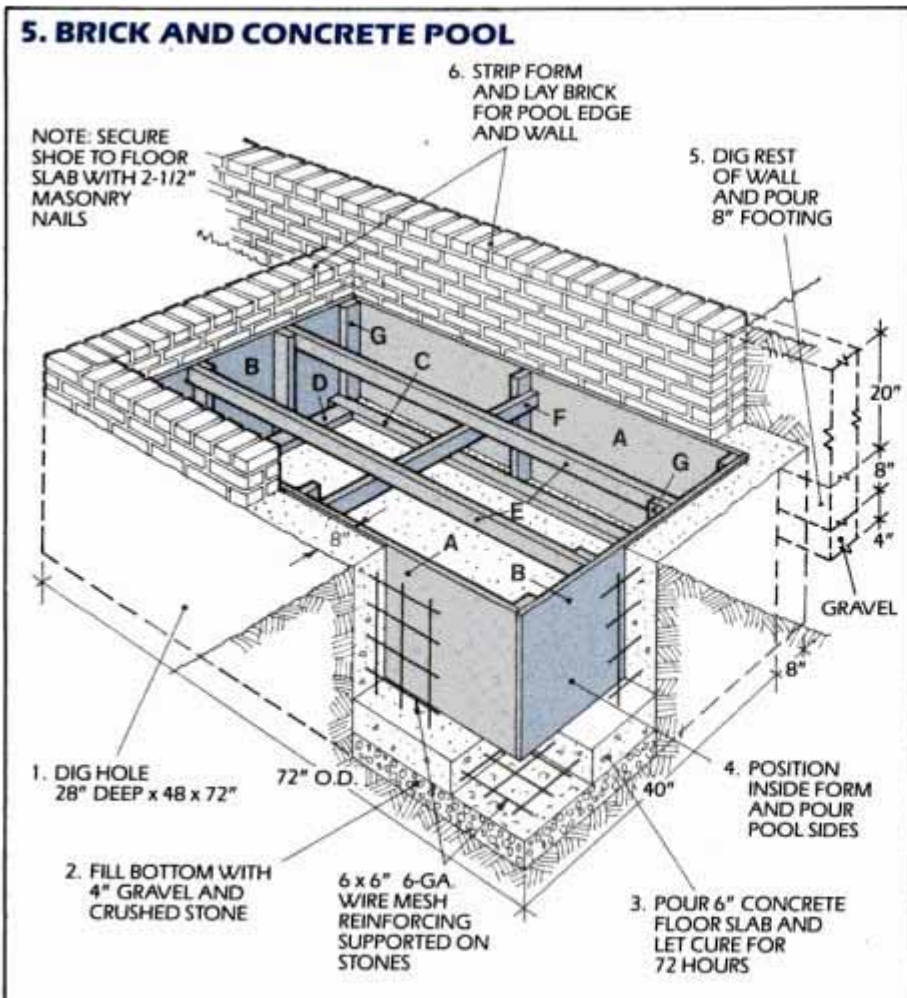
After 8 to 10 hours hose off the forms and install them. Then pour the walls. Pour to a depth of 1 1/2 ft. around the entire pool. Then immediately continue pouring to the top of the forms.

Again, keep the concrete wet by sprinkling it with water, every hour if needed. Remove the forms after 8 to 10 hours.

If you plan to add color to the concrete you can either add dye to the concrete mix before pouring it, or paint the pool after it has been poured and

(Please turn to page 130)

5. BRICK AND CONCRETE POOL



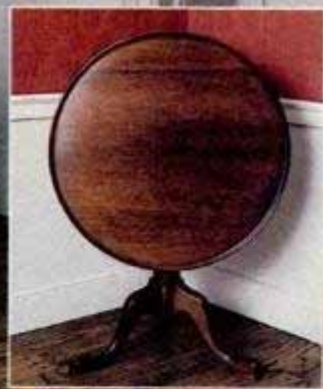
MATERIALS LIST— BRICK/CONCRETE POOL FORM

Key No.	Size and description (use)
A	2 3/4" x 18" x 54 1/2" exterior plywood (sides)
B	2 3/4" x 18" x 32" exterior plywood (sides)
C	2 1 1/2" x 3 1/2" x 54 1/2" pine (shoes)
D	2 1 1/2" x 3 1/2" x 18" pine (shoes)
E	2 1 1/2" x 3 1/2" x 54 1/2" pine (top braces)
F	1 1 1/2" x 3 1/2" x 30 1/2" pine (top braces)
G	10 1 1/2" x 3 1/2" x 18" pine (ribs)

Misc: 6d common nails to secure A and B to G; 8d common nails to secure E and F to G; 2 1/2" masonry nails to secure C and D to floor slab.



Chippendale furnishings include a shop-built tilt-top tea table, plus corner chair and wall-hung looking glass, both assembled from kits. Tabletop tilts down for storing (right).



How To Create A Chippendale Room

From the tilt-top table to the period moldings, we'll show you how to create a Chippendale setting.

With more people developing an interest in reproduction furniture, PM is proud to introduce the first in a series of stories showing how to create a period room. Each story will offer detailed drawings for reproducing furniture, sources for kit furniture pieces and a guideline for re-creating authentic moldings and choosing the appropri-

ate wallpaper, paint, rugs and window coverings for the period. Each room will illustrate close copies of actual antiques that have the same details, proportions and scale for each stylistic period.

To begin the series, we've chosen the period around the time of the American Revolution when the Chippendale style was popular. The room shown is similar

Tilt-top table design, construction and text: William Ralston, Ralston Furniture Reproductions, Cooperstown, N.Y.

Molding construction, text and how-to photos: Rosario Capotosto

Color photos: Harry Hartman Studios, Room stylist: Gabe Herick, Technical art: Eugene Thompson

to one that might have been found in a Connecticut home between 1760 and 1790. The furnishings include a corner chair, a Chippendale looking glass and a tilt-top tea table. The chair and mirror are available in kit form. Plans for building the table are on the next page.

The room moldings—baseboard, chair rail, cornice and door surround—are accurate reproductions of the Georgian architectural style which was popular during the Chippendale period. Georgian architecture is named after the classical architecture built in England and the colonies from 1714 to 1820, during the consecutive reigns of King George I, II and III. The actual moldings and their relative scale were simplified from moldings found in two Connecticut houses built around 1760. The woodwork and the wall below the chair rail are painted a putty color.

Most plaster walls were white-washed throughout the colonial period—only a few Americans could afford imported silk or wool damask to hang on their walls. Although still a luxury, wallpaper was a less costly substitute. The wallpaper shown here is an imitation of a silk damask bedspread owned by Dolly Madison, wife of President James Madison.

Since only a few 18th-century curtains survive today, we must use prints and paintings to make accurate renditions. All finer textiles were imported and extremely expensive during colonial America. Thus, curtains were not used as regularly as we use them today. Valances were often placed above windows as decoration and for protection from cold drafts.

In the Chippendale period, curtains could be drawn up like Venetian blinds,

pulled diagonally to form a swag, or gathered to one or both sides and tied back. Decorative border tapes were added for color and to outline the stylish form of the valance. The printed cotton chintz used for the curtains imitates the curving, naturalistic rococo taste of the years between 1750 and 1780.

Painted floors sometimes brightened a room and sealed the wood from dirt. Oriental carpets were rare for most 18th-century Americans. Canvases with painted designs, called floor cloths, were much more common. However, most floors during the Chippendale period were left unfinished, as shown. We chose a random-width oak plank floor.—*Gilbert Tapley Vincent*

Mr. Vincent is an adjunct professor in architecture, painting and decorative arts in the Cooperstown Graduate Program, Cooperstown, N.Y.

HOW TO BUILD THE TILT-TOP TABLE

Round tilt-top tea tables supported by a central shaft and three curved legs first appeared around 1740. Our mahogany table is supported by a bird cage—a wooden assemblage consisting of a top and bottom joined by four small posts—which allows the top to rotate on the pedestal. When not in use, the top tilts down to save space. Elegant snake-foot legs, fitted with shoes, are dovetailed into the turned pedestal.

Tabletop and bird cage

First, glue up the top using no more than three $\frac{5}{4}$ -in. boards. Join the edges to achieve a tight-fitting joint, then glue and clamp the boards together. Next, cut the parts for making the bird cage. Note that the bird cage top has two $\frac{5}{8} \times \frac{5}{8}$ -in.-dia. pins protruding from each end (see detail 1). The pins fit into holes bored in the cleats, which enable the top to pivot down. To make the bird cage top, start with a $\frac{7}{8} \times 7\frac{3}{4} \times 7\frac{3}{4}$ -in. mahogany block. Next, rip $\frac{7}{8}$ in. off one side and turn the two pins on this piece. Trim the remaining block to $6\frac{1}{2}$ in. long. Then glue the piece with the turned pins back onto the block. Now you can trim the assembled bird cage top to $6\frac{1}{2}$ in. wide. Finally, round over the top edge where the tabletop pivots down.

Next, turn the four small posts on a lathe to the same exact length. Now turn the $4\frac{1}{4}$ -in.-dia. washer using a faceplate and make the wedge that locks the bird cage to the pedestal. Don't assemble the bird cage yet. Put it aside until later when finishing the parts will be easier.

Unclamp the tabletop after allowing the glue to dry overnight and rough-cut it to within $\frac{1}{4}$ in. of the finished diameter of $31\frac{3}{4}$ in. Now plane and sand both



After rough-cutting the glued-up tabletop to size, glue and clamp the pivot dowel and pivot block to the tabletop center.



Place the tabletop upside down and shape the bottom edge using a $\frac{3}{4}$ -in. rounding-over bit fitted with a ball-bearing pilot.

sides smooth. Be sure to scrape off all hardened glue squeeze-out before planing.

Rout the tabletop to its final dimensions using the router jig. The jig pivots on a $\frac{3}{8}$ -in.-dia. dowel protruding from a wood block glued to the tabletop center. Note that a wood spacer the same thickness as the pivot block is glued to the underside of the jig. The spacer rides on the outside edge of the tabletop to keep the jig level.

First, trim the tabletop to exactly



Trim the tabletop to its finished diameter using the router and jig combination. Note that a stop is nailed inside of the router.



Rout the tabletop's curved lip using a $\frac{1}{2}$ -in.-rad. core-box cutter. Note that the stop is now nailed outside of the router.

SUPPLIERS

Chippendale corner chair: The Bartley Collection Ltd., 747 Oakwood Ave., Dept. PM520, Lake Forest, Ill. 60045.

Chippendale looking glass, small size: The Bartley Collection Ltd.

Wallcovering: Dolly Madison Damask (No. T-6528), Richard E. Thibaut Inc., 706 South 21st St., Irvington, N.J. 07111.

Drapery and chair fabric: Nassau Tracery (No. F-92103), Richard E. Thibaut Inc.

Flooring: Village Plank by Bruce Hardwood Floors, 16803 Dallas Parkway, Dallas, Tex. 75248.

TILT-TOP TABLE

ALL PARTS MAHOGANY HARDWOOD

TABLETOP
1 x 31-3/4" DIA.
(EDGE—GLUE 2 OR 3 BOARDS)

CLEAT
1-1/8 x 1-3/4 x 28-1/2"
(2 REOD.)

1" NO. 10 FH SCREW (4 REOD.)
5/8"-DIA. x 3/4" HOLE (2 REOD.)
2" NO. 10 FH SCREW (4 REOD.)

WASHER—5/8 x 4-1/4"-DIA.
(NOTCH TOP FOR WEDGE)
WEDGE—3/8 x 1-3/8 x 4"

HARDWOOD RAILS

ROUTER
3/4 x 1-1/2" STOP BLOCK

WIDTH OF ROUTER BASE
1-1/4" SLOT

3/8"-DIA. PIVOT HOLE

16"

3/4" PLYWOOD BASE

3/8"-DIA. DOWEL PIVOT

3/4" x 2" SPACER

3/4" BLOCK GLUED TO TABLETOP

ROUTER JIG FOR TABLETOP

EACH SQ. = 1/2"

5"

4"

3"

2"

1"

POST PATTERN

5/8"-DIA. x 5/8" PIN (BOTH ENDS)

SHOE—1/2 x 2-1/4 x 3-3/4" (3 REOD.)

LEG (3 REOD., SEE PATTERN)

75°

LEG PATTERN

EACH SQ. = 1"

7-3/4"

6-1/2"

7/8"

1. RIP 4 GLUE

2. TURN 5/8"-DIA. PINS

3. TRIM TO 6-1/2"

5. TRIM TO 6-1/2"

DETAIL 1 BIRD CAGE TOP

GRAIN

5/8"

1-15/16"

65°

75°

LEG DOVETAIL DETAIL

COLUMN PATTERN

CARVE OUT (3 PLACES)

120°

25"

20"

15"

10"

5"

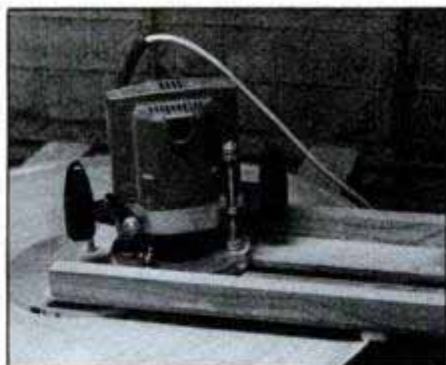
3 1/4 in. dia. using a 1/2-in. straight bit. Nail a stop to the plywood base of the jig between the router and the pivot dowel, as shown, to hold the cutter at the proper distance from the tabletop center. Move the router in a counterclockwise direction. Next, turn the top upside down and round the bottom edge using a 3/4-in. rounding-over bit. Now screw the cleats temporarily to the tabletop underside (perpendicular to the top's grain) to prevent warping while the top surface is routed. Use the bird cage top to space the cleats properly and remember that the finished ta-

bletop is only 5/8 in. thick when determining screw length. Now, with the tabletop right-side up, use the router and jig to cut the 1/8-in.-deep step into the top with a 1/4-in. straight bit. Then use a 1/2-in.-rad. core-box cutter to rout the 3/8-in.-deep hollow that forms the tabletop's curved lip. For both of these cuts, nail the stop outside of the router and circle in a clockwise direction. Rout the rest of the top with a 3/4-in. straight bit set at 3/8 in. deep. Continue spiraling toward the center until a 3-in.-dia. section of the tabletop remains unrouted. Because this process

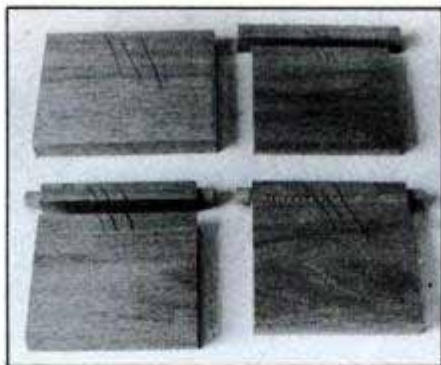
creates a lot of dust, be sure to wear a dust mask and goggles. Now clear the remaining tabletop center with a chisel and plane and sand the tabletop smooth.

Making the legs

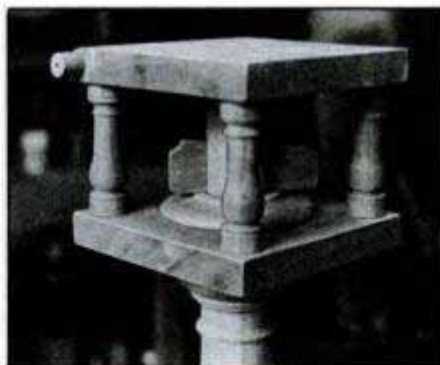
To build the legs, make a full-size leg pattern out of 1/4-in. hardboard. Outline the pattern on three 2-in.-thick mahogany boards and then trim the legs to size. Next, plane the bottom and back of each leg square and carefully cut the legs to the same height. Then scribe the dovetails onto the legs with a marking gauge



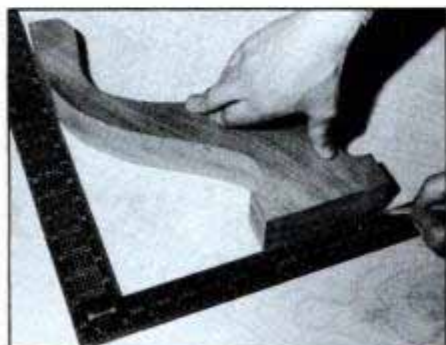
Dish out the tabletop surface using a 3/4-in. straight bit set 3/8 in. deep. Leave about 3 in. of the tabletop center unrouted.



Shown here is the sequence for making the bird cage top. Rip one side, turn the pins, then glue ripped piece back to the board.



The assembled bird cage is held to the pedestal column by the wedge. Note the placement of the washer under the wedge.



After rough-cutting the legs to shape, check to be sure the leg top and foot are square. Plane and sand as needed.



If the legs won't fit into the pedestal column, pare down the dovetail using a sharp chisel. Don't remove too much wood.



The legs should fit tightly into the pedestal column. If the fit is too loose, glue a thin wood shim to the leg dovetail.

and cut the dovetails as shown with a backsaw. Shape the legs using a spokeshave, rasp and file.

Turn the pedestal on a lathe from 4-in.-square stock. If necessary, make the blank by gluing up 2-in. lumber. Before turning the blank, however, locate the 3/8-in.-wide mortise for the wedge and bore a series of overlapping holes. Then, after turning the pedestal, chisel out the waste. Note that the top of the mortise is angled to match the wedge. Turn the blank and sand the pedestal while it's still in the lathe.

Next, cut the dovetail grooves in the pedestal bottom for accepting the legs. First, make a pattern of the leg dovetail out of 1/8-in. hardboard. Then use the pattern to mark three dovetails 120° apart as shown. Using a dovetail saw, cut the angled sides of each dovetail

groove and chisel out the waste.

Now finish-sand the legs and make the shoes. Glue and nail the shoes to the legs with 1-in. brads. Then glue the legs to the pedestal by gently tapping them in with a mallet. Carve the rounded V-groove detail between each leg.

Finishing

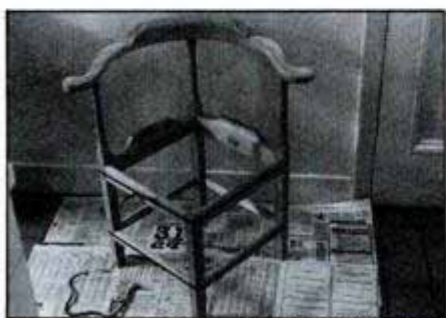
Remove the cleats from the tabletop for final sanding and staining. Sand all parts starting with 80-grit abrasive paper and then 120-grit. Before applying the stain, fill the wood's grain with a paste filler. Once the filler dries, sand lightly with 120-grit paper. Next, apply a medium mahogany stain to all parts. Once the stain is thoroughly dry, brush on a coat of sanding sealer. Allow the sealer to dry, then sand lightly with 220-grit abrasive paper. Now apply two

coats of cabinet varnish. Sand between coats with 220-grit. After the final varnish coat, sand lightly with 280-grit abrasive paper and rub all parts with 2/0 steel wool, and then again with 4/0 steel wool.

Next, glue up the bird cage, making sure it's square. Screw the cleats to the tabletop with the bird cage between them. Mount the bird cage and washer on the pedestal and secure them with the wedge. Mount the brass latch to the tabletop underside and mortise the strike plate into the front edge of the bird cage top. (The tilt-top table latch, No. 12046, is available from Faneuil Furniture Hardware, 100 Peterborough St., Boston, Mass. 02215, for \$11.95 postpaid.)

Apply paste wax over the varnish for protection.—*William Ralston*

CORNER CHAIR FROM A KIT



Glue and clamp legs, rails and stretchers. Unglued arm section keeps legs aligned.

This Chippendale corner chair kit from The Bartley Collection Ltd. comes pre-cut and rough-sanded with most of the holes prebored. The instructions suggest that you dry-assemble the chair to check if sanding is needed at the joints. This rehearsal also gives you insight for the actual assembly with glue.

I sanded the parts before assembly, when they were easier to work with. It's also important to sand the chair after assembly to eliminate glue smudges that keep the stain from penetrating.

Both the stain and finish top coat are in a gel form. They're less messy and easier to control than liquid, and provide a good, even finish.

The corner chair is available in cherry, as shown, or mahogany, with padded seat ready for fabric. The kit is \$258 postpaid. The finished chair (\$740 plus shipping) is also available from The Bartley Collection Ltd., 747 Oakwood Ave., Dept. PM520, Lake Forest, Ill. 60065.—P.S.

(Please turn to page 122)

Maple telephone tower fits neatly between wall studs. Two upper doors provide storage for telephone books and answering machine (below). Open bottom section houses the telephone.



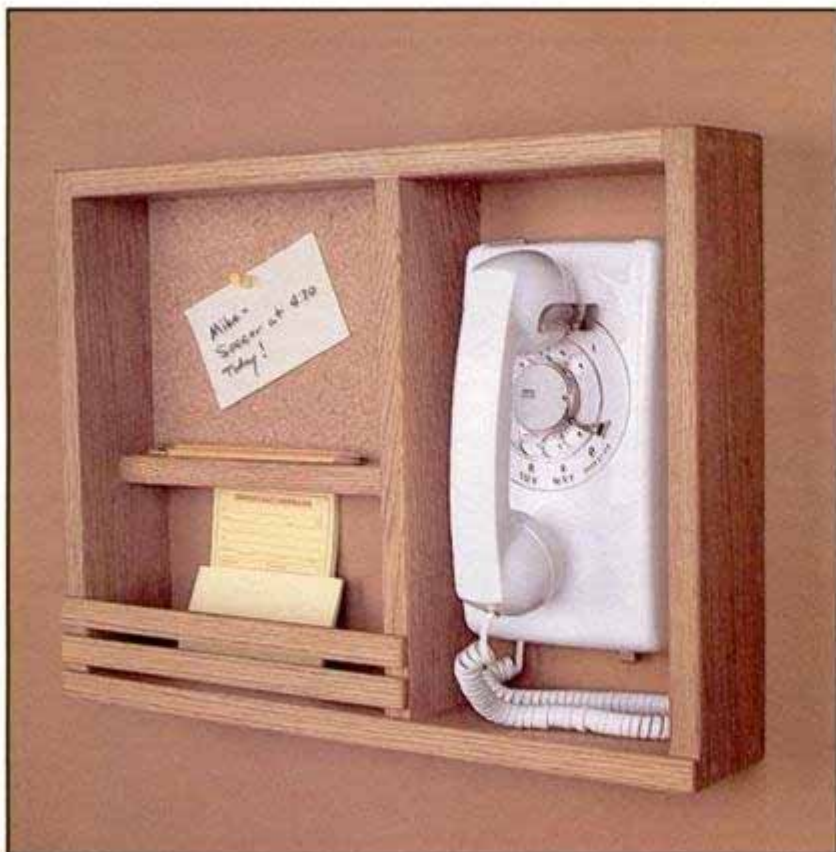
Dial O For Organized

Here are five ways to turn your telephone into a family communications center.

Today's home telephone is the center of activity for conducting personal business, recording messages, scheduling the day's activities and keeping in touch with family and friends. To help organize the telephone and accessories such as an answering machine,

telephone directory, pad and pencil and cordless phones, PM offers five build-it-yourself telephone centers which range from simple wall-hung cabinets to an elaborate, space-saving in-the-wall telephone tower.

The dimensions of the telephone centers can be altered easily to conform to your specific equipment.



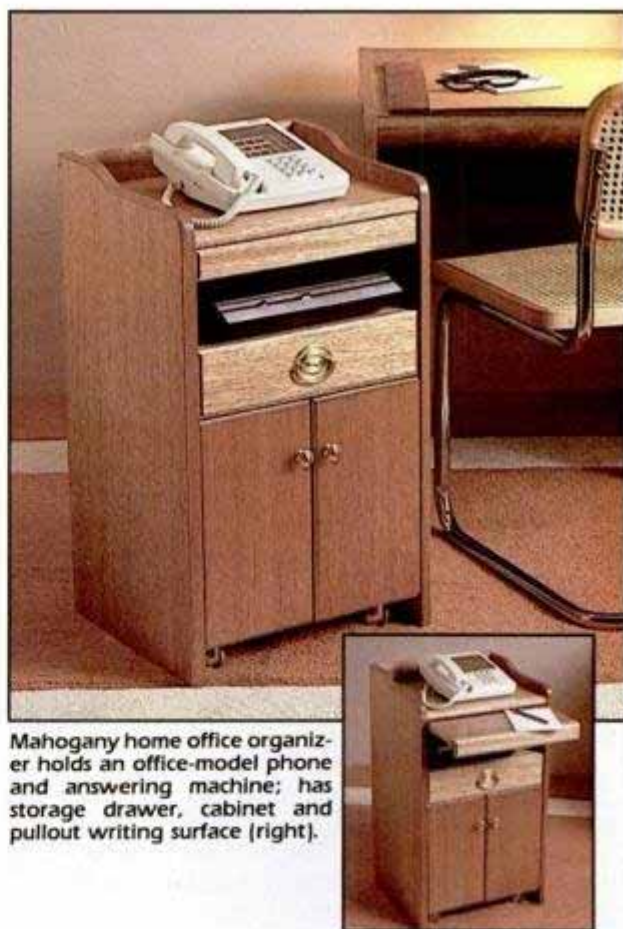
This oak message center contains a cork bulletin board, pencil shelf and storage corral. You can mount the unit right over an existing wall-hung telephone.



Easy-to-build pine phone cupboard has a convenient drawer located under the slanted writing surface.



Install the slim under-the-cabinet phone shelf to your upper kitchen cabinets. Plastic laminate tambour door rolls up for access to pullout shelf (right).



Mahogany home office organizer holds an office-model phone and answering machine; has storage drawer, cabinet and pullout writing surface (right).

Construction, text and black and white photos of the in-the-wall tower, under-the-cabinet shelf and home office unit: Rosario Capotosto.
 Construction and color and black and white photos of the oak message center and pine phone cupboard: Cornerstone Designs Inc.
 Color photos: Harry Hartman Studios; Room styling: Gabe Henick; Technical art: Eugene Thompson.

1 In-the-wall telephone tower

This unit is designed to utilize the dead space between wall studs. It's dimensioned to fit between studs spaced 16 in. on-center. When installed, the cabinet will project into the room less than 2½ in.

The two fold-down doors have built-in storage racks for holding telephone directories and an answering machine.

The open, bottom section of the cabinet is for a wall-hung telephone. Behind the lower front panel is an electrical outlet and a phone jack. If a cordless phone is used, be sure to install a dual-receptacle outlet for the answering machine and phone base.

Cabinet construction

Make the cabinet frame from nominal 1-in. maple (actual thickness: 13/16 in.). Use 3/4-in. maple ve-

ner plywood for the doors and shelves; 1/4-in. maple veneer plywood for the back.

Begin by cutting the cabinet top, bottom, sides and front panels. Next, using a router or table saw, rabbet the top, bottom and sides to receive the 1/4-in. back. Also, dado the cabinet sides for the shelves. Cut three shelves from 3/4-in. maple veneer plywood and bore holes for the hinges in the two upper shelves. The hinges used are concealed flap hinges which are invisible when the door is closed. Each hinge requires two 1/2-in.-deep × 35-mm-dia. (1 3/8 in.) holes. A special flat-bottom, 35-mm-dia. drill bit is available from the same source that supplies the hinges.

Next, cut out the lower shelf for the two electrical boxes and saw a wire access slot in the bottom. Bore a hole in the middle shelf for the answering machine wires. Sand all parts smooth.

Assemble the cabinet with 2-in. finishing nails and carpenter's glue. First glue and nail the shelves to the sides; then add the cabinet top, bottom and two front panels. Note that the front edges of the plywood shelves are hidden by the doors so there's no need to edge-band them. Be sure to bore pilot holes before trying to nail through the maple. Also, nail the top front panel so that the nails will not interfere with shaping the rounded cabinet top. Now set and fill all nail holes.

Next, round the cabinet top using first a bench or jack plane and then a block plane. Complete the shaping with a belt sander and finishing sander.

Next, round the cabinet top using first a bench or jack plane and then a block plane. Complete the shaping with a belt sander and finishing sander.

Door construction

Cut the plywood doors on a radial-arm or table saw using a sharp, smooth-cutting saw blade to prevent splintering the maple veneer. Next, glue 1/4-in.-thick × 3/4-in.-wide maple hardwood edging to each door, as shown, to conceal the plywood edge.

Now rout the mortises for the recessed door pulls using a router, fitted with a guide bushing, and a 1/4-in. hardboard template. To make the template, first trace the base of the pull onto the hardboard, extend the outline 1/8 in. and then cut out the outline using a sabre saw. Next, clamp the template flush with the door top and rout the 7/16-in.-deep mortise using a 5/16-in.-dia. straight bit. Now bore holes in the doors for the hinges as shown. Separate the hinge halves and install the half with the retaining screw to the shelf. Screw the remaining hinge half to the door. Mount the doors by rejoining the hinges and make adjustments, if necessary, to achieve a good fit.

Next, install the telescopic drop-leaf supports to each door before putting on the cabinet back. Position the supports as shown in the drawing. Then, cut and assemble the two storage racks from 3/8-in.-thick maple. Install the racks to the doors using 1/4-in.-dia. hardwood dowels. Use a doweling jig to bore 1/4-in.-dia. holes in the bottom edge of the racks; then insert dowel centers and transfer the hole locations to the doors. Bore the dowel holes and glue the racks to the doors. Be certain to notch the back corners of each rack to clear the hinges and bore a hole in the back of the answering machine rack for the wires.

Finish

Sand all surfaces smooth with first 100-grit abrasive paper and then 120-grit. Sand and finish the cabinet back before nailing it in place. Next, apply three coats of a clear, satin finish to all wood parts. Sand lightly between coats with 220-grit paper. Glue wood pulls to the doors and nail the back to the cabinet with 3/4-in. brads.

To install the telephone tower, cut away the plasterboard between two studs 1/4 in. longer than the cabinet. Have an electrician and a telephone serviceman connect power to the two boxes. Then screw the unit to the studs through the cabinet sides. Nail molding around the cabinet to conceal the cut plasterboard.—Rosario Capotosto



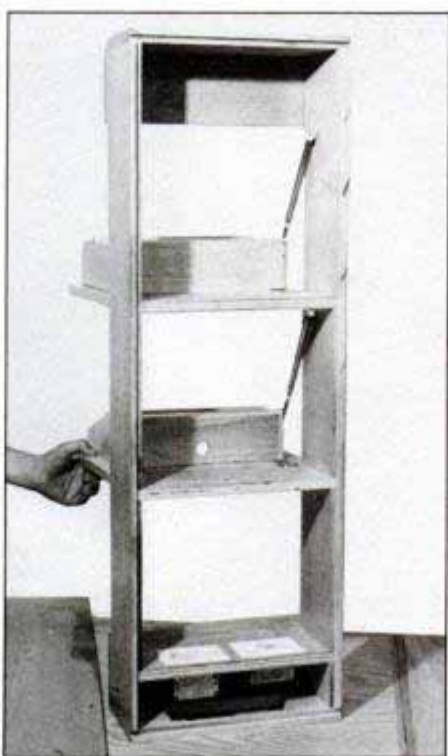
Finished cabinet is shown ready for installation. Note the clock outlet with recessed receptacle placed next to the phone jack.



Round the top of the cabinet using first a bench plane and then a smaller block plane. Finish the shaping with a belt sander.

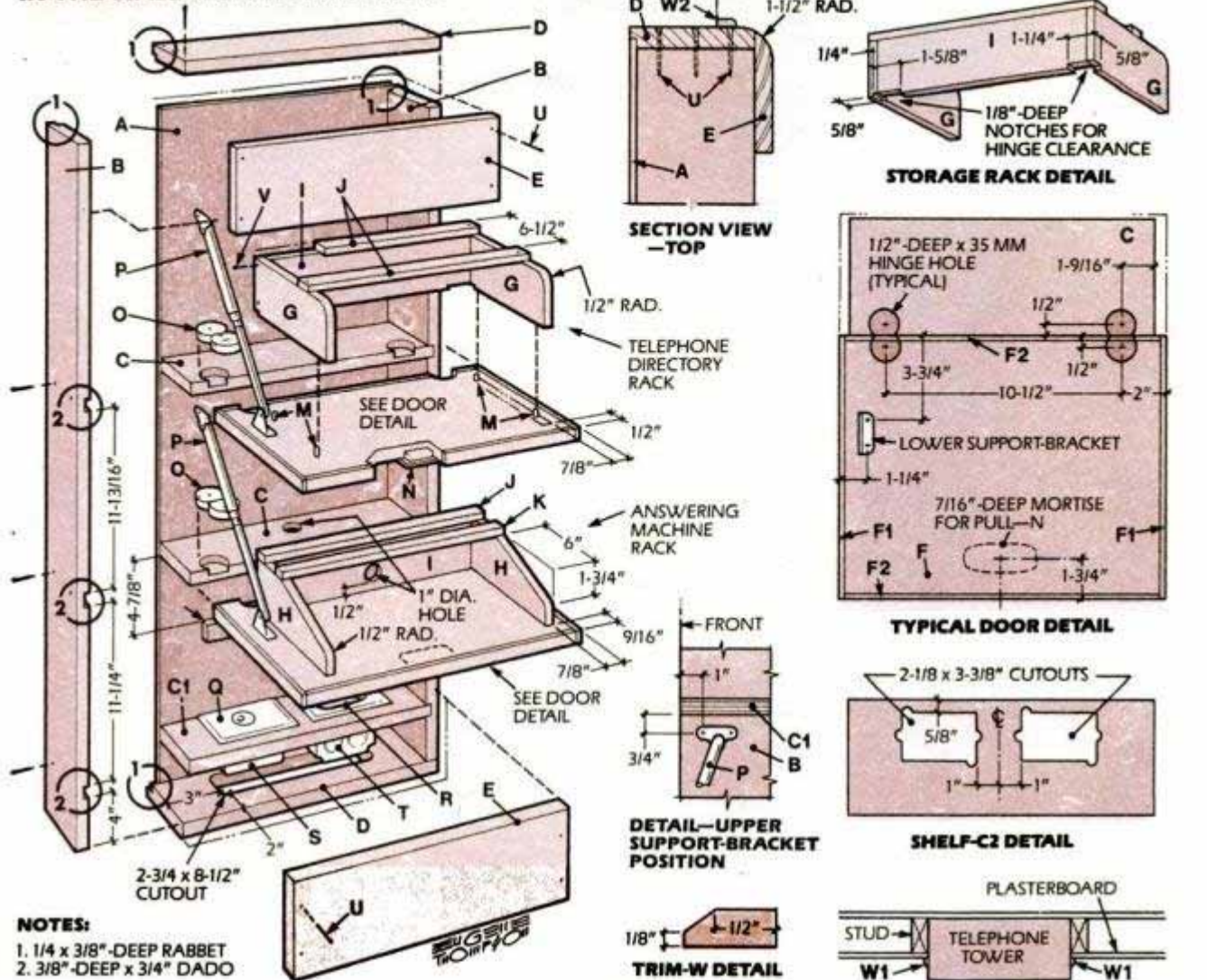


Rout the doors for the recessed maple pulls using a hardboard template, a 7/16-in.-dia. guide bushing and a straight bit.



Shown here is the back view of the nearly completed cabinet. Note that the bottom is cut away for wiring the electrical boxes.

IN-THE-WALL TELEPHONE TOWER



NOTES:

- 1/4 x 3/8"-DEEP RABBIT
- 3/8"-DEEP x 3/4" DADO

MATERIALS LIST—IN-THE-WALL TELEPHONE TOWER

Key	No.	Size and description (use)	F1	4	1/4 x 3/4 x 11 13/16" maple (door edging)	N	2	1 1/4 x 3 1/4" recessed maple pull
A	1	1/4 x 13 3/4 x 44 1/2" maple veneer plywood (back)	F2	4	1/4 x 3/4 x 14" maple (door edging)	O	4	Flap hinge
B	2	13/16 x 5 1/2 x 43 3/4" maple (side)	G	2	3/4 x 3 1/4 x 10 1/2" maple (rack side)	P	2	9" drop-leaf support
C	2	3/4 x 5 1/4 x 13 3/4" maple veneer plywood (shelf)	H	2	3/8 x 3 1/4 x 10" maple (rack side)	Q	1	Modular phone wall plate and jack
C1	1	3/4 x 5 1/4 x 13 3/4" maple veneer plywood	I	2	3/8 x 3 1/4 x 11 1/4" maple (rack back)	R	1	Recessed clock outlet
D	2	13/16 x 5 1/2 x 14 1/2" maple (top and bottom)	J	3	3/8 x 1 x 12" maple (rack slat)	S	1	2" electrical box
E	2	13/16 x 5 1/2 x 14 1/2" maple (front panel)	K	1	3/8 x 3/4 x 12" maple (rack slat)	T	1	2 1/2" electrical box
F	2	3/4 x 11 1/16 x 14" maple veneer plywood (door)	L	1	3/8 x 1 x 8" pine (cleat for mounting wall-hung phone)	U	2	finishing nail
			M	8	1/4"-dia. x 3/4" hardwood dowel	V	3/4"	brad
						W1	2	5/16 x 3/4 x 46 1/2" maple (molding trim)
						W2	2	5/16 x 3/4 x 14 1/2" maple (molding trim)

2 Oak message center

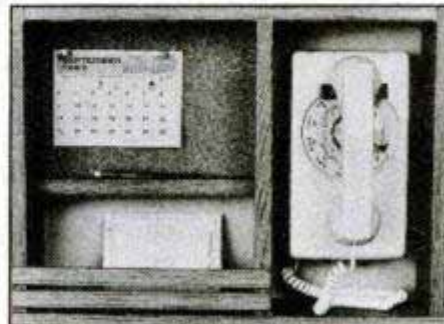
The oak message center provides an easy way to jot down and post important phone messages. The slim, wall-hung cabinet, with bulletin board and pad and pencil storage areas, can be installed in a kitchen, workshop, garage or rec room.

Start by cutting all the cabinet members as shown. Next, rout rabbets in the cabinet top and the pencil tray to receive the 1/4-in.-hardboard back. Then, using a 3/8-in. core-box cutter, rout two grooves into the pencil tray.

Counterbore the cabinet sides for 3/8-in.-dia. oak plugs and screw-shank

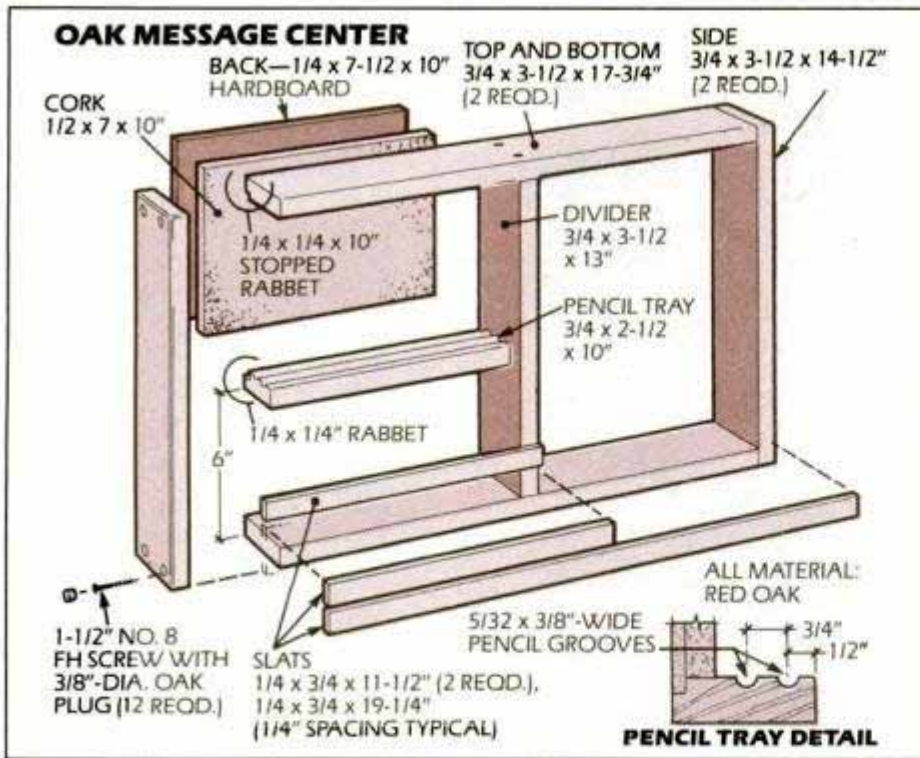
clearance holes. Then glue and clamp the frame, bore pilot holes and screw the parts together. Assemble the cabinet frame with 1 1/2-in. No. 8 flathead screws. Now glue and nail the pencil tray to the divider using 1 1/2-in. finishing nails before screwing the divider to the cabinet frame. Bore pilot holes before nailing. Next, attach the divider/tray assembly to the cabinet frame. Nail through the cabinet side to secure the pencil tray. Glue and nail the slats in place using 3/4-in. brads. Bore pilot holes first to prevent splitting.

Stain and finish the cabinet before



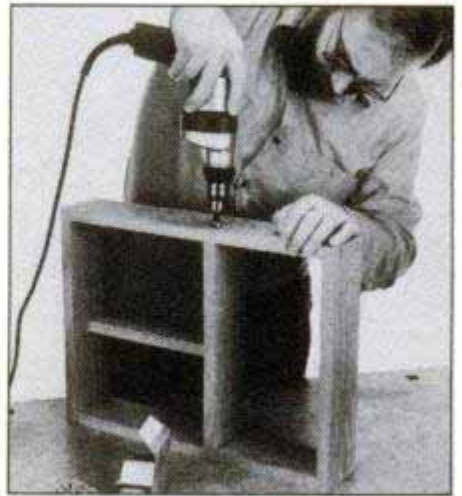
Post phone notes on cork bulletin board.

installing the back and cork. Use a light oak stain. Then apply three coats of polyurethane varnish. Finally, glue and



nail the back using $1/2$ -in. brads and attach the cork with contact cement.

Install the cabinet using two flat picture hangers or cut keyhole slots in back to hang it on two screws.—J.T.



Counterbore all screw locations to receive $1/2$ -in.-dia. oak plugs. Also bore screw-shank clearance holes and pilot holes.

3 Pine phone cupboard

This simple wall-hung pine cabinet has three convenient features: a slanted writing surface, a storage drawer and a top shelf. Its attractive profile makes it suitable for use in the kitchen, den and finished basement.

First, cut the cabinet sides from 1×10 pine. Measure carefully before cutting to obtain the appropriate angled profile. Then use a router and a $1/4$ -in. straight bit to cut two stopped rabbets in each side. The upper rabbets hold a hardboard shelf that keeps the phone cord out of the drawer, and the lower rabbets receive $1/4$ -in. hardboard or plywood strips that act as drawer guides.

Next, cut the cabinet top, top shelf, writing surface and pencil stop. Use a router fitted with a $1/4$ -in. rounding-over bit to smooth the sharp edges on the top shelf and cabinet sides. Sand all parts smooth, then assemble the cabinet as shown using glue and $1 1/2$ -in. finishing nails. Glue and nail the pencil stop with $3/4$ -in. brads. Set and fill all nail holes. Now glue the hardboard

shelf and the plywood drawer guides into the rabbets.

Next, cut the drawer from birch or mahogany plywood. Make the drawer face from $3/4$ -in. pine. Before assembling the drawer, rout a $1/4 \times 1/4$ -in. rabbet in each side to accept the drawer guides.

Note that the drawer sides and drawer front are cut at a 10° angle to match the cabinet profile.

Finish-sand all surfaces with 120-grit abrasive paper. Stain as desired, then finish with two coats of polyurethane varnish.

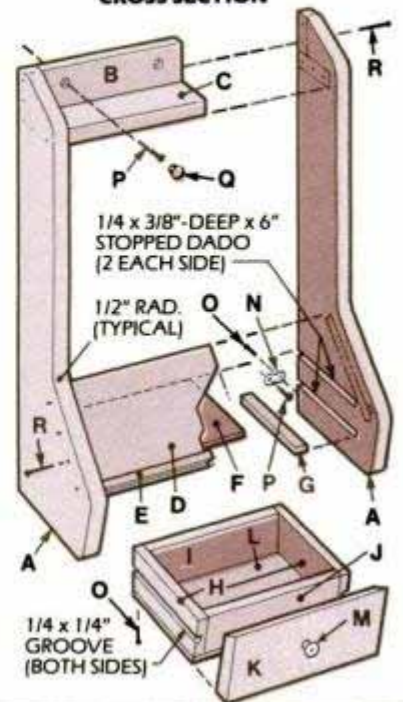
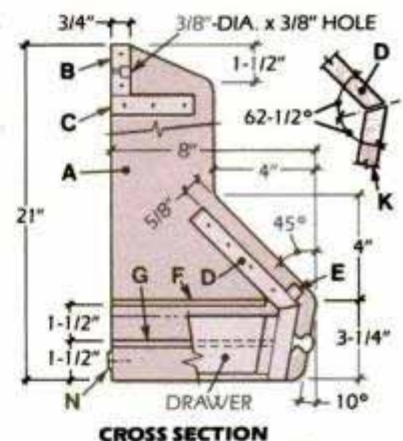
To install the pine cupboard, screw through the top as shown and then attach two flat picture hangers at the cabinet bottom just behind the drawer.—J.T.

MATERIALS LIST—PINE PHONE CUPBOARD

Key	No.	Size and description (use)
A	2	$3/4 \times 8 \times 21''$ pine (sides)
B	1	$3/4 \times 1 1/2 \times 7''$ pine (top)
C	1	$3/4 \times 3/4 \times 7''$ pine (top shelf)
D	1	$3/4 \times 5 1/2 \times 7''$ pine (writing surface)
E	1	$1/2 \times 1/2 \times 7''$ pine (pencil stop)
F	1	$1/4 \times 6 \times 7 1/2''$ plywood (shelf)
G	2	$1/4 \times 3/8 \times 6''$ plywood (drawer guide)
H	2	$1/2 \times 2 1/4 \times 6 1/2''$ birch plywood (drawer side)
I	1	$1/2 \times 2 1/4 \times 5 1/2''$ birch plywood (drawer back)
J	1	$1/2 \times 2 1/4 \times 5 1/4''$ birch plywood (drawer front)
K	1	$3/4 \times 3 1/4 \times 6 1/4''$ pine (drawer face)
L	1	$1/4 \times 6 1/8 \times 6 1/4''$ plywood (drawer bottom)
M	1	$3/4''$ -dia. ceramic pull
N	2	Flat picture hanger
O	*	$3/4''$ wire nail
P	4	$1 1/2''$ No. 8 rh screw
Q	2	$3/8''$ -dia. wood button
R	*	$1 1/2''$ finishing nail

*As required

PINE PHONE CUPBOARD



Easy-to-build pine cupboard is an attractive way to complement any wall phone. Stain the cupboard to match your room furnishings.

4 Under-the-cabinet phone shelf

If limited space is preventing you from installing an extra telephone in your kitchen, laundry room or workshop, consider building this space-saving phone shelf. It's designed to be mounted to the underside of an upper cabinet, but it could also be installed under a bar, countertop or similar work surface. Run the phone wire under the upper cabinets or through the cabinet interior. Then bore through the back of the phone shelf to connect the wire.

First, cut the cabinet sides and bottom from nominal 1-in. red oak (actual thickness: $\frac{13}{16}$ in.). Next, rout the tracks for the tambour door into the cabinet sides using a hardboard template and a router fitted with a $\frac{7}{16}$ -in. guide bushing and $\frac{5}{16}$ -in.-dia. straight bit. Then cut the oak cabinet bottom and the $\frac{1}{2}$ -in.-plywood top. Cut a $\frac{9}{16} \times \frac{5}{8}$ -in.-wide rabbet in the front edge of the cabinet bottom using a table saw or router. Also rabbet the back edges of the cabinet sides and bottom to accept a $\frac{1}{4}$ -in.-plywood back. Now screw the cabinet together temporarily to fit the tambour door and pullout tray.

Cut the plastic laminate tambour on a table saw. **Caution:** Be sure to use a hold-down stick when cutting the tambour to prevent lifting and possible kickback. Then make the oak handle for the tambour door. Rout a finger recess into the handle using a $\frac{3}{8}$ -in. cove cutter.

Next, cut the $\frac{1}{2}$ -in.-plywood pullout

tray. Edge-band the tray sides and then cement a piece of plastic laminate to the top surface. After flush-trimming the laminate, attach the tray handle and rear stop. Note that the stop is notched to clear the tray guidestrips. Now apply two strips of adhesive-backed nylon sliding tape to the cabinet bottom to ensure smooth tray operation. Then, with the tray in place, mark screw-hole locations for the guidestrips.

Disassemble the cabinet, bore the guidestrip pilot holes and then reassemble cabinet with glue and screws. Next, apply three coats of polyurethane varnish to all wood surfaces. After the varnish has dried, insert the tray and install the guidestrips with screws only. Slide the tambour door in from the rear; attach the cabinet back with $\frac{5}{8}$ -in. brads.—*Rosario Capotosto*



Rout the tambour door tracks using a template and a router fitted with a $\frac{7}{16}$ -in.-dia. guide bushing and a straight bit.

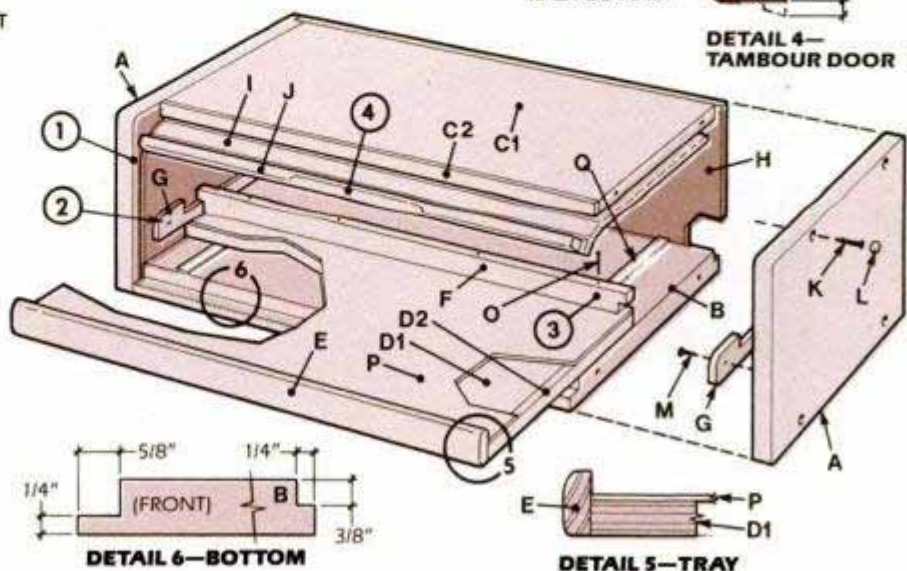
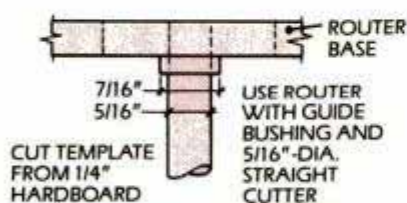
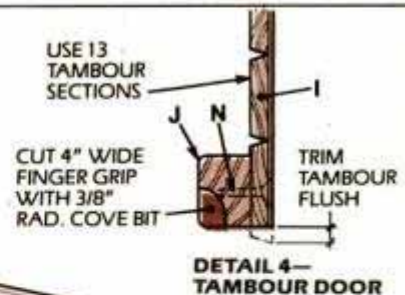
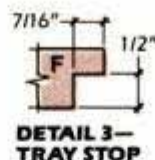
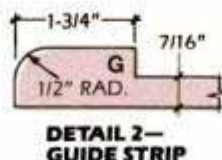
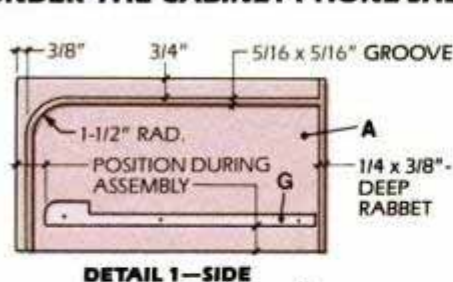


This space-saving under-the-cabinet phone shelf is a great way to add an extra telephone without sacrificing valuable countertop.

MATERIALS LIST— UNDER-CABINET SHELF

Key	No.	Size and description (use)
A	2	$\frac{13}{16} \times 6\frac{3}{4} \times 12$ " oak (side)
B	1	$\frac{13}{16} \times 12 \times 16\frac{1}{2}$ " oak (bottom)
C	1	$\frac{1}{2} \times 8\frac{1}{2} \times 16\frac{1}{2}$ " fir plywood (top)
C1	1	$\frac{1}{4} \times \frac{1}{2} \times 16\frac{1}{2}$ " oak (edge trim)
D	1	$\frac{1}{2} \times 10\frac{3}{4} \times 15\frac{15}{16}$ " fir plywood (tray)
D1	2	$\frac{1}{4} \times \frac{1}{2} \times 10\frac{3}{4}$ " oak (edge trim)
E	1	$\frac{3}{8} \times \frac{7}{8} \times 16\frac{7}{16}$ " oak (tray front)
F	1	$\frac{1}{2} \times \frac{7}{8} \times 16\frac{7}{8}$ " oak (tray stop)
G	2	$\frac{3}{8} \times \frac{7}{8} \times 16\frac{7}{16}$ " oak (guidestrip)
H	1	$\frac{1}{4} \times 6\frac{3}{4} \times 17\frac{1}{4}$ " oak veneer plywood (back)
I	1	13 sections of Wilsonart tambour plastic laminate: type II natural almond
J	1	$\frac{3}{8} \times \frac{1}{2} \times 16\frac{7}{16}$ " oak (door handle)
K	8	$1\frac{1}{2}$ " No. 8 fh screw
L	8	$\frac{3}{8}$ "-dia. oak plugs
M	6	$\frac{3}{4}$ " No. 6 fh screw
N	4	$\frac{1}{2}$ " No. 6 fh screw
O	4	$1\frac{1}{4}$ " finishing nail
P	1	$\frac{1}{16} \times 10\frac{3}{4} \times 16\frac{7}{16}$ " plastic laminate
Q	2	$\frac{3}{8} \times 10\frac{1}{2}$ " nylon sliding tape

UNDER-THE-CABINET PHONE SHELF



NEW IN HOME PHONES

2-Line Modular



Practically a necessity for roommates, small businesses and large families, Model 828SW two-line modular phone has a switchable dialing system which allows use in the rotary or tone modes (long-distance services require a tone system). The 828SW has a last-number-redial feature, memory storage for 13 numbers and a backup battery to retain the numbers in the memory. The unit is from Webcor Electronics Inc., 28 South Terminal Dr., Plainview, N.Y. 11803. It costs \$119.95.

2-Frequency Cordless



The owner of a Cobra Model CP-460S cordless phone can use two of the 10 new operating frequencies authorized by the FCC last year, and any of 512 personalized digital codes for security. Other features are nine-number memory, full speakerphone and two-way intercom. The phone costs \$199.95 and is made by Dynascan Corp., 6460 West Cortland St., Chicago, Ill. 60635.

Genesis Keypad



The Genesis Telesystem offers 10-number, one-touch dialing. Snap-in cartridges and modules add automatic redial, easy access to calling features and an electronic lock. Console costs \$349.95, cartridges are \$39.95 each and a universal module with memory is \$269.95. From AT&T Consumer Products, 5 Wood Hollow Rd., Parsippany, N.J. 07054.

Video-Security System



The three components of the Videophone—2½×3-in. viewing screen, wide-angle lens and power supply—provide a security system for home or office. Press the call button to see and talk to the visitor, and another button to allow entry. From Onyx Telecommunications Ltd., 505 Eighth Ave., New York, N.Y. 10018, the Videophone costs about \$750.

Voice Dialer



Model VRT-1100 Command Dialer phone can recognize spoken words and names and match them with up to 16 preprogrammed numbers—no need to dial. A child can pick up the phone and say "police" to get help. There's automatic redial of any number for up to an hour. Price is \$249.95, from Audec Corp., 299 Market St., Saddle Brook, N.J. 07662.

NEW IN HOME PHONES

(Continued from page 109)

Wall Or Desk Pay Phones



Suitable for desk or wall use (and for use as a bank), Mini Payfone (left) and Payfone Jr. are actually extension phones. They are tone/pulse switchable and, in the pulse mode, feature last-number redial. A coin-operated model of Payfone Jr. allows local calls only (a quarter activates the mechanism). Both models come in black or white (\$69.95) or chrome (\$99.95); the coin-op Payfone Jr. in chrome is \$119.95. They are made by TeleConcepts Inc., 36 Holly Dr., Newington, Conn. 06111.

Privacy Protector



The Phone-Guard keeps private calls private. It replaces the mouthpiece of most Bell phones, with no wires to connect or boxes to install. A red light alerts the speaker to eavesdroppers, even on a home extension. It fits in a pocket, so it can be used away from home. Made by Cose Technology, Phone-Guard is \$49.95 postpaid from Worldwide Marketing Group Inc., 120 East Prospect Ave., Mount Vernon, N.Y. 10550.

Rapid-Fire Dialer



The Demon Dialer is controlled through a Touch-Tone phone, so one dialer unit can service every phone on a line. Redial busy and unanswered numbers while allowing incoming calls. Model 93H, which stores up to 93 numbers (\$130) and Model 176T (176 numbers, \$200) are from Zoom Telephonics, 207 South St., Boston, Mass. 02111.

Hands-Free Headset



The Elite plug-in headset gives hands-free convenience to standard-phone users. The 10-ft. cord lets you work freely at desk, sink or workbench. It's \$53.40 postpaid from Innovations, 110 Painters Mill Rd., Owings Mills, Md. 21117.

Telephone Elegance



The danMark 2 phone, now on permanent exhibit in New York's Museum of Modern Art, is a Touch-Tone unit with access to the alternative long-distance services. It comes in four matte-finish colors—white, red, gold and brown—and measures 6×9×1½ in. It costs \$199 from G.N.T. Automatic Inc., 1560 Trapelo Rd., Waltham, Mass. 02154.

Extension-Cord Reel



Make phone calls from the garden, basement workshop or anywhere inside or outside the house up to 50 ft. from the wall outlet with the Snapit Port-A-Phone Extension Cord Reel. Plug the reel into the wall outlet. Then plug one or two rotary or Touch-Tone phones into the reel. It offers smooth feed-out, rewinding self-storage cord and a grip handle. Price is \$14.95. It's made by Cable Electric Products Inc., Box 6767, Providence, R.I. 02940.

Tiny Speed Dialer



With this full-function 1½ × 2¼ × 3-in. phone dialer, you can speed-dial numbers and codes from any phone in a Touch-Tone service area. Program up to 100 numbers and have them dialed by pressing a two-key code as you hold the dialer to the phone. Also has display of number dialed, alarm clock and calculator. Price is \$74.50 postpaid from Hammacher Schlemmer, 147 East 57 St., New York, N.Y. 10022. **PM**

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CARS FROM KOREA

(Continued from page 87)

but present quotas won't let them. The Chevrolet/Toyota joint venture in California is one way around these quotas. Another way is to bring in cars from Korea instead of Japan.

Daewoo currently builds two basic cars: the Royale on a 106-in. wheelbase and a new model for Far East consumption called the Maepsey-na, which sells for \$3,300 in Seoul. It's a 1.5-liter, 94.7-in.-wheelbase sedan about the size of a Toyota Corolla.

Last year, Hyundai launched a well-planned invasion of Canada and, by 1986, plans to be selling cars in the United States. An advance party of Hyundai representatives currently is laying the groundwork for a U.S. dealer organization.

To get an idea of what sort of threat the Koreans might pose to Detroit, I recently flew to Vancouver, B.C., to drive a 1984 Hyundai Pony five-door liftback sedan. I have to admit: I came back *impressed*.

It's not the world's greatest car, but it definitely qualifies as a solid bargain if Hyundai manages to sell it here for the present \$4,530. It's a relatively simple, low-tech car, but, even stripped, it comes with such standard equipment as Michelin all-season radials, power disc brakes, reclining buckets, split folding rear seats, full carpeting, intermittent wipers, day/night mirror, heater, rear-window defroster, locking gas cap, childproof locks, tool set and lots of rust protection.

Deluxe model

There's also a GL model, which adds a standard five-speed transmission, deluxe trim, tinted glass, quartz clock, side moldings, and rear wiper/washer. Finally, the top-line GLS gives you all those items plus cloth upholstery, AM/FM stereo cassette player, and fancier trim inside and out.

A four-speed gearbox comes standard in the base Pony, with a five-speed or an automatic in the GL and GLS. Power steering, air conditioning and other amenities are also optional.

The Pony's engineering is strictly fundamentalist, with front-engine/rear-drive, MacPherson struts fore and a live axle on leaf springs aft. Body styling is by Guigiaro's Ital design, which accounts for its Western flavor.

Hyundai has some catching up to do in workmanship and superficial quality. The Pony's paint leaves a lot to be desired. It looks like it was put on with a roller—not so much orange-peely as just plain rough. I also noted glue runs on the window ledges, and I had to slam all four doors fairly hard to get them to shut properly. And you can't miss the

big gap between the horn button and the steering wheel.

Cosmetic glitches don't necessarily mean a lack of mechanical reliability, but in this case they do give an insight into the thought and work processes of Hyundai managers and assemblers.

The Canadian Pony comes with a manual choke, which I don't mind at all. There's a warning light on the instrument panel that signals when the choke isn't fully pushed in. The engine starts easily and idles smoothly, but it definitely needs more low-speed torque. I had to slip the clutch quite a bit to keep from bogging down at takeoff. Even keeping the revs up, the Pony has a hard time keeping up with city traffic. The engine, at 68 hp, just isn't strong enough.

The Pony's a pretty softly sprung automobile, so it tends to pitch and chop over undulating surfaces. This choppiness is due more to weak shocks than the short wheelbase. I also noticed a touch of transmission whine and some wind noise at around 60 mph. The engine, though, stays quiet at up to its top speed of about 82 mph, when it starts to buzz rather loudly.

Handling and braking feel fine under normal driving conditions, but since there was no test track available, I can't say much about these qualities when the car becomes stressed.

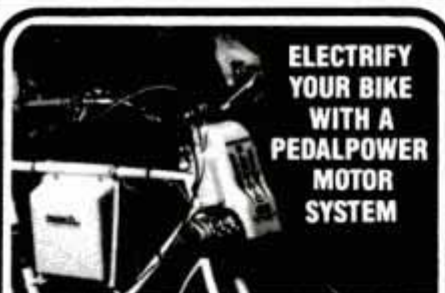
The Pony's interior layout and its general comfort are big plus factors. The covered hatch offers a lot of usable cargo space and, with the split folding seats, plenty of versatility for hauling different passenger and load combinations. The driver's seat could use better lumbar support, and I'd prefer a longer seat track for more legroom.

Needs refinement

All in all, the Canadian Hyundai Pony strikes me as roughly equivalent to an 85th-percentile Chevette. The Pony needs refinement and tweaking, but it won't be hard to raise this car to 100 percent with a little more engineering effort and care in assembly.

The rear-drive Pony might be brought into the United States for a year or two, but it'll soon be replaced by a fwd subcompact utilizing a Mitsubishi Silent-Shaft ohc Four. This car will be very similar to the Mitsubishi Colt in everything but bodywork.

Korea, I'm told, enjoyed an annual economic growth rate of 8.2 percent in the decade that ended in 1982, while our own growth rate barely got to 2.3 percent. As the Japanese lift themselves up to parity with U.S. standards of wages and living, and as Detroit boosts car quality to match the Japanese and Europeans, we'll all have to glance over our shoulders from time to time to see how quickly the Koreans are catching up. **FM**



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JIMMY CARTER

(Continued from page 75)

that cabin: trundle beds, chairs, benches, tables, four-poster beds and things like that.

■ **What would you say was the most difficult project you ever undertook?**

Well, I made a cradle for my fourth grandchild, and it took me about 120 hours, just working off and on when I had time. It was a lot of very detailed hand work. It had sloping dovetail sides with cane ornaments.

■ **Do you work on your projects pretty much every day?**

No, unfortunately. I'm not home that much. I wish I could do more. We just got back from Australia and New Zealand and I teach at Emory University. My schedule has been very tight. But ordinarily I try to work at least part time a day or two each week.

■ **How do you schedule that time?**

Well, I'm writing another book now. The best time for me to work in the wood shop is when I'm writing a book. After three or four hours on the typewriter or word processor, I go out and work two or three hours in the shop. It's a good manual break, and then I'm ready for more writing.

■ **Do you work alone?**

Yes, I work alone, except when ham-

mering a chair together. In its final form you really need somebody to hold it. But other than that and cutting down and moving the tree, I do all the work myself. Rosalynn came out and helped me weave the chair seats.

■ **Does she do any building or any work around the shop?**

No, just the weaving—except when she tells me what to do.

■ **How did you get started in woodworking?**

I've been making furniture since I was a young boy. I grew up on a farm. We didn't have electricity or running water and no close neighbors. The standard operating procedure on the farm was that we had our own blacksmith shop and our own wood shop. Whenever anything broke or we had to build something, we did it in our own shop. So I learned quite early how to use basic tools and make useful things.

Manual work is just like breathing, just like plowing with a mule or driving a wagon—it was just something everybody did. My daddy could do blacksmith work for himself. I was in the Future Farmers of America, and they taught us about making tables and things like that. When I was a young Naval officer, Rosalynn and I had our first unfurnished apartment in Hawaii. I made a lot of the furniture there. When I

came home from the Navy I made several pieces of furniture that we still use. I have pieces in the house now that are more than 30 years old that I made.

■ **Have you bought any major tools lately?**

When I came home from the White House my cabinet and staff got together and took up a collection and gave me a going-away present. It was tools to outfit a wood shop, which I never had before. What I had before was a circular saw and a hammer. But now I have a radial saw, a lathe, a drill press—things like that. So since then I've studied a lot. I have a lot of books on woodworking and I try different projects.

■ **How does working with your hands affect your outlook on life?**

I have an empathy with people who work with their hands. When I went into a factory during my campaigns where people were making shoes, automobiles, airplanes or whatever, I knew all the tools and how to use a lathe and different kinds of wrenches. I really find manual labor a great release—a kind of vacation for me—something that I hungered for when I was in the White House. Every now and then I would use the carpentry shop at Camp David to make small things that I gave to friends. You need to keep up with this sort of thing, and I always have. **PM**

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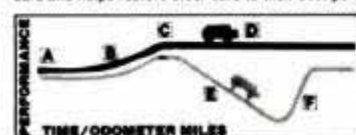
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Motor Age Magazine, April, 1982

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A. Performance level of Black and Grey cars when new. B. Improvement in performance as both cars break in. C. Further improvement of Black car's performance when TUFOIL is added. D. Regular use of TUFOIL in Black car significantly slows decline in performance through age and mileage. E. Decline in performance of Grey car with age and mileage without use of TUFOIL. F. When TUFOIL is added to Grey car, performance dramatically improves.

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3 SOUND INVESTMENTS

(Continued from page 88)

We had suspected that this would involve ignoring the very lowest-priced makes and models—it did turn out that way—but we just weren't prepared for the sheer beauty of sound we heard in cars equipped with our chosen system.

A good system

The least expensive system we put together mates a Proton receiver/tape player with a pair of Genesis speakers. This system provides for upgrading with an additional pair of speakers, self-powered, so you don't have to add an external power amplifier. The system costs \$590. That's not a tiny sum even today. But even without the added \$350 for a second speaker set, this system compares favorably in terms of sound quality with a home stereo rig costing about the same.

Like a good home system, you can add to it any time you want to or switch components, although the logistics of removing and installing rigidly mounted car componentry can be difficult and you might mess up your car's interior.

The Proton 212 looks like a rather basic receiver and tape player, yet it features the Schotz variable-bandwidth FM tuner. It closely tracks FM signal conditions and narrows or widens the bandwidth admitted to the FM decoder. This eliminates noise when it is present in certain amounts, but lets the radio open its arms to the full signal when the signal is clean and unimpaired.

The 212 has a 12-watt-per-channel amplifier built into it to power a pair of speakers—the two-way Genesis AM 135s. In case you want to add another pair and outside power amplification, there are two pairs of phono plug leads attached to the Proton's rear panel. Any power amplifier can be linked to the leads, as can one of the excellent new powered speakers, such as the two-way Canton AC 200, which will take the same output feed. (Powered speakers need their own power to work and must have a lead to the battery or your car's accessory buss. Most switch on automatically when they sense an audio signal from the main unit.)

A better system

Radio on wheels sure has its woes. If you drive in big cities, you already know that skyscrapers have made FM conditions worse than they were when radios were more primitive but had to contend with fewer steel structures to mess up the signal. If you move a car a few feet, for example, while waiting for a light, the change in FM reception can be dramatic. And maddening.

FM diversity antenna systems rely on two antennas and a circuit integral to

the tuner to pick the better signal. This is not an add-on option. It must be built into the radio. We based our better system on a tuner with diversity reception circuitry—the Audia DTX-1000. Audia's DTX-1000 comes with a free-bee window antenna if you don't feel like adding a second external antenna to your brand new car. The other features of this trailblazer are four—not the usual two—tone controls. In addition to bass and treble, there is a well-chosen loudness curve and a helpful button to eliminate some of the resonance most cars have around 180 Hz, in the lower midrange.

Multiple preamplifier outputs enable not only the use of more than one external power amp but the insertion of equalizers and noise reduction modules into the system. A handy feature is the switch to turn on the tuner during tape fast winding. Alternatively, when you eject a cassette, this switch can spare you that blast of unwanted radio racket many units surprise you with.

Both loudspeakers are among the finest automotive models available at any price. B+W's LM-1 comes with various panel brackets, or without the brackets, and in an attractive, fully enclosed version. It has a loudness compensation switch to adjust for individual car acoustics. The ADS P120 power amplifier packs 60 watts per channel to one pair of speakers. Should you choose to use four B+W speakers, you'll have to add another P120 to the system.

The best system

Ultimate fidelity. That's what this dream system is all about. And for a cost of over \$2,300, it should be. The system is based around Nakamishi's TD-800 digital tuner/tape player and Audiobile's 1600, an integrated system of six speakers, an amplifier and fader control.

Nakamishi, the folks who made the cassette a tape medium we could believe in, center their attention on the tape transport and handling. Like the Audia (and unlike the auto-reverse equipped Proton), the Nak 800 is unidirectional. It plays tapes in one direction only. To hear the other side, a listener manually flips the cassette and re-inserts it into the ingenious slide-out tape drawer. The most clever and useful feature of the player, though, is the small remote-mounted knob that adjusts the tape head's azimuth *during play*. Your ears, always the best judges of musical performance, let you fine-tune the tape's orientation to the head. The very audible result is an astonishing clarity of treble response. A major benefit of this is the superior stereo imaging good treble gives you in the controlled environment of a car.

Audiobile's 1600 pits six speakers

with a total of 10 drivers, a powerful 160-watt amplifier that will just about blow out your car windows, and a handy remote fader control, all against your car's acoustics. The small size of the four visible satellite units permits rather subtle and simple adjustments to get the best position, while the woofers simply use your trunk or a custom-built bass enclosure as an acoustic baffle. The speakers are engineered to cover the entire musical range in ways that reproduce all of the audible spectrum clearly but partially cancel the resonance which plagues midrange performance near the bass frequencies.

A final addition to our dream system is an Alpine 3015 equalizer. The 3015 performs the tonal adjustments you'd expect of a good seven-band equalizer, stores up to four memorized eq curves, and will even automatically equalize the sound for the car's interior. For driving in very widely different noise conditions such as stop-and-go traffic or partially paved roads, an automatic level control can monitor interior noise levels and adjust the music volume to compensate. This makes nearly every nuance of sound audible and is subtle enough not to offend listeners sensitive to the natural dynamics of their music.

Getting it installed

Unless you're a crackerjack electrician and a neat worker with the patience of an IRS investigator, leave the installation of super costly car stereo systems to the pros. Their fee can be 15 percent or more of the total cost, but at least it's a fixed cost. If you have to pay a dealer/installer to troubleshoot your misbehaving, self-installed system, you can easily run up that much in hourly charges.

The electrical connections, proper grounding and adaptation of components to each others' requirements are an installer's best reasons to do the job for you. A faulty or improper ground can blow speaker cones to smithereens. Using the wrong system of speaker grounds can overstrain an amplifier or burn out delicate parts that cost a lot to replace.

There's no changing the fact that installation of a car stereo system alters a car's looks. Remember, cutting into a car's interior is permanent, unless you plan to invest heavily in cosmetic repairs. Think before anything is cut. Weigh the placement of each component as a balance between aesthetics and musical effect on listening. Then trust your installer to do the kind of job you want in a way that facilitates both servicing and removal without damage.

Finally, you should use an installer because manufacturer's and dealer's warranties usually depend on professional installation. **FM**

PHONES ON THE GO

(Continued from page 93)

ally requires the use of two frequencies at a time.

What makes the cellular system unique is its method of operation. In the standard cellular plan an area is divided into six-sided cells. At the center of the cell is a radio transmitting and receiving



Portable phones for in-car use, like this Nynex Mobile Telephone, are mounted between front seats. The power output of mobile units can be as high as 25 watts.

station. A microcomputer ties it to the rest of the cellular system. Each cell site reports to a master office—the mobile telephone switching office—which connects the cellular system to the rest of the phone system.

In operation, each cell site communicates with the mobile units within the range of its antennas at a fairly low power level, about 10 watts. This method makes it possible to keep the amount of potential interference with nearby cell sites to a minimum.

How can several stations use the same system for concurrent phone calls? Microcomputers. Each cell site is assigned a certain number of frequen-

cies and the microcomputer determines which frequencies are best for a particular conversation. As the distance changes, the microcomputer determines whether the particular cell can handle the call or whether it must be shunted to the next one. Meanwhile, the same computers are determining whether there should be a frequency change at the same time because of the different frequencies used by the cell sites.

Behind the scene

The beauty of the engineering in this system is that the user never knows anything is going on. The quality of the conversation remains the same as one cell hands off to another one. Before the introduction of digital microcomputers, this type of situation never would have been possible.

The potential number of users of the cellular phone system is astronomical. In all of this, though, there is one sobering consideration: cost. At the moment, most cellular mobile phone units are expensive. Though their cost has fallen since the first ones were introduced, they are still about \$2,700 to \$2,800 for a typical installation, and that doesn't include the \$150 per month service charge.

Further, the handheld Motorola unit isn't cheap. The company has set its price at \$3,145.

However, most industry sources expect the handheld units will be leased, rather than owned outright.

Lower-priced alternatives

For the average buyer, there may be some hope in the form of two proposed specialized communications services, one from General Electric and the other

(Please turn to page 116)

Mobile Phone Precautions

Safety

Although experts disagree on the affects and amount of radio frequency energy to which you may be exposed, there are some health precautions you must take when using a cellular phone.

First, be careful to keep away from the unit's antenna when it is transmitting. Certain parts of your body—notably the eyes—are sensitive to these emissions and it's possible to burn them. It is especially true with handheld units where the antenna is on top of the radio.

When you are using a handheld telephone, position the unit so the antenna is well away from a direct line with your eyes. Even a watt or two of power can be enough to make your skin uncomfortably warm, so avoid touching the antenna when the unit is being used.

Generally, the field of a cellular phone in a car is around the antenna outside the vehicle, so it's safe to operate.

Privacy

While we all take privacy for granted during our normal phone conversations, the chances are good that you won't be alone during a mobile phone call. The reason is the scanner radio.

Scanner radios allow listeners to eavesdrop on many radio services and conversations.

Since a mobile phone, whether cellular or conventional, is actually a radio device, there's always the possibility that someone might be listening. The cellular phone system operates from 840 to 900 MHz, and soon scanners will be available to cover these frequencies.

You might think that such listening is illegal. Well, it isn't. Under various court rulings and interpretations of the Communications Act of 1934, private parties can listen to your conversations, provided that listening is for their own use and not for retransmission or reuse.—M.S.

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PHONES ON THE GO

(Continued from page 115)

from Mura Corp. Under the GE plan, which at press time was still awaiting FCC approval, a new radio service would be created. It would be known as the Personal Radio Communications Service. The PRCS would consist of a base station connected to the phone network and one or more mobile units



General Electric mobile works with proposed Personal Communications Service.

which can easily be installed in a consumer's car.

Each PRCS unit would have a unique identification number for security and privacy.

This system would offer automatic interconnection to the public telephone and would allow mobile users, within the system's range—five miles, on average—to place calls to any phone. At the moment, cost estimates for a complete PRCS system are about \$400.

The Mura Corp. proposal would simply import a radio system that is currently in operation in Japan. Called the Consumer Radio Service, it would give a user a five-mile communications range. The low-cost transceiver units—\$100 to \$400—would meet what Mura perceives as a clearly identified demand for emergency and personal communications. **FM**

MANUFACTURERS—MOBILE PHONES

- Fujitsu America, 10 East 53rd St., New York, N.Y. 10022
- General Electric, Customer Service Center, Lynchburg, Va. 24504
- GlenAyre Electronics, Seattle, Wash.
- Harris RF Communications, 1680 University Ave., Rochester, N.Y. 14610
- Hitachi, 2696 Peachtree Square, Doraville, Ga. 30360
- E.F. Johnson, 299 10th Ave. SW, Waseca, Minn. 56093
- Motorola Communications, 1301 East Algonquin Rd., Schaumburg, Ill. 60196
- NEC America, Mobile Radio Div., 4936 Rosecrans Ave., Hawthorne, Calif. 90250
- Oki Advanced Electronics, One University Plaza, Hackensack, N.J. 07601
- Panasonic, One Panasonic Way, Secaucus, N.J. 07094
- TacTec Systems, Meadow Lands, Pa. 15347

ARTIFICIAL ISLANDS

(Continued from page 79)

ments. Gravel islands are most popular in inland seas or other protected waterways. Sohio Alaska Petroleum Co., for example, is drilling oil near the center of a man-made island in Harrison Bay, Alaska. The seas are relatively calm in the area and surrounding ice helps keep currents from undermining the 1.25 million cubic feet of gravel fill that sits on a subsea ledge.

For slightly rougher seas, engineers at Exxon and other companies favor the "monotower" type construction. Such oil platforms, twice the length and width of a football field, sit atop concrete and steel conical collars that rest on concrete pillars tapering out to a broad support structure. They are widely used in the Bering Sea in areas where ice chunks are pushed against the base of the collar. Its conical shape lets the ice slide back into the sea, safely minimizing collision damage to the supporting pillar. This pillar, made of concrete, sits on a heavy base that stays anchored to the sea floor by virtue of its weight.

Other oil platforms use heavy steel anchors connected to the surface by cable to keep the island stable, but floating, so that the anchoring doesn't snap against heavy currents.

Modifications of this type of technology have been proposed for the Tokyo harbor airport tunnel, which would sit on prestressed concrete pillars and oil rig-type anchors. Mitsui Engineering, which has conducted early engineering studies for the airport project, favors keeping the island structure above the water level. This permits harbor traffic to pass under the island.

Concrete shock absorbers

For that project, the pillars will have to support extra weight in an area also affected by earthquakes. These likely will sit on concrete pads that give to the roll of an earthquake in much the same way that a shock absorber gives to the shifts in mass of a moving car.

Some of the man-made islands in Osaka Harbor, Japan, have been completed. Over three square miles of gravel-filled structure now house a supertanker port and several office buildings. High-rise apartments have gone up on the landward side of the island. When it's completed early in the next decade, the entire complex of interconnected islands will be nine square miles.

American engineers have taught the Japanese much of what will go into the Tokyo airport island and much of what already has gone into the Osaka Harbor Island. But Japanese applications will provide a new "living laboratory" for builders of a place like Liberty Island.

One of the contributing geniuses to

the Japanese man-made island culture was the late Buckminster Fuller. He provided some of the early sketches of the Tokyo airport island. Shortly before his death, Fuller told an Atlanta meeting of engineers that artificial islands will "by the end of this century prove to be man's biggest hope for getting out of his own way." Fuller envisioned islands topped with clear domes that would finally allow man to live and work in a totally controlled environment, free from stress and pollution.

This past spring, the American Society for Civil Engineers' convention in Atlanta sponsored a major session on

artificial islands. Papers on island construction methods, the use of these structures and the history of man-made land masses were presented. It was, as one society member noted, "a method for summarizing where we've been, so we can move the technology into the next century."

With hard-nosed engineers considering artificial islands in such a straightforward light, we have every reason to look at our mythical Liberty Island as much more than a vision of the future. It is, in fact, a reflection of engineering and technology with which we are already comfortable. **PM**



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Russia's vast new air armada: Good and getting better

Soviet-watchers are watching the skies with increased concern. According to intelligence reports, Russia is in the process of launching the biggest new air armada since World War II. At least seven new combat planes of advanced design are known to be in service already or nearing production. These include three highly sophisticated interceptors—the MiG-31 Foxhound, MiG-29 Fulcrum and Su-27 Flanker; three deadly ground-attack fighter/bombers—the Su-24 Fencer, MiG-27 Flogger and Su-25 Frogfoot; and a huge new intercontinental bomber known as the Blackjack A.

Their significance lies not just in their number, but in their type. In the past, Russian aircraft designers have tended to settle for quantity over quality; now they're going for quality as well. The three new interceptors all have speeds in excess of Mach 2—twice the speed of sound—and possess what is known as "look-down, shoot-down" radar—one of the most advanced weapons-guidance systems in existence. It enables a Soviet fighter to hide undetected at high altitude, spot a target 20,000 to 30,000 feet below it and then fire its missiles straight

down for a kill—without the target even being aware of the attacker's presence.

The MiG-31 Foxhound, designed especially to counter our new Rockwell B-1B bomber, has a reported speed of Mach 2.4, a ceiling of 80,000 feet and a combat range of more than 1,000 miles. Such awesome performance has led Pentagon experts to fear that it might well give our own vaunted F-15 Eagle a run for its money. (The F-15, while slightly faster, is limited to a ceiling of 63,000 feet and an unrefueled range of about 600 miles.)

Also evident is an ominous switch in Kremlin strategy from planes intended purely for home defense to those capable of making aggressive attacks on worldwide targets. The Su-24 Fencer, a long-range, low-level, terrain-following fighter/bomber, is specifically designed to sneak in under radar detection and strike NATO positions deep inside Western Europe. The MiG-27 Flogger and Su-25 Frogfoot, two other new fighter/bombers, have already been spotted attacking guerrilla strongholds in embattled Afghanistan.

Britain's *Illustrious* carrier

Britain's newest antisubmarine aircraft carrier, HMS *Illustrious*, is on her first world tour. Sister ship of the HMS *Invincible*, which launched Harrier jump jets in the Falklands, the *Illustrious* is 670 feet long and displaces 20,000 tons. We boarded her in New York harbor, where she paid a call this spring. On her pocket-size deck was a wing of Harriers and long-range Sea King helicopters. *Illustrious* has a ski jump at the end of the deck for quick Harrier takeoff. In addition to the aircraft, she carries Sea Dart missiles for surface-to-air or ship-to-shore combat. Her newest sister ship, HMS *Ark Royal* is scheduled for launch next year. It will give Britain five Harrier carriers.

PHOTO BY STEVE ESKOW



HMS *Illustrious*, Britain's newest Harrier carrier, visited New York.



One example of Russia's switch to offensive strategy is the Su-24 Fencer (top), a sophisticated, swing-wing fighter/bomber similar to our F-111. Capable of high-speed, low-level attack to avoid radar detection, it's specifically designed to strike NATO targets deep inside Western Europe. Above are two Yak-36 V/STOL jump jets comparable to our Harrier, but with one advantage—they're supersonic.

Editor: Dennis Eskow
 Contributors: Sheldon M. Gallager, Jack Hammond, Ida Beck,
 Michael A. Fallon, Fran Wenograd Golden, Kevin
 Shyne, Jim Peterson, Terence Dickinson, Bruce Most

Perhaps the most fearsome member of the new armada is the Blackjack A, a mammoth long-range, supersonic bomber that for the first time gives Russia hit-and-run capability anywhere in the world. Bigger, faster and more powerful than our B-1B, it can also launch cruise missiles from points beyond the reach of our fighter protection.

For those who may think we're spending too much on defense, the following facts are sobering: In the U.S.S.R., military expenditures consume more than 15 percent of the country's gross national product; in the United States, they account for less than 7 percent of the GNP. Soviet fighter production averages 1,060 planes a year. Current U.S. fighter production: less than 500 a year. The implications are grim. Until now, we've enjoyed technical superiority if not numerical superiority. But by the end of this decade we may face the threat of a Soviet air force that is at least equal to ours in quality and still vastly superior in quantity. The Russians may not have caught up quite yet, but they're getting awfully close.



Pencil thin, lightning fast

The U.S. Army Artillery unit at Fort Sill, Okla., is experimenting with a new mobile radar unit that sends out pencil-thin beams to detect hostile weapons in the field. The portable "Fire-finder" unit, developed by Hughes Aircraft, transmits its data to friendly units that return fire.



DRAWING BY DEAN ELLIS
 X-ray beams target kidney as wave generators shatter stones.

MEDICINE

Kidney stone blaster

Doctors who have tried it say the Lithotripter is as easy to work as the controls of the arcade game "asteroids." But the newest medical machine from West Germany takes care of one of medicine's most serious problems: kidney stones. The device consists of a hydraulic lift that lowers a patient into a bathtub. Wave generators at the bottom of the tub use electrodes to send harmless waves through the water. A pair of X-ray cameras hooked to a computer focus in on the kidney to show the doctor just where to point the waves. The generators send over 1,000 waves during a one-hour session. The waves have no effect on biological organs, but do break up the crystalline minerals that make up the kidney stone. After one visit, the patient reportedly can expel the powder that remains in his or her urine. Tests of the machine are under way this summer at six hospitals in the United States. In early tests, the Lithotripter received excellent grades.

Handy new X-ray unit

The Lixiscope is a handheld X-ray imaging scope that's expected to revolutionize sports medicine. Developed by Lixi Inc., the lightweight device gives off such low levels of radiation that no screening is needed to protect the doctor or patient. A screen inside the battery-powered device gives clear images at the scene of an accident or on a playing field. It was first developed for NASA, which uses a different version to photograph celestial objects.



Lixiscope (top) is a portable, battery-powered X-ray device. It takes images of fractures, such as the one shown above.

AVIATION



Auto-release cartridge (left) fits on manual release handle and blasts the chute free if pilot can't.

Lifesaving chute release

Naval pilots who have to eject at sea face the grim prospect of becoming entangled in their parachute shrouds and drowning unless they release the chute the second they hit the water. The danger is especially great where injuries or unconsciousness make a quick release impossible.

Now the Navy has come up with a self-actuated parachute release that "thinks." Obviously, it had to be activated by water, but how? A release triggered by wetness alone—any kind of wetness—would have been simple. But suppose a pilot ejected in a rainstorm or was soaked with perspiration from stress? Whoops—no parachute.

The answer proved to be a sensor that measures the salinity of water by its electrical conductivity. Only when the presence of salt water is indicated does a cartridge fire, automatically blasting the chute free from the pilot.

Known as the Seawars system, the chute release takes less than two seconds to sample the water and make up its mind whether to fire or not.

Helicopter hits 185 mph

British and Italian manufacturers have developed a new helicopter that carries 30 passengers at a cruising speed of 185 mph. The EH101 will first be used by NATO for antisubmarine warfare. But by 1986, civilian models built for short-haul passenger service will be in production. The craft will be powered by a three-engine configuration turning a five-blade rotor. The European designers of the craft won't say what its speed will be without a load, but it's expected to move at a brisk combat pace.



New European helicopter uses three engines to run its rotor.



HUD (left) displays flight data on a transparent screen (right).

Heads up for safer flying

Airline pilots may soon get the same kind of head-up display (HUD) that fighter pilots now have. The HUD, mounted at eye level, shows vital flight information such as airspeed, altitude, descent rate and heading superimposed on a transparent holographic screen. This enables the pilot to read his instruments without taking his eyes off the view ahead. Currently under test on a Boeing 727, the HUD was developed by Flight Dynamics Inc. of Hillsboro, Ore.

INVENTIONS

Swimming in place

Joggers have their treadmills and football players have tackle dummies. Now swimmers can use a device that lets them practice their sport in a confined space. The Swimmers Tread Mill is an indoor-outdoor prefab pool the size of a compact car. The swimmer wears a waist harness tethered to the pool frame by shock cords. By

varying the length of the cord the swimmer can add or subtract line resistance to control his practice "swimming."



Swimmers Tread Mill allows a swimmer to exercise in place.

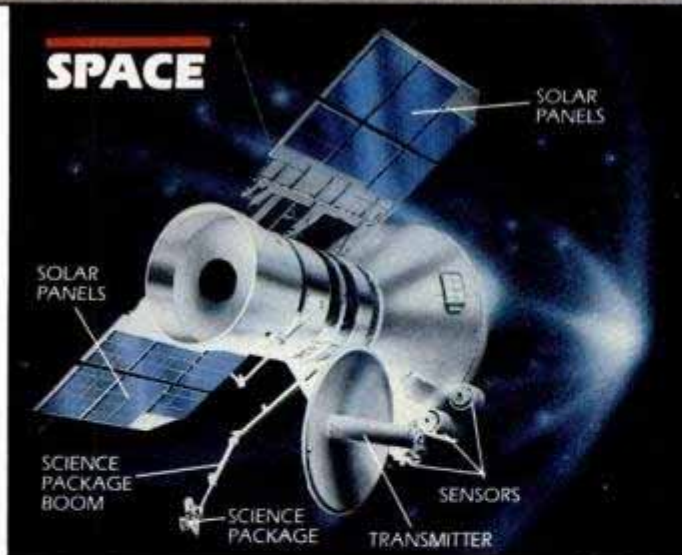
Row, row, row your bike

For those who build up cardiovascular fitness on a rowing machine, here's a new twist. The Rowcycle is a cross between a rowing machine and a tricycle. You sit on the seat, pull back on a telescoping oar and wheels move you along. The rowing mechanism turns the bike's wheels. The machine stops with caliper brakes. The Rowcycle sells for approximately \$800.

Rowcycle combines a rowing machine with a tricycle. Pull back on a telescoping oar and wheels move. You steer with your feet and stop with a set of caliper brakes.



SPACE



ART BY BRIAN SULLIVAN

Artist conception shows spacecraft that will explore Halley's comet.

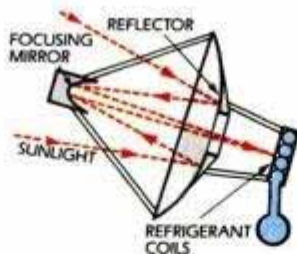
Russia's Halley watcher

The Soviet Union is expected to launch two space probes in December, sending both on a complicated mission for a March 1986 encounter with Halley's comet. Vega 1 and Vega 2, identical 4-ton probes, will fly around Venus, loop back toward Earth, then plunge at speeds more than 50 times faster than a bullet—300 miles per minute—right into the cloud of dust and vapors enveloping Halley. Vega 1 will pass about 6,000 miles from the comet's nucleus; Vega 2 will come within 2,000 miles. Solar panels will run on-board computers and a package for performing experiments. Sensors will measure temperature and moisture content of the Halley cloud.

ENERGY

Weaving in the sun

The Blyle of America knitting mill outside Atlanta gets half of its electricity, heat, hot water and air conditioning from a new solar-energy system. Using 114 parabolic solar collectors, the mill gets 400 kw. of electricity on a sunny day. Each collector has a focusing mirror that concentrates solar



rays on refrigerant coils that carry the heated (750°F.) fluid to an exchanger. That fires up the electric generating plant. The system may lead to the solarizing of manufacturing plants throughout the sunbelt.

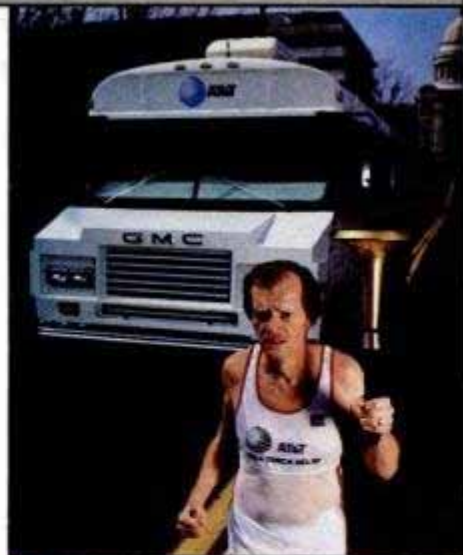


On a sunny day, the parabolic solar collectors generate 400 kw.

AUTO

High-tech torch

Carrying the traditional torch to the opening of the Los Angeles Olympic Games this summer has been a feat of runner prowess and high technology. More than 2,000 runners have taken turns carrying the torch on an 8,700-mile zig-zag trip from New York to the L.A. Memorial Coliseum. Following the runners was a 34-vehicle support caravan including a fleet of 14 specially designed GMC motor homes. One served as a communications van with a teletype terminal, computer and printer. Another van was a rolling doctor's office complete with an examining room and diagnostic equipment. Computers in the caravan helped monitor the weather and kept tabs on the runners' conditions. Reports on the runners are expected to contribute a wealth of knowledge to sports medicine.



Medical van follows an Olympic torch bearer in Washington (top). Below, a medical technician monitors health records.

HOUSING



Tuvalu house uses ribbed aluminum to replace scarce thatch.



New British vacation home takes just six hours to assemble.

Thatch life

Thatch for roofing is getting more difficult to find in the Pacific island nation of Tuvalu. Even when it's available, it leaks and blows away easily. But University of Colorado architect D. Stafford Woolard has designed modular housing that uses ribbed aluminum sheets for walls and roof. The first 100 houses are under construction.

Six-hour home

It takes just six hours to assemble and can be anchored into the ground with four concrete and steel pillars that come with the package. It's Britain's newest entry in the vacation home market. The two-room chalet is made of aluminum-alloy modules that snap together. Britons are paying \$12,000 for a complete kit.

HOW TO CREATE PERIOD MOLDING

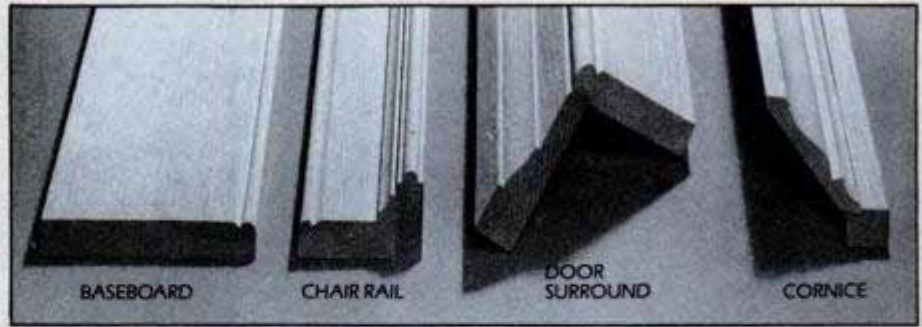
Re-creating authentic period moldings *exactly* would be frustrating. But, by using stock lumber, you can closely duplicate the moldings of yesteryear.

Baseboard—Shape the baseboard from 1×6 using a 1/4-in. and 1/2-in. quarter-round molding head in a table saw. Make the first pass with the cutter tilted at 28°. Adjust the depth-of-cut so that only the corner of the cutter projects above the table. Then readjust the cutter to a perpendicular position and make the second pass with the rounded portion of the molding head.

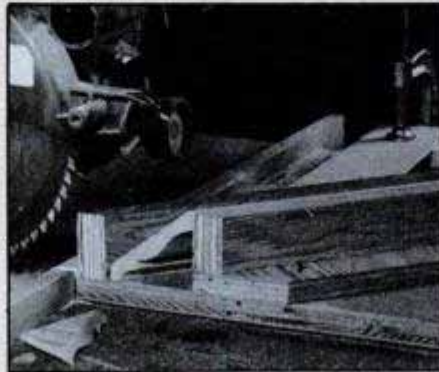
Chair rail—Shape the backboard from 1×3 using the same method as described above for the baseboard. Next, nail a 1×2 to the top surface of the backboard. Add 1/2-in. half-round and 1/2-in. cove moldings as shown. Nail the chair rail to the walls level, between 33 in. and 35 in. from the floor.

Door surround—The trick to reproducing the gently curving S shape of the authentic door surround is to cut out the center of 2 1/2-in. crown molding. Note that three cuts on a table saw are required to produce this piece. For the final cut, tack the center section temporarily to a scrap-wood guide. Rip remaining members from 3/4-in. stock.

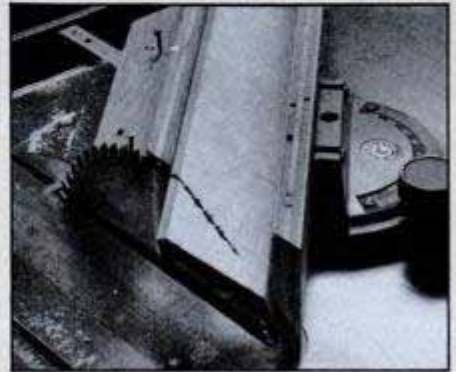
Make the jamb by first cutting a 45°



Reproduce period moldings from stock items available at lumberyards and home centers.



This homemade jig makes it easy to cut compound angles on the radial-arm saw. Note that molding is positioned upside down.



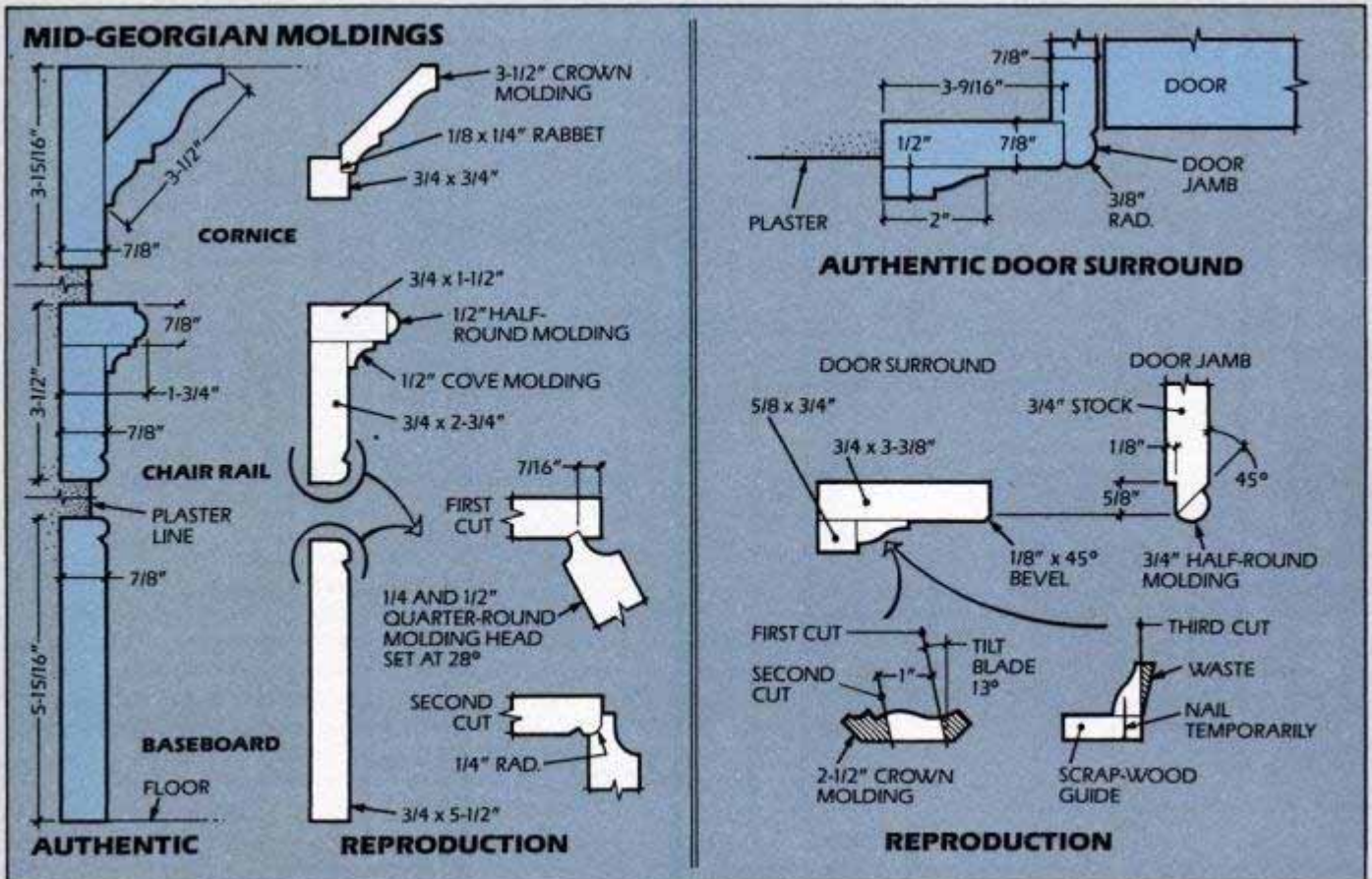
This simple jig is used in conjunction with a miter gauge, set at 45°, for cutting compound angles on the table saw.

bevel on one edge and then a shallow rabbet as shown. Finally, nail 3/4-in. half-round molding to the bevel face.

Cornice—Make the cornice from 3 1/2-in. crown molding and a 3/4 × 3/4-in.

piece. Rabbet the piece to fit molding. Nail the cornice where ceiling and walls meet. Butt top of the molding to the ceiling.—Rosario Capotosto

(Please turn to page 124)



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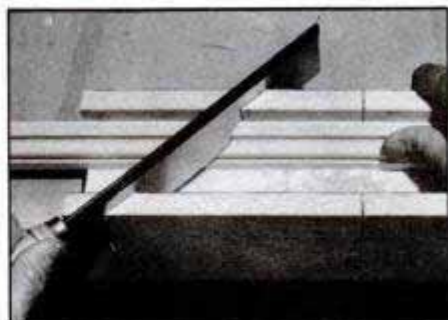
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CHIPPENDALE ROOM

(Continued from page 122)

COPING A JOINT



To make the coped joint, first cut molding at a 45° angle in a miterbox using a dovetail saw, as shown, or a backsaw.



Then use a coping saw, held at 90°, to cut along the profile. Mark the profile with a pencil for a more visible outline.



The coped-cut molding fits neatly into the square-end piece of adjoining molding.

Because inside corners are seldom, if ever, square, mitered joints are rarely tight-fitting joints. But here's a coping saw technique that ensures tight-fitting joints every time.

First, position the molding in a miterbox as it would be installed on the wall. Then trim the end at 45° to expose the molding's profile. Using a coping saw held at 90°, cut along the molding profile. This cut duplicates the profile of the adjoining molding.

To install the molding, first butt a square-end piece of molding into the corner, then abut it with the coped piece. The coped cut will match the adjoining piece exactly.—J.T.

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GOOD DRIVER

(Continued from page 91)

Bertil Roos School of Motor Racing at Pocono International Raceway in the hills of eastern Pennsylvania. Roos does most of the teaching himself and takes genuine interest in his students.

Most unique are the school's Slide Cars—stock Saab 900s with their rear suspensions modified to let the rear wheels steer outward whenever the fronts turn into a corner. The effect is like driving on glare ice, even at very low speeds, and Roos feels it's better than a greasy skidpad for learning smoothness, concentration, skid control and what he calls Ocular Driving Tactics (ODT) which is, essentially, looking where you are trying to go.

Think about it. If you're sliding off the road, where are you likely to be looking? Probably where you're heading and at what you may be about to hit—a guardrail, tree or ditch.

"Wrong!" says Roos. You should always be looking at, and pointing the front wheels, where you want to go. "Eye technique is what makes everything possible," Roos emphasizes. "It's the key to good, safe driving and car

control, whether on the track or on the road. Peripheral vision is good enough to see what's directly around you and to place the car where you want it."

Roos' curriculum also includes extensive classroom instruction and a very complete and well-written textbook.

Then there's the small but proficient Bill Scott Racing School at Summit Point Raceway in eastern West Virginia, about 70 miles northwest of the Baltimore/Washington, D.C., area. A two-time pro Formula Vee champion, Scott keeps busy building and campaigning race cars for clients in addition to running his competition and highway driving courses.

The highway school is short but broad in content and aimed at students' specific needs. It emphasizes smoothness, consistency, braking and cornering techniques and potentially lifesaving subjects like what to do if you go off the road (let off the gas and drive as straight as possible). Slippery-road and bad-weather driving are other Scott subjects. The on-track instruction is excellent and highly personalized; the instructors spent considerable time riding with me to correct any mistakes.

Still another former racer, three-time

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	Intro. to racing	1	Formula Fords	325
	Race weekend	2	Formula Fords	795
	Practice day	1	Formula Fords	375
Bob Bondurant School of High Performance Driving Sears Point International Raceway Highways 37 and 121 Sonoma, Calif. (707) 938-4741 Year-round	Competition road racing	4	Formula Fords and Mustangs	1,500
	Adv. road racing	3 or 2	Formula Fords and Mustangs	1,350/900
	High performance driving	3 or 2	Ford Mustangs or your car	825/550
Bertil Roos School of Motor Racing Box 221 Blakeslee, Pa. (717) 646-7227 Apr. to Oct.	Competition	3	Volvos, Formulas	995
	Highway driving	2	Saab Slide Cars, Volvos	450
Blakeslee, Pa. (717) 646-7227 Apr. to Oct.	Adv. competition	1	Saab Slide Cars	350
	Intro. to racing	1	Saab Slide Cars, Super Fords	325
Jim Russell British School of Motor Racing 22255 Eucalyptus Ave. Riverside, Calif. (408) 372-7223 Year-round in Calif., June to Nov. in N.C., May to Nov. in Quebec	United States Competition	3	Formula Fords	1,050
	Championship	4	Formula Russells	1,000
	Race weekend	2	Formula Russells	800
	Adv. lapping days	2	Formula Russells	775
Quebec Competition	3	Formula Fords	1,050*	
	Race weekend	2	Formula Fords	850*
	Adv. lapping days	2	Formula Fords	720*
Bill Scott Racing School Box 190 Summit Point, W.Va. (304) 725-6512 Feb. to Nov.	Adv. competition	1	Your car	550
	Highway safety	1	Police Malibus	245
	Solo I	2 or 1	Your car	125/75
	Friday at the track	1	Your car	75

Individual instruction at various prices and duration.

Note: Many schools also offer corporate and chauffeur courses. Some schools charge an additional fee for the use of their cars.

*Canadian

Sports Car Club of America national champion Skip Barber, conducts a unique competition-only school that travels throughout the East, Midwest and South—plus two fantastic racing series for his graduates—all in Formula Ford racing cars. Right now, he offers no highway courses, but he does have a reasonably priced (\$325) one-day Introduction to Racing school.

The other outstanding racing-only school is Jacques Couture's Jim Russell British School of Motor Racing. A former Canadian national champion, Couture worked extensively in England under the notable Jim Russell before bringing Russell's name and methods across the Atlantic in 1969. The Canadian branch is at Mont Tremblant in Quebec, while two California branches operate at Riverside and Laguna Seca (near Monterey). Just last year a fourth location opened at North Carolina's Charlotte Motor Speedway. The curriculum includes the regular three-day school, a weekend race series and a season-ending four-day racing "festival" that pays real prize money and crowns an overall JRBSMR champion.

Any one of these schools can provide the sort of instruction that you and every driver in your family should have in order to become truly skilled and safe on the road. The full competition



Dirt Ridin' School

Motocross dirt bike racing is a form of madness that makes the mechanical bulls in saloons look tame. Several schools teach motocross riding. One of the oldest and best-known is run by former motocross champ Gary Bailey. Gary's best student is his son, 22-year-old David—a top competitor in the

AMA/Wrangler Super Series of motocross races.

It so happens that the same techniques needed to win on the track are also the best for fast, safe trail riding. I attended the Gary Bailey Motocross School, and it can make trail riding fun for a 50-year-old as well as for a 13-year-old.

Gary had us all figured out before we arrived: he knew that we'd all try to ride far faster than our abilities would allow. His motto is, "Slow down, and I'll teach you how to go faster." And his method is simple enough: He rides each obstacle on the trail or track first to show you how it's done. Then he watches each student ride (above), shouts and signals instruction, then stops the riding and tells each student what he did right and wrong. The four-day course costs \$200, plus track fees. Contact Bailey at Box 130, Axton, Va. 24054.—Robert Schleicher

courses are great fun and intense training for anyone who wants to become a *real* expert. But they're also pretty serious, expensive and time-consuming for the person with little or no interest in racing. The basic highway schools, on the other hand, start at less than \$250 (see the chart on page 128) and take just a day of your time, plus travel and lodging.

Still can't afford it, you say? Don't need it? Don't have the time? Compare the cost of the schools to that of one small accident at today's high body-shop prices. Professional training can help you avoid run-of-the-mill fender benders, as well as more serious smashups. Now ask yourself one more question: How much is your family's safety worth? **PM**

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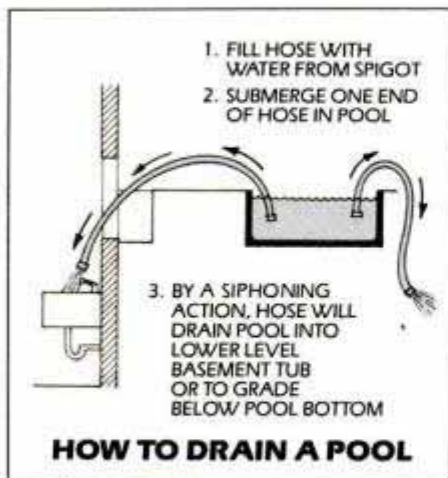
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YOUR OWN GARDEN POOL

(Continued from page 97)

cured. According to Van Ness Water Gardens, if you select dye, fill the pond as soon as it has hardened enough to hold water.

Newly cemented pools release quantities of lime, which is toxic to fish and



HOW TO DRAIN A POOL

plants in the water. To eliminate the hazard you must further cure the pool. Add one gallon of household vinegar for each 200 gallons of water in the pool and let this set for five days. Drain this water, scrub the pool surface with

kitchen detergent and water; rinse thoroughly and drain. Then immediately refill the pool with water.

If you select paint, you must dry the pool after curing it so the paint will adhere. After removing the side forms, let the concrete dry for a day or two; however, keep the top surface moist by sprinkling it with water. To counteract the lime, scrub the surface with a solution of 1 gallon vinegar to 10 gallons water. Scrub vigorously with a broom or scrub brush. Rinse thoroughly and drain the water completely.

Let the concrete cure five more days while you continue to sprinkle water on the top surface. Then remove the excess water and let the entire pool dry for three days before painting. Use a rubber-based pool paint such as Nelsonite. This paint seals hairline cracks and comes in a variety of colors: dark green, Bahama blue, brown and black. Allow the paint to dry for seven days. Then clean the surface with detergent and water, rinse thoroughly and you're ready to plant the pool.

5 Brick-concrete pool

The techniques used to construct the brick and concrete pool are similar to those used in the concrete pool previously described. However, this pool

requires only an interior form. Since the concrete walls are poured only to ground level, the soil serves to define the outer limit of the wall.

Build the pool before constructing the retaining wall. Note that the pool walls are 8 in. thick, since the back wall serves as the foundation for a double thickness of brick.

Lay out the area and excavate to depth. Then fill the bottom with gravel and crushed stone. Line the floor and walls with mesh, supporting the floor mesh with bricks.

Pour the floor and cut a key in its perimeter. After 8 to 10 hours hose off the inside form, install it and pour the floor. Keep the slab wet by sprinkling it with water and covering with polyethylene to keep the top surface moist while the concrete cures.

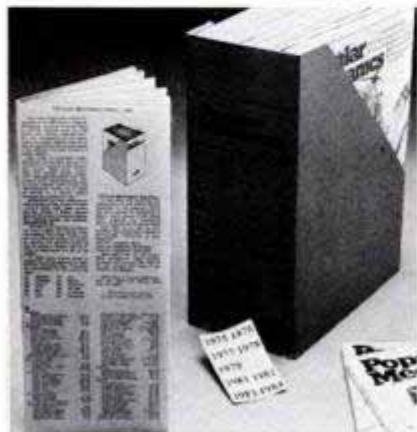
Excavate for the rest of the wall and pour the footing. Then remove the form and lay brick topping. Treat the concrete as previously described before painting or planting. **PM**

GARDEN POOL SUPPLIERS

- Lilypons Water Gardens, 6800 Lilypons Rd., Box 10 PM, Lilypons, Md. 21717; or 839 FM 189, Box 188 PM, Brookshire, Tex. 77423-0187; catalog \$3.50.
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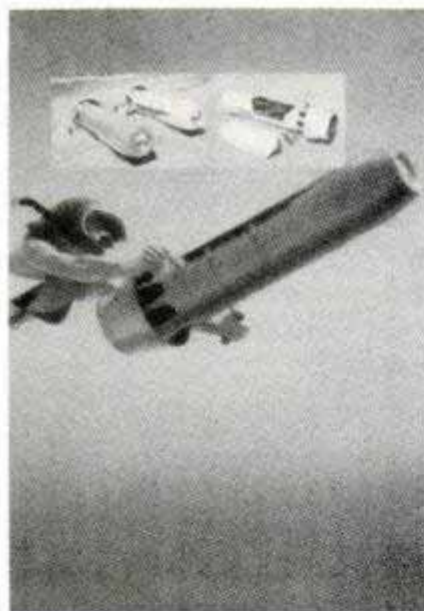


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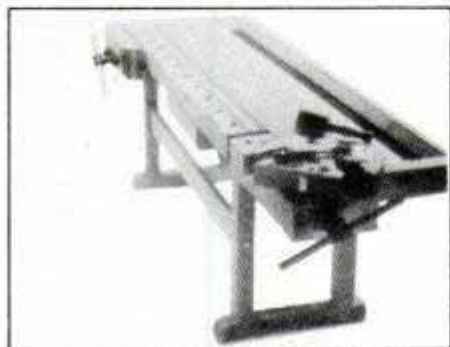


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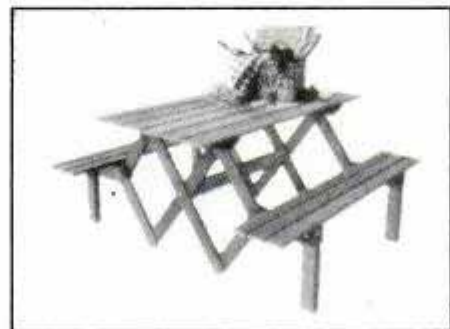
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For details, contact Griset Industries Inc., Box 10114, Santa Ana, Calif. 92711.—Rosario Capotosto



Bench clamp (top) has jaws on top and bottom of channel. Straightedge clamp is shown in two positions.



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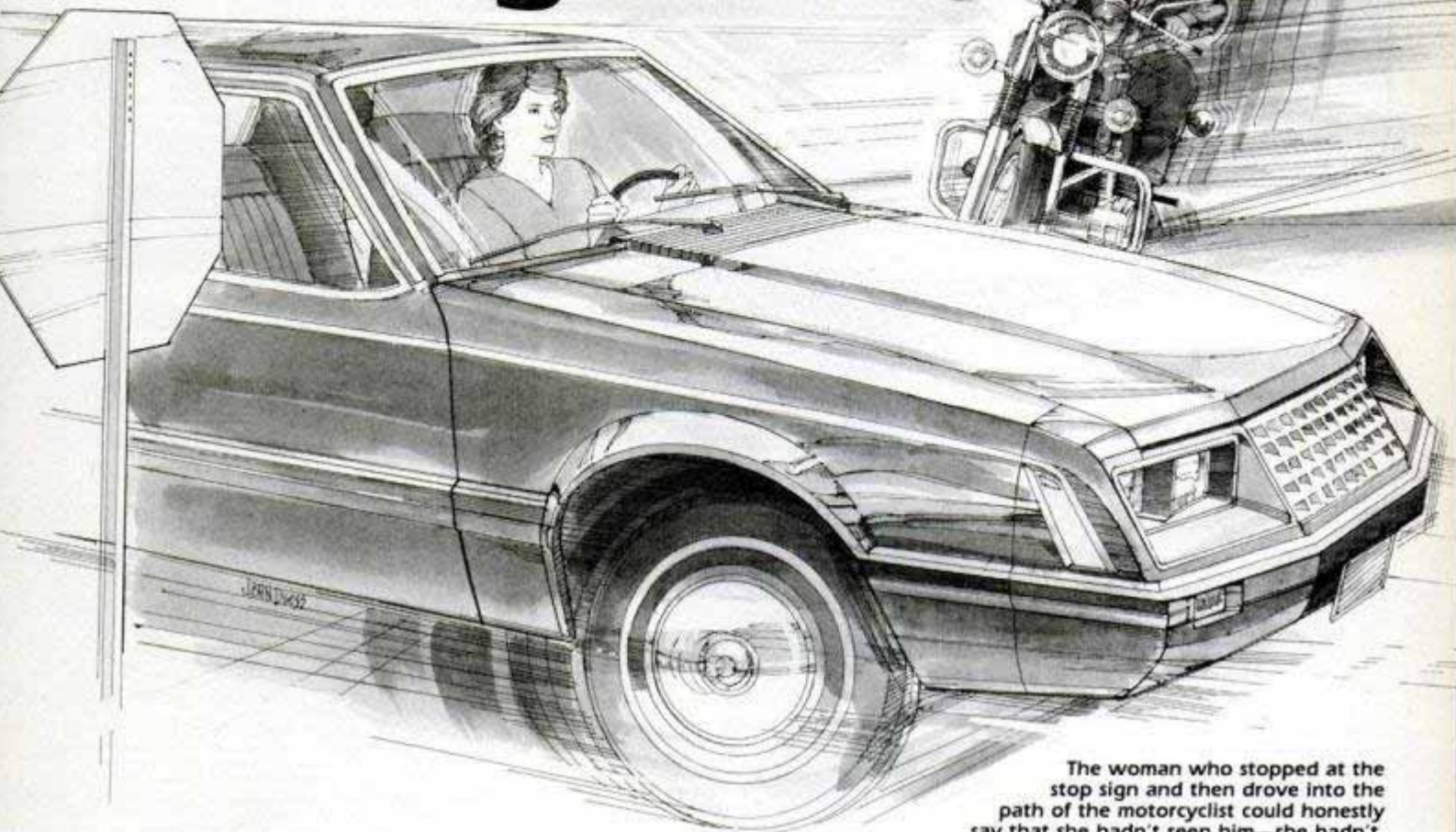
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How To Improve Your Driving Vision



The woman who stopped at the stop sign and then drove into the path of the motorcyclist could honestly say that she hadn't seen him—she hadn't.

I never saw him coming," cried the distraught woman to the state trooper investigating the accident. "I stopped at the stop sign and looked both ways before I pulled away. Then this motorcycle crashed into my car. *It came from nowhere.*" The trooper had heard similar statements before, during other accident investigations involving cars and motorcycles. Motorcycles seemed to appear from nowhere.

This accident, like most car/cycle confrontations, had occurred in daylight. Yet the woman said she had never seen the approaching motorcycle. Was she lying? Not if she hadn't *consciously* seen the motorcycle coming. Chances are she looked right through the motorcycle, whose rider had assumed the woman saw him approaching. The woman in the car was an unwitting victim of "mental set."

Mental set is a kind of mental block that results in a "short circuit" between the eyes and the brain. A person with mental set can have good physical vision, but still fail to see well under certain conditions. This fact isn't hard to believe when you realize that seeing is largely a mental process. The eyes

'Mental set,' 'brain fade' and other problems can keep you from seeing the obvious.

BY BILL HAMPTON

collect visual impressions, but the brain must interpret them to form meaningful images.

In a sense, a person sees as well as he or she wants to, assuming, of course, that the eyes and optic nerves are healthy. "Too many drivers are visionally lazy," explains a prominent psychologist. "They simply don't take enough interest in their driving environment to see as well as they are capable of seeing."

Some psychologists go so far as to say that mental set drivers are introverted. They withdraw into their own little worlds within the confines of their vehicles. Consequently, the mental set driver's range of vision decreases to a point where he becomes a potential threat to others.

At times, every driver is susceptible

to mental set. We've all operated vehicles somewhat unconsciously while our minds were on something else. Periods of "driving unconsciousness" usually last only a few seconds while the brain goes on autopilot. Psychologists say that when boredom and fatigue set in, a driver slips in and out of unconscious states. "Brain fade" is the familiar term.

The first step in eliminating mental set and improving vision is adopting the right frame of mind. Because seeing is mostly a mental process, taking more interest in your driving environment will actually help you see more effectively. You'll also tend to spot potentially dangerous conditions that you normally wouldn't notice.

Guard against boredom and fatigue when driving for extended periods. If you find your attention wandering, talk to yourself. Tell yourself that you will remain alert, that you aren't tired. By programming your subconscious mind in this manner, it'll act upon these suggestions to minimize driving fatigue and improve vision acuity.

In your desire to see better, don't
(Please turn to page 138)

He reaches speeds of 800 miles an hour.

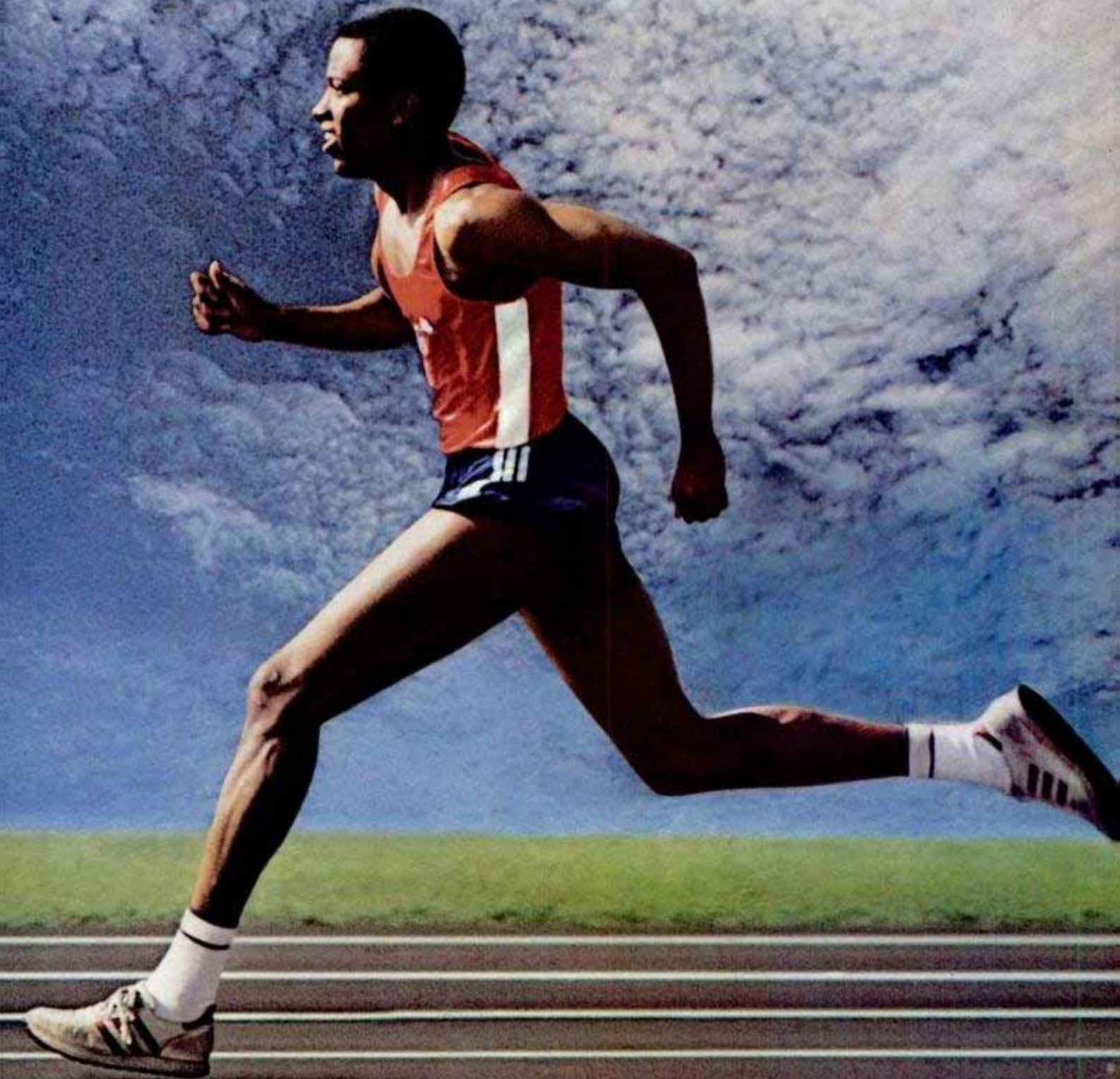
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DRIVING VISION

(Continued from page 134)

make the mistake of straining to see something. Straining leads to staring, which in turn makes the eyes tense. Since tense eyes are tired eyes, they can deplete your body's energy.

When you find yourself straining to see, relax your facial muscles and breathe deeply. The extra oxygen will help you relax and may even provide a momentary sharpness in vision. Blinking helps minimize tension, too. Squeezing your eyelids shut every so often will increase circulation in your eyes and lessen tension as well.

Another way to minimize eye tension

and widen your field of view is to move your eyes in a scanning fashion. By never focusing on one point for more than three seconds, you'll prevent staring and tension before it leads to tired eyes. Frequent, quick glances at the rear-view mirror make a fine exercise.

Eye fatigue is directly related to eye movement. Though it might seem more tiring to keep your eyes in near-constant motion, these organs thrive on it. Furthermore, alternate your line of sight between points at varying distances. For instance, glance down the road, then back to a point somewhere in front of your car. This two-point scan is a good method to use at night to avoid

(Please turn to page 140)

Visual Exercises For Drivers

Optometrists specializing in sports medicine point out that superior athletes owe their consistent victories as much to their ability to rapidly process information through their eyes as to their athletic skills. Winning race car drivers are victorious because they can make sense of, and react to, on-the-track situations which may change in an instant. Not all of us need to develop skills on the level of a Formula I driver, but improving the ability to use your eyes in everyday driving might save your life.

Good eyesight is a lot more than "perfect" 20/20 vision. Peripheral vision, depth perception, rapid shift of focus from near to far, and quick application of visual information are critical factors that cannot be measured with an eyechart. These learned skills can be improved with practice and exercise. Dr. Gary Etting, a Southern California sports optometrist, provided us with basic exercises to help improve visual skills required for everyday driving.

Part of the problem is that driving a car requires doing two things at once—watching the road and operating the vehicle. To see what we mean, have a friend take a pencil and randomly trace patterns in the air. Try to follow the pencil as your friend asks you to solve simple arithmetic problems like "nine plus nine, minus eight, plus 16, minus four, plus 33."

Sooner or later, you'll find yourself eliminating one function to concentrate on the other—precisely what happens to drivers. Eventually, a driver will sacrifice his ability to perceive the panorama for some other function, whether daydreaming or turning up the radio. Either way, his vision narrows and his effectiveness as a driver diminishes—he becomes a risk.

Develop peripheral vision

Good driving requires the development of strong dynamic peripheral vision—a driver's field of vision should be as wide as possible. Fatigue, stress, sensory distractions (a loud radio, screaming kids) and the pressure from too much concentration (staring) all can narrow a driver's field of vision. His eyes focus like a beam, shutting out all other visual information.

One way to develop your peripheral

vision is to take a pair of cotton swabs and hold one at either side of your head until they are just in view. Try walking around a room, keeping both cotton swabs in sight at all times. It sounds silly, but it's much more difficult than you think.

Binocular depth perception, or perceiving distance with both eyes, also figures heavily in driving performance. Using one eye at a time provides only part of the picture and can severely handicap driving performance, particularly at night. After dark, there are no shadows to help a driver judge distance.

You can improve your binocular depth perception by tying colored beads every 8 inches along a yard of string. Tie one end of the string to a doorknob and hold the other under your nose. As you focus on each bead, an X will form through the bead you're focusing on. If the X disappears, one eye is shutting down. This exercise will teach your eyes to work as a team.

Change focus quickly

Shifting focus from near to far is a visual skill that is used constantly in driving. Your eyes have to make a big adjustment when you glance at the speedometer and then look down the road. How quickly your eyes will shift is critical to the way you drive.

There's a quick and easy way to learn to change focus. Take a single letter from a large newspaper headline and place it on a wall at eye level. Cut out a small classified ad from the paper. Stand 8 to 10 feet away from the wall and look at the letter. Hold the ad up at eye level and read it, bringing the ad toward your face until the words blur. Switch your focus back to the letter. With practice, your ability to focus from far to near can be improved dramatically.

Clearly, this is a quick look at the basic elements of a complex field. In fact, there are a number of optometrists across the country whose practices are devoted to improving the visual skills we've discussed. To be referred to such a specialist in your area, write the American Optometric Assn., 243 West Lindbergh Blvd., St. Louis, Mo. 63141.

Using your vision is a learned skill and, with proper exercise, it can be improved for greater driving safety.—David Ellis

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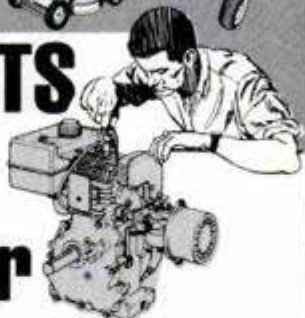
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DRIVING VISION

(Continued from page 138)

the headlight glare of oncoming vehicles. During this two-point scan, you accomplish two things: You avoid looking directly at the other vehicle's lights and you have enough peripheral vision to keep track of the vehicle's position.

A peculiarity of the human eye is that it has a natural blind spot where the optic nerve enters the eye. If you have trouble seeing in low light, turn your head away slightly and view your subject—your eyes looking straight ahead.

Night driving hazards

If you have any kind of vision weakness, night driving will only intensify it. Some drivers have an ocular-muscle imbalance. If they become tired and have trouble keeping their eyes in motion, they tend to fix on anything within their line of sight. Virtually anything on the windshield—a water droplet or a speck of dirt—can act as a powerful hypnotic stimulus to stop eye movement. If a driver doesn't catch himself, his eyes will turn inward, or "cross," and he will experience double vision.

Another danger of less-than-perfect vision is that the color red—another vehicle's taillights, for example—appears hazy and seems farther away than it really is. Severe instances are termed protanopia. The danger here is that the vehicle a protanopic driver follows will be closer than he realizes.

Because the eyes can suffer from a host of problems, you should have your eyes examined at least once a year. You could have a vision weakness without being aware of it.

Age is also a critical factor in how well you see. If you're over 50 and have 20/20 vision, you're still going to need twice as much light as a 20-year-old to see as well as he does. Even if you're a young driver with good sight, your night vision is still going to be only one-tenth as effective as your daytime vision. Your capacity to distinguish contrast will diminish nearly 90 percent.

Is there anything you can take to improve your night sight? Other than ensuring that you get an adequate intake of vitamin A, along with a balanced diet that includes other vitamins and minerals, there's nothing you can consume to miraculously improve your vision. Large doses of vitamin A will not give you cat's eyes at night.

There are, however, several physical exercises that can help you see better (see box on page 138). The most important technique you can cultivate is the desire to see better. With that, you'll stand a good chance of never having to answer a state trooper's questions about why you didn't see the other guy in time to avoid a collision. **PM**

WORKSHOP MINICOURSE



Using handsaws

The most useful handsaws for work around the home and shop are the crosscut, rip, compass and coping saws. Two others that are somewhat specialized but still very useful are the dovetail saw and backsaw. And, for cutting metal and other tough materials, a hacksaw is indispensable.

Ripsaws and crosscut saws are similar in appearance, but a close look at their teeth reveals quite a difference. The rip saw, used to cut wood lengthwise in the direction of the grain, has teeth that are filed straight across to form chisel-like points. These teeth cut by chipping away the wood. The crosscut saw is used for cutting across the grain. Its teeth are beveled on both sides, like knife edges, and the blade cuts by slicing through the wood fibers.

These saws, and the others shown, are classified by the number of saw teeth points per inch (PPI). This factor determines whether the saw will cut fast but rough (fewer teeth per inch) or slow and smooth (more teeth per inch). Ripsaws, for example, are commonly 5½ or 6 points, while crosscut saws are usually 7 or 8 points. Saw teeth are also set—that is, alternately bent outward—to create a kerf cut slightly wider than the blade body. This allows the body to move freely through the cut without binding.

The compass saw is used for making cuts where the rip saw or crosscut saw won't fit and for cutting curves and internal cutouts. But for intricate curves and scroll work, the coping saw is the better choice. It makes a finer cut and its removable blade permits shallow internal cutouts up to the depth of the tool throat. To do this, just bore a blade entry hole into the waste area, thread the blade through the hole, reattach it and make the cut.

The dovetail and backsaws also resemble each other. Both have thin blades with fine teeth and a stiff spline across the blade top to keep it rigid. And both excel at making precise, clean cuts, like the examples shown in the photos.—Rosario Capotosto



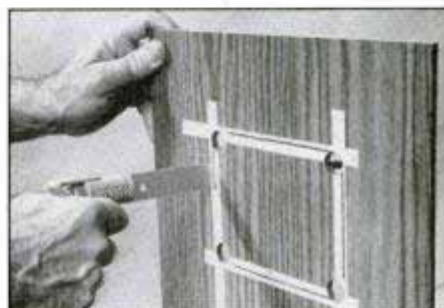
The most common handsaws for shopwork are (1) crosscut saw, (2) backsaw, (3) coping saw with removable blade, (4) rip saw, (5) dovetail saw, (6) compass saw with interchangeable blades, (7) hacksaw for metalwork.



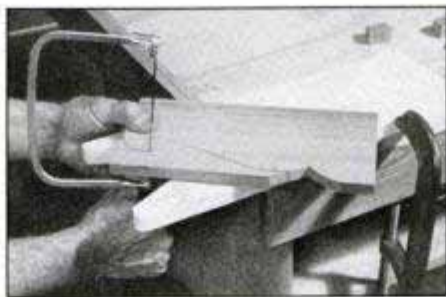
Use thumb knuckle as guide to start crosscut saw precisely on waste side of cut line. Draw blade back a few times to gain entry, then push blade forward at 45° angle.



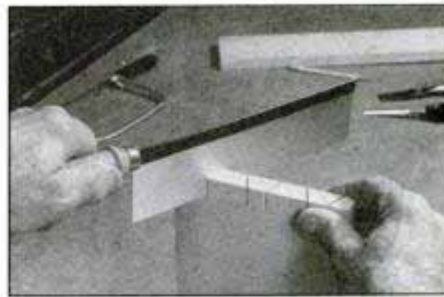
Start rip saw like crosscut saw, but use a 60° cutting angle. On long cuts, kerf may close and bind blade. To prevent this, insert nail or wedge to spread kerf open.



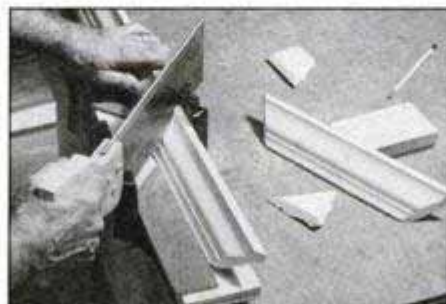
Use a compass saw for making internal cuts. Bore a blade entry hole at each corner, then cut out waste between. Draw cut lines on masking tape for greater visibility.



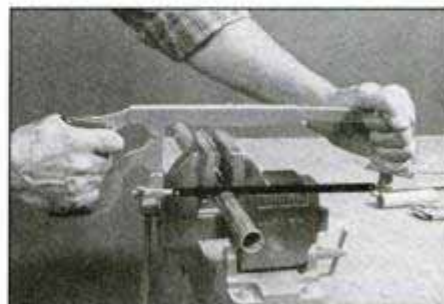
Use a coping saw for curved cuts. For best results, blade teeth should point down so saw works on pulled downstroke. Clamp a V-notched board underneath for support.



Dovetail saw has thin blade with short, fine teeth for great cutting accuracy. It's ideal for dovetail depth cuts and for cutting off installed dowel plugs flush to surface.



Use a backsaw in a miterbox for making accurate angle cuts. The saw also works well for cutting tenons and dovetail joints that are too deep for the dovetail saw.



Use a hacksaw for cutting metal. Hold it firmly with both hands and apply cutting pressure only on the push stroke. Lift blade off stock slightly on each return stroke.

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POPULAR MECHANICS • AUGUST 1984

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DODGE CARAVAN/ PLYMOUTH VOYAGER

"We could use three Caravans
in this family."
—OHIO HOUSEWIFE

"Should have a wind deflector to keep
the rear window clean."
—MICHIGAN PAINTER

"My 18 mpg is a far cry from
the EPA estimates."
—COLORADO WELDER



"A dream to load and unload."
—MARYLAND ATTORNEY

"Needs a little more than 101 hp."
—TEXAS SALESMAN

"I'm going to buy another one when
the '85 comes out."
—WISCONSIN FLORIST

Early buyers love these Chrysler minivans, but ask for more power and better fuel economy.

The downsized van has become one of the great milestone brainstorms of the Eighties. Chrysler Corp. caught all the other American carmakers flat-footed, just as Ford—back in the Sixties—got the jump on everyone with the Mustang. That, of course, started the ponycar stampede, and now it looks like Chrysler's T-vans are about to start a similar rush in family transportation.

These two Chrysler T-vans—better known as the Plymouth Voyager and Dodge Caravan—represent the same sort of forward, right-on thinking as the Mustang did in its time. And surprise!



Folding, removable bench seats help to make these vans more versatile. Three-person bench (shown here) is an option.

They're brought to us by the cigar-chomping gentleman who led the motoring world to ponycars—Lee Iacocca.

Right now, Chrysler can barely keep up with T-van demand. Ford and GM are puffing to catch up, but they're bound to ride in on Chrysler's wake, much as the Camaro rode in on the

A NATIONWIDE SURVEY BASED ON 1,470,353 OWNER-DRIVEN MILES

Mustang's coattails way back in 1967. Meanwhile, as Uncle Lee chuckles and shuffles to the bank, owners of the company's popular T-minis told us why they feel so good driving them.

A Missouri librarian: "I really feel it's
(Please turn to page 144)

DODGE/PLYMOUTH O. R.

(Continued from page 143)

a great design, especially with front-wheel drive. If the Ford and GM small vans come with rear drive, I believe they'll have failed to take advantage of a

good layout. No doubt that rear drive works, but for a family vehicle, the others won't measure up in such areas as seating capacity, interior-space versatility and traction. Chrysler management really is tuned in to what people want."

A Minnesota attorney marveled, "I can't conceive how Chrysler could design and engineer such a revolutionary vehicle to such a high state of refinement the first year out!"

"This is the first automotive product in five or six years," mused a Michigan

SUMMARY OF 1984 PLYMOUTH VOYAGER/DODGE CARAVAN OWNERS REPORTS*

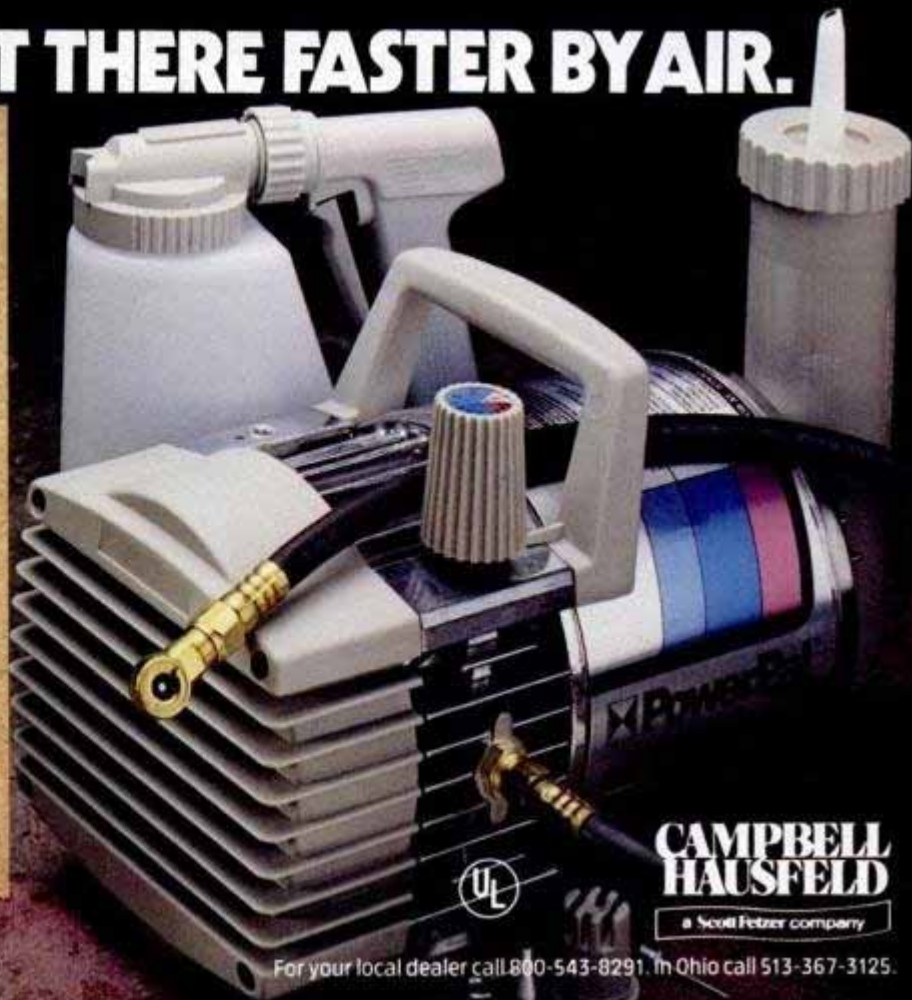
Total miles driven	1,470,353	Five-speed manual	9.7	How much did you pay?		Dealer service opinion:	
Average miles per gallon		Why choose the Voyager/Caravan?		Range	\$9,970-15,000	Excellent	32.2%
2.2-liter Chrysler ohc Four		Roominess, carrying capacity	46.1%	Average	\$12,231	Good	43.1
In town	19.8	Economy	33.1	Workmanship opinion:		Average	18.4
On the highway	25.5	Size	25.8	Excellent	49.6%	Poor	6.4
2.6-liter Mitsubishi ohc Four		Styling	24.7	Good	46.8	Number of vehicles owned:	
In town	19.0	Front-wheel drive	14.9	Average	3.1	This car only	23.3%
On the highway	23.5	Specific likes:		Poor	0.6	Two cars	57.7
Vehicle choices:		Handling	52.2%	Comfort opinion:		Three cars	12.2
Plymouth Voyager	51.0%	Comfort	39.9	Excellent	56.2%	Four or more cars	6.8
Dodge Caravan	47.1	Roominess	33.4	Good	42.7	Makes of other cars owned:	
Dodge Mini Ram utility van	1.9	Styling	27.8	Average	1.1	Chevrolet	18.4%
Series choices:		Economy	25.0	Poor	0.0	Dodge	17.3
Base van	10.1%	Ride	24.4	Had any mechanical trouble?		Ford	15.2
SE series	60.4	Specific dislikes:		No	60.4%	Plymouth	12.0
LE series	28.9	Mpg lower than expected	23.6%	Yes	39.6	Volkswagen	8.8
Seating arrangements		Underpowered	14.2	What type of trouble?		Buy another Voyager/Caravan?	
Front buckets only	0.8%	Needs rear washer/wiper	9.7	Electrical	16.7%	Yes	79.6%
Front buckets + one bench	26.8	No complaints	9.7	Carburetor	9.7	No	2.7
Front buckets + two benches	72.4	Sliding door hard to use	8.1	Brakes	9.0	Maybe	17.7
Engine choices:		What changes would you like?		Horn	9.0	Buy another Chrysler product?	
2.6-liter Mitsubishi Four	54.7%	No changes	16.4%	Poor fuel mileage	8.3	Yes	82.2%
2.2-liter Chrysler Four	45.3	Rear washer/wiper standard	9.3	Air conditioner	6.2	No	1.1
Transmission choices:		Better fuel mileage	9.0	Did you repair it yourself?		Maybe	16.7
Automatic	90.3%	More horsepower	8.7	No	90.1%	Age distribution of owners:	
		Better-engineered seating	8.7	Yes	9.9	15-29 years	6.2%
				Dealer repairs satisfactory?		30-49	66.3
				Yes	67.6%	50-plus	27.6
				No	32.4		

*Percentages might not equal 100% due to rounding or insufficient data.

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utility fuel buyer, "that's even interested me. Children plus current transportation needs had me looking at full-sized station wagons. For the same money, though, I was able to purchase the Caravan, which now gives me more flexibility and much better fuel economy."

"The Voyager works very well for our family of five," echoed a Nebraska city manager, "and it's also great for carpooling. Last winter, we were snowed in inside the van for almost a whole day. Being able to move around and having space to let the kids sleep kept it from becoming a nightmare. The only drawback is that everyone we meet in parking lots wants to stop and chat about this vehicle."



Three-person rear bench will fold flat for extra storage when you can't remove it.

An Alabama teacher: "As a mother, I'm especially pleased with the Caravan—the ease with which I can lift my small children in and fasten their seat belts/child restraints. I no longer get a backache from bending over. Also, I like the way I can walk from the front seat to the rear area without my husband having to stop the van."

Not *everything's* milk and honey in minivanland, however. Demand being what it is, some owners felt their dealers may have given them short shrift. "The salesman," lamented a Michigan nuclear physicist, "acted as though he didn't care whether I bought the Voyager or not. In fact, better that I didn't, because I'd ordered the van with minimal options, and if I didn't take it, the dealer could probably load it up for the next guy."

And a Texas dockworker added, "Price gouging in the Houston area was more than I expected. Prices were \$500 over sticker, and some dealers' allotments for six months already had deposits on them. This happened one month after these vans had been released!"

A few owners had other small bones to pick. An Alabama supervisor was one of nearly a quarter of our respondents who expressed disappointment in fuel economy. "I never expected the high mileage on the sticker, but I did expect in the mid-20s. So far I'm getting

(Please turn to page 146)

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DODGE/PLYMOUTH O. R.

(Continued from page 145)

only 16 mpg in town and about 23 on the highway. The dealer says everything's okay. If this is typical, this van's got a problem."

Nor was a Massachusetts teacher alone in the following complaint: "The 2.2-liter engine lacks power, even with the five-speed. This is my first four-cylinder vehicle, and maybe I was spoiled by our big American V8s." A Michigan sales engineer added, "The 2.2-liter seems nice but underpowered for the Voyager, which raises the question of its long-term durability."

In all, 14.2 percent of the owners we queried said the Voyager and Caravan could use more horses, especially when teamed with the automatic transmission (which 90.3 percent had in our survey). Several drivers suggested adding an optional turbocharger, and there's a good chance that Chrysler will. As it is now, this Maryland crime-lab technician was typical of drivers who'd tried both engines: "I'm very glad we got the 2.6, because we did notice a certain sluggishness when we test-drove a Voyager with the 2.2."

The one complaint we heard about the Mitsubishi-built 2.6 engine, though, concerned oil-filter access. "It's even

harder to get at," groaned a Florida retiree, "than my 1980 Citation's."

Just over 60 percent had had no mechanical problems with their vans and, of those who did, 75.3 percent rated their dealers' service *good to excellent*. Workmanship was also judged *good to excellent* by 96.4 percent of our respondents—a fantastically high figure for start of production. "Of the 10 new cars I've owned," said a Michigan office worker, "this Voyager has, by far, the best fit and finish."

Everyone appreciated the T-van's good visibility in most directions, but several drivers pointed out that hind-sight wasn't always 20/20. An Illinois design draftsman: "The rear window really gets dirty fast when roads are dusty or wet," and a Maryland child-birth instructor suggested, "A washer/wiper is a necessity the way dirt collects on the rear window." Chrysler offers such a washer/wiper as an option.

Other Chrysler minivan owners mentioned that children and grandparents sometimes don't have the strength to open and close the large sliding side door. It's something most buyers hadn't realized until after they'd lived with their vans awhile.

On the other hand, "... great comfort," beamed a Delaware homemaker. "Overall it's one of the most comfort-

able cars I've ever driven or ridden in. Even the back seats are roomy enough for big people."

"I'm much impressed," remarked a Michigan mail carrier, "not only with the van's comfort but the easy access to the glove box under the front seat, the legibility of all gauges, and the unique use of every nook and cranny."

On the topics of handling and maneuverability, an Ohio high school principal summed it up for many when he wrote, "The Voyager handles well in snow, especially climbing snow-covered inclines. Standard rear-drive vehicles couldn't make it last winter and got stuck in places where I kept going."

An Illinois clergyman: "We reached Cleveland in a blizzard, and a stretch that normally takes 1½ hours to drive took us 4½ via an unplowed I-90. Trucks, 4x4s and a lot of cars were stuck or off the roadway. We made our destination warm and safe, though, and even averaged 28 mpg under such adverse conditions. God bless Lee Iacocca and Chrysler for not trying to rip off America; rather I think they're striving for quality and honesty."

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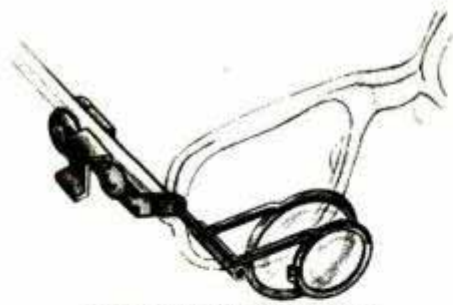
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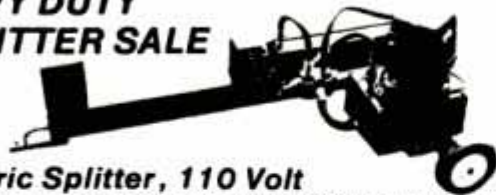
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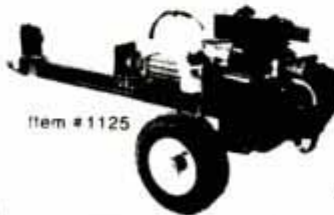


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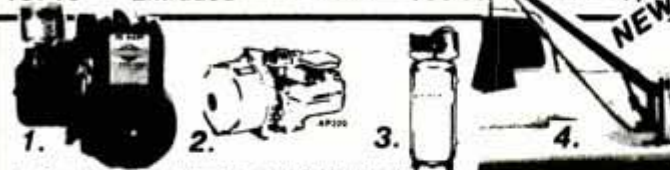
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10 HP Tecumseh 1/2 shaft electric start #60101	Horizontal	\$269
8 HP Tecumseh 1/2 shaft #7082	Vertical	\$199
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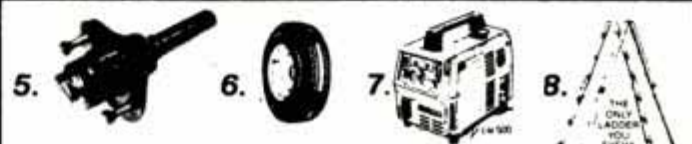
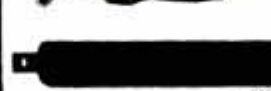
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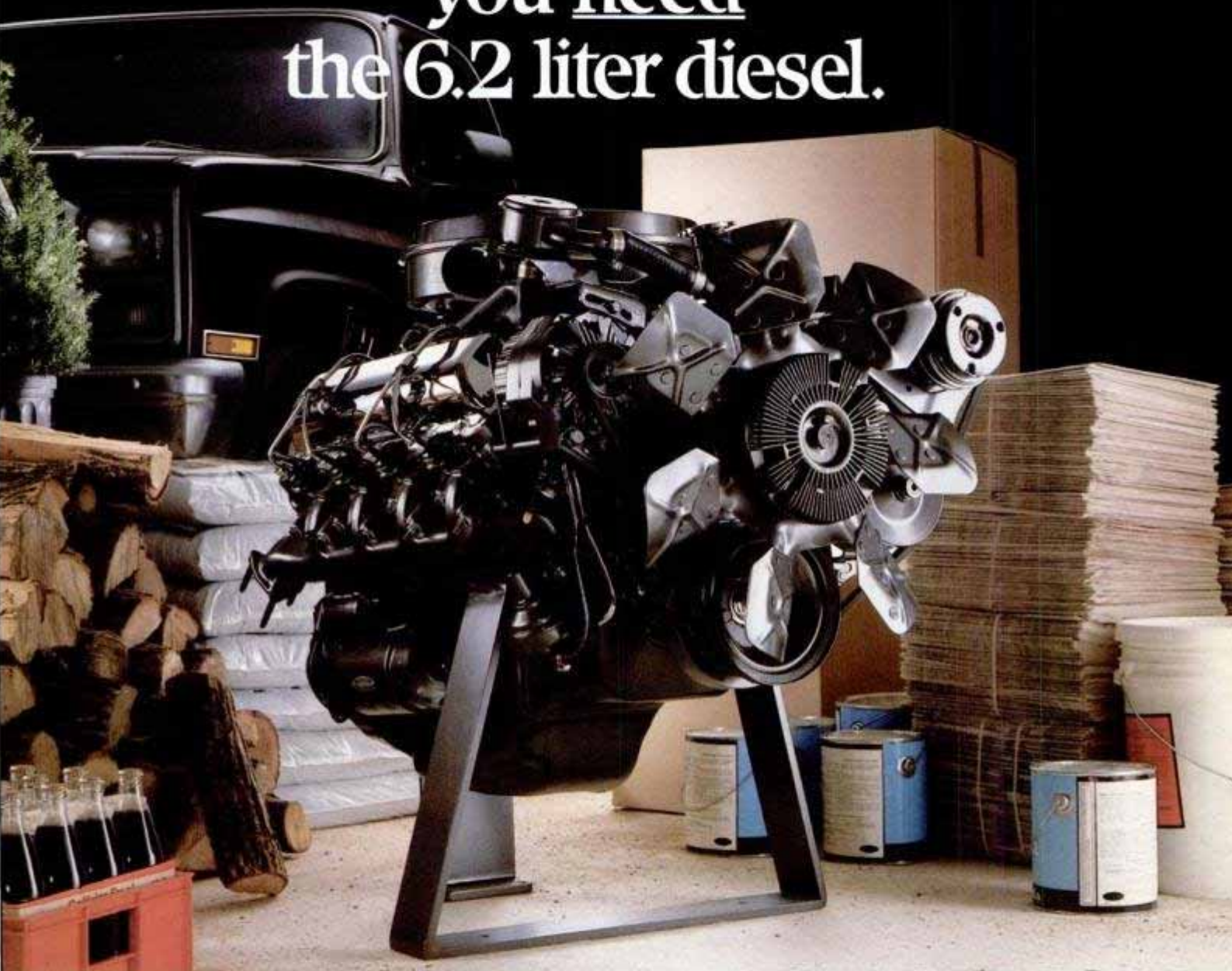
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