

Today's roads come with standard features most cars aren't equipped to handle.

Today too many cars are designed without enough regard for the way most roads were designed.

Without enough regard for the hazards of everyday driving. Without enough regard for the ever present threat of inclement weather.

A car as tough as the roads it travels.

Fortunately, Subaru has designed a complete line of cars for these realities. And we started long before it was fashionable to do so.

We gave Subaru Front Wheel Drive for improved road holding. Rack and pinion steering for quicker response. Independent McPherson strut suspension for a

better ride over rough roads. And a dual diagonal braking system for extra safety.

As a result, Subaru has a proven record of durability and reliability. A record achieved on real streets and highways, not just on test tracks.

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Since driving conditions can go from bad to worse in an instant, we've added the option of "On Demand"™ Four Wheel Drive to our Four Door Sedan and Two Door Hardtop. Making Subaru the only car company in America with a full line of front to "On Demand" Four Wheel Drive vehicles. Cars that give you more traction when the road gives you less.

This year the Two Door Hardtop incorporates our latest innovation. Turbo-Traction.™ It's our unique combination of Fuel-Injected Turbo Charging, "On Demand" Four Wheel Drive, and automatic transmission.

The result is unmatched versatility for exceptional handling under any conditions.

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built to stay that way.



This One



W5R5-61N-Y1K5

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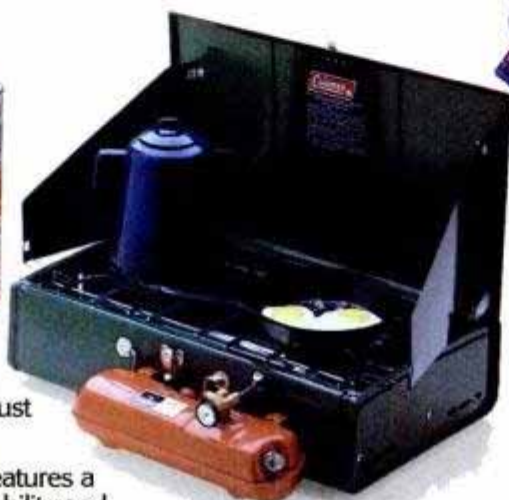
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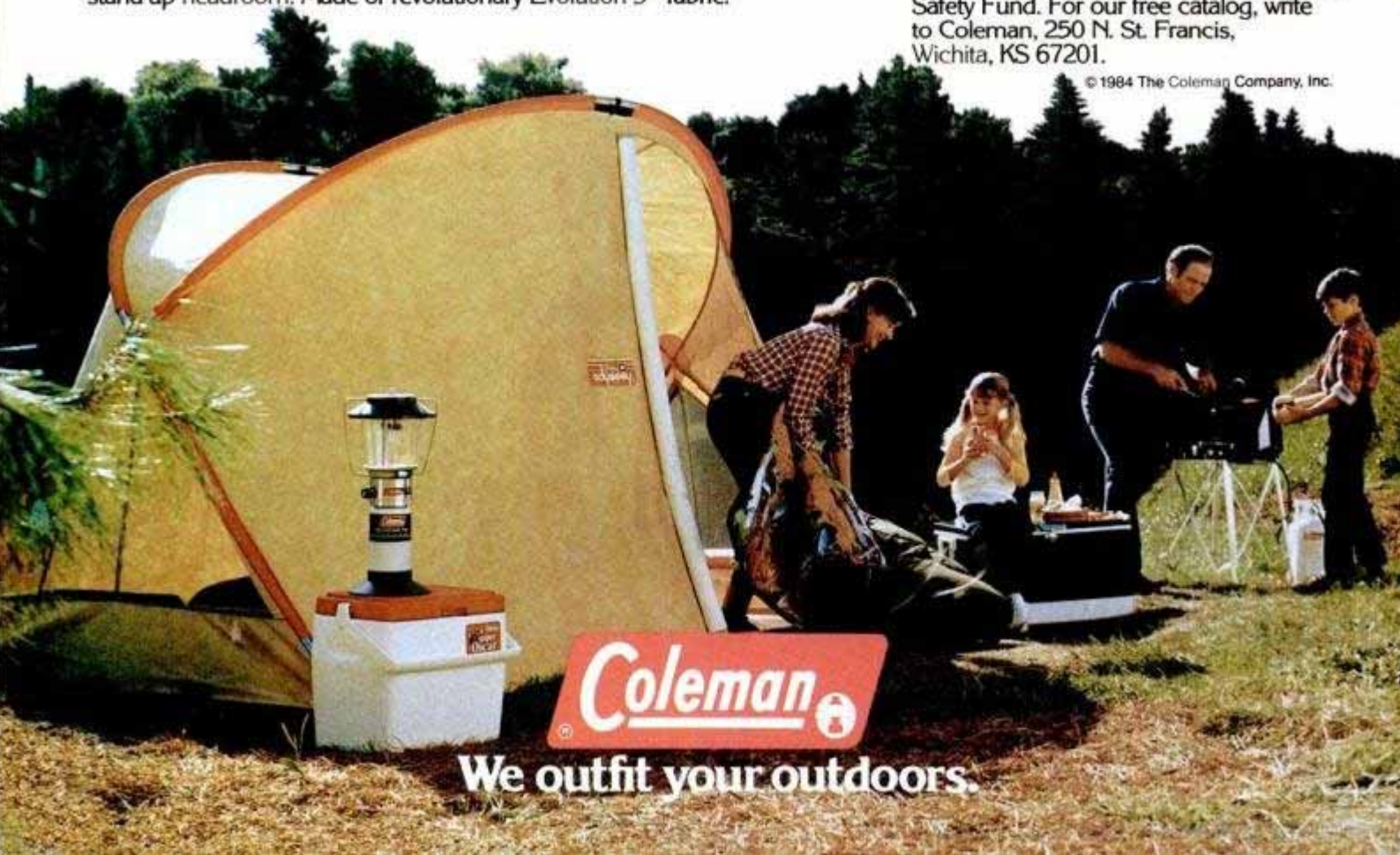
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We outfit your outdoors.

THIS MONTH

The Mirage sleeps four, gets 20 mpg and is as fun to drive as a family car—all for \$15,000. It's one of a new breed of light, compact motor homes that offers easy on-the-road living at an affordable price. Story on page 82.

—PM photo by Frank Zagarino



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MAY 1984

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This 1964 Pontiac GTO is a shining example of what topnotch car care can do. The GTO appears in the 1984 Car Care Guide (page 103) and, for a newsstand test in some areas, on the front cover of this issue. The GyrMax decked canoe (also on the test issues) was provided by Perception Inc., Liberty, S.C.—PM photo by Frank Zagarino



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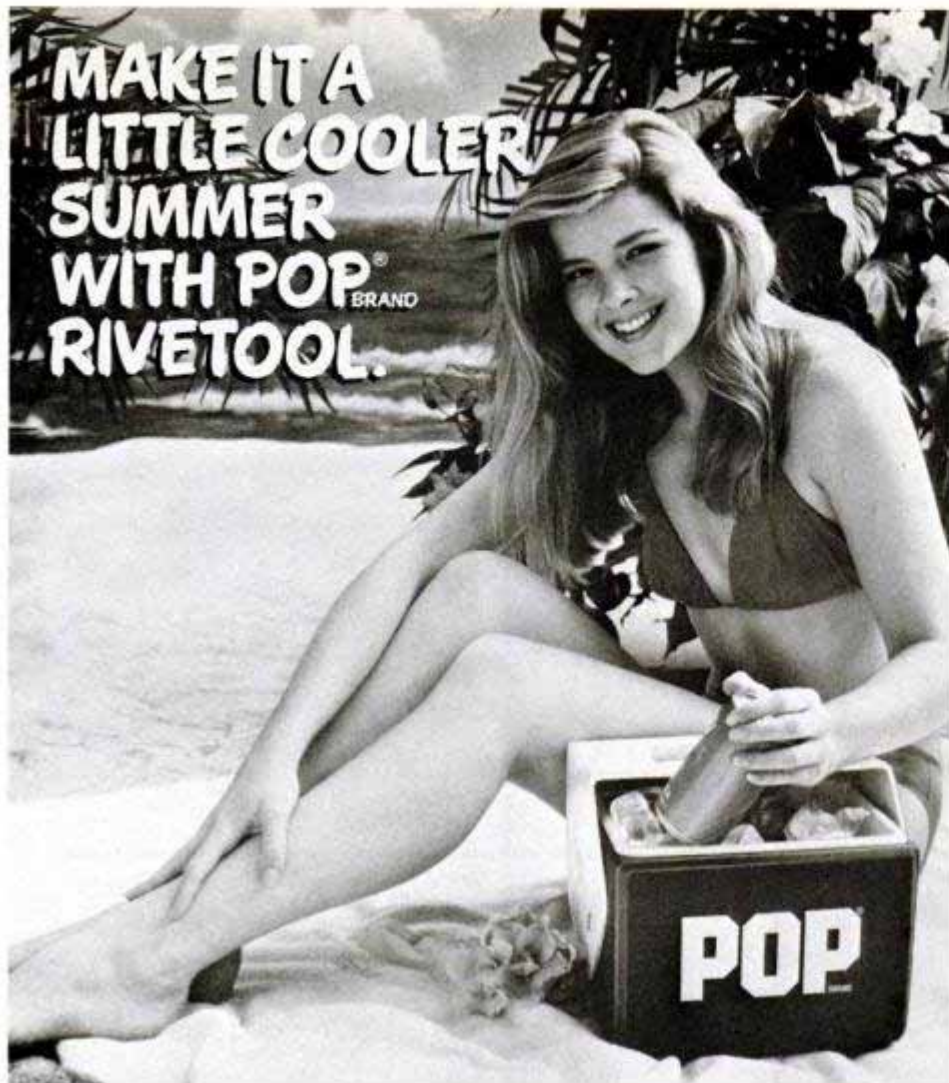
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EDITOR'S NOTES

Worried about your kids' physical well-being when they spend hours at video games? Take heart. The San Francisco Giants baseball team is issuing video equipment to players this year and encouraging them to use it. One researcher who examined some 300 pro players told Science Editor Dennis Eskow that those who spend lots of time at video games turn out to have the quickest reflexes. You'll find more about the melding of science and athletics in *Science Goes To Bat* (page 71) **Dennis also delved into the black arts** of our national sport (*The Dark Science Of Baseball*, page 74) to reveal how certain participants sort of—well—doctor things up to gain an advantage. Some call it cheating. Of course, none of the informants did it himself. But a number were conversant with the aerodynamics of spitballs and the home-team advantage gained by the creative contouring of a playing field. . . . **No sooner had Norman Mayersohn**, our new assistant auto editor, joined the staff than we sent him off on a week-long trek from Canada to Mexico in Jeep's new downsized four-wheel-drive Wagoneer. Not only did the off-road trip take Norman back to California (where he formerly worked for *Car Craft* magazine), but it also gave him an opportunity to pose for his "Hi, folks" photo in proper Western garb. Norman describes himself as a third-generation car enthusiast who has raced cars for 12 years. He set a number of National Hot Rod Assn. records and won two division championships. Norman joined us in time to be inundated with this year's *Car Care Guide* (page 103). You'll be



Mayersohn ponders options on a four-wheel-drive cross-country trek.

hearing more from him in future issues. . . . **Picture this:** The ambiance is Palm Beach. The action is a bunch of men trying to break into one of a string of sleek, new Cadillacs. The assumption: Crime is afoot. The truth is that an impressive gold key would not open the door of one of the Cadillacs being tested by several auto writers, including PM's Wade Hoyt (*GM's New C-Cars*, page 76). Even with a "slim Jim" entry tool, the experienced car crowd failed. It took a passing motorist to make the entry a quarter of an hour later. In New York, we figure, most passersby could have done it in 30 seconds.



Front-wheel-drive is great. Now all that's needed is the right key.

John A. Lillenton



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LETTERS TO THE EDITOR



A pair for play

We were about to buy an expensive swing set for our 3-year-old when we came across your great plans for a children's playhouse (*Build PM's Play Tower For Your Kids*, page 130, June '81). I'm not much of a carpenter, but it was simple to build because the plans were easy to follow.

I did make one change that other readers might like to know about. I built a sandbox into the base (near right). The upper deck and the roof keep the sandbox nicely sheltered from rain.

BRUCE W. BOWEN
MECHANICSVILLE, VA.

I followed your basic design for the play tower, but extended a frame from one side to support a full swing set and a slide (far right). The arrangement is very sturdy and provides a wide vari-



ety of play activities for our youngsters. Thanks for the idea.

TERRY SLIMKO
LA SALLE, ILL.

Thanks for sharing your ideas. The



Two good ideas: At left, PM's play tower with added sandbox built by reader Bruce Bowen. Above, the tower with swing frame extension built by reader Terry Slimko.

swing frame and sandbox are both clever additions. Photocopies of the plans for the play tower are available for \$2.50 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Too much action

That was a great cover picture you had of our new M901 Improved Tow Vehicle (Feb. '84; story on page 68). I must point out, however, that the ITV cannot fire its missiles on the run; it must be stationary. Also, that machine gunner in the open hatch behind the missile's backblast would surely have his eyebrows singed.

RONALD C. DIETRICH
U.S. ARMY TANK-AUTOMOTIVE COMMAND
WARREN, MICH.

Our artist admits to taking a little license to dramatize the action.

Slingshots score a hit

Thanks for your terrific article on new-fangled slingshots (*Now: Super Accurate Slingshots*, page 92, Jan. '84). I've been looking at them in stores and wondering which type would best serve my needs. Now I know.

JOHN B. SHEAHAN
EAST NORTHPORT, N.Y.

All tracks aren't tanks

Your article *Our Fast New Armada* (page 83, Jan. '84) was very informa-

tive, but why do popular military writers always insist on calling anything that rides on tracks a tank? What you referred to as a tank is actually an M-2 Bradley Mechanized Infantry Combat Vehicle (MICV). Its 25-mm cannon is a popgun compared to the big 105-mm cannon typically found on true battle tanks.

CPL. ED WASH
MYNARSKI PARK, ALTA.

Technically, you're right. However, the Bradley vehicle also is equipped with the deadly antitank TOW missile and is designed as a fighting companion to the M-1 Abrams tank. As such, it is sometimes referred to loosely as a light tank.

Illegal bass boat?

Your article *Inner Tube Bass Boat* (page 93, Feb. '84) is probably going to get a number of people in trouble with the law.

The craft uses a plastic milk crate to support the seat and electric trolling motor. However, these crates aren't sold to the public, so the only way you can get one is to steal it.

Perhaps you'd be interested in my

plans for building a grandfather's clock from parking meters.

JOHN PENN
OAKLAND, CALIF.

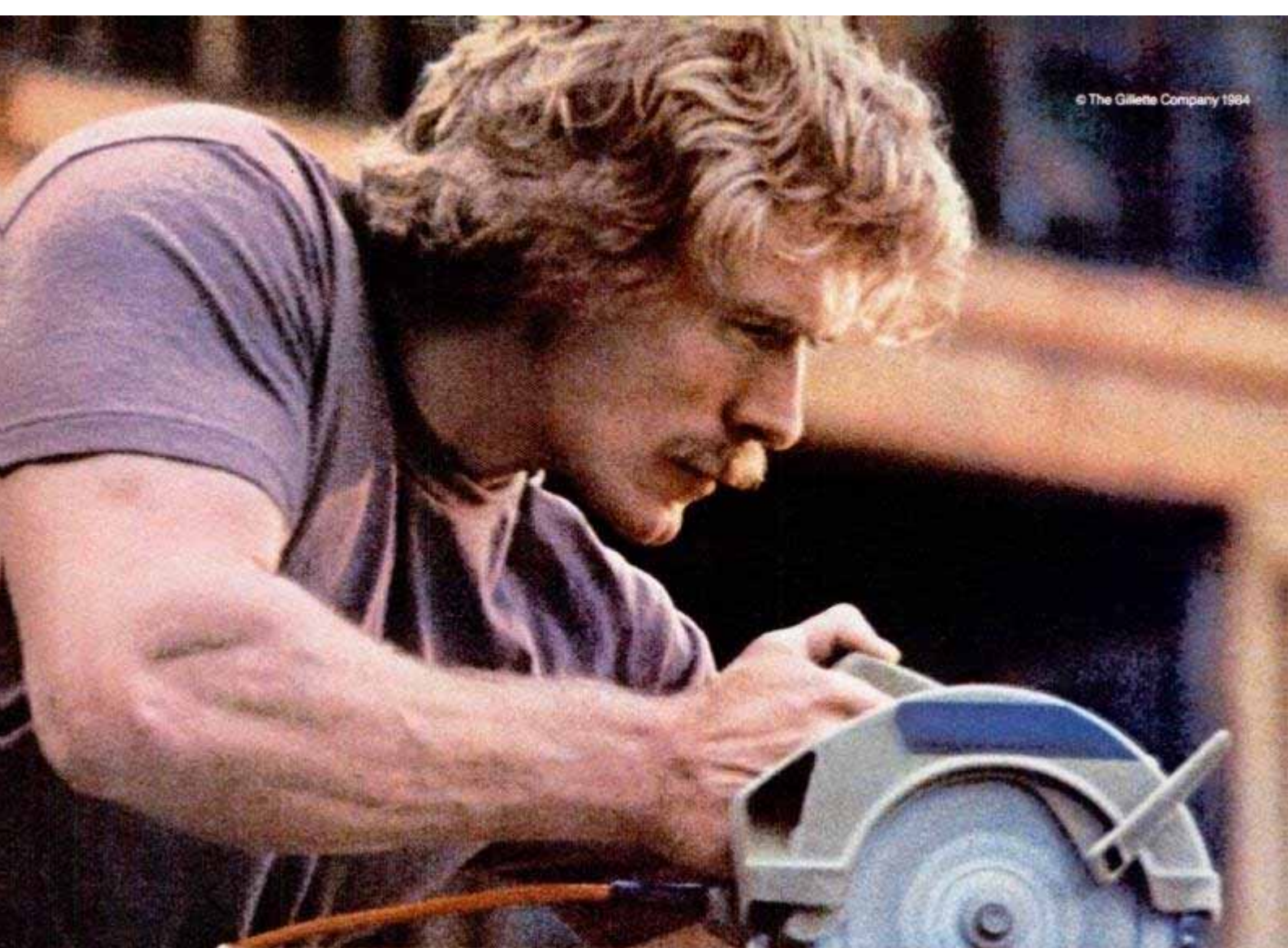
You raise a good point. Used milk crates can sometimes be purchased from milk companies and supermarkets for \$5 to \$10. However, if there is difficulty in obtaining one locally, a similar size plastic crate is available by mail from West Marine Products, 2450 17th Ave., Santa Cruz, Calif. 95063. It's called a Space Case (catalog No. 152280) and sells for about \$6 (exact price depends on shipping distance). For information on ordering, call (408) 476-1900.

It looks like a great little boat, but where do you put all the fish you catch? There appears to be only enough room for the fisherman.

JUDY SCHWEPPE
GOLDEN, COLO.

The area ahead of the motor mount can be decked over to provide ample space for a pail or creel. We omitted this from our photograph so that we could show the basic construction more clearly.

PM



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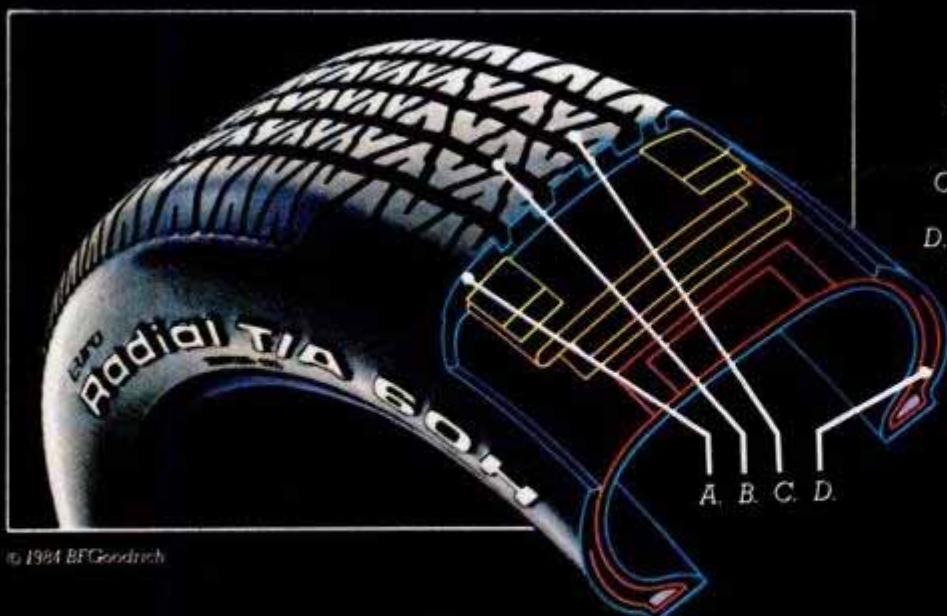
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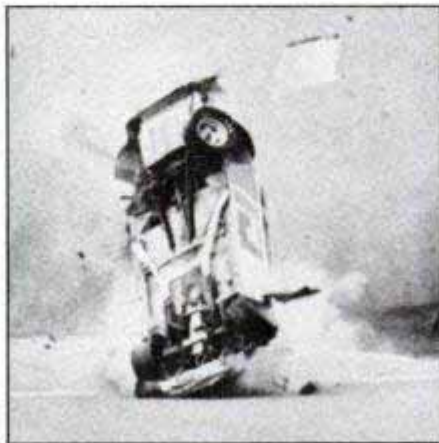
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Stay with it, Ricky!



Ricky Rudd totaled this car, but got another to run the Daytona 500 the next week.

This month's riddle: How is flipping end over end at Daytona like driving down to the corner store? The answer: You can get hurt or killed.

But you're more likely to be hurt or killed driving to the store.

If you don't believe that, you can ask Ricky Rudd or dozens of other racers.

You can't ask the thousands of drivers—last year alone—who never came home from the store.

Every one of those dead drivers had the same lifesaver in his car as Ricky. He used it. They didn't. He wasn't thrown out of his stocker and he wasn't puréed through the windshield. Rudd joins the long list of race car drivers saved by the belt. His was a full harness, of course, and a helmet cradled his head. A rollcage kept his car from squishing like a paper cup. At 200 mph you need that kind of additional protection.

Going to the store at 35 mph, a seat belt is enough to get you through. Ricky Rudd was unhurt and ran the Daytona 500 a week later, finishing seventh with an average speed just under 150 mph. It was a great race, and a safe one. This month, on the 27th, when you watch the Indy 500, think about your drives to the store.

1985 Saab Turbo 16 Aero



Saab's new Turbo is on sale in Europe, but for us it'll be an '85 model. The hatchback, aerodynamically improved with lower side panels and front spoil-

er, is even bolder-looking than the '84 Turbo. With its high-speed VR tires on new, three-spoke aluminum wheels, it's good for 130 mph. That's some cookin' from four cylinders. But what a Four it is: turbo with inter-cooler, double overhead camshafts with four valves per cylinder and new Bosch LH microprocessor-controlled fuel injection. That adds up to 175 hp in European trim—and you'll get an easy 30 mpg at 55 mph.

What's in a name?

We'll give Renault the perfect name for its version of the hottest shape in personal transportation. "Spacecar" is the best description for a comfortable, quiet and spacious vehicle with phenomenal visibility. Renault's will join the Chrysler Corp. Caravan and Voyager, Toyota Van and Mitsubishi Vista high-roof sedans (okay, call them minivans; that'll probably be the name that



Renault will be joining the minivan competition with its front-wheel-drive model.

Voting for cars

We can't always own the car we want, but we can join in "best car" polls. In Germany, for example, *Auto Motor und Sport* has readers vote. Best car in '83 was the Mercedes 500 SEL, best import under 2.5 liters was the Saab Turbo for the fourth straight year.

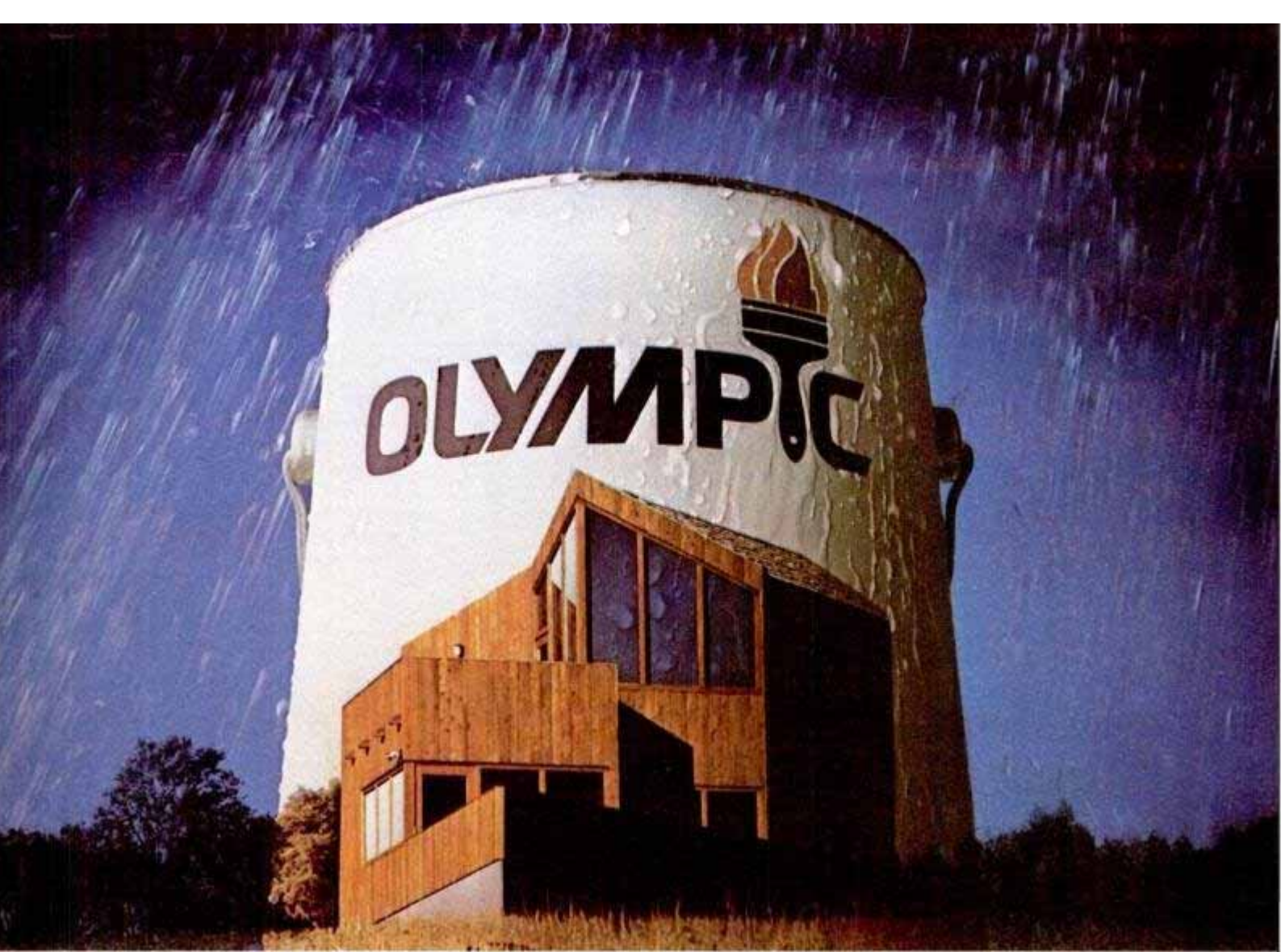
In Japan, *Motor Magazine* has a World Car of the Year, with voting by an international panel of automotive journalists. This year, my third on the panel, I gave 5 points (of 15) to the Civic, 3 to the Fiero, 3 to Mitsubishi's Chariot (Vista to us) and 2 each to the Mercedes 190 and Corolla. All my choices made the top ten. The 190 was World

Car of the Year; Civic, in 2nd place, was Japanese Car of the Year; Corolla came in 5th, Chariot 7th, Fiero 10th.

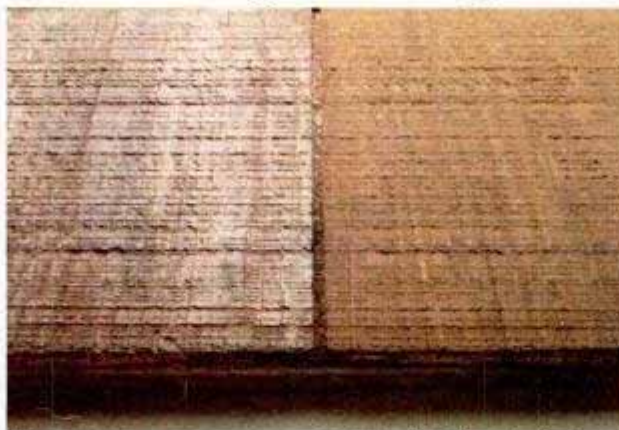


Cover of Motor.

Another way of voting is in the British magazine *Car*. In "The Good, Bad & Ugly," editors group the cars they've tested as Interesting, Adequate and Boring. How's that for casting a vote in simple English!



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ALL OUTDOORS



Wooden craft out of the past



A new Chris-Craft club is dedicated to the preservation of boats, like this '41 runabout.

Who are these people who still mess around in wooden boats? This is the age of fiberglass!

Not all sailors who enjoy modern, maintenance-free boating are as puz-

zled by the dedication of enthusiasts who restore wooden boats, or those who are building them from scratch. They know that there is great satisfaction leaving the dock at a beautiful

mahogany wheel, teak deck under foot, and boat name in gold leaf on a varnished transom. We celebrated these boaters in a PM story not too long ago (*They're Still Building Them Of Wood*, page 94, Feb. '82).

Restoring a wooden boat is hard work, but getting the information to do the job right is often harder. That's why people get together to share their knowledge, as in antique car clubs, for example. Now, there's a similar group for wooden power craft.

The Chris-Craft Historical Boat Society encourages the use, maintenance, restoration, display and history of power craft of the past. The primary interest is in Chris-Craft boats more than 30 years old, but you don't have to own a Chris-Craft—or any boat—to join. For more information, write to the Chris-Craft Historical Boat Society, Box 9450, Bradenton, Fla. 33506.

Binocular compass



Binocom clamps onto binoculars. Compass reading is seen through eyepiece (inset).

Binoculars with a built-in compass, such as the Steiner Commander, are expensive—usually \$500 to \$600. Of course, they can be worth the price for navigation or hunting. A moose at 223° is much easier to find than one that's just "over there." And by triangulating landmarks, compass binoculars can pinpoint your location.

But now you don't need the expensive binoculars: Binocom is an add-on binocular compass with clamp-screw mounting. It comes in two sizes to fit 7×35s or 7×50s. And the compass can be removed easily. It's \$25.50 plus postage from Goldberg's Marine, 202 Market St., Philadelphia, Pa. 19106.

Catamaran dink

Small enough to stow aboard, light enough to transport easily by land or sea, yet big enough to carry 375 pounds, the Cricket dinghy gains stability from its twin-bow semicatamaran configuration. High freeboard helps keep passengers and gear dry in choppy harbors while the broad beam makes her less tippy when stepping in or out. Rowed or towed, she tracks straight. Cricket's 7-foot fiberglass hull has positive flotation molded in. The dink, with 4-foot beam and 21-inch depth, can be used as transportation between boat and dock or as a play boat for the kids. Cricket lists for \$409 from Ensign Dinghies & Marine, Box 547, Rye, N.Y. 10580.



Cricket with cat bow has a 4-foot beam and 7-foot length. It carries 375 pounds.

Fishhook sharpener



Fishhook sharpener uses a narrow fine-grit wheel to fit the gap on tiny bream hooks.

You can't sharpen your fishhooks by poking them into a device like a pencil sharpener. To get the needle point required to set fish on the hook and keep them from pulling off, you need the sharpest possible point. Even new hooks require sharpening.

The slow-turning, fine-grit wheel of the Point Maker is narrow enough to allow you to get a point quickly by touching the hook to it three times. First, touch the gap, then each side for an instant needle point on hooks of all sizes—from tiny bream to the largest saltwater gamefish varieties.

The Point Maker retails for \$69.95 and is available from Texas Tackle Products, Box 2761, Richardson, Tex. 75080.

PM

CHILDHOOD DREAM.

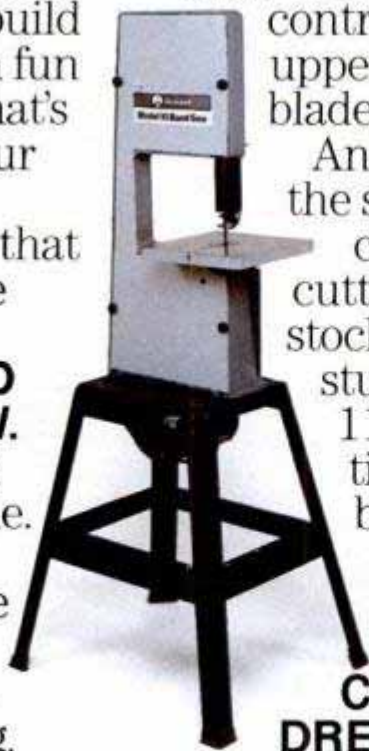
One of the great pleasures of everyone's childhood was that special toy. The one that was more fun because it took all the serious play you could dish out without complaint. The toy that was part of you for years.

This plucky rocking horse could be that kind of toy for someone. Made from a design especially created for Rockwell International, it's meant to be fun. For a long time.

We know it takes special care to build a toy that's both fun and durable. That's why we build our machines with special care. So that they're accurate for a long time.

CHILDHOOD DREAM SAW.

Our 10" Band Saw, for example. For precision, we designed the upper arm to prevent springing and twisting. For long life, we made it from cast-iron. To maintain accuracy, we



made blade alignment and tension setting easy: with convenient controls for the upper and lower blade guides.

And we made the saw rugged, capable of cutting 6" thick stock, with a sturdy 10" x 11" table that tilts 45° for bevel cutting and compound miter work.

CHILDHOOD DREAM PLANS.

For a limited time, full-scale working plans for this exceptional



"childhood dream" rocking horse will be supplied with every purchase of our 10" Band Saw. It's a very special offer, for the very special craftsman. And it's now at very special prices.

To find out the Rockwell machinery dealer nearest you, call Rockwell Power Tool Division toll-free 800-438-2486 (In PA, 800-438-2487).

Offer good only in the continental U.S., January 1, 1984, through December 31, 1984, or until supplies are exhausted.



Rockwell International

...where science gets down to business

DETROIT LISTENING POST



Ford's new minivan previewed

Last month in this column we printed a spy photo of Ford's rear-drive minivan, code-named Aerovan (see *What's Up Next?*, page 94, Apr. '84). Ford is now showing a fiberglass mockup of this 1985 vehicle on the auto show circuit, and it's been officially named the Aerostar.

Standard engine will be a 2.3-liter overhead-cam Four with multiport electronic fuel injection. Optional engines will include a 2.8-liter V6 and a Japanese-built, 2.3-liter turbodiesel. No horsepower figures are available, but EPA city/highway fuel economy figures are expected to be 20/30 mpg with the V6, 30/40 with the gas Four and "even better" for the diesel. Transmissions will include a five-speed manual and a new four-speed overdrive automatic.

Although the unibody chassis is all new, the drive train comes from the Bronco/Ranger, which means that it would be possible to build a 4x4 version, something that a Ford engineer says "is very definitely on our minds."

The reason for rear-drive, they say, is to allow a 5,000-pound trailer towing option. Other options will include rear seats that fold into a bed, rear seat air



The production Aerostar will have door handles and conventional headlights, but won't have the flush windows of the show car. Aero headlights similar to Mark VII's are expected in '86. "Single-finger" operation of the sliding side door is also promised.

conditioning and a wild six-speaker "Omnisound" system that has head-phone jacks and a volume control in the rear seats, so the kids can liquefy their brains without disturbing the driver.

Ford describes the Aerostar as not carlike and not trucklike, but "right in the middle." At 175 in. long, 6 ft. wide and 6 ft. high, it's about an inch shorter than Chrysler's T-van, but 3 in. wider

and 7 in. taller. It will carry a 4x7-ft. panel between the wheelwells with the rear hatch closed, but a 4x8-ft. panel will stick out, just like on the T-van. Interior volume is 142 cu. ft. with two seats in place and 175 cu. ft. with only the driver's seat, which is more than the T-van's 125/150. With all of its seats in place, it will seat seven adults.

1989 ohc Firebird V8

The aftermarket in Detroit does a great deal of work that later wears a carmaker's logo, often because the in-house engineers are all busy with safety and emissions work. Most interesting lately is work done for Pontiac by I.C.E.

The group has married two overhead cam 1.8-liter Fours in a complicated operation that produced a Siamese 3.6-liter V8. Output is rumored to be around 300 hp, helped by some very sophisticated head work and advanced fuel delivery technology. The engine may go in the '89 F-car (Camaro/Firebird), now being developed by Pontiac.

GM to buy Jaguar?

What a coup that would be for America's No. 1 carmaker! GM is rumored to

be interested in Jaguar Cars Ltd., and has had exploratory talks with company officials.

Now that Jaguar is enjoying a major resurgence in sales and earnings, with sales up 53 percent last year, the company is being "privatized" by Great Britain—that is, sold to a private party. Also interested: Ford (Great Britain's top seller) as well as Nissan. Jag Chairman John Egan, the tea-and-scones Lee Iacocca, is also rumored to be exploring a buy-out by current management.

Mazda Mustangs?

In an era when GM wants to build cars with Toyota, as well as sell minis imported from Suzuki and Isuzu, the idea that Mazda could build a new gen-

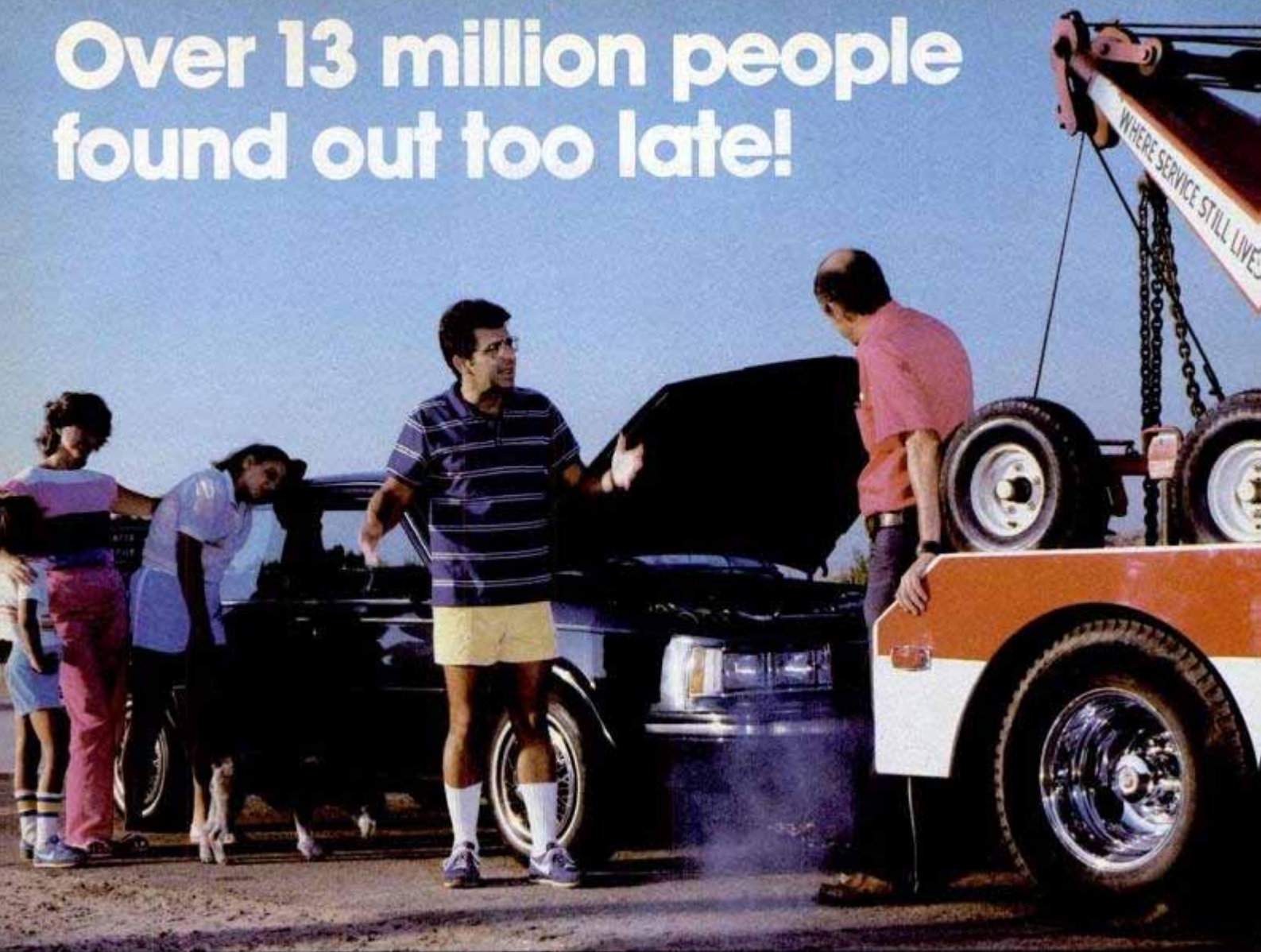
eration of Ford Mustangs isn't so outlandish. Mazda, 25 percent owned by Ford, is rumored to be casting an inscrutable eye at Ford's mothballed Michigan Casting Center, located south of Detroit in Flat Rock, Mich. Mazda would purchase the plant and build small, sporty Ford products—including the new Mustang now in development. Mazda already provides Ford with engines and transmissions. A Mazda plant building Ford products in America would blunt much of the criticism such a joint venture might generate, and the UAW is certain to be represented.

GM-Toyota venture

General Motors has every confidence that its joint car-building venture with

(Please turn to page 16)

Over 13 million people found out too late!



They shoulda had-a Hayden.

What's-A-Hayden? Low cost insurance against transmission burnout.

Today's downsized cars run hotter due to emission controls, smaller engines and higher RPMs. Heat problems develop when you carry extra passengers ... extra baggage ... drive in stop-and-go traffic ... drive on ice or snow ... drive in hot temperatures ... climb steep grades ... and do towing. A small investment now in a Hayden Trans-Cooler® can extend the life of your car. Remember, each 20°F drop in temperature doubles oil and equipment life.

Over 13 million transmissions failed last year.* Nine out of ten failures were caused by overheating. Had these people known about transmission oil cooling protection, they would have saved \$500 to \$1200 on repairs.

*Courtesy ATRA (Automatic Transmission Rebuilders Association).

Quick do-it-yourself installation. If you can change the oil in your car, you can install a Hayden Trans-Cooler yourself using our patented Quik-Mount and Quik-Connect systems.



Don't become a statistic. See your local auto parts store, automotive chain store, RV dealer, mechanic or installer today and ask for Hayden oil cooling protection. The car's life you save may be your own.

Send today for a free product brochure to discover **What's-A-Hayden.**

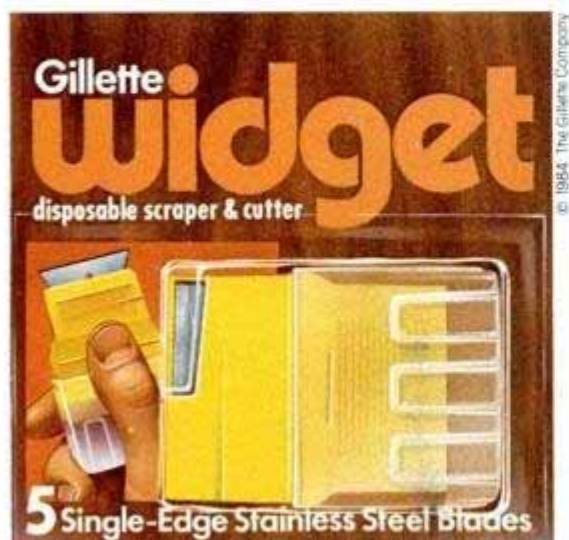
HAYDEN INC.
1531 Pomona Road, P.O. Box 848, Corona, CA 91720

Watch for this ad in Popular Mechanics, Popular Science, Mechanix Illustrated, Car & Driver, Trailer Boats, Trailer Life and Motorhome.

Hayden Trans-Cooler® prices start as low as \$29.95 (Does not include installation). To receive direct ordering information call toll free outside CA 1-800-854-4757 or (714) 736-2665.

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SCRAPE \$2.00 OFF THE COST OF THE PAINT.

Buy a Gillette Widget® disposable scraper and cutter, and any gallon of paint and we'll send you a check for \$2.00. See store display for details.

Offer Expires August 31, 1984.



WIDGET®

"IT'S PERFECT FOR SCORES OF CHORES!"

DETROIT LISTENING POST

(Continued from page 14)

Toyota will continue to gain momentum, even in the face of a lawsuit filed by Chrysler following preliminary approval of the deal by the Federal Trade Commission. GM Chairman Roger Smith told the Detroit Auto Show's Annual Industry Dinner: "GM is prepared to take whatever steps are necessary to insure our dealers have the products they need to attract and serve our GM customers."

Work to renovate the Fremont, Calif., assembly plant continues, and structural steel for new buildings has been erected. Major equipment orders have been placed with suppliers, a GM source reported.

Note: A little-known codicil to the 12-year GM-Toyota agreement is that GM can sell Toyotas in GM dealerships. The lines of demarcation between domestic and foreign automobiles get fuzzier all the time.

Ear to the ground

Front-drive woes: A survey of automotive fleet managers by Runzheimer and Co. found GM's front-drive X-cars to be especially troublesome. Some 30 percent of the managers reported "abnormal maintenance" needs on various front-drive cars. Over 85 percent of the managers with problems pointed a finger at the X-cars, while only seven percent have had problems with the newer J- and A-body cars. Chrysler K-cars accounted for eight percent of the complaints, Ford Escorts for six percent and Tempos for one percent. Over 80 percent reported transmission woes.

Seat belt laws: Building on the success of laws passed in 42 states and Washington, D.C., requiring child safety seats in cars, lawmakers in 19 states will consider mandatory seat belt use laws for adults in 1984, according to the Highway Users Federation. The states are Arizona, California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Iowa, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Rhode Island, South Dakota, Vermont and Washington.

Double-nickel attack: Nine states will consider bills to weaken or repeal the 55-mph federally imposed speed limit, risking a cutback in federal highway funds. California, Colorado, Idaho, Iowa, Louisiana, Michigan, Minnesota, South Dakota and Wyoming feel speed limits are a state's rights function.

Detroit's Japanese connection: Isuzu (owned to the tune of 34.2 percent by GM) has developed a *ceramic diesel engine*, but the unit remains experimental. Size and weight are reduced and fuel consumption is cut 50 percent. Ceramics are utilized in the engine's hottest parts, including exhaust manifold, cylinder head liners and valves.

GM has begun to import an Isuzu line of *Japanese-built, medium-duty trucks*. The commercial vehicles will be sold through GMC and Chevrolet truck outlets. Because only 1,000 units are expected to sell in 1984, GM said it couldn't justify building them itself.

Honda Motor says it may build a *second U.S. auto plant* by 1986. The plant would build engines, and supplement production at Honda's existing Marysville, Ohio, plant. That facility, birthplace of four-door Accords and Honda motorcycles, will open a second \$150 million assembly line to assemble Civics.

GM's Isuzu/Suzuki *minicar plans* are throttled by the 1984 "voluntary" import restrictions. Under the GM pact, Isuzu was to provide up to 200,000 subcompacts and Suzuki 90,000 minicars. Not now, however. Isuzu's new U.S. allotment is 50,000—substantially above the 16,800 it was permitted under the last agreement, but less than GM expected. Suzuki, new to these shores, is permitted to import a paltry 17,000 units.

PM

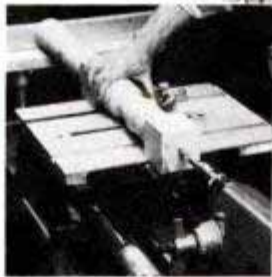
As easy as 1, 2, 3... 4 and 5.



1 It's a 10" Table Saw with 3-1/4" depth-of-cut and huge 48" ripping capacity.



2 It's a 16-1/2" Vertical Drill Press with locking quill feed for accurate depth control.



3 It's a Horizontal Boring Machine that makes doweling operations a snap.



4 It's a 34" Lathe with 16-1/2" swing capacity for turning table and chair legs, or large bowls.



5 It's a 12" Disc Sander with 113 sq. in. of sanding surface to reduce stock up to 6" thick in a single pass.

The MARK V combines these five major power tools in one space-saving, economical unit. You can perform change-overs in less than 90 seconds.

Plus, the MARK V's 5-in-1 versatility and built-in accuracy make it easy to achieve professional results on all your projects.

The MARK V is the tool to start with... the system you grow with. You'll find a full range of MARK V Accessories to help you do the most sophisticated woodworking operation with ease.

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With Shopsmith® you get a dedication to woodworking, education, and buyer protection. We believe in the virtues of quality, value, pride and craftsmanship, which show in our educational training and products.

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Learn how the MARK V can help you do more projects more professionally. Send for

your FREE MARK V Information Kit today! Included in the kit is "How To Determine Your Best Power Tool Buy".

You'll also receive a FREE one-year subscription (\$6.00 value) to HANDS ON, our Home Workshop Magazine packed with project ideas and helpful tips. You are under no obligation. So mail your card today!

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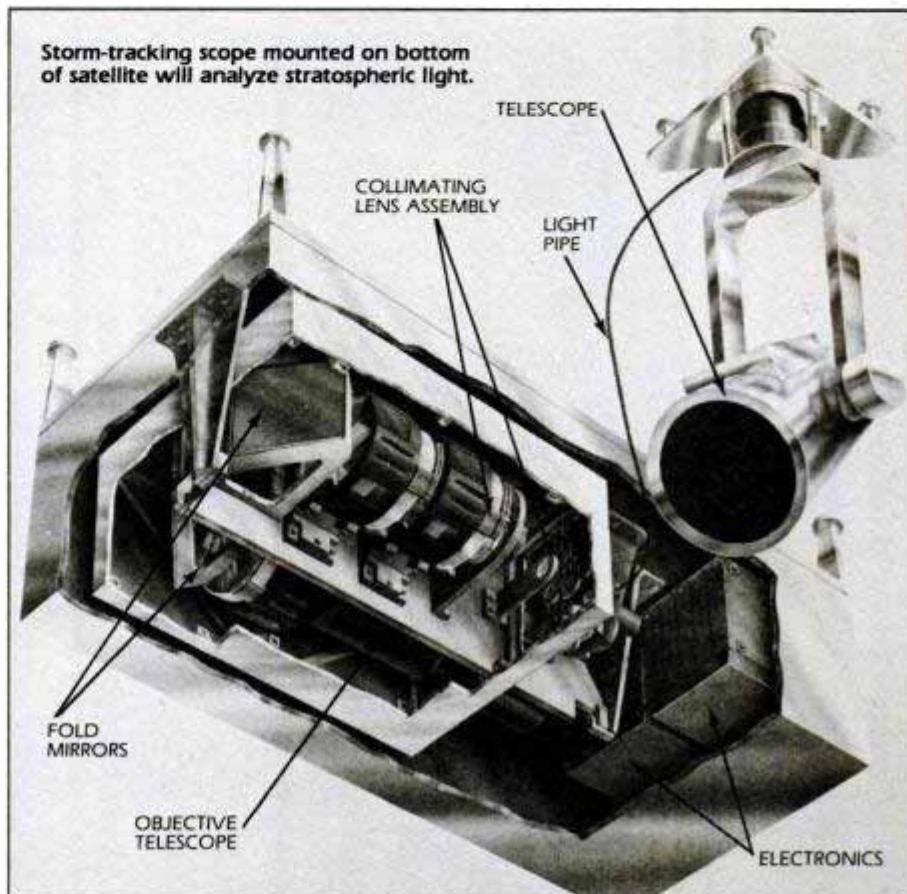
SCIENCE WORLDWIDE



Telescope for weather forecasts

In 1989, the Space Shuttle is scheduled to put into orbit a satellite with a new weather-forecasting telescope suspended from its bottom. The University of Michigan's High-Resolution Doppler Imager (HRDI) will use light, chemistry and computers to forecast the buildup of hurricanes in the jetstream. The HRDI consists of a 7-inch telescope and a separate light-diffraction and computer center. The scope will photograph the stratosphere, rotating at the command of the computers. The computers will tell it where to point with signals fed through a fiberoptic light pipe. Fold mirrors and an objective telescope will measure light coming off the cloud top at different angles and altitudes. Their readings will be analyzed in the electronics section of the rig.

"The HRDI also will provide the opportunity to determine how changes in the sun effect our weather and climate," notes University of Michigan Prof. Paul B. Hays, who heads the project. "So far, ideas on solar influences are speculative." Construction of the HRDI is now under way.



Storm-tracking scope mounted on bottom of satellite will analyze stratospheric light.

Science flips out



Lucky, a 300-pound turtle, tries out her new front flippers after surgical attachment.

When Lucky, a 300-pound loggerhead turtle, lost her two front flippers in a fight with a shark, Goodyear scientists decided to help. They fashioned a pair of rubber flippers for Lucky, then surgically attached them with a fabric reinforcement. But after the surgery in January, Lucky lost one of the flippers

because there wasn't enough of her own skin to keep it on. Scientists decided not to reattach it, since the turtle is doing swimmingly with just one front flipper at her home at Theater of the Sea in Islamorada, Fla.

Salt of the earth

From September 1982 to June 1983, Utah's Great Salt Lake rose 5.2 feet. The U.S. Geological Survey calls that the highest seasonal rise measured in 136 years of record-keeping. If it hadn't been for what a USGS official calls "consumptive use of water" by Salt Lake City area residents, the lake might have risen about 5 feet higher, posing a greater threat to lakefront property. Greater rainfall, unseasonably cold weather that reduced evaporation and other factors are blamed for the rise. Scientists are not yet able to predict how the level will change in the next year, but they're watching closely.

Spending antifreeze

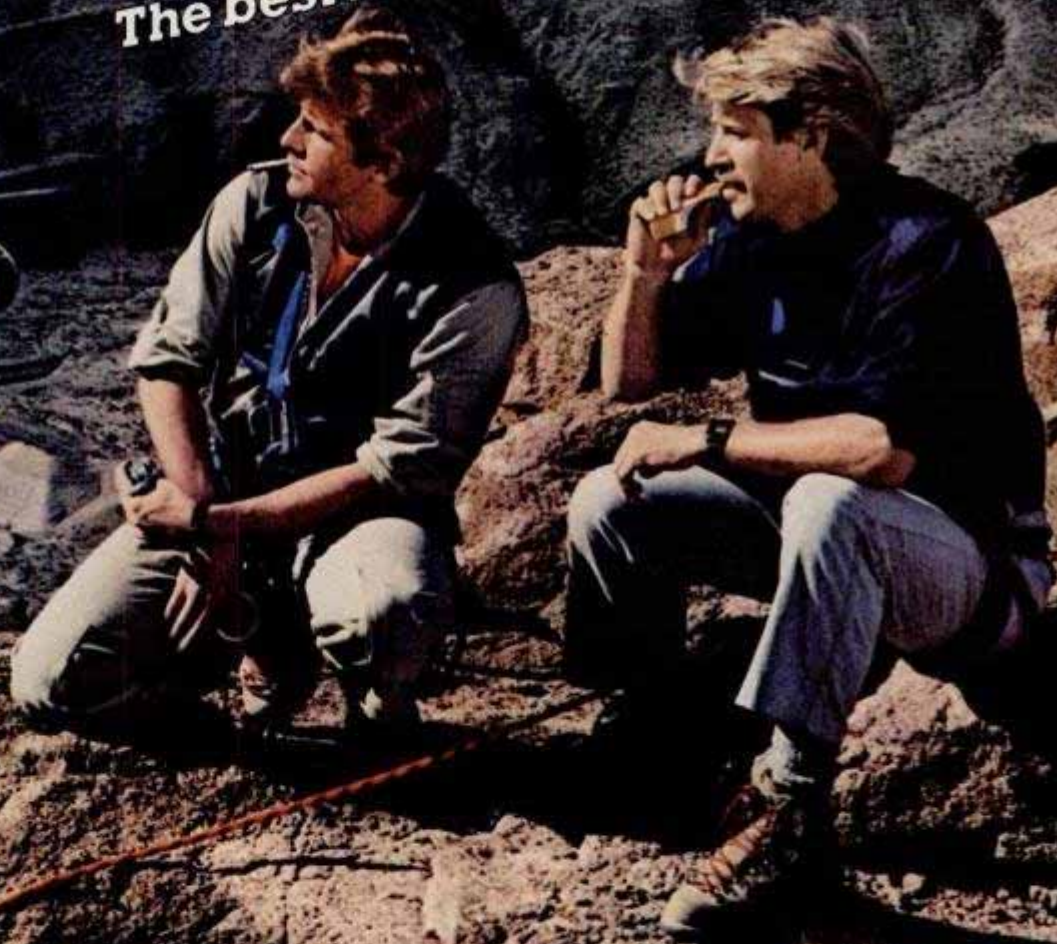
The Army expects to cut its annual \$12 million antifreeze budget by \$2 million this year using an experimental extending agent that reduces acidity in old antifreeze. Using a chemical test kit, GIs will be able to tell when a vehicle needs the extender. If it works, it may be out on the civilian market by next year.

Absorbing physics

If you have trouble understanding a physics textbook, it may be because you've never learned to form a picture of a physical experiment in your mind. In his new book, titled *Thinking Physics Is GEDANKEN Physics* (Insight Press, \$12.95), Lewis C. Epstein takes you on a step-by-step exercise in forming mental experiments. The experiments in Epstein's book are fun. And they teach basic physics eloquently. **PM**

Winston America's Best.

Excellence.
The best live up to it.



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

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

Your engine makes 8,000
explosions a minute.

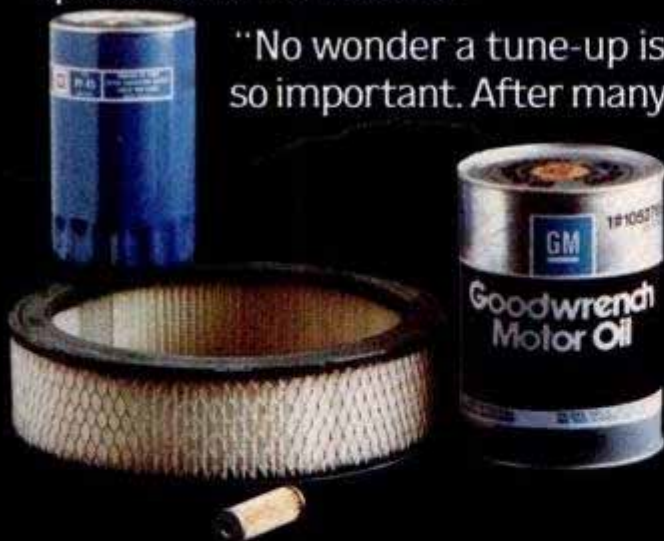


A tune-up helps make sure they're split-second right.



As Mr. Goodwrench explains, "At 55 miles per hour, an 8 cylinder car or truck makes about 8,000 explosions per minute. And the more precise they are, the better performance you get.

"That's what a tune-up is about. Perfect timing. You see, for 8,000 explosions, your engine needs 8,000 perfect gulps of air, 8,000 perfect sips of gas, and 8,000 perfect sparks of electricity less than a tenth of an inch long. One of each—per cylinder—per six-hundredths of a second. That splits it pretty fine. And everything has to happen at the exact split second it's needed.



"No wonder a tune-up is so important. After many



thousand miles, a natural process of wear can throw these precise adjustments way out of whack."

So see Mr. Goodwrench whenever a tune-up is recommended in your GM car or truck maintenance schedule. And ask him to check your filters, too, for better engine performance. He has quality GM parts, the right tools, equipment and training available. And he's at participating independent GM dealers who sell Chevrolets, Pontiacs, Oldsmobiles, Buicks, Cadillacs, GMC and Chevy trucks.



LET'S GET IT TOGETHER... BUCKLE UP.

Mr. Goodwrench

KEEP THAT GREAT GM FEELING WITH GENUINE GM PARTS

APPLIANCE CLINIC



Automatic shutoff doesn't work

I have a Maytag dryer, model No. DE606, serial No. 703274HW. This dryer has an automatic shutoff feature that incorporates sensors in the dryer to stop the cycle when the clothes dampness reaches a certain level. However, this automatic shutoff doesn't work and the unit has to be turned off manually each time we use it. Do you have any ideas about where to look for the source of the problem?—Mark OConnell, Huntington Beach, Calif.

Your model dryer is a very complex

machine to diagnose because it's electronically controlled. The only simple thing you can look for is to make sure that there is nothing on the three baffles on the drum inside the machine. These baffles contain the sensors which tell the machine when the clothes are dry and when to stop the unit.

If you have a buildup of lint, a piece of chewing gum, a straight pin or something of that nature on the sensor, it would create an electrical path between the sensor and ground instead

of sensing up to the electronic control.

If the sensors are okay, the next best thing I can suggest is for you to order a service manual for your model dryer from Maytag.

The part number for the manual is 56133, and it costs \$2.75 plus tax and postage. You can order the manual from The Maytag Co., Newton, Iowa 50208; Attention: Product Order Department. Section 5 in the manual covers electronic control checks and has troubleshooting charts for your clothes dryer.

Knotty clothes

We own a Sears clothes washer, model No. 110.568-04701W00, serial No. 0148C847. My problem is that during the wash cycle, the clothes wrap around the agitator. I have to stop the machine to unravel the clothes. I noticed that the inner drum is spinning in a clockwise direction. I would like to know if there is an adjustment to prevent the inner drum from spinning during the wash cycle.—George S. Muise, Pittsfield, Mass.

It sounds as if your 16-year-old washer may need a clutch adjustment or possibly an expensive major overhaul job. The cheapest and easiest thing to do is to check the clutch adjustment. To do this, first be sure the machine has finished its wash cycle. Then, make certain that you unplug the washer from its power source.

Remove the rear inspection cover from the back of the washer. The cover is held in place with two screws at the bottom. Reach in with pliers and remove the spring which holds the brake yoke to the transmission. This is located on the right side and

toward the back of the transmission. Next to the spring you will notice a long split shaft with a cam bar going through it. At the top of this shaft is a 3/4-in.-dia. nut. You will have to adjust this nut upward until you get the proper clearance between the clutch lining and the basket drive pulley. The clearance should be 1/16 in., or approximately the thickness of a matchbook cover. Once the clutch is adjusted, reconnect the spring and plug in the machine.

Run the machine through a cycle. If the adjustment doesn't work, look back in through the inspection port. Look for a black line or ring around the inside of the cabinet about 10 in. from the floor. This indicates that the basket bearings and water seals are worn and soapy water is running down the shaft, mak-

ing the brake useless. The brake holds the tub stationary. At this point, you are looking at either an expensive overhaul job or replacing the washer.

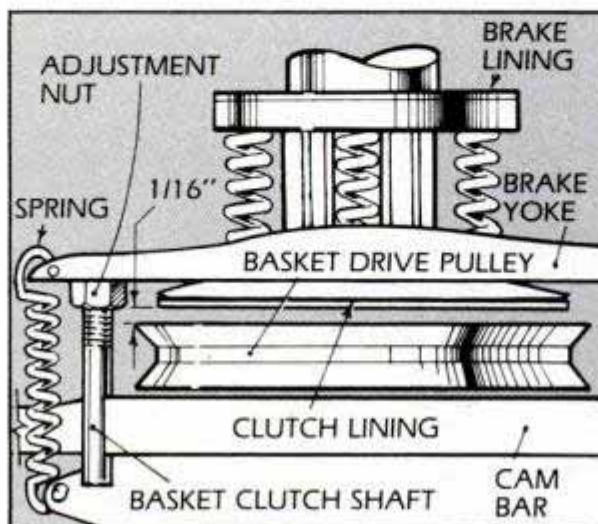
Popper not pumping

I have a Wear-Ever Popcorn Pumper, catalog No. 72000, which quits working as soon as a few kernels of popcorn have popped. As soon as the machine cools down, it starts running again, then pops a few kernels and shuts off. What could be the problem?—Darwin L. Knutson, Aloha, Ore.

Wear-Ever Aluminum advised me that parts except for the chute and butter cup are no longer available. If your No. 72000 unit is out of warranty, write to Wear-Ever Aluminum Inc., 1089 Eastern Ave., Chillicothe, Ohio 45601; Attention: Customer Service. Or you can phone (614) 773-9100, extension 469. The company will send a form letter making available for purchase a refurbished No. 73000 unit. The unit carries a one-year warranty.

If your No. 72000 unit is still within the warranty period (one year from date of purchase), return the base along with a letter stating the problem and a proof of the purchase date. They will replace the unit with a new No. 73000 Pumper at no charge. **FM**

Turn the 3/4-in. adjustment nut upward to get the proper 1/16-in. clearance between clutch lining and basket drive pulley.



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.

DRIVE A DIESEL OVER YOUR LAWN.

It looks like a riding mower. It cuts like a riding mower. But this Kubota is something else.

We call it a Kubota G. You might just call it great. Because it's the first lawn and garden tractor of such remarkably small size to have a diesel engine.

A Kubota G tractor comes with a powerful 2- or 3-cylinder water-cooled diesel engine. The engines are built to the same exacting standards as our bigger tractors. And the advantages of a diesel engine vs. gas are many.

Diesel is thriftier on fuel.

Maintenance is cheaper, too, with no spark plugs, carburetor or distributor to wear out. So you can just concentrate on maintaining your lawn instead of your lawn mower.

Most important, a Kubota diesel will last longer. A good

deal longer than any gas mower.

Other big tractor features include a live front PTO shaft drive to the mower. Unlike a belt drive, the shaft can't stretch and is unlikely to break. The result is a smooth, more even cut.

You can also attach a front

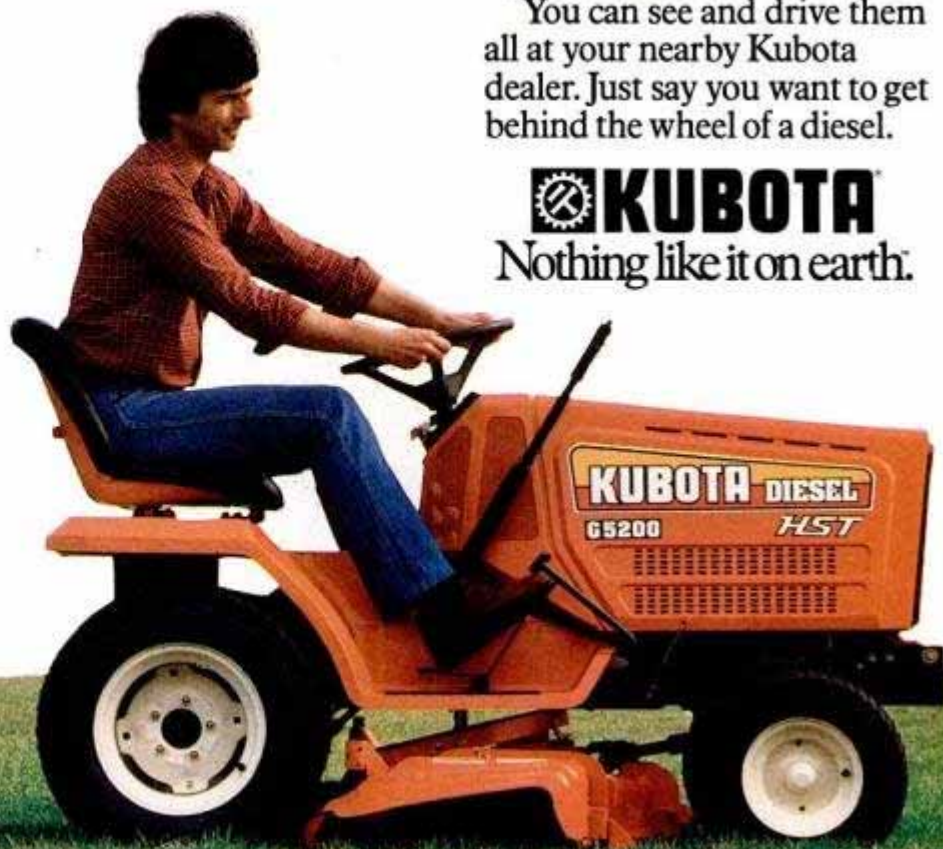
blade or snow blower. While an optional rear power take-off lets you operate a tiller.

There are four Kubota G lawn and garden tractors, from 10 to 14 horsepower. Two models come with an easy-to-drive hydrostatic transmission.

You can see and drive them all at your nearby Kubota dealer. Just say you want to get behind the wheel of a diesel.

 **KUBOTA**

Nothing like it on earth.



Wagner® revolutionizes

Introducing the Wagner® Power Twin™ airless sprayer/roller.

Imagine painting an entire wall and never once coating your roller in a paint tray.

Or tackling some intricate staining chore like shake shingles without the endless tedium of dabbing and poking with a brush.

Think about how nice it would be to never again have to pour paint from a can to a tray.

Now you're beginning to see the beauty of a versatile, new tool that stands to revolutionize painting around the house.

The Wagner® Power Twin™ airless spray/roller.

A Choice of Rolling or Spraying.

Created especially for home owners, the Wagner Power Twin is the first and only product of its kind.

It gives you the flexibility of an interchangeable spray gun and roller, both on a twenty-five foot hose.

The roller looks like the usual kind, but that's where the similarity ends. With this roller, a squeeze of the trigger pumps paint from the can, straight to the inside of the roller cover. Specially designed perforations distribute the paint evenly to the outside. So you can paint wall after wall nonstop, in smooth, even strokes. But

that's only half the story.

For covering large areas of hard-to-paint surfaces, you can attach the spray gun.

You'll be amazed how fast you can paint siding, shutters, decks, furniture, and more—all with a smooth, even finish and no brush marks.

The spray gun comes with a tough, tungsten carbide tip that lets you adjust the fan width of the spray for added precision.

And because it's powered by a piston pump, there's no bulky air compressor.

Applies Virtually All Kinds of Paint.

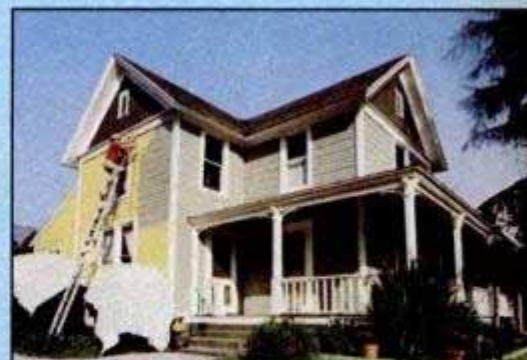
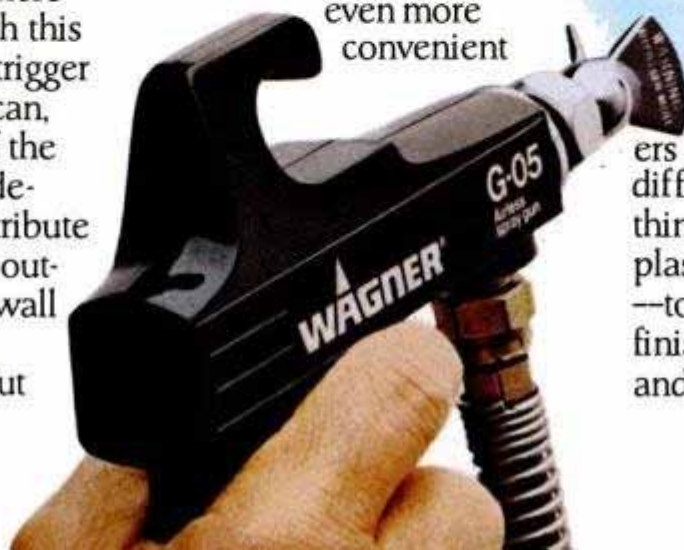
The Wagner Power Twin will spray oil-based paints and even heavy latex paints.

You can also apply stains, varnishes and lacquers. Or almost any other liquid, including sprayable pesticides.

Helpful Accessories.

A variety of accessories can help make painting with a Wagner Power Roller®

even more convenient



2 hrs. 10 mins.

We painted this house, excluding trim, in 2 hrs. 10 minutes with the Wagner Power Twin. It took us 6 hours, 32 minutes with a brush.



24 mins.

We painted this porch floor and adjoining outside deck in just 24 minutes with the Power Twin. It took us 34 minutes (and 32 dunks) with a conventional roller.

and efficient.

For painting the ceiling or for reaching the top of a wall, you can avoid using a ladder by adding an eighteen inch extension to the roller.

An optional spatter shield will make the job all but speckle free.

Power Twin roller covers are also available in four different naps to give you everything from a very fine finish on plaster, drywall and woodwork—to a more heavily textured finish on stucco, rough plaster and cinder blocks.

painting. Again.



next painting project, whether it's the new baby room or the old shed out back, consider the incredible Wagner Power Twin.

It's the kind of blue chip investment that'll pay for itself over and over again in time savings, ease and professional-looking results.

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CAR CLINIC



Ford VV carburetor advisory

Is the variable venturi (VV) carburetor in your Ford Motor Co. car still giving you a headache, although you did the things suggested in the October 1983 *Car Clinic* (see "Not So 'Vonderful,'" page 20)? If so, there's a development that may fix it once and for all.

A new diaphragm (part No. E3PZ-9A900-A) has been issued for both the 2700 and 7200 VV carburetors. It

resists the damaging effects that some types of fuel have on the old diaphragm. Diaphragm damage causes a leakdown condition that floods the engine.

The new part is very delicate. If your mechanic is heavy-handed when he installs it, you'll be left with the same performance problems (stalling, stumbling) you have now.

Chrysler's better way

The 1982 Dodge Omni I bought four months ago has a problem. After running about an hour, during which time I make five or six ignition-off stops, the engine cuts off completely while the car's in motion. AAA mechanics tell me the carburetor develops vapor lock. One mechanic suggested I change my brand of gas. This didn't help. Another said to squirt starter fluid into the carburetor. Isn't there a better way to solve this problem?—Victor Strinck, Tampa, Fla.

Yes there is, and it applies to 1981-82 Aries, Dodge 400s, Horizons, LeBarons and Reliants that have 2.2-liter engines, as well as your Omni. The repair is to install parts from the Fuel Hose and Tube Package (part No. 4293704) that Chrysler Corp. issued to overcome the vapor-lock condition. Parts in the package insulate fuel lines from engine heat. I suggest you have a Chrysler dealer do the job. Remind him that instructions for the installation are provided in technical service bulletin (TSB) 14-34-82 (9/13/82).

Finally, your own TSBs

"How can I get technical service bulletins?" In 21 years of *Car Clinic*, that's been one of the most frequently asked questions. Until now, my answer has been, "You can't." But that's about to change.

As part of an agreement between General Motors and the Federal Trade Commission, you can now get TSBs for GM vehicles manufactured from 1982 to the present. Here's how:

Call 1-800-551-4123 (toll-free). A taped voice will ask for your name,

address and make of car. You'll then receive a form and index. You can order one TSB, several, or a whole model year, plus other GM publications including service manuals. The cost for TSBs is \$3 for the first one and \$1 for each additional TSB. A year's TSB subscription is: Buick, \$89; Cadillac, \$110; Chevrolet, \$100; GMC, \$85; Oldsmobile, \$70; and Pontiac, \$70. Prices include the cost of a binder. You can order technical service bulletins without a binder for a few dollars less.

I don't have definite word yet concerning other auto manufacturers, but I know similar plans to provide customers with TSBs are in the works. I'll let you know what's going on as soon as I find out.

Some like it hotter

I have a 1981 Caprice Classic with a 5.7-liter V8 diesel. When the car is parked for a while with the engine hot, the engine won't start. It turns over okay, but there's no response other than a white vapor cloud from the exhaust. When the engine is cold it always starts right up. I've had the batteries and glow plug system checked. They're okay. Please help.—E.J. Perry, Sebastian, Fla.

There are at least four reasons for a hard-starting-when-hot problem with a diesel engine: insufficient fuel injection into the cylinders, not enough heat to ignite the fuel, slow cranking speed and insufficient compression.

The fact that the engine starts and runs at other times eliminates insufficient fuel as the trouble—especially with white exhaust smoke. That smoke is fuel vapor that hasn't ignited.


If the starter motor doesn't spin the engine as fast as it should, the engine may fail to start. Sometimes a starter will work fine when cold, but as heat (and consequently resistance) increases, the cranking speed falls. Have your mechanic measure the cranking speed while the engine is hot and compare it to the manufacturer's spec.

One cause of the engine heat being

(Please turn to page 30)

PM CAR CARE





SURROUND, BUT DO NOT FILL,
BOLT HOLES WITH A BEAD OF SEALANT

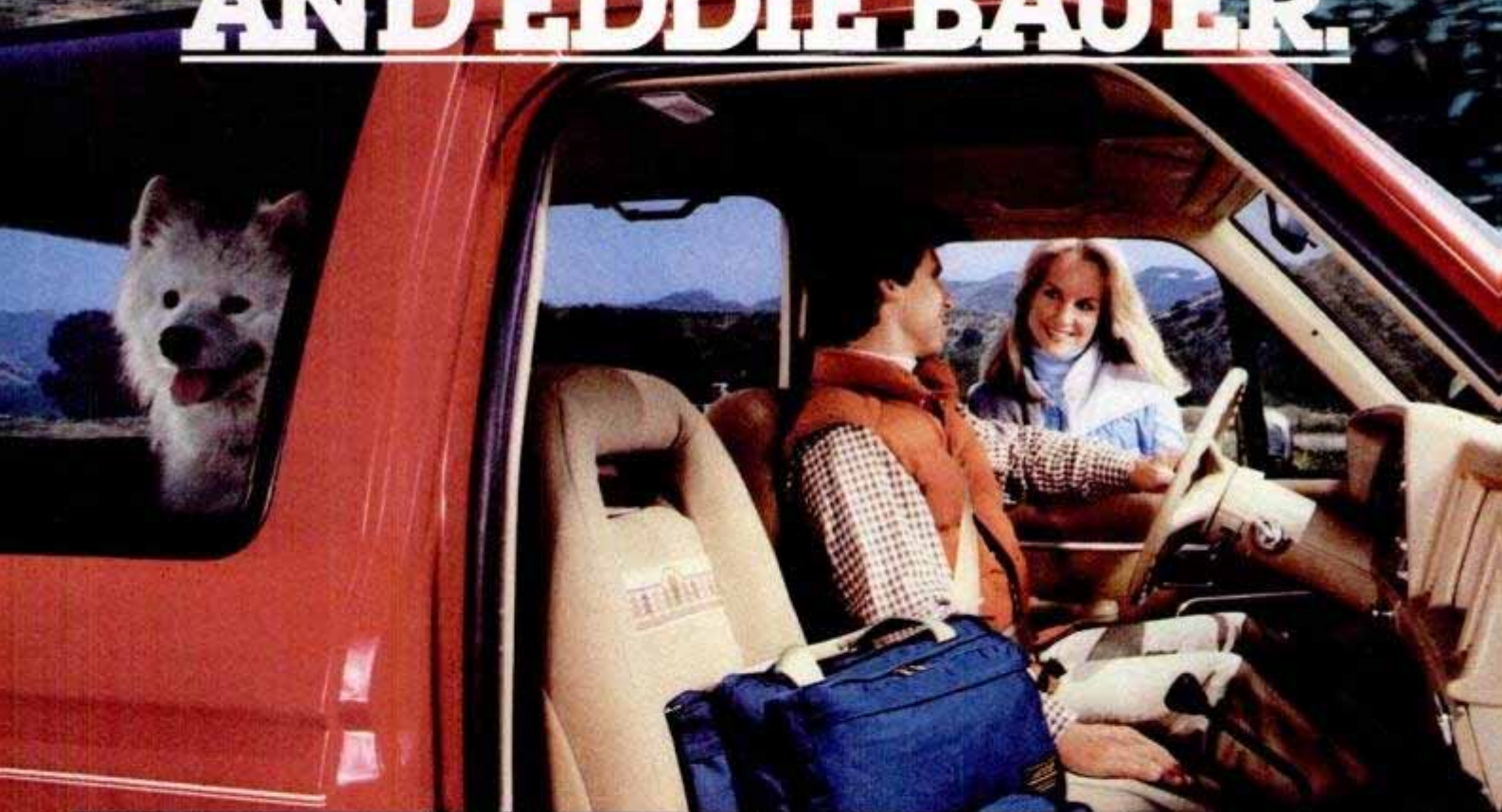
Using RTV

Technology has given us tubes of RTV silicone sealant, which does away with having to use "paper" gaskets when replacing such parts as valve covers, thermostat housings, oilpans, automatic transmission pans, and water pumps. However, the product works properly only if applied properly. Here are some precautions you should take:

- Surfaces must be clean, dry and free of oil. Clean surfaces with carburetor cleaner. Don't use a petroleum product, which
- includes gasoline. It leaves a film to which RTV won't adhere.
- Apply the sealant to one surface only. The bead should be only about 1/8 in. thick and continuous—there must not be any gaps.
- Go around bolt holes (see illustration). Sealer that gets into a hole may prevent the bolt from securely clamping the part. In trying to get the part to seat, you could overtighten and damage it, strip threads or break off the bolt.



TWO TOUGH OUTFITS! FORD BRONCO II AND EDDIE BAUER.



SPECIAL EDDIE BAUER BRONCO II

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Like all Bronco's, Bronco II is field-tested... built Ford tough, with husky frame and Twin-Traction-Beam suspen-

Get it together—Buckle up!

sion. Eddie Bauer survival gear has been field-tested too... right to the top of Mount Everest!

The Eddie Bauer Bronco II is outfitted for all outdoors—with unique interior and exterior trim plus an optional flip-away spare tire carrier. Free Eddie Bauer top quality gear bag and map folder included, plus

scheduled maintenance and a limited warranty for 24 months/24,000 miles, whichever comes first, excludes tires, fluids, accidents or abuse.

Trimmer Bronco II is fun to drive, easy to park and maneuver... with a V-6 engine standard. Seats 4 in comfort, with split fold-down rear seats for extra cargo.

Eddie Bauer Bronco II—it's a brand-new kick in survival gear!

Bronco II

Eddie Bauer



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Spark Plugs. Filters. Ignition Parts. Brakes. Starters. Alternators. Belts. Accessories.

CAR CLINIC

(Continued from page 28)

inadequate to ignite the fuel is a malfunctioning cooling system thermostat. Test it and replace it if necessary. If the starting problem continues, test cylinder compression.

Normal compression for the 5.7-liter diesel is 380 psi. However, if any cylinder shows less than 300 psi or if there's more than 20 percent difference between the highest and lowest cylinders, the problem is probably caused by internal engine damage, such as worn piston rings, bad valves or a bad head gasket.

Three-card Monte

My car, a 1978 Chevrolet Monte Carlo with a 305-cu.-in. V8 engine, has a coolant leak that empties the overflow tank after driving 25 to 50 miles. My mechanic thinks the leak is located at the front of the intake manifold on the driver's side of the car. He says he's had several similar complaints concerning cars with the 305 engine. Do you agree with him? Is there a service bulletin on this?—Jim McCraney, Pacifica, Calif.

There doesn't seem to be a service bulletin that deals with your problem.

PM CAR CARE

'Wheel' world

What do you do after you've balanced wheels and checked tires to try and rid your car of vibration? Check the wheels themselves. They aren't immune to damage. Even damage you can't detect visually can cause a heck of a vibration.

Check radial and lateral runout on both the inboard and outboard wheel rim flanges. Wheels may remain on the car and tires may stay on the wheels. Mount a dial indicator to record runout at the places shown. Slowly rotate the wheel one revolution. If

INBOARD SIDE

OUTBOARD SIDE

LATERAL RUNOUT

RADIAL RUNOUT

the wheel exceeds the following specs in any one spot, replace it: .040 in. for steel wheels and .030 in. for aluminum wheels is the maximum amount of allowable radial runout; .045 in. for steel wheels and .030 in. for aluminum wheels is the maximum amount of lateral runout you should have.

Note: Disregard jumps made by the indicator needle as the indicator hits a weld, scratch or glob of dry paint on the wheel rim.

but that doesn't mean you have to resort to guesswork. Cooling system diagnosis is usually quite simple.

If the leak is in the pressurized part of the system, you can confirm it with a pressure test. Simply pump the cooling

system up to the specified operating pressure and watch the tester gauge to see if it holds the pressure.

If it doesn't hold the pressure, check all hoses, gaskets and freeze plugs for leaking coolant. If you can't find an

external leak, check the dipstick for water bubbles. Have your mechanic check for CO emissions from the open radiator with his emissions analyzer while the engine is running. If CO is present, you have a head-gasket problem.

If the system *does* hold pressure, the coolant is leaking from the recovery tank itself and replacement of the tank should solve your problem.

Flick your click

I have a 1975 Datsun 280Z that has an electrical problem which two Datsun dealers haven't been able to correct. Half the time, when I turn the ignition key to start, there's a single click, but the engine won't start. After several turns of the key and several clicks, it starts. The rest of the time the engine starts on the first try.

Dealers have replaced the starter solenoid, checked the rest of the starting system, and tested the alternator and voltage. They've told me this problem affects a number of older Z-cars they've seen. Do you have a solution?—James L. Dutt, Federal Way, Wash.

Check the starter positive and negative circuits for high resistance by performing voltage-drop tests. You'll probably find that the ignition switch is the source of the resistance while it's in the

start position, but the problem could be the result of a loose connection or partially broken wire. Also check the seat-belt interlock on this model.

Big band sound

My problem isn't serious, but it is annoying. From the first day, the FM band of my 1983 Oldsmobile Cutlass Supreme radio has had static. The dealer's radio guy says the radio and antenna are okay—that it appears to be an ignition noise. But he doesn't offer any fix.—Tom Lange, Memphis

Pull the ignition cables out of the dis-

tributor cap and wipe off their ends. Then, wipe out the insides of the cap towers. In production, a nonconducting lubricant is put on the ends of cables to make them easier to insert. If too much lube is applied, lubricant is forced into distributor towers and coats electrical contacts. This creates ignition noise on the FM band. **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.

Can WD-40 solve all your problems?



Dissolves tar, won't harm paint.



Lubricates window cranks.



Cleans bike gears.



Loosens hard water deposits.



Frees sticky locks.



Dissolves crayon marks.

SERVICE TIPS

■ Some 1983 Omnis, Chargers, Horizons and Turismos equipped with 1.6-liter engines are susceptible to ignition timing variation. If you've had a problem keeping that engine's timing adjusted to specs, Chrysler says the trouble is excessive wear of the cross-shaft drive gear bushing. A repair package (No. 4293858) has been issued. Your dealer should check TSB 09-10-83.

■ In an effort to service a No. 1 bearing knock noise on some 5-liter engines used in 1982 Ford, Mustang, Mercury, Capri, Lincoln, Bronco, and E- and F-series vehicles during warm-engine operation, Ford has issued a new upper main bearing (No. C3AZ-6333-R). The part is .0004-in. thicker than the No. 1 upper main bearing now in this engine. It is to be used with a standard-size No. 1 lower main bearing. The knock is because the No. 1 crankshaft main journal is slightly under size.

■ Your 1984 Wagoneer or Cherokee Sport Wagon with a four-cylinder engine and automatic transmission may need a different rear propeller shaft. Replace the shaft if there is a rumbling noise in THIRD as the vehicle decelerates and/or at speeds above lockup torque converter engagement. If the vehicle has a 207 transfer case, the part number for the new shaft is 8952042502. For a 229 transfer case, use No. 8952042503.

Just about. Because WD-40 helps clean and do repairs in the yard, the garage and all through the house.

Got a problem with window tracks? WD-40 loosens corrosion and rust. Try it on chairs to keep them working quietly. Even unfreeze ski bindings with no problem.

And now your favorite use can win you an exciting prize like a Buick Riviera or a Caribbean cruise in the *WD-40 Take Off Sweepstakes*. Look for displays and entry blanks at participating stores. **WD-40 Company, San Diego, CA 92110**

HOMEOWNERS' CLINIC

Humid, leaking basement

We have two problems with our 2-year-old house: water penetration through the concrete floor and excess basement humidity in the range of 60 to 70 percent at temperatures of 50° to 55° F. We do have a sliding door exiting the basement.—Clarke Peters, Janesville, Calif.

Both the leaking and the humidity stem from one source—ground water surrounding and saturating walls and floors. Saturated and damp walls and floors, whether water is visible or not, will increase the humidity to the point of continual condensation. Water seeks its own level and will create tremendous pressures in doing so. It will work up walls and raise and crack slabs. Patching from the interior is, in a sense, treating the symptoms. First you must direct all surface water away from the house.

Collect roof water runoff with gut-

ters, being careful to lead the downspouts (leaders) onto splash blocks sloped and directed away from the house walls. Grades at the walls must be raised and sloped about 1 in. per foot for a distance of approximately 6 ft., measured perpendicular from the walls.

Give this a try. It will provide some improvement, and it may solve the problem. If it doesn't, you must consider a sump pump, and drain tiles if the basement is still wet. The sliding door means you could install drain tile under the slab and feed out downhill.

Before you do anything other than the exterior water control, write to the American Society of Home Inspectors, Ashi Pamphlet, Box 1769-B, Rockville, Md. 20850. Enclose \$1 and a self-addressed envelope and make sure that you ask for the paper on "Wet Basements."

Double brick wall

I own a house built with an inner and outer brick wall. There is a 3-in. unventilated airspace between the walls with steel ties. Should this space be ventilated or insulated?—Arthur A. Carlson, Mobile, Ala.

The wall construction that you refer to is a typical brick cavity wall and is used in residential masonry construction. This type of wall has a number of advantages. Because of the cavity, the inner wall is resistant to rain penetration. If rain penetrates the exterior wall the water drops to the bottom of the cavity and simply drains through the weepholes.

These walls also have 25 percent greater insulating value than solid walls of the same material. During the construction of the walls, insulation can be placed in the cavity for additional protection. However, once the walls are built, it's difficult to put insulation into the airspace effectively.

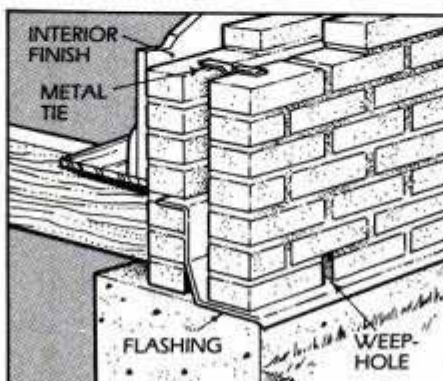
Whether or not there is insulation, the walls must be ventilated to drain moisture which accumulates in the cavity either through rain penetration or condensation. The ventilation is provided through weepholes at the bottom section of the wall. The weepholes are

basically open joints between the bricks which have not been filled with mortar. Look for the openings in the joints. Keep the weepholes clean and unblocked at all times.

Storing paint

How can I prevent a skin from forming on paint after it's been partially used?—Sydney Oshrin, Centerport, N.Y.

Try storing the can upside down. This might help.



A double brick (cavity) wall is typical residential masonry construction. For good ventilation, it's important to keep the weepholes unblocked at all times.

Cleaning aluminum siding

We have been unable to find anything that will clean the accumulation of dirt and other particles found on the aluminum siding of our house. It seems the aluminum siding is clean from about 4 to 5 ft. down from the eaves. Above that, the siding seems to have a rough or granular surface, which will not come off with a sponge and laundry detergent or other cleaning material. What is the best way to handle this problem?—Steven Stiles, Chicago

For surface soil or stains which may result from tree sap, industrial fallout, chimney fumes or vent fumes, we recommend applying ordinary nonabrasive household detergents. For example, try washing with a solution of one-third cup of Tide per 1 gal. of water.

As with any cleaning operation, start at the top so there will be less streaking. After cleaning and washing, it is important that the siding be thoroughly flushed with water. A garden hose does a good job.

If you encounter stubborn stains, you can buy siding cleaners specifically made for this purpose at your local hardware store.

Mildew which appears as black spots usually shows up in areas isolated from rainfall, such as porch enclosures and under eaves. The solution might be to use three quarts of water, one quart of 5 percent sodium hypochlorite (Chlorox), one-third cup of nonabrasive detergent and two-thirds cup of trisodium phosphate (Soilax). Again, thoroughly rinse with your garden hose.

Removing bathtub decals

How do I remove the rubber decals and remains of decals from the floor of my bathtub? I've tried almost everything, including rubbing alcohol.—Rosemarie Richardson, Everett, Mass.

Try using typewriter cleaning fluid or trichloroethylene. **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.

FORD UNVEILS THE CUTTING EDGE!

Take one good look at the new Ford Yard Tractor, and you'll be impressed. Check the price tag, and you'll like it even more.

It's a new concept in power equipment for the home—a premium-quality tractor that does most of the same jobs a big lawn and garden tractor can, but priced hundreds of dollars lower. That's the cutting edge!

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This is a real tractor, with a 5-speed transmission, PTO, electric key starting, and a super-comfort seat.

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He's listed in the Yellow Pages under "Lawn Mowers," "Tractor Dealers" and/or "Snow Removal Equipment!"

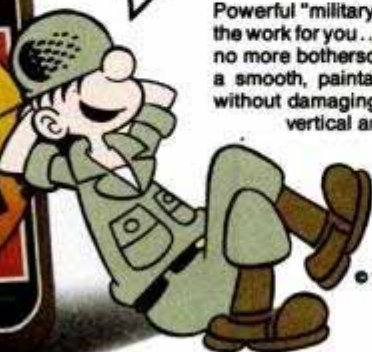
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THE THINGS I ENJOY.



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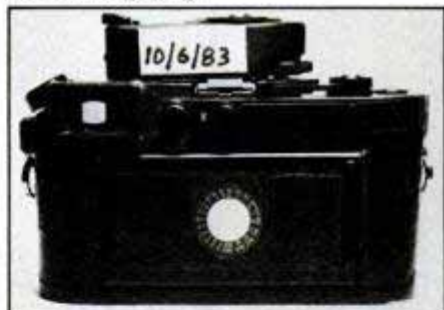
PM PHOTO HINTS

Hang 'em high



Use a retractable clothesline in your darkroom for hanging prints and film to dry. The spring-loaded portable reel is perfect for a darkroom in any room where you can't use a permanent line.—*Kenn Oberrecht*

Memory jog



When did you install the battery in your camera? A dated, stick-on label will be a constant reminder to change the battery at the right time.

—*Robert Hertzberg*

Special filters



Remove the red safety filter from an enlarger's swing-away holder and epoxy a step-down filter ring to it. Now you can use your camera filters for special effects.—*Ron Jegerings*

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Cutaway View of New LO-DOME™

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Now, you can train for an exciting, rewarding career in robotics and industrial control right at home in your spare time. NRI, with 70 years of experience in technology training, offers a new world of opportunity in one of the most fascinating growth fields since the computer.

You need no experience, no special education. NRI starts you at the beginning, takes you in easy-to-follow, bite-size lessons from basic electronics right on through key subjects like instrumentation, digital and computer controls, servomotors and feedback systems, fluidics, lasers, and optoelectronics. And it's all reinforced with practical, hands-on experience to give you a priceless confidence as you build a programmable, mobile robot.

Program Arm and Body Movement, Even Speech

Designed especially for training, your robot duplicates all the key elements of industrial robotics. You learn to operate, program, service, and troubleshoot using the same techniques you'll use in the field. It's on-the-job training at home!

Building this exciting robot will take you beyond the state of the art into the next generation of industrial robotics.

You'll learn how your completely self-powered robot interacts



You get and keep Hero 1 robot with gripper arm and speech synthesizer, NRI Discovery Lab for electronic experimentation, professional multimeter with 3 1/2-digit LCD readout, 51 fast-track training lessons.

with its environment to sense light, sound, and motion.

You program it to travel over a set course, avoid obstacles using its sonar ranging capability. Program in complex arm and body movements using its special teaching pendant. Build a wireless remote control device demonstrating independent robot control in hazardous environments. You'll even learn to synthesize speech using the top-mounted hexadecimal keyboard.

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NRI training uniquely incorporates hands-on building experience to reinforce your learning on a real-world basis. You get professional instruments, including a digital multimeter you'll use in experiments and demonstrations, use later in your work. And you get the exclusive NRI Discovery Lab[®], where you examine and prove out theory from basic electrical concepts to the most advanced solid-state digital electronics and microprocessor technology. Devised by an experienced team of engineers and educators, your experiments, demonstrations, and equipment are carefully integrated with 51 clear and concise lessons to give you complete confidence as you progress. Step-by-step, NRI takes you from the beginning, through today, and into an amazing tomorrow.

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THE PM GARAGE



Rear bumper winch mount

A rear bumper winch mounting kit from Warn Industries has three tons of pulling power. It can yank me and my truck backward out of trouble, or load firewood and other heavy cargo right into the truck bed. Warn's kit combines a 7-inch, chrome-plated step bumper with a concealed winch mount to make a neat rear installation. The rig will allow me simple loading of boats or cars onto trailers, too. The rear mount is perfect for trucks with front-mounted snow plows. The mounting kit lists for \$249, the 5,000-pound rated winch for \$445 and the 6,000-pound model for \$525. For a free brochure, write to Warn Industries, 19450 68th Ave. S., Kent, Wash. 98032.—*N.S.M.*



Rear bumper-mounted winch is neatly hidden, pulls loads right up to truck bed.

Trouble gauges

The ISSPRO R1235 Engine Protection System does more than just indicate my oil pressure and coolant temperature to within $\pm 2^\circ$ F. A light between the gauges flashes "LOW WATER" whenever coolant capacity falls below normal.

The system is wired to the engine's ignition coil (or the fuel shutoff solenoid of a diesel) to automatically cut off the engine if oil pressure drops or coolant gets too hot. A 30-second delay before

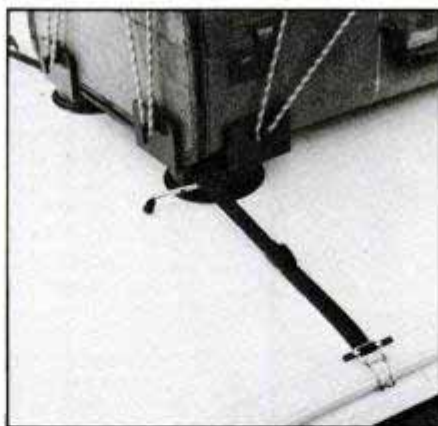


ISSPRO gauges give early warnings, shut engine down before damage occurs.

shutoff gives me time to note the problem and pull off the road. An optional warning buzzer is \$10.

The unit can be ordered for \$202.50 from Instrument Sales and Service Inc., 315 Southeast 7th Ave., Portland, Ore. 97214.—*Mort Schultz*

Four-corners roof rack



Removable roof rack corners reduce drag to save fuel, but hold luggage securely.

The trouble with most roof racks is their permanence. Many just look bad, and their drag can cost you a mile or two per gallon. Yet removing and installing them is such a chore, I usually leave them on. Besides, they take up too much storage space.

Quick Rack solved these problems for me. Four plastic corner assemblies with large, lever-actuated suction cups stick firmly to my VW's roof. When not in use, they nest in a shoebox-sized carton. The corners can be positioned to fit odd-sized loads and have hooks for bungee cords that can hold everything from a boat to a bookcase. The price is \$34.90 from Delta Enterprise Corp., 972 Dean St., Brooklyn, N.Y. 11238.—*Angus Laidlaw*

Test lamp

Most \$3 test lamps I've seen have wiring that's easily pulled out and bulbs that are hard to find replacements for. S&G's 6/12-volt test lamp solves both problems. It has a simple but neat strain relief for the wiring, and the housing holds a spare bulb, so I won't need another one for a long time. Made by S&G Tool-Aid Corp., 43 East Alpine St., Newark, N.J. 07114, it's at auto parts stores.—*Pete Warren*



A spare bulb and secure wiring make this test lamp last much longer than most.

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

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ULTRA LIGHTS: 5 mg. "tar", 0.5 mg. nicotine av. per cigarette by FTC method.
FILTER 100's: 9 mg. "tar", 0.7 mg. nicotine av. per cigarette. FTC Report MAR. '83.

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100's

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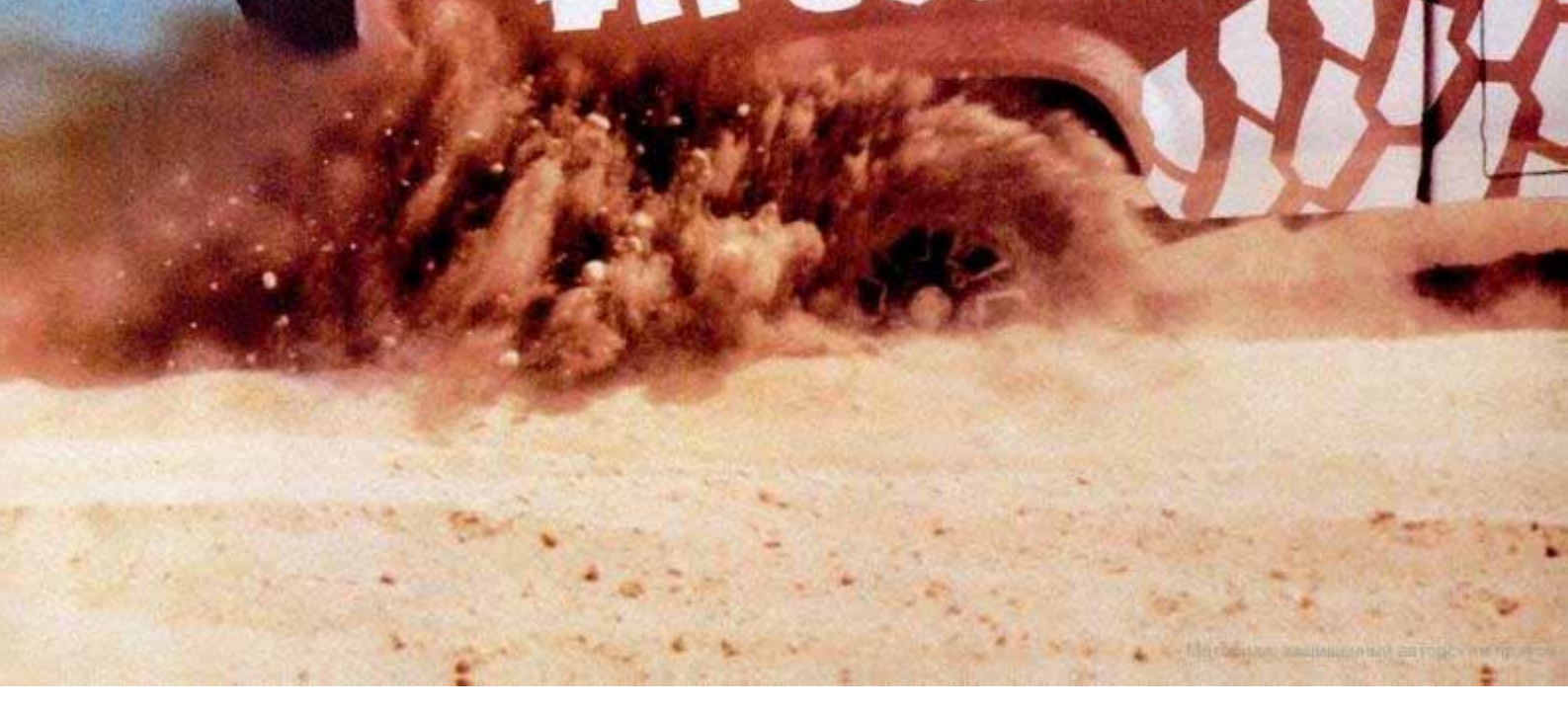


RADIAL ATX

RADIAL ATX

WE

ATX RADIAL 23"
Firestone



ATX Radial 23™

FIRESTONE BUILDS LIGHT TRUCK RADIALS TOUGH.

AND THE WAY WE RACE THEM PROVES IT TO YOU.

Nothing proves the toughness and traction of a tire like off-road racing.

So Firestone goes off-road with the same light truck radials you can buy, and we win.

In fact, Firestone light truck radials have won almost every major off-road race there is.

The Parker 400, the Mexicali 250, the Barstow Classic, the Frontier 500, the Mint 400, the Baja 500, and the Baja 1000. To list a few.

And though you may never race our tires off-road, it's good to know we do. Because it's real proof of toughness and traction.

Toughness and traction you'll find in light truck tires like our Radial ATX and our new ATX Radial 23°

Tough tires for your pickup, van, RV, or 4WD. Whether you drive it for work or drive it for play.

Check 'em out at your Firestone retailer along with our other light truck radials like our Steeltex ASR™ all season steel belted radial and Steeltex RTH™ for on-highway use.

At Firestone, we build light truck radials tough. And our proof is in performance.



Remember the safety of any tire depends on wear, load, proper inflation and driving conditions.

Firestone

OUR PROOF IS IN PERFORMANCE.

PM ELECTRONICS MONITOR



A revolutionary new computer

In the past two years, the question I've been asked most frequently is, "Which computer should I buy?"

Now, with the release of the Apple Macintosh computer, the answer no longer takes a few pages to write. It is often one word: Mac.

No other computer system approaches Mac in its combination of speed, power and its almost unbelievable ease of use, even for people who have never seen a computer. Here's a quick rundown of Mac's features and why we think so highly of this new machine.

When you sit down at the keyboard of a Mac, the first thing you notice is a little device about the size of a pack of cigarettes connected to the machine by a flexible cable. The device, with one button on it, more or less invites you to experiment by rolling it smoothly about a small section of the desktop.

As you roll the mouse, a pointer on the computer's screen moves to echo your hand's movement. You can quickly point to any area of the screen, then click the mouse button, which accomplishes various tasks, depending on where the pointer is on the screen. This takes all of a minute to learn, and no more than an hour to become extremely comfortable with.

As you move the mouse and begin to point to areas onscreen, you will notice the crisp, clear quality of the Mac's visuals. To put it into computer terminology, the screen is completely bit-mapped. For most people, that means the resolution and general look of things are better than on any other computer at the consumer level.

Though the 9-inch screen will seem small at first glance, the crystal-clear quality of this black and white display technique will be an eye-opening experience. In most Mac programs, the display shows as a clear white background with the letters—often in various type styles and type sizes—in black. It's as if there were a piece of printed paper behind the glass. Since there is no color, the Mac is presently unsuitable for arcade gamers.

What you do with mouse and display is called window management, and it will make Mac the easiest computer you have ever owned (see *Software*—

Now It Does Windows, page 84).

Various program areas may be split so as to appear in these windows, or sections of the screen. In one window, you might have a report you are writing. Another area might contain a list of what other reports are on the disk. Using the mouse, you can make windows smaller or larger and move them to where you want. You can even stack windows on top of each other.

In fact, Apple refers to the screen as the "desktop," a most apt analogy. The windows are like sheets of paper and you easily move from one to the next. Also, forget about having to learn such command structures as PIP A:-B: or BSAVE TEXT. Mac gets around all this by the use of tiny, visual cues, little pictures called "icons."

Let's say you want to store a report on the disk. Using the mouse, you point to and move a little picture of a report folder, place it on a little picture of a disk drive and click the mouse's button. You are now a Macintosh expert.

A computer is only as good as the software and hardware available for it. Mac arrives with two programs on disk called *Macpaint* and *Macwrite*. The first is an amazingly good graphics program; the second is an acceptable word

processor. Put them together and you can use the graphics to design a letterhead and the word processor to write the letter—all shown onscreen.

Mac's one disk drive (a new cartridge type with far less fragile disks) holds 400K of information. But you can also add another one outboard. The Image-writer printer, while dot-matrix in order to handle Mac's repertoire of graphics and typography, produces copy acceptable in even the most critical situations.

Check out the Mac and see if it doesn't make computing fun.

Goodbye, and call FORTH

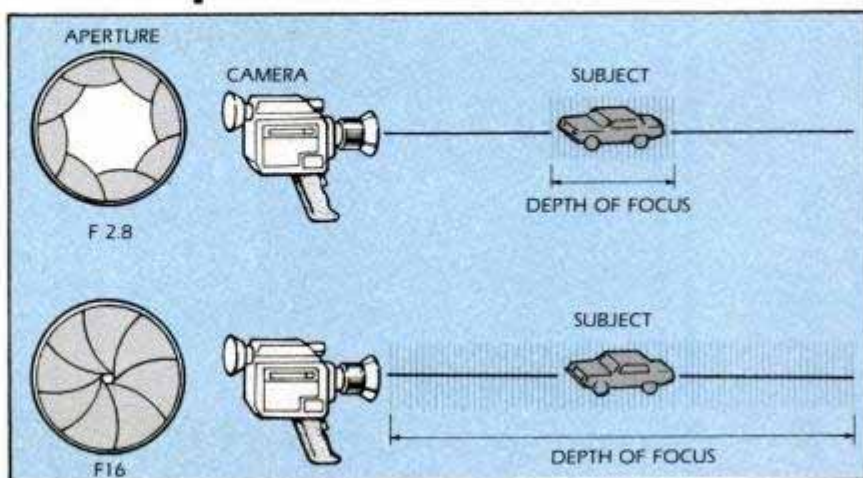
First, we just want to correct a phone number listed in March for a computer bulletin board devoted to the FORTH language. The correct number is: (415) 538-3580.

Secondly, and finally, this is my last *Electronics Monitor*.

I'm moving to a new area of the corporation concerned with electronic publishing. If you have a modem you'll be hearing more from me soon. If not, well, I may still be doing an occasional piece for PM.

It's been fun "meeting" you all! **PM**

Video Depth of Field



Depth of field is important to consider when using video as well as film. Depth of field is the distance between an object in focus in the foreground and

one in focus in the background. "Stopping down" your lens aperture increases depth. A good photo handbook can help even the video enthusiast.



Help your image as well as your bottom line.

The trucks you choose for your business say a lot about your business. So let GMC's good reputation add to your reputation. GMC trucks are done right, because, after all, we're the people who bring you nothing but trucks.

But a GMC pickup can pick up more than just your image. It can help your business run more efficiently by being just the right truck for the job.

The full-size pickup on the right will handle really large loads. Depending on the model, you can haul from 1,983 up to 5,256 pounds of whatever you're hauling. Or, when properly equipped, it can tow up to 10,000 pounds.

If you choose the rugged 6.2 liter V-8 diesel engine as an option, you'll have a practical pickup ideal for work situations involving stop and go driving.

The compact S-15 on the left is available with 4-cylinder or V-6 power. The 2.2 liter L4 diesel can haul up to 1,250 pounds, and the V-6 up to 1,625 pounds. Or when properly equipped, the S-15 can tow up to 5,000 pounds.

Full-size pickup cargo beds are available in 6½' and 8' lengths. The S-15 pickup has 6'1" or 7'5" cargo beds available.

Both versions feature tough, girder-beam, independent front suspension. You can get optional four-wheel drive. S-15's Insta-Trac system lets you shift from 2- to 4-wheel drive without stopping.

Whatever you choose, a full-size C-series or compact S-15 truck, you'll have picked right; a pickup that knows how to work.

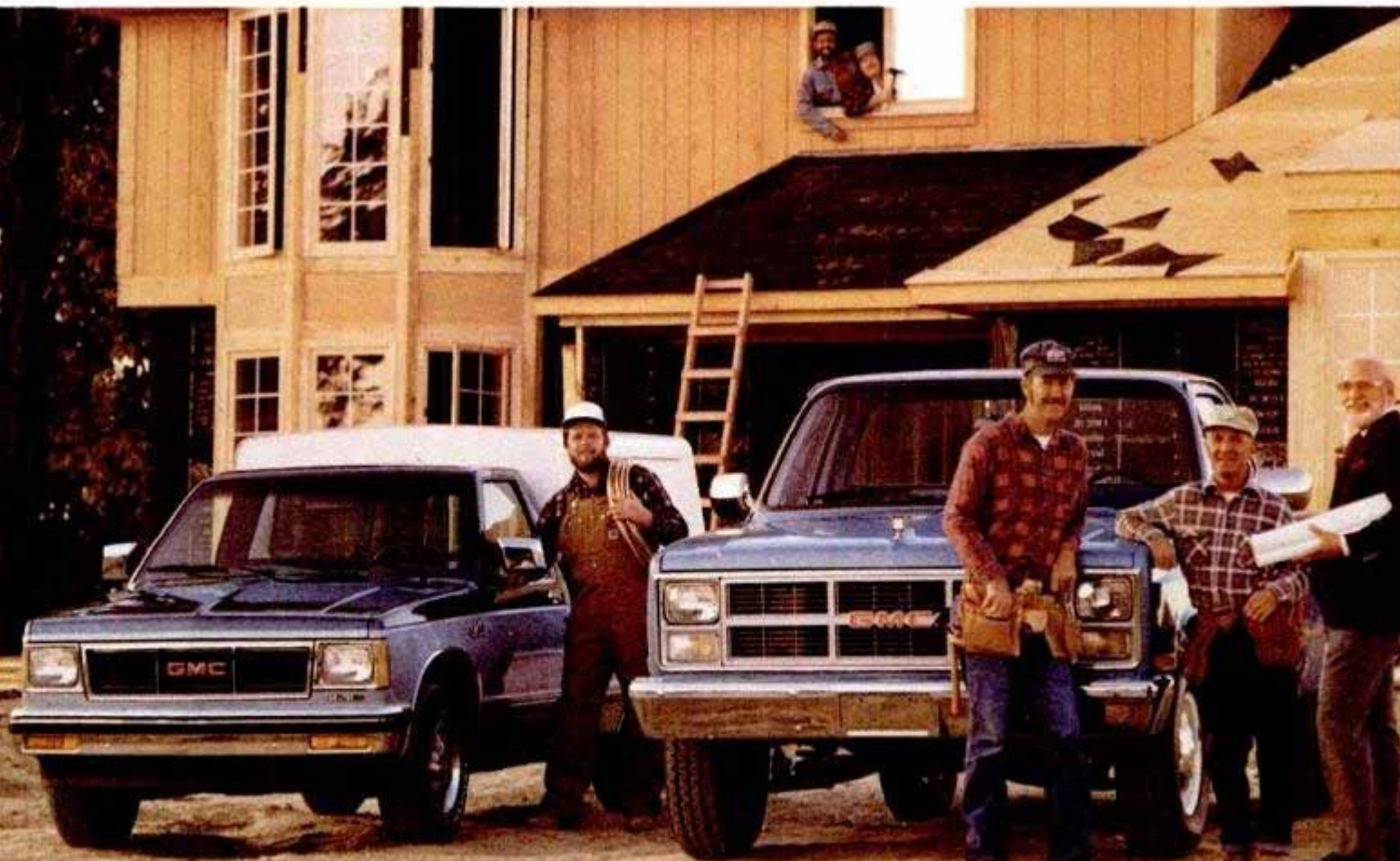
Hard.
From GMC.



Official Truck
of the XXIIIrd
Olympiad
Los Angeles
1984

GMC

A truck you can work with.



Some GMC trucks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your GMC truck dealer for details.

PM SOFTWARE MONITOR



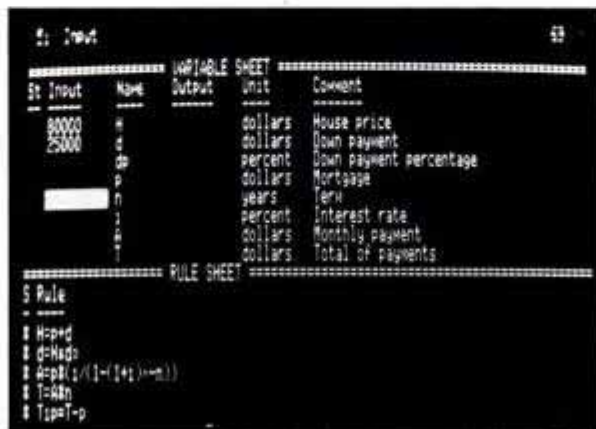
New program challenges the spreadsheets

TK! Solver is a new program from Software Arts. If the name of that company seems hauntingly familiar, it's probably because it helped to design the popular *VisiCalc* spreadsheet program available from *VisiCorp*. Indeed, until recently, Software Arts was responsible for updating that package each time it was revised.

But now Software Arts has set out on its own corporate quest for the elusive grail of software success. We think it has an excellent chance of vanquishing all of the many industry and marketing obstacles, the "dragons," along the way.

The first obstacle the potential user of the package encounters is defining and understanding the differences between this program and a spreadsheet. At first, they seem very similar. Both styles of programs will investigate "what-if?" situations. Once you have entered your own mathematical definition of a problem, you use the keyboard to change one value, and all other values dependent on that change are automatically calculated.

Both types of programs do have some overlap. They may both be used for such things as solving interest rates



Two areas of the screen in *TK! Solver* (above) are Variable Sheet and Rule Sheet. Formulas are entered on Rule Sheet and solved on Variable Sheet.

and amortizing your mortgage over and over again very quickly in order to compare various percentages from different banks. Both programs may be used to generate many different results from one overall mathematical relationship of different variables.

But *TK! Solver* is equation-based, while a spreadsheet is designed more to display an equation's variables than the equation itself. A simple example of figuring time as a result of speed and distance can illustrate this point.

The equation to solve this problem (one familiar to anyone who has been in a road rally) is: $T=D/S$, where the

time in hours is equal to the distance in miles divided by the car's speed in miles per hour. No one expects a road rallyist to have a computer that can run *TK! Solver* in his dashboard (at least not this year), but this gives us a relationship among the three variables of time, speed and distance to see what these programs do.

In a spreadsheet you might have a three-column setup. At the top of each column would be the headings of Time, Speed and Distance.

When you set up the spreadsheet, you would define the relation among the columns by typing in the formula. Once entered, the formula would not ordinarily be visible, but the effects of it would be. Every time you entered a new set of time or speed figures, the distance column would show a different result.

TK! Solver uses a different method. The first thing you do is to type in the formula in its usual form ($T=D/S$). The formula is typed on a part of the screen called the "Rule Sheet." Once you enter the formula, the letters T, D and S are listed separately in a column by the program on the top portion of the screen which is called "The Variable Sheet." Next to them you can enter what they mean, and any other memory-jogging comment.

Now, on the Variable Sheet, you just fill in the blanks next to the variables. When you hit the exclamation-point key, the program automatically solves for any variables left blank; it can figure from what you have filled in.

You may have 20 layers of equations with over a hundred variables, but *TK! Solver* never gets confused over which way to solve for a missing variable.

Next time you reach for a spreadsheet, maybe you should investigate *TK! Solver*, which is now available for the IBM PC and the Apple IIe (requires at least 128K).—N.S.

When computers were bold

Absolutely stunning animation and graphics make *Chivalry* from Weekly Reader Family Software (for the Apple II) a treat that the whole family can play.

The disk contains over 20 games, the order of play being governed by the results of a simple board game that's also included.

While the games are far easier than most arcade games, some, such as a jousting game, feature the most attractive graphics we have seen in any home video game.—N.S.



Title screen of *Chivalry* shows some of the same style of graphics that are found in full animation on the many games included.



OUR OUTDOOR LINE COMES IN SMALL, MEDIUM AND LARGE.

Honda can give you all the power you need for good times in the great outdoors. With a complete line of lightweight, portable generators from 500 to 800 watts. Each is really easy to operate. Just turn it on, pull the cord and you're off and running.

Honda generators are ideal for lighting up a campsite, charging the boat battery, powering

small appliances, or providing standby power.

Each one features a quiet, reliable Honda four-stroke engine. An advanced Oil Alert™ system that warns when the oil level gets too low.*

IT'S A HONDA

An Automatic Decompression system and CD Ignition for quick, easy starts. And a USDA approved spark arrestor muffler so it can even be used in National Parks.

So if you're looking for the best generator to fit your outdoor power needs, size up a Honda.

Check your Yellow Pages for the Honda Generator dealer nearest you today.

Nautilus® brings fastest way to a trim,

Now, maintaining a lean waistline doesn't have to be a full-time occupation. Spartan diets aren't fun.

And ordinary exercises like running and tennis don't do much either. Because no matter how hard they work your arms, legs and lungs they just don't challenge the abdominal muscles.

A trim waist without sacrifice.

Finally, there's a quick, efficient way to have the lean, flat stomach you want—thanks to an extraordinary invention from Nautilus: the new home Abdominal Machine. An engineering triumph so powerful it tones and tightens your mid-section in *less than 10 minutes a day*. Applying the same advanced principles to abdominal exercise that have made all Nautilus body conditioning equipment legendary—*variable resistance*.

Variable resistance. The key to fast progress.

Fixed weights, like barbells, are limited in their ability to exercise muscles. Why? Because the structure of every muscle is unique, and each one has different capacities at different points in contraction. (For example, the biceps can lift more weight near full contraction than when extended.) In practice, this means that the amount of fixed weight you can lift is limited by the muscles' weakest point. So barbells light enough to lift with reasonable

effort aren't heavy enough to work the strongest parts of your muscles.

Nautilus overcomes this limitation with a simple, brilliant invention: the cam. The cam's genius is that it automatically varies the amount of weight (or resistance) you work against, challenging a muscle at every point in its contraction. The harder one part of a muscle can work, the more resistance a Nautilus cam gives it—through its *entire range of movement*. And without the danger of strain or injury.

The new Nautilus Abdominal Machine uses the same principle to tighten your stomach. And does so with such efficiency you'll start to feel results in only one or two workouts.

You literally see results in a few short weeks. No other form of exercise even comes close.

Five minutes of Nautilus versus an hour of situps.

Everyone considers doing situps or leg-lifts. If you've ever tried doing them regularly, you already know what a grueling exercise in futility they are. Worse yet, increasing the number of repetitions is wasting even more of

your time. And the reason is not readily apparent: situps and leg-lifts never work your abdominals to capacity because it's actually the hip flexor muscles that are doing most of the work. And since resistance is limited to the weight of the upper body alone—it would take a torturous number of repetitions to noticeably increase your abdominal strength.

Nautilus exercise is totally different. The Abdominal Machine is precisely engineered to completely isolate and work your abdominals. This is exercise that leaves you elated instead of exhausted.

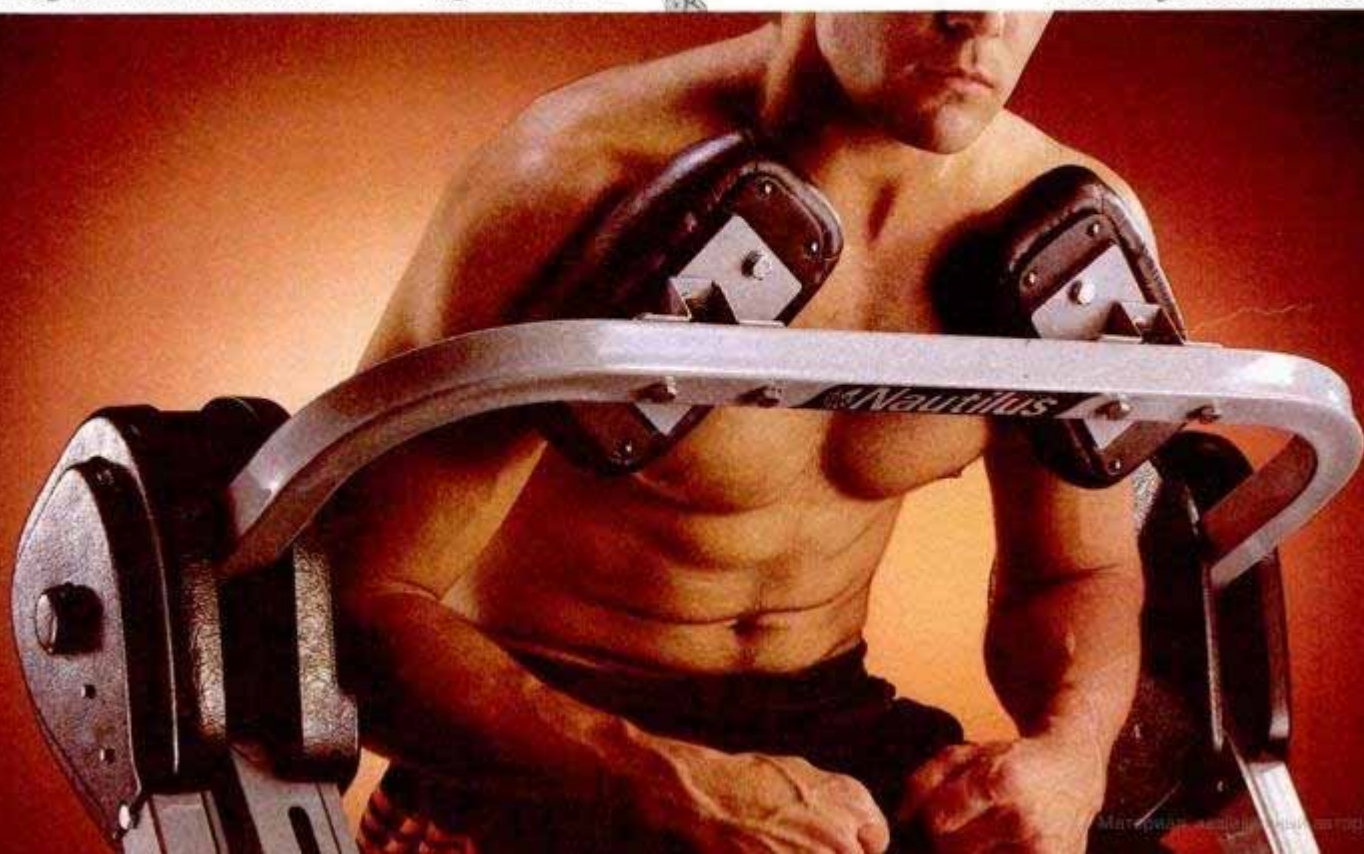
Sitting on the comfortable, padded seat, you begin your workout by pushing the movement arm forward and down, as far as possible. As your abdominals contract you feel an invigorating warmth; pause a moment and slowly raise back up (releasing yet still pressing against the machine's resistance). You get *twice* the workout, strengthening your muscles on both the forward and back strokes. This positive/negative resistance is essential to balanced muscle development.

As your strength grows, nine tension settings from mild to strenuous let you gradually increase the resistance. A muscle needs constant challenging to remain vigorous.

Exercising on Nautilus five



The Nautilus cam (resembling a deep sea nautilus shell) works your muscles in a way normal exercise can't.



home the tight stomach.

minutes a day, three times a week is all it takes to turn a flabby tummy into a tight, strong stomach.

A strong stomach—a friend to your back.

Shaped-up abdominal muscles do a lot more good for you than you think. Besides a trim appearance, they're essential for good posture,

proper breathing and even a healthy back. Because without full, firm abdominal support your lower back is forced to take on more and more of the job supporting the upper body. This continual strain can lead to tension and tightness, greatly increasing the risk of serious, painful back injuries.

But stomach exercise can fight this imbalance.

With the Nautilus Abdominal Machine, the

benefits to your back, in fact, start with the first day of exercise. Before long, posture will improve, you'll stand taller, tension will be lessened. And you'll have more stamina.

A toned abdomen is literally your back's best ally.

Famous Nautilus construction.

Nautilus is known to build their machines like battleships. And this compact home unit is no exception. The husky tubular steel

frame will stand up to a lifetime of energetic exercise. All contact surfaces are cushioned with high density foam and covered with tough, double gauge Naugahyde. Measures 48 x 38 x 35½". Weighs 150 lbs.

Minimal assembly is required and takes less than 5 minutes. Comes with full instructions, exercise program and 90 day warranty. And you don't have to move a muscle to own it.

The Nautilus Abdominal Machine is available to you by mail with a free phone call to The Sharper Image.



Home test Nautilus risk-free for 30 days.

In the past 12 years Nautilus has changed the way the world exercises. Today, over 3½ million men and women stay in shape on Nautilus equipment—including professional football players, olympic skiers and marathon runners. And now this legendary company brings that wealth of experience into your home.

Best of all, you have 30 days to try your Abdominal Machine, absolutely risk-free. You must be fully satisfied with the results or simply return it for a full refund. (Please allow 3 to 4 weeks for delivery).

Call toll-free or write today to order the remarkable Nautilus Abdominal Machine. And in only minutes, do for your stomach what diet, weights and hours of sweat can't.

ORDER TOLL FREE

For fastest delivery, credit card holders please call toll free. Order product #MNT200 for the Nautilus Abdominal Machine. Or send a check for \$485 plus \$55.00 delivery. CA residents add 6% tax.

ORDER TOLL FREE 24 HRS. EVERY DAY.

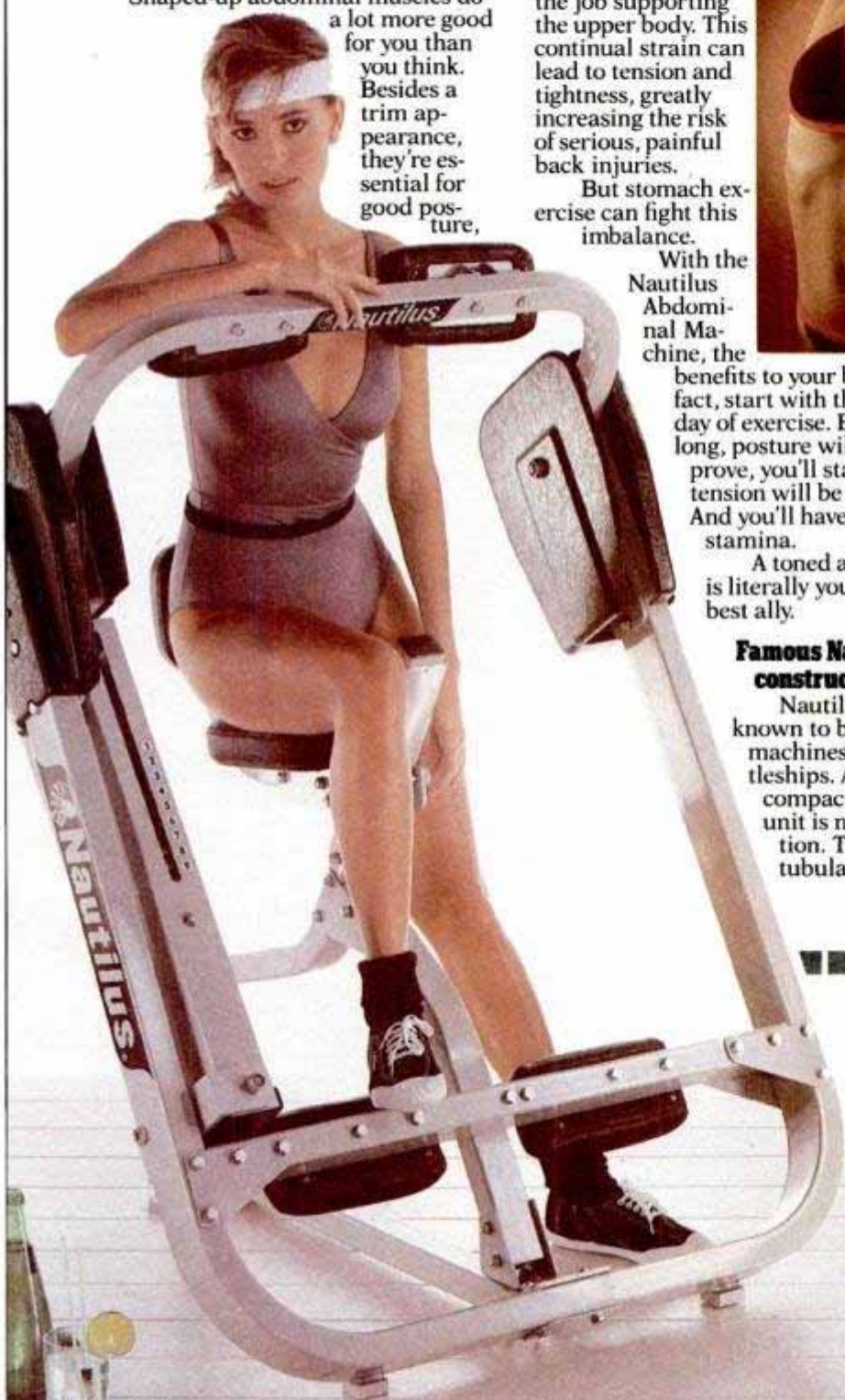
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THE PM WORKBENCH



Time-saving partition layout tool

Whether you're a professional carpenter or a do-it-yourself remodeler, this wall partition layout tool may replace the framing square as your most helpful tool. It's a simple tool designed to aid in laying out wall studs (both middle partition and corners), squaring windows and doors, and scribing angles, rafters and seat notches. Two pivot points show layouts for 2x4, 2x6 and 2x8 walls.

The versatile tool can provide a helping hand to hold a chalkline or tape measure. It can also be used as a saw guide for making square cuts with a circular saw.

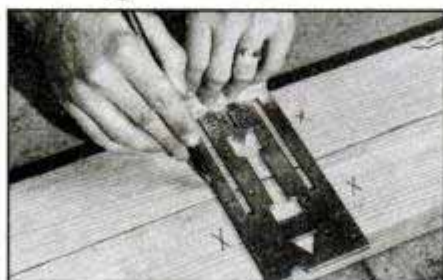
The wall partition layout tool is made of a lightweight, noncorrosive aluminum alloy.

It is available through Gomito Distributors Inc., Box 38307, Sacramento, Calif. 95838. It costs \$19.95. Include \$2 for postage and handling.

A clip-on pouch is available for \$6.69.—J.T.



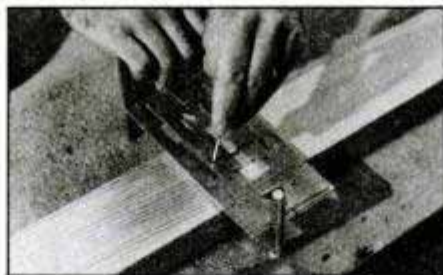
Maker claims this new layout tool has more than 50 uses.



Use the partition tool to mark wall stud locations on the sole plate and top plate.



Tool's markings allow you to lay out common and hip and valley rafters accurately.



Transfer the anchor bolt locations to the sill plate without using a tape measure.

Glass-boring bit

Boring holes in glass is easy using this diamond-coated drill bit. Unlike the spear-point bit that requires a special coolant and very slow rpm, this bit is used at high speed and requires only water as a coolant. It's at stained-glass



Start boring the hole at an angle. Then rotate the drill in a circular motion until the bit cuts through the glass.

supply shops in 1/8-, 3/16- and 1/4-in.-dia. for about \$10 each. A 3/8-in.-dia. bit is \$14. Contact Glastar Corp., 19515 Business Center Dr., Northridge, Calif. 91324.—Rosario Capotosto

Lincoln rocker update

The original Lincoln rocker that we reproduced in February (*Build Lincoln's Rocking Chair*, page 60) was reported to have been purchased by Abe in the 1860s. Lincoln actually bought the rocker in the 1840s while his children were young enough to be rocked to sleep. The walnut hardwood and caning used to build the reproduction rocker is available by mail from Craftsman Wood Service, 1735 West Cortland Court, Addison, Ill. 60101. Photos and construction were by David J. Warren, son of long-time PM contributor David A. Warren.

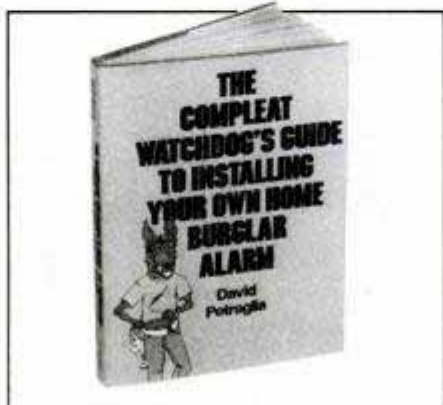
More on hinging plywood

In trick No. 6 of *10 Carpentry Tricks From A Master Craftsman* (Feb. '84 page 117), the main cause of a drill bit deflecting off course is that it strikes the dense summer-wood and slides into the softer spring wood. **PM**

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.

An alarming book

With the burglary rate in the United States nearing 500 per hour, more and more homeowners are installing home burglar alarm systems. A professionally installed system is very expensive, but a new book, *The Compleat Watchdog's Guide To Installing Your Own Home Burglar Alarm*, offers an alternative. The 225-page book explains how to design, install and customize an effective, inexpensive home alarm system. It's available in bookstores or by sending \$7.95 (include your state's sales tax) to Prentice-Hall, Englewood Cliffs, N.J. 07632.—J.T.



This book gives clear, concise instructions for how to install a home alarm system.

Yamaha outboards. The nitpicker's pick.

In designing small outboard motors, it's tempting to think small.

Yamaha resisted the temptation.

Instead, we rethought every millimeter of every small engine.

One major result is that our eight twin and single cylinder outboards — from 2 to 30 horsepower — run on a remarkably clean 100:1 fuel/oil mixture, instead of 50:1. It's the beginning of a new performance standard. And the end of blue smoke.

Our 30, 25, 15, 9.9 and even our 2 horsepower model are loop-charged for more efficient combustion. We put an Energy Advi-



sor graph on every throttle handle so you not only run quick, you run smart. Yamaha even includes a tool kit with every outboard.



An emergency stop switch is on our engines from the 8 hp model on up. The 4 and 5 hp Yamahas have 360° steering, plus a full gearshift. And expect superior corrosion protection on all our outboards, from 2 horsepower to 220-plus.

So if you're a picky buyer, maybe it's time you picked up a Yamaha.



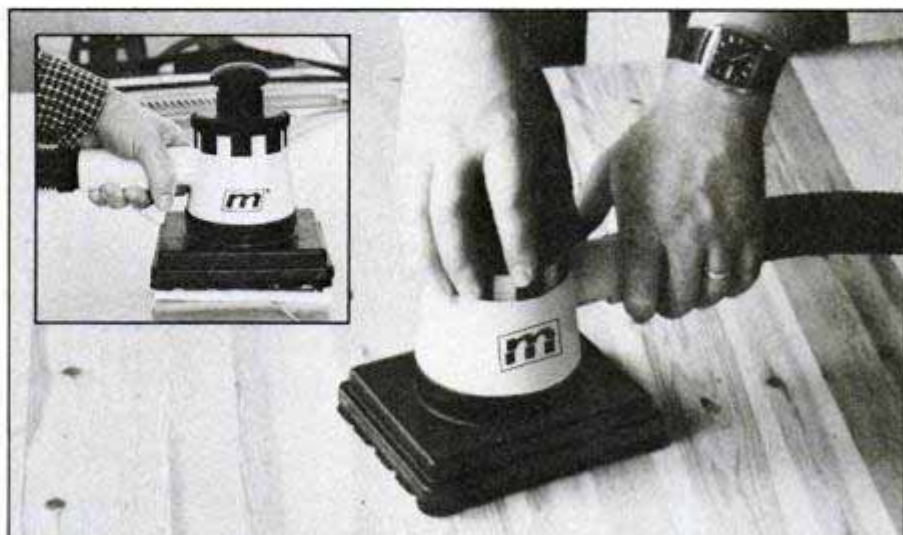
For your nearest dealer, call
1-800-447-2882

OUTBOARDS by
YAMAHA
EXPECT A LOT.™

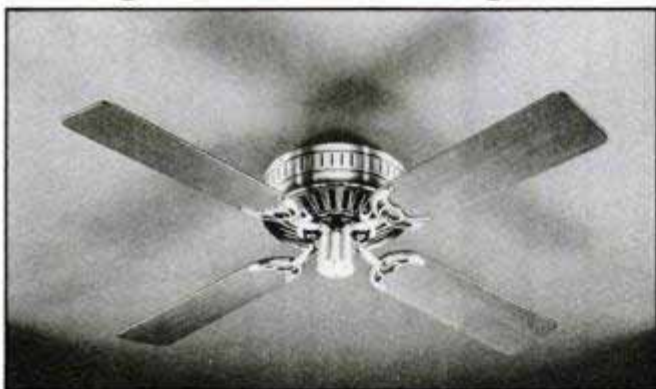


Sander converts to polisher

The Marshall Model 3000 sander/polisher operates off a vacuum cleaner to perform dust-free sanding, polishing and cleaning chores. An air motor generates 18,000 oscillations per minute to draw sanding dust and particles into the vacuum. The Model 3000 can also be used with a polishing pad to shine automobiles, boats and furniture. The unit comes with adhesive-backed abrasive paper, two polishing pads and an adapter hose for \$39.95 postpaid. To place orders or to obtain more information, contact Marshall Electronics Inc., 5425 West Fargo Ave., Skokie, Ill. 60077.

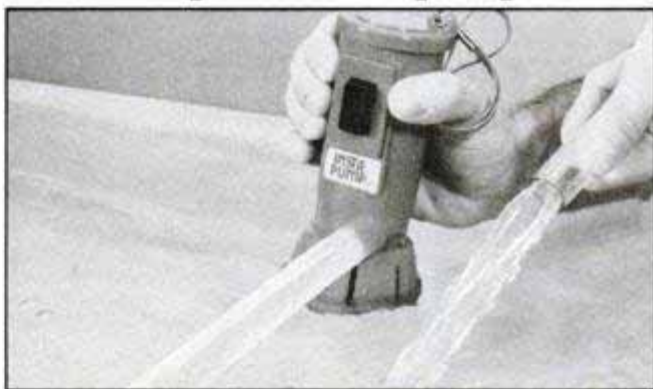


Ceiling fan for low ceilings



Hunter introduces a low-profile, flush-mounted ceiling fan for use in rooms with ceilings 8 ft. or lower. The fan features a three-speed, reversible motor, solid wood blades and a metal motor housing. Finishes are available in bright brass and antique brass. The fan sells for about \$185. For more information, contact Hunter Fans, Robbins and Myers Inc., Box 14775, Memphis, Tenn. 38114.

Portable, pocket-size pump



Insta-Pump, a compact utility pump, is offered by Omni Corp., Box 305, South Holland, Ill. 60473. The Insta-Pump is designed to handle small flooding and water removal problems faced by homeowners, campers and boaters. It's available at home centers in three models: rechargeable (shown, \$40), electric (\$39) and 12-v. battery-operated (\$38). For more information, contact the manufacturer.

Quick mixer

Johnson's Industrial Supply Co., 1941 Karlin Dr., St. Louis, Mo. 63131, manufactures Jisco auger-type mixers. Use the mixers in a drill to mix paint, joint compound, epoxies and more. They're available in paint and hardware stores in two sizes: 15 in. (\$6.95) for mixing 1- and 2-gal. cans and 24 in. (\$11.95) for mixing 5-gal. cans.



A new glue

Elmer's new Stix-All adhesive is claimed to bond to almost everything—except skin. Stix-All is a general-purpose glue that works on a wide variety of porous and nonporous materials, such as wood, ceramic, glass, plastic, concrete, metals, leather, canvas and other fabrics, according to the maker. It dries clear and is resistant to water, heat and cold. A 1-ounce tube costs about \$3. For details, contact Borden Inc., 180 East Broad St., Columbus, Ohio 43215.



COMPARED TO CHEVY S-10 LONG BED, THE COMPETITION COMES UP SHORT.

Chevy S-10 Long Bed is almost 5 inches longer — and wider — than Ford Ranger. And it's longer than Nissan and Toyota, too.

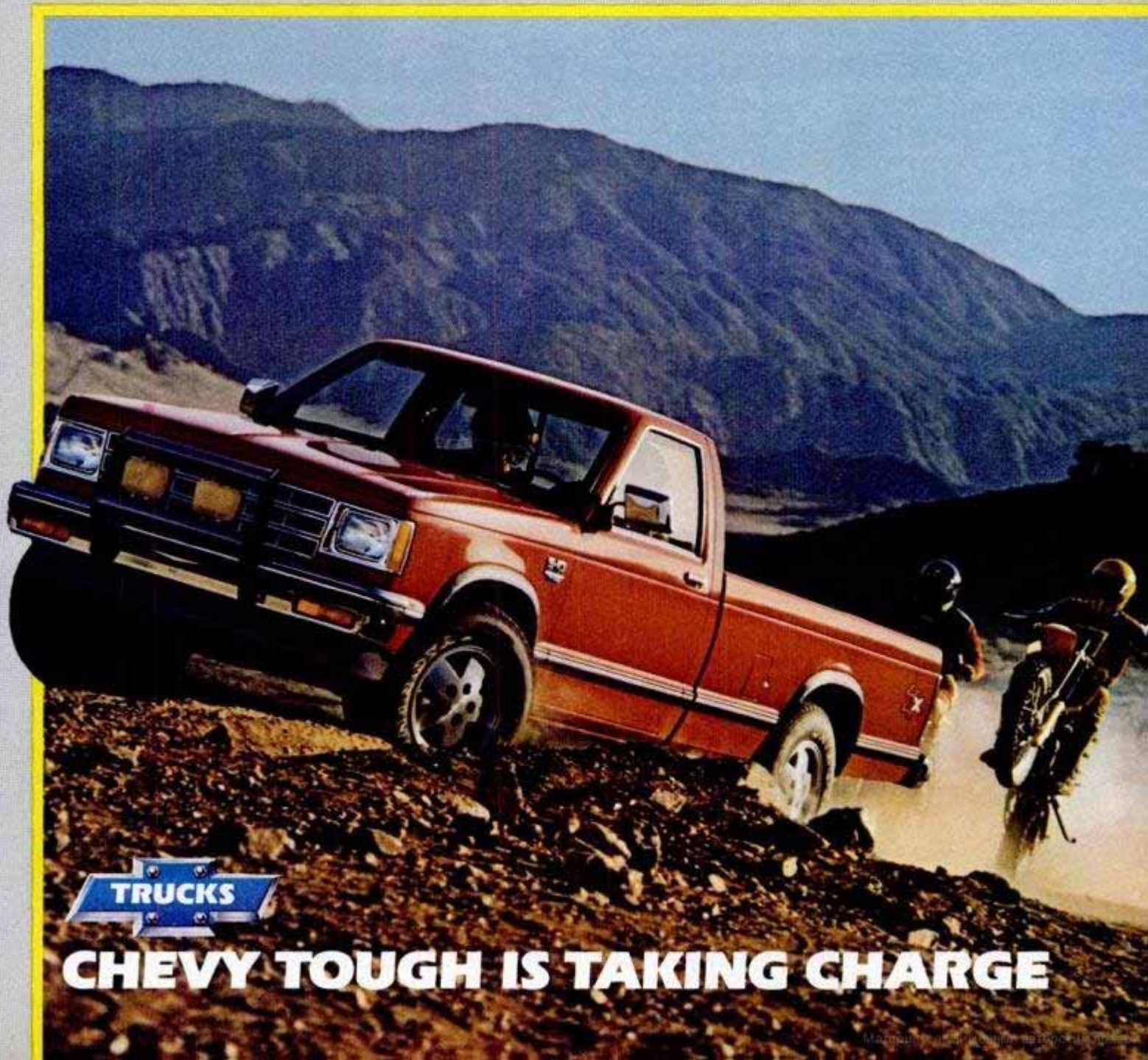
Revolutionary 4x4. Available Insta-Trac lets you shift from freewheeling 2WD to 4WD High and back at any speed. You can't do that with Ford or the imports.

Gas pressure shocks available. Delco/Bilstein gas shocks, standard with the optional off-road 4x4 package, are designed to fine-tune themselves for amazing traction off-road and a highway ride so smooth you may forget you're driving a truck. Gas shocks are a factory-installed option Ford and the imports don't offer.

Longer box. And a whole lot more. S-10 Long Bed.



Let's get it together... buckle up.



PM'S TIME MACHINE

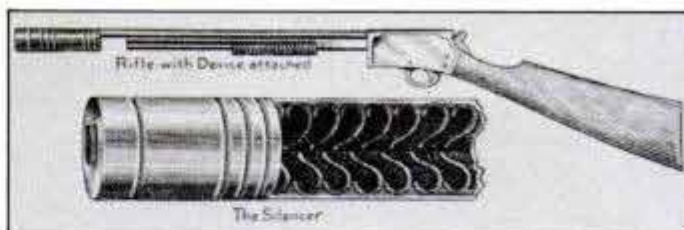
75 YEARS AGO: May 1909



A new trestle made of timber.

New logging trestle

The cover illustration shows a logging train rounding a trestle 150 ft. high on a logging line near the Columbia River in Washington. The train is composed of 25 heavily loaded cars drawn by a light locomotive of only 57 tons' weight. The road is but 19 miles long and the train makes two round trips a day. The construction of so high a trestle, of timbers, and built on a curve, makes a beautiful but difficult piece of engineering work.



Silent shooting

The device known as the "silencer," with which Hiram P. Maxim has succeeded in making all ordinary firearms practically noiseless, appears to be nothing more intricate than a small section of highly polished gaspipe.

Coal and oil

The essential feature of a new process of burning coal and oil together . . . is the retort in which the oil changes into gas. The retort is arranged around the fire box, the oil being injected into it from the front by a jet of steam.

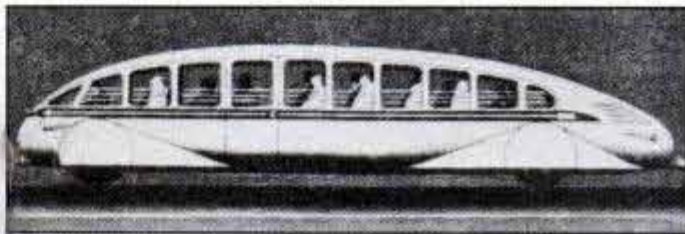
50 YEARS AGO: May 1934



Airplane has pulsating wings.

Flies like a bee

Pulsating wings oscillated by a ten-horsepower motor are to propel a 2,200-pound plane of unusual design being built by Dr. Raymond Nimfuhr, Austrian scientist. The craft, a metal frame about thirty-eight feet long with two large forward wings thirteen feet long and two smaller rear ones ten feet long, has neither a screw propeller nor a rudder. The under side of the wings is caused to pulsate like the wings of a bee. Small wings serve as propellers.



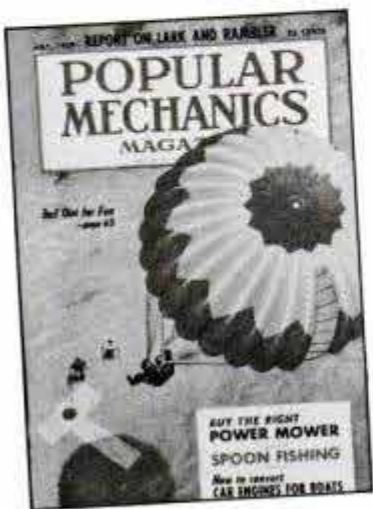
No sparkplugs

An oil-fueled engine of the Diesel type (for futuristic car shown above) has no cylinder heads, camshafts or crankshafts. The horizontal pistons are fired by a new sparkless source—the heat of compression from opposing valves.

Counting the words

How many words can be written with the ink remaining in the latest fountain pen can be determined by a glance at a "word gauge" engraved on the transparent ink section of the barrel. The scale goes up to 7,000 words.

25 YEARS AGO: May 1959



Sky diving: The new sport.

Jumping for fun

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PM owners report

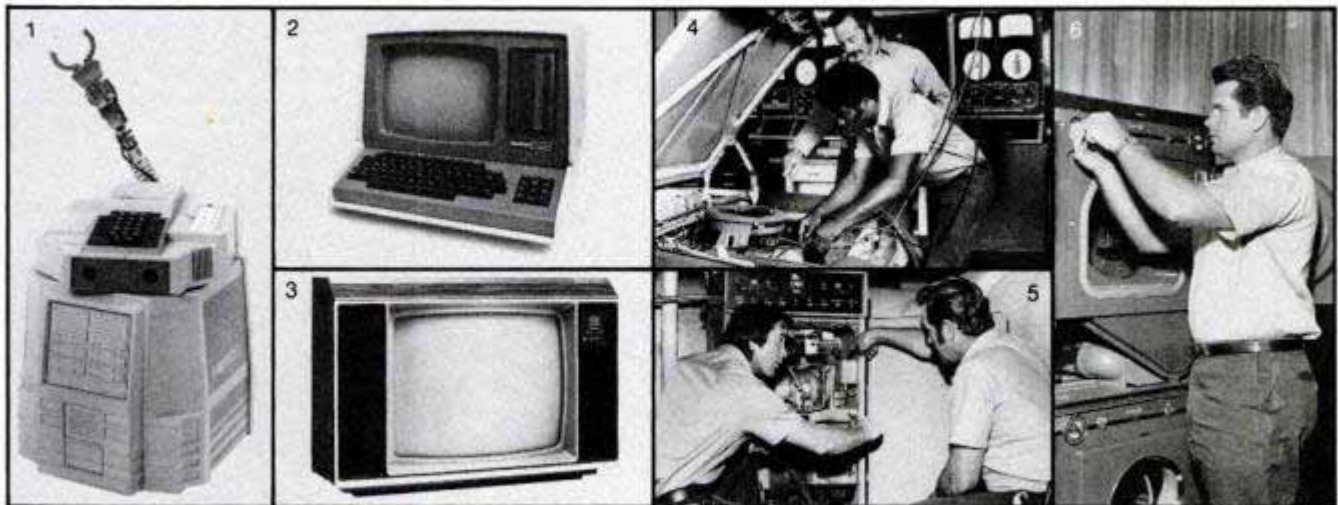


The owners of Larks (above) are a happy bunch, although overall they are not quite so well pleased as Rambler owners. With Studebaker, the V8 owners are happiest. Those few who do rate the Lark poor (2.7 percent) are six-cylinder owners. A small percentage (1.6 percent) mentioned poor workmanship.

Salt of the sea

In a dozen United States shore and inland laboratories, the salty water from our seas and brackish wells is being evaporated by the sun's free energy under endless rows of plastic tents designed to pluck molecules of pure water from a sluggish stream of brine. In still more labs, ocean water is being frozen in refrigerators that wash the salty brash from ice. Reason: To help banish the looming specter of a national water shortage. Last year, industry gulped 77 billion gallons a day. **PM**

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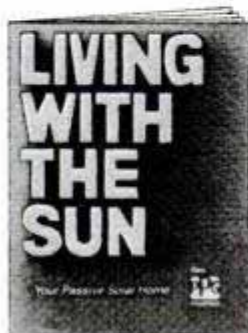
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HINTS FROM READERS

Wire ties in the shop



A large pill bottle filled with colored wire ties is helpful for binding wires or keeping parts together. The ties are also useful to color code machine parts for later identification, and to secure plastic bags of small parts.

—Walter E. Burton

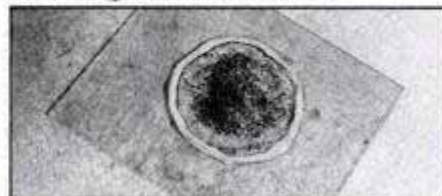
Paintbrush becomes scrub



An old paintbrush is useful as a small scrub brush. Cut off the frayed bristles within 1/2 in. of the ferrule. The remaining stiff bristles serve as an efficient brush for cleaning tight areas of small motors and other equipment.

—Louis Hochman

Testing for moisture

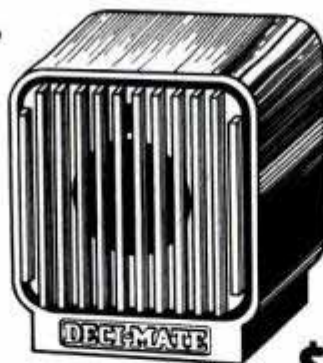


Before laying tile on a basement slab, check for moisture. Make a 1/2-in.-thick x 3-in.-dia. circle of caulk. Pour 1/4 teaspoon of calcium chloride in the center and cover with glass. Any moisture will dissolve the substance and will appear on the glass. —Ed See

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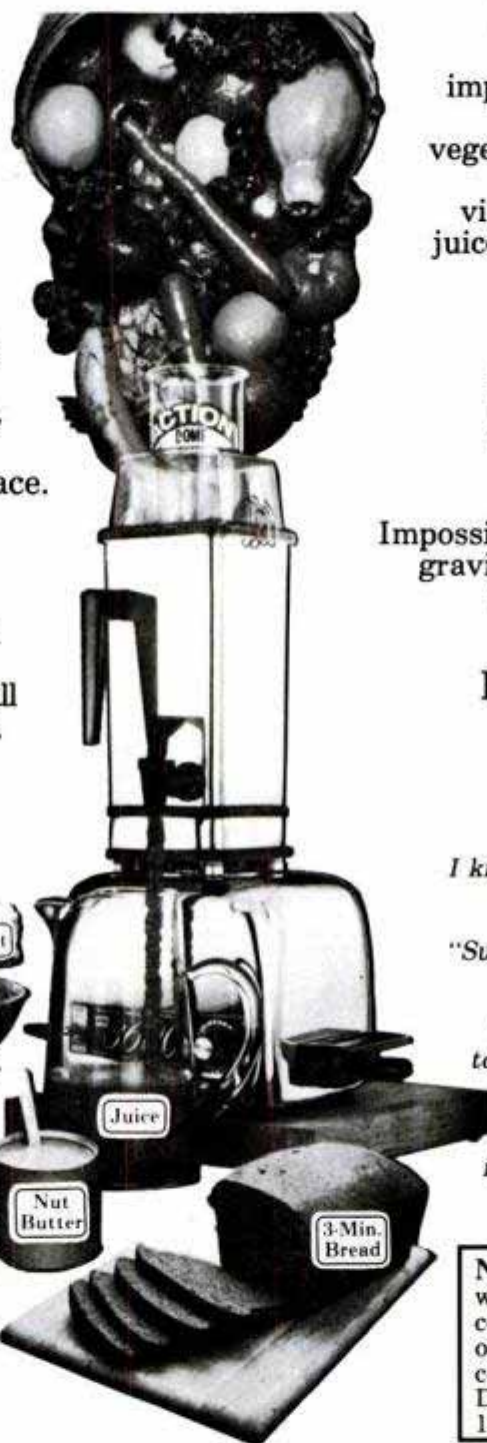
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U.S. Dept. of Agriculture Handbook #8:

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*Per pound of fruit †Fresh ripe Valencias

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ESCORT finds radar before radar finds you

You may have been a passenger in a car equipped with a radar detector. Unless the detector was an ESCORT, you probably came away unimpressed.

A Good Idea, But...

The fact is, most radar detectors create more problems than they solve. They buzz and beep for no reason. And when they do pick up radar you're close enough to see the patrol car. But not all detectors are created equal.

Does it work?

Listen to the experts. When Car and Driver magazine first tested ESCORT, they said "You will be pleased to know that the radar detector concept has finally lived up to its promise...once you try the ESCORT, all the rest seem a bit primitive." Their most recent test adds "All things considered, the ESCORT is the best piece of electronic protection on the market."

Red Alert

Other detectors simply sound an alarm. You have to go on full alert, because you don't have enough information. How close is the radar? Just over the hill, or a mile away? Is it ahead or behind? X band or the insidious K band?

And how is it being used? "Instant-On" from a stationary trap? A moving radar unit approaching rapidly from ahead? You have no way of knowing.

Advantage ESCORT

Upon radar contact, ESCORT's alert lamp responds and the analog meter shows radar signal strength. At the same time, you will hear an audio warning—pulsing slowly when the radar is weak, quicker as it strengthens, then constant as you approach the radar unit.

ESCORT even uses a separate warning tone for each radar band. "Beep" for X band, a more urgent "brap" for K band because you have less time to act.

Quite simply, ESCORT tells you everything you need to know about radar encounters.

Informed Source

Another problem with most detectors is false alarms. They sound off so often you're never sure if it's radar or something else. Most frequently they're set off by "polluting" radar detectors, cheap imports so carelessly designed they actually *transmit* on radar frequencies. These "polluters" can set off an ordinary detector up to a mile away.

But not ESCORT. Our special ST/O/P™ (Statistical Operations Processor) circuitry recognizes and rejects these spurious signals. With ST/O/P, ESCORT does not report on fellow travelers.

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THE RADAR DEFENSE KIT

User Friendly

And when the warning does come, it's in a friendly voice. The audible warning is the same frequency used for Morse code (1024 Hz). And a fully adjustable volume control lets you set the level—ESCORT can cut through a Ferrari's interior noise, or leave a resting passenger undisturbed. Even the alert lamp is carefully thought out. It's bright enough to be seen in direct sunlight, but is automatically dimmed during nighttime operation.

A quick glance at the red LED assures you that ESCORT is on, and a City/Highway switch optimizes performance to either condition. All of this packaged in a low-profile aluminum case only 1½ inches high and 5¼ inches wide so you can have it, but not flaunt it.

The Bottom Line

It's easy to try ESCORT at no risk. Just dial our toll-free number; we're only a parcel delivery away. Take the first 30 days as a test. If you're not absolutely satisfied, we'll refund your purchase and pay return postage. We also back ESCORT with a full one-year limited warranty on parts and labor.

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Make An Adjustable Toolpost For Your Lathe

Here's an addition that will put more precision in your lathe work.

TEXT AND PHOTOGRAPHS
BY WALTER E. BURTON

Most smaller home workshop lathes don't have the intricate toolpost adjustments found on larger, more expensive machines. This makes it difficult to position the tool-bit precisely. Often, metal shims are used to align the tool bit with the workpiece—a tedious chore. But this adjustable toolpost will reduce setup time and increase the precision of your lathe work.

Begin by milling the adjusting ring (part E in the materials list) from a 3/4-in.-dia. pipe cap. *Caution:* Always wear eye protection when working with a lathe. Screw the cap onto a short section of pipe, clamp the pipe in the lathe chuck and machine the pipe cap as shown. Mill a 1/8-in.-deep recess in the cap's top inside edge to accept disc F.

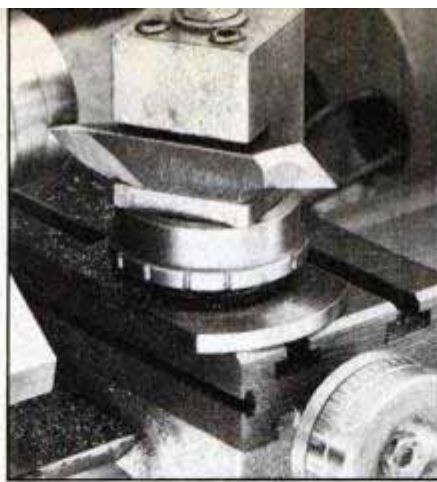
Next, make the base plate (A) from a 2-in.-dia. steel washer. Enlarge the washer center hole on the lathe, then thread it with a 3/4-in. pipe tap. Now tightly screw a 3/4-in.-dia. nipple (B) into the base plate, leaving about 3/8 in. of thread protruding from the top surface. Cut off the unthreaded portion of the nipple flush with the base plate underside. Machine a recess into the bottom inside edge of the threaded stud B for holding disc C.

Drill a 3/16-in.-dia. hole in the base plate for a brass rivet (D). The rivet

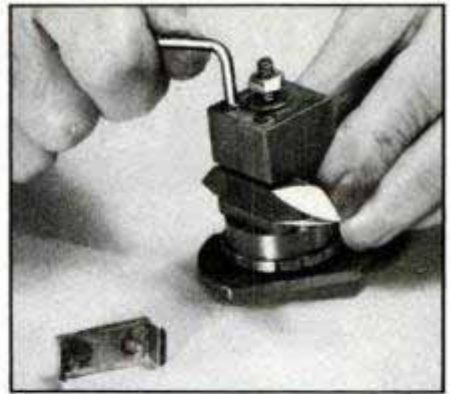
MATERIALS LIST—LATHE TOOLPOST

Key	No.	Size and description (use)
A	1	2"-dia. steel washer (base plate)
B	1	3/4"-dia. x 1/2" nipple end (stud)
C	1	5/8"-dia. x 1/8" steel disc
D	1	3/16"-dia. x 3/16" brass rivet (pin)
E	1	3/4"-dia. pipe cap (adjusting ring)
F	1	1 3/32"-dia. x 1/8" steel disc
G	1	1 x 1 x 1 1/4" steel bar (tool-holding block)
H	1	3/4"-dia. steel washer
I	1	10-32 x 2 1/2" rh machine bolt, nut and washer
J	1	5/32 x 3/8 x 1" aluminum (shim)
K	1	3/8 x 1 3/4" spring brass (clip)
L	2	1/8" No. 2 fh machine screw
M	2	1/4-20 x 3/4" hollow-head setscrew

*Approximate diameters; cut discs to fit respective recesses.



Mount the toolpost securely to the T-slot in the lathe cross slide. Tighten the hexnut to lock the toolpost in place. Tool bit is held in position by two setscrews.

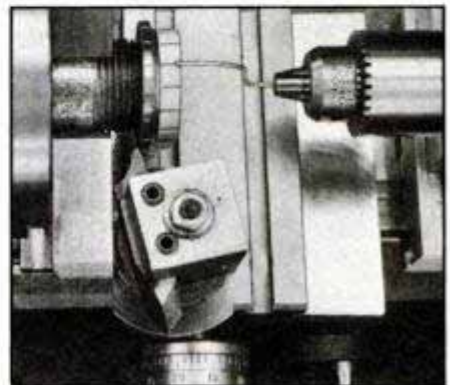


Use a hex-key wrench to tighten the two setscrews that hold the tool bit in place. Install the clip-on shim (shown in the foreground) under the bit when needed.

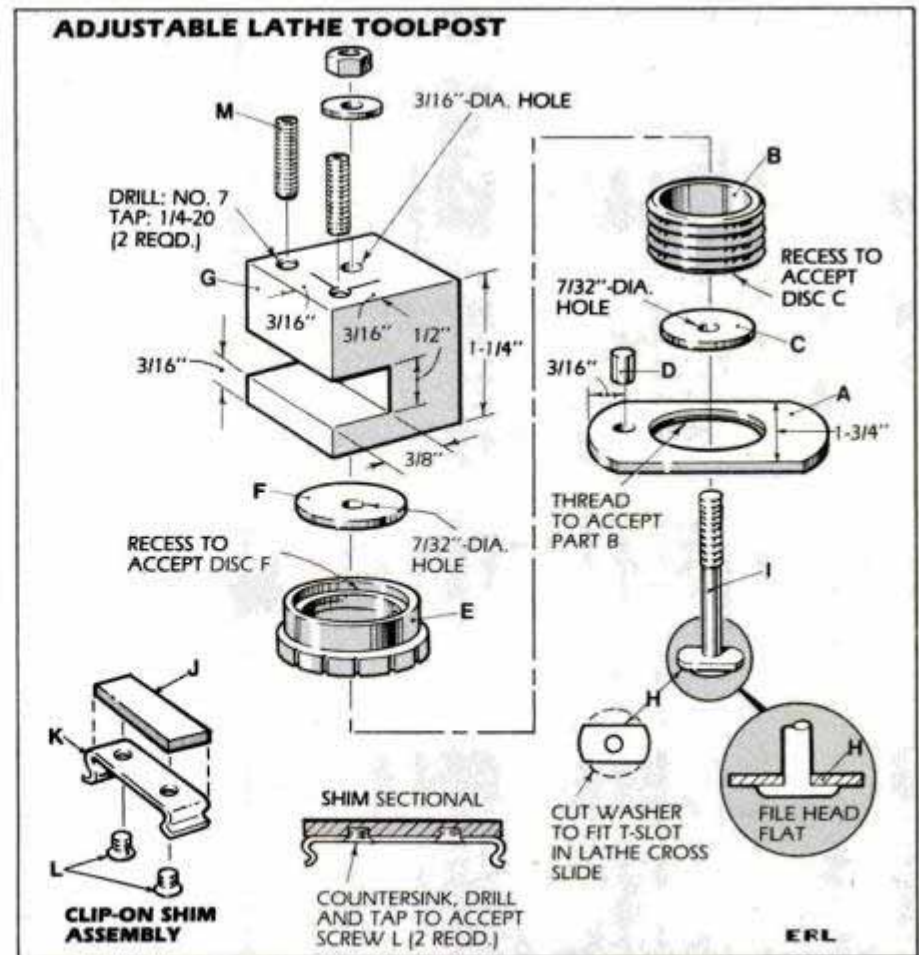
projects into the T-slot of the lathe cross slide to prevent the toolpost from turning when adjustments are made.

Next, cut the tool-holding block (G) from 1 x 1-in. metal bar stock. Then mill a 3/8 x 1/2-in. tool-bit channel as shown. Drill a 3/16-in.-dia. hole through the center of block G for the locking bolt (I). Then drill and tap the two holes for the setscrews (M).

To use, mount the toolpost onto the lathe cross slide with the locking bolt head and washer (H) in the cross slide's T-slot. Turn the adjusting ring to raise or lower the tool bit, then tighten the hexnut. Finally, make the clip-on shim for use with narrow 1/4-in. tool bits. **PM**



Bent wire in tailstock chuck acts as a pointer when scoring notches in adjusting ring. Graph paper strip with lines 1/4 in. apart provides the proper spacing.



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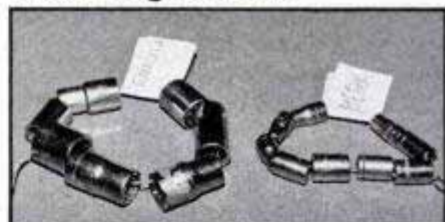
HINTS FROM READERS

Salvaging sandpaper scraps



Scraps from sandpaper trimmed to fit a holder can be salvaged by gluing them to flat or odd-shaped sticks. These tools are useful for sanding irregularly shaped workpieces and for reaching into small areas. Here, a sandpaper-coated Popsicle stick is being used. Parts for a square abrasive stick are at right. —Walter E. Burton

Corralling sockets



Keep sockets organized in your car trunk or toolbox. Load them on a wire and twist the ends together. For metric and English sockets, label them on separate wires for identification.

—George A. Mayerchak

Aluminum plant tags



Make weatherproof tags for labeling seedbeds from empty beer and soft drink cans. Cut the tags with tin snips; make tie holes with a paper punch. Place the tags on a pile of paper napkins and incise letters with a ballpoint pen. —D.W. Roberts

California Millionaire Wants To Share The Wealth

You think times are tough and you've got problems?

Well, I remember when a bank turned me down for a \$200 loan. Now I lend money to the bank — Certificates of Deposit at \$100,000 a crack.

I remember the day a car dealer got a little nervous because I was a couple of months behind in my payments — and repossessed my car. Now I own a Rolls Royce. I paid for it in full — with cash.

I remember the day my wife phoned me, crying, because the landlord had shown up at the house, demanding his rent — and we didn't have the money to pay it.

Now we own five homes. Two are on the oceanfront in California (I use one as my office). One is a lakefront "cabin" in Washington (that's where we spend the whole summer — loafing, fishing, swimming, and sailing). One is a condominium on a sunny beach in Mexico. And one is snuggled right on the best beach of the best island in Hawaii — Maui.

Right now I could sell all this property, pay off the mortgages, and — without touching any of my other investments — walk away with over \$750,000 in cash. But I don't want to sell, because I don't think of my homes as "investments." I've got other real estate — and stocks, bonds, and cash in the bank — for that.

I remember when I lost my job. Because I was head over heels in debt, my lawyer told me the only thing I could do was declare bankruptcy. He was wrong. I paid off every dime.

Now, I have a million dollar line of credit; but I still don't have a job. Instead, I get up every weekday morning and decide whether I want to go to work or not. Sometimes I do — for 5 or 6 hours. But about half the time, I decide to read, go for a walk, sail my boat, swim, or ride my bike.

I know what it's like to be broke. And I know what it's like to have everything you want. And I know that you — like me — can *decide* which one it's going to be. It's really as easy as that. That's why I call it "The Lazy Man's Way to Riches."

So I'm going to ask you to send me something I don't need: money. Ten dollars to be exact. Why? Because I want you to pay attention. And I figure that if you've got \$10 invested, you'll look over what I send you and decide whether to send it back... or keep it. And I don't *want* you to keep it unless you agree that it's worth at least a hundred times what you invested.

Is the material "worth" \$10? No — if you think of it as paper and ink. But that's not what I'm selling.

PROOF!

Don't take my word for it. These are excerpts from articles in newspapers and magazines:

Time:

He only works half the year in his stunning office on California's Sunset Beach, and even when he's there he puts in short hours... In other words, Joe Karbo... is the prototype for... "The Lazy Man's Way to Riches."

Money:

Joe does more than dwell on personal problems; he solves them...

Which is a nice change: Karbo almost went bankrupt back in '62....

Boston Herald-American:

The book has drawn hundreds of letters from persons who have profited by it....

Los Angeles Herald-Examiner:

"Going broke was the best thing that ever happened to me," explains Joe Karbo who went from one business trouble to a million-dollar business fortune....

Forbes:

After bouncing around show biz, advertising, and real estate, he made his fortune... \$250,000.

Money Making Opportunities:

Maybe Joe Karbo has the secret. Don't you think you owe it to yourself to find out what it is all about?... I just finished it — and I'm off on a vacation myself. Get the idea?

Long Beach Independent:

He's programmed the path to riches for the lazy man.

The Kansas City Star:

He prints statements like "Most people are too busy earning a living to make any money." He should have added that too many people these days are too busy earning a living to do any living.

What I am selling is information. *More* information than I give when I'm paid \$1000 as a guest speaker. *More* information than I give in a one-hour consultation for \$300.

But you're really not risking *anything*. Because first, I don't want you to send me any money — at least none that I can use. Instead, as a token of your sincerity, send in your check or money order and *postdate* it for *six weeks* from today. You see, it's not really money because it's not negotiable — besides, I won't even touch it for six weeks anyway.

In this way you'll have plenty of time to receive my material, look it over, try it out and *prove* to yourself that everything I am telling you is true.

I know what you're thinking: "He got rich telling people how to get rich." The truth is — and this is very important — the year before I shared "The Lazy Man's Way to Riches," my net income was \$216,646. And what I'll send you tells just how I made that kind of money... working "part time"... a few hours a day... about 8 months out of the year.

It doesn't require "education." I'm a high school graduate.

It doesn't require "capital." Remember I was up to my neck in debt when I started.

It doesn't require "luck." I've had more than my share. But I'm not promising you that you'll make as much money as I have. And you may do better. I personally know one man who used these principles, worked hard, and made 11 million dollars in 8 years. But money isn't everything.

It doesn't require "talent." Just enough brains to know what to look for. And I'll tell you that.

It doesn't require "youth." One woman I worked with is over 70. She's travelled the world over, making all the money she needs, doing only what I taught her.

It doesn't require "experience." A widow in Chicago has been averaging \$25,000 a year for the past 5 years, using my methods.

What does it require? Belief. Enough to take a chance. Enough to absorb what I'll send you. Enough to put the principles into *action*. If you do just that — nothing more, nothing less — the results will be hard to believe. Remember — I guarantee it.

You don't have to give up your job. But you may soon be making so much money that you'll be able to. Once again — I guarantee it.

I know you're skeptical. Well, here are some comments from other people. (Initials have been used to protect the writer's privacy. The originals are in my files.) I'm sure that, like you, these people didn't believe me either when they clipped the coupon. Guess they figured that, since I wasn't going to deposit their checks for six weeks, they had nothing to lose.

They were right.

And here's what they gained:

'Made \$50,000 just fooling around'

"In February you sent me (for ten bucks) your Lazy Man's Way to Riches. Since then I have made approximately 50 grand (\$50,000) just fooling around on the basis of your advice. You see, I really am lazy — otherwise I could have made 50 million! Thank you!"
R. McK., Atlanta, GA

'\$24,000 in 45 days'

"...received \$24,000.00 in the mail the last 45 days."
E.G.N., Matewan, WV

From \$50 to \$565 per week

"...when I sent for your (Lazy Man's Way to Riches), I was delivering the L.A. Times for \$50 per week... Now... I earn an average of \$565 per week, have \$7,000 in the bank and a condominium that's worth \$85,000..."
J.N., Culver City, CA

'There's no stopping me'

"Since I've got your (Lazy Man's Way to Riches) in July, I've started 4 companies... there's no stopping me and I'm so high I need chains to keep me on the ground."
M.T., Portland, OR

\$260,000 in eleven months

"Two years ago, I mailed you ten dollars in sheer desperation for a better life... One year ago, just out

of the blue sky, a man called and offered me a partnership... I grossed over \$260,000 cash business in eleven months. You are a God sent miracle to me."

B.F., Pascagoula, MS

\$7,000 in five days

"Last Monday I used what I learned on page 83 to make \$7,000. It took me all week to do it, but that's not bad for five days' work."
M.D., Topeka, KS

What I'm saying is probably contrary to what you've heard from your friends, your family, your teachers, and maybe everyone else you know.

I can only ask you one question.

How many of them are millionaires?

So it's up to you.

Six weeks from today, you can be nothing more than a little older — or you can be on your way to getting rich. You decide.

The wisest man I ever knew told me something I never forgot: "Most people are too busy earning a living to make any money."

Don't take as long as I did to find out he was right.

I'll prove it to you, if you'll send in the coupon now. I'm not asking you to "believe" me. Just try it. If I'm wrong, all you've lost is a couple of minutes and a postage stamp. But what if I'm right?

Some have called it a Miracle. Some have called it Magic. You'll call it "The Secret of the Ages."

As for me, I thank God that before he died Millionaire Joe Karbo left, for all to share, the secret of "The Lazy Man's Way to Riches." The above story, which is in his own words, is his gift to you.

Because of the nature of this special offering, we can guarantee delivery *only* to the readers of this publication who respond within the next 10 days.

After that date, orders will be filled on a "first come, first served" basis as long as supplies last.

To order, write your name and address on the coupon and send it with your \$10 today.

Remember, the *only* way to guarantee prompt delivery is to respond *today*.

If you have any questions, you may call us at (714) 898-4357 during normal business hours. Make your check or money order payable to Financial Publishers.

©Joe Karbo - 1979, 17105 South Pacific, Sunset Beach, CA 90742

Sworn Statement:

"On the basis of my professional relationship as his accountant, I certify that Mr. Karbo's net worth is more than one million dollars."

Stuart A. Cogan

Bank Reference:

Bank of Westminster
8251 Westminster Avenue
Westminster, CA 92683

Financial Publishers
17105 South Pacific, Dept. 551-B
Sunset Beach, California 90742

You may be full of beans, but what have I got to lose? Send me The Lazy Man's Way To Riches. Enclosed is my check or money order *postdated* six weeks from today!

If I return your material — for any reason — within that time, return my uncashed check or money order to me. On that basis, here's my ten dollars.

Name _____
(Please Print Clearly)
Address _____
City _____
State _____ Zip _____

SORRY — NO COD'S
(All foreign orders please add two dollars)

How To Replace A Washer Drive Belt

A frequently asked question sent to PM's *Appliance Clinic* comes from owners of Whirlpool and Sears clothes washers: How can I replace a broken drive belt? The first step is to purchase a new drive belt from a Whirlpool or Sears appliance parts store. The part is No. 95405; it costs about \$6. Then, simply follow these steps:

1. Disconnect the washer from the electrical power supply. Also disconnect the water fill hoses leading to the machine. *Note:* If the belt broke during operation, remove by hand the water left standing in the tub.

2. Tilt the machine over onto its front panel. Be certain to place a rug or pad on the floor to protect the machine from scratches.

3. Remove the machine's rear service panel.

4. Next, loosen the nut holding the motor mounting bracket. Then slide the motor to the right to relieve the tension on the belt.

5. Slip the belt off the motor pulley and slide the motor to the left as far as possible.

6. Now, remove the three support braces attached to the gear case and base plate using a 1/2-in. socket.

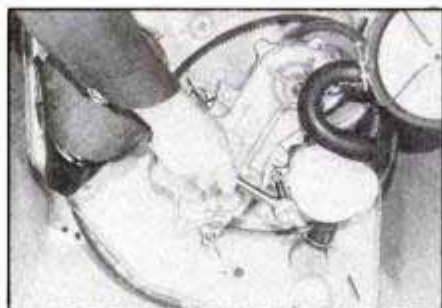
7. Next, unscrew the two pump mounting bolts. Then move the pump (with the hoses connected) away from the gear case.

8. Now, manually lift the spin solenoid plunger and begin turning the main drive pulley (the large pulley on the righthand side of the gear case). Continue turning the main drive pulley until the spin cam bar advances to the end of its travel and into the spin position.

9. Remove the clutch spring from the gear case.

10. Next, use a 5/16-in. socket to remove the one gear case mounting bolt that has a spacer. Remove the spacer and then loosen the two remaining gear case mounting bolts about seven turns. Now, pull the gear case down until it rests on the two loosened bolts. *Note:* On machines built after 1971, use a car battery terminal puller to push up the clutch shaft to remove the spin cam bar. On 1971 and earlier models, the clutch shaft can be pushed up by hand.

11. Attach the battery terminal puller to the gear case cover extension beneath the clutch shaft. Turn the puller screw until the shaft roller is high enough to clear the cam bar. Then use a screwdriver to pry the cam from the clutch shaft. Make certain that the plunger hasn't dropped into the



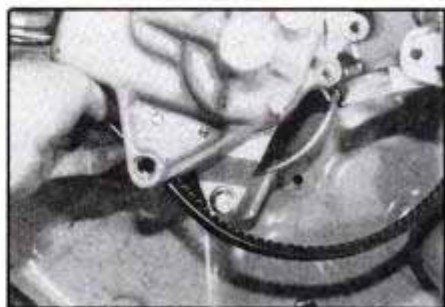
First, remove the two pump mounting bolts; then move pump away from the gear case.



Unscrew the gear case mounting bolt and remove the spacer (shown in right hand).



If necessary, you can use a car battery terminal puller to push out the clutch shaft.



Pass the belt between the yoke and clutch shaft, then through open spot left by spacer.

lower slot of the spin cam bar after turning the puller screw.

12. Loosen and remove the terminal puller. It will be used later to replace the clutch shaft during assembly.

13. Now, pass the belt through the space between the clutch yoke and the top of the clutch shaft, and then through the area from which the spacer was removed.

14. To install the new belt, first position it on the four pulleys. Again, use the battery terminal puller to push up the clutch shaft. Make certain that the belt is between the clutch shaft and the spin pulley. Then advance the cam bar back into its original position in the slot

of the clutch shaft. *Note:* A 5/16-in.-dia. steel ball is used with the T-bearing on later models. Also, in some models the clutch shaft adjusting nut is replaced with washers. In both cases, you should check to be certain that these parts are in place before reassembling the gear case.

15. Loosen and remove the terminal puller.

16. Replace the spacer, bolt and clutch spring.

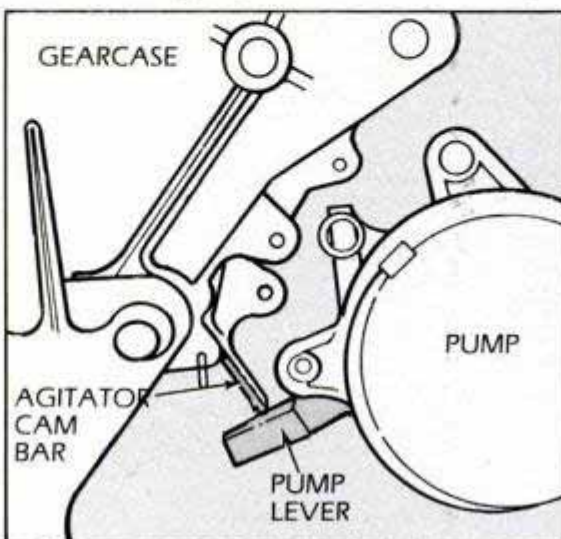
17. Next, replace the pump. Make certain that the pump lever is engaged in the notch of the agitator cam bar (see drawing) before tightening the pump to the gear case.

18. Reinstall the three gear case support braces.

19. Adjust the belt tension using pliers by pulling against the motor bracket. Then tighten the nut to hold the motor. A properly adjusted belt should have about 1/2 in. of play midway between the motor pulley and the drive pulley when a force of about nine pounds is applied.

Finally, replace the machine's rear service panel.

—Steve Toth



After replacing the pump, be sure the pump lever engages the notch in agitator cam bar.

Save Gas, Save Engine with 'POLY'

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

WHAT IS POLY? "Poly" is short for polytetrafluoroethylene (TFE). It is the slipperiest substance known to man (1981 Guinness Book of World Records, p. 188). The Petrolon Corporation, makers of Slick 50, has invented a way to permanently bind this slippery chemical to your engine with one treatment. All you do is add one quart of Slick 50 to your oil during oil and filter change. By reducing engine friction, Slick 50 increases gas mileage and horsepower and reduces engine operating temperature, thus causing your oil and engine to last longer. Just as important, it reduces metal wear, defraying costly overhauls.

HOW DO I KNOW THIS ISN'T A FRAUD? Slick 50 has some very impressive credentials. The "Consumers Digest" magazine (March/April, 1982, p. 35) states "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon." Researchers at the Franklin Institute Research Laboratory, after applying a powerful ultrasonic cleaning process to a Slick 50 treated engine, were surprised at its permanence. They stated, "We actually expected the Petrolon Slick-50 TFE Resin coating to also be removed, but later found it was still there."

The FAA (Federal Aviation Administration) has fully accepted Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). An FAA test simulating 1400 hours of engine use (equivalent to about 70,000 miles on a car) showed almost zero engine wear!

2500 miles after removing Slick 50 from the crankcase, lab tests at a leading university engineering experiment station showed that the benefits of Slick 50 were still there. They reported a horsepower increase of 16.9% and 9.9% for light and heavy loading respectively. The senior engineering researcher at the University of Southern California in San Diego stated this, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university." The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a tor-



ture test overseen by the Automotive Services Council for Pennsylvania and shown on television station WTVE. Three cars with between 75,000 and 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars were driven without the oil plugs for about a half hour. The water temperature never rose, and the engines sustained no apparent damage. There are many more tests available. If you are still skeptical, send \$2.00 to defray printing and postage costs, and we will send you additional, more detailed test information, etc.

HOW DO YOU TREAT AN ENGINE? Very simply. A few minutes before oil and filter change, add engine flush (sent free with each order) to clean out the engine. Let the engine idle for 10 minutes. Then drain the oil, change the filter, and add the proper amount of oil less one quart. Add one quart Slick 50, drive for 30 minutes, and leave it in the crankcase for 3,000 miles. As the engine operates, the oil carries the polytetrafluoroethylene between the parts where it is burnished into the pores of the metal. Once impregnated, it is permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4-, 6-, and 8-cylinder gasoline and diesel engines.

WILL IT WORK WITH MOST OILS? Yes, Slick 50 will work with all petroleum-based oils and all synthetics that are compatible with petroleum-based

oils. An exception is graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

WHAT ARE THE BENEFITS OF SLICK 50? Your actual benefits in percentages may vary, depending on the kind of driving you do, vehicle condition, weather, and geographic area. By reducing friction, Slick 50 does all of the following: It increases gas mileage. It increases horsepower—small economy cars and large RV's really need this! It reduces operating temperatures, thus increasing the lubrication and life of the oil and the engine. Last but not least, the drastic reduction in engine wear defrays or eliminates costly overhauls which could save you up to \$1,000. Slick 50 eliminates the "lubrication starvation" that all cars experience when first started before the oil has a chance to circulate. Up to 90% of the engine wear on a car can be caused by this lubrication starvation. You receive all of these benefits for \$34.95, less than the cost of two tanks of gas.

WILL SLICK 50 HARM MY ENGINE OR AFFECT MY WARRANTY? No! Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, Slick 50 is the only product of its kind to have both an API (American Petroleum Institute) and an SAE (Society of Automotive Engineers) rating imprinted on the package. It also has a SF-CC-CD service classification.

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

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

For purchase or further information, call toll-free 1-800-525-8624 (in Colorado call 1-303-762-1385) or send to SLICK 50, 3148 S. York St., Englewood, CO 80110.

I enclose \$34.95 + \$4.00 shipping and handling.
 I want 2 or more (free shipping and handling).
 Check C.O.D. Visa MasterCard
 Card No. _____ Exp. Date _____
 Name _____
 Address _____
 (Give street address if possible for UPS delivery)

Build A Carry-All Bike Cart

Save gas and keep in shape with PM's easy-to-build, tow-behind bicycle trailer.

TEXT AND PHOTOS BY GEORGE CAMPBELL



The lightweight, easy-to-handle bike cart shown above turns shopping into a healthy, gas-saving exercise. The cart features a quick-connect hitch assembly (far left) made from an air hose coupling, which is available at most auto parts stores. The axle assembly (left) is made from easy-to-find brass plumbing parts. Cart is of PVC pipe and rolls on two 20-in. bicycle tires.

Millions of Americans are gearing up for the bicycle-riding season. Bicycling saves gas and is healthy exercise, and now you can use your bike for lightweight hauling by building our carry-all cart.

This easy-to-build accessory is constructed of tough PVC plastic pipe, except for the galvanized metal draw bar leading from the bike seat post. The cart weighs less than 20 pounds, but will carry a 50-pound load easily. The most unique feature is the hitch assembly, which is made from a quick-connect air hose coupling. The cart snaps on and off the bike in seconds.

Begin by cutting the PVC pipe to the dimensions given in the materials list on page 66. Use a miter box to ensure square cuts. Note that 1/2-in.-dia. PVC is used for the upper frame and vertical pieces. The bottom frame is made with 3/4-in.-dia. pipe. Schedule 40 PVC pipe is recommended because of its light weight, strength and availability.

Schedule designations refer to the pipe's wall thickness. A Schedule 40 pipe has an outside diameter of .840 in., an inside diameter of .608 in. and a minimum wall thickness of .109 in.

Assemble the cart's bottom frame first (parts B, C, G, H, L in the materials list). Be certain to roughen the pipe ends with medium-grit abrasive paper before applying the PVC cement. Slide the pipe into the fitting while the cement is still wet, give the pipe a quarter-turn and let the joint set for about 30 seconds. Next, assemble the upper frame (parts E, F, I). Then screw the eight adapters (J) into the upper and bottom frames. Join the two frames with the four vertical pieces (D). Be sure to dry-fit the parts before cementing. Now make the draw bar (O, Q, N) of galvanized metal pipe. Attach the bar using an adapter (K) and close nipple (P). Paint the draw bar with white enamel to match the cart.

Begin building the axle assembly (A,

BB, K, R, S) by drilling out the shoulder of the compression sleeve fittings (S) with a 5/16-in.-dia. drill bit. Use a 5/16-in.-dia. x 27-in. steel rod for the axle (AA). Cut 3/16-24 threads, 3 1/2 in. long, onto each end of the axle. Note: The thread specified will work *only* on an American-made wheel.

Insert the axle through the bottom frame, add the compression fittings (S) and tighten the fitting caps securely. Screw on the inner bearing cone, slip the bearing over the axle and add the wheel (A). Repeat the same procedure for the outer bearing. Adjust the bearings to allow a small amount of play, then tighten the self-locking nut (BB).

Next, make the hitch assembly by drilling a 1/4-in.-dia. hole through the pipe cap (M). Attach the eyebolt (Y) with two nuts, then screw the cap to the draw bar. Spread the eyebolt enough to slip on the ring (W), then add the bushing (V) and the female air hose coupling

(Please turn to page 66)

Must Liquidate At Below Dealer Cost!



Factory New!
Factory Perfect!

GENUINE LEATHER ATTACHE CASE

The manufacturer over-projected sales and wound up with a surplus! Fortunately, we acquired a portion of the inventory and can offer these genuine leather cases to our customers at a low liquidation price!

Here's a fine quality leather attache case! It's a roomy 17" x 12" x 3". Plenty of capacity for carrying and protecting important papers, books, and miscellaneous items. Two large pockets allow you to organize contents into separate compartments for faster, easier retrieval.

Genuine leather exterior with rich burgundy finish. Doublestitched for added durability. Suede-like interior lining in dark gold. Sturdy folding hinges at two corners lock securely to keep lid firmly upright when in use.

- Two large pockets inside, 14 1/2" wide. Expandable to 1 1/2" on top.
- Two smaller front pockets, 5 1/2" wide.
- Brass-plated hardware (except for front pocket snaps).
- Two, 3-dial combination locks for security.

Retail Value
\$99.00
\$44
NOW

Item No. 8025
Ship/handling: \$5

90 Day
Warranty!

700 foot
range!

512
frequency
combinations
for maximum
privacy!

POLARA CORDLESS PHONE

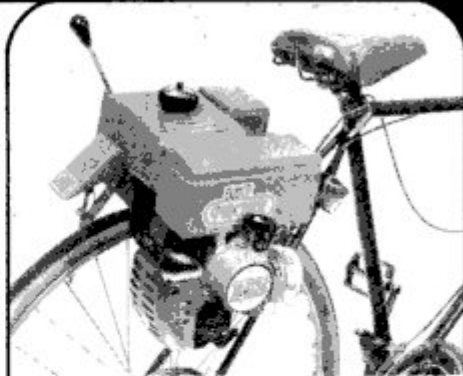
These high quality, cordless telephones were part of a surplus from a sales campaign of a major mail order firm. We've arranged to liquidate this excess inventory at big savings to you!

This cordless phone goes where you go! Out in the yard! To the garage! Next door! Down the street! This powerful unit allows you to make and receive calls up to 700 feet away from your own home!

It uses radio waves to transmit and receive, rather than wires. The Compact Base Unit plugs into your modular phone jack and standard 110V outlet. The Portable receiver works just like a regular phone, even for long distance calls! You can make calls from anywhere within the 700 ft. range! And if you're expecting a call but have house or yard work to do away from regular phones, take the cordless receiver with you. When someone calls, it rings!

- Maximum privacy with 512 frequency choices.
- Works on both rotary and push-button systems.
- Telescoping antenna for clear reception.
- Batteries in receiver automatically recharge when it's placed on base unit.
- Automatic re-dial button recalls the last busy number you tried to reach. It's a real time-saver!

Mfgs. List
\$129.95
\$59
NOW
Order No. 62190
Ship/handling: \$4.00



Powerful MITSUBISHI BIKE ENGINE

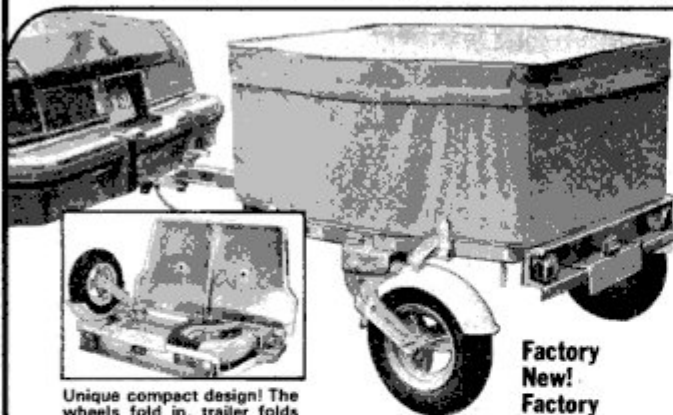
Factory New! Factory Perfect!

Because of a factory surplus, we can offer you this finely crafted, 1 1/2-hp. bike engine. It's a dependable product of world-renowned MITSUBISHI!

With this lightweight engine, you can add new distance and fun to bicycle riding! Pedal for the exercise. When you get tired, enjoy the ease of motorized power for assistance up hills, or cross-country. This "powerhouse" weighs only 15 lbs. and zips along at speeds up to 25 mph. Travel up to 40 miles on a single 1/3 gallon tankful of fuel (gas/oil mixture). Features include:

- Rear-mounted engine attaches securely with just simple tools.
- Spring tension on friction drive roller provides go-power to rear wheel.
- Fingertip throttle control on handlebar gives you quick, easy control of speed.
- Centrifugal clutch automatically engages or disengages for smooth, easy operation.
- 2 handy compartments. One for tools; one for pre-measured oil container.

Mfgs. List
\$269.95
\$88
NOW
Item No. 1751
Ship/handling: \$12



Unique compact design! The wheels fold in, trailer folds down like a suitcase!

Factory New!
Factory Perfect!

Portable! Stowable! Ideal for cars or motorcycles!

FOLDING TRAILER

A distributor's overstock now makes these strong, folding trailers available to you at an amazingly low liquidation price! This unique trailer can haul up to 300 lbs. And it assembles easily and securely WITHOUT tools!

Trailer includes a pair of sturdy wheels with inflatable rubber tires. Steel tongue for 1 1/2" trailer hitch. Brake lights, parking lights, turn signals, and license plate light. Plug-in electric cable for easy hookup to car. A Water-resistant, zippered nylon tarp. Quick-assembly tubular steel box frame. Elastic cord for strapping down cargo. Special metal rack for carrying two bicycles.

Designed for highway travel! Comes with the mfgs. statement of origin (title card) for license registration. Made of strong, yet lightweight aluminum. Has 40" x 43" deck, 18" box height, 36" overall height with wheels, 70 1/2" long with tongue. Weight at tongue is 73 lbs. Fits onto 1 1/2" trailer hitch ball. (Hitch ball unit not incl.)

Mfgs. List
\$595.00
\$166
NOW
Item No. 61723
Shipped freight collect



Credit card customers can order by phone, 24 hours a day, 7 days a week.

Toll-Free: 1-800-328-0609

If busy signal, or if no answer, call:

Toll-Free: 1-800-328-5727

In Minnesota, call: **1-800-742-5685**

C.O.M.B. Co.

The Nation's LARGEST Liquidator!

14605 28th AVENUE NORTH
MINNEAPOLIS, MINNESOTA 55441

SEND ME THE ITEMS I HAVE LISTED BELOW

(All prices subject to change after 60 days.
Offers void outside original 48 states.)

Item No.	How Many	Item	Ship/Handl.	Price

C.O.M.B. Co. / Liquidators Dept. X-103
14605 28th Avenue N. / Minneapolis, Minn. 55441

Send the items indicated at left. (Minnesota residents add 6% sales tax. Allow 3-4 weeks for delivery. Add 2-3 weeks extra if paid by check. Sorry, no C.O.D. orders.)

My check or money order is enclosed.

Charge my: MasterCard® VISA Am. Ex. Diners Club

Acct. No. _____ Exp. _____

PLEASE PRINT CLEARLY

Name _____

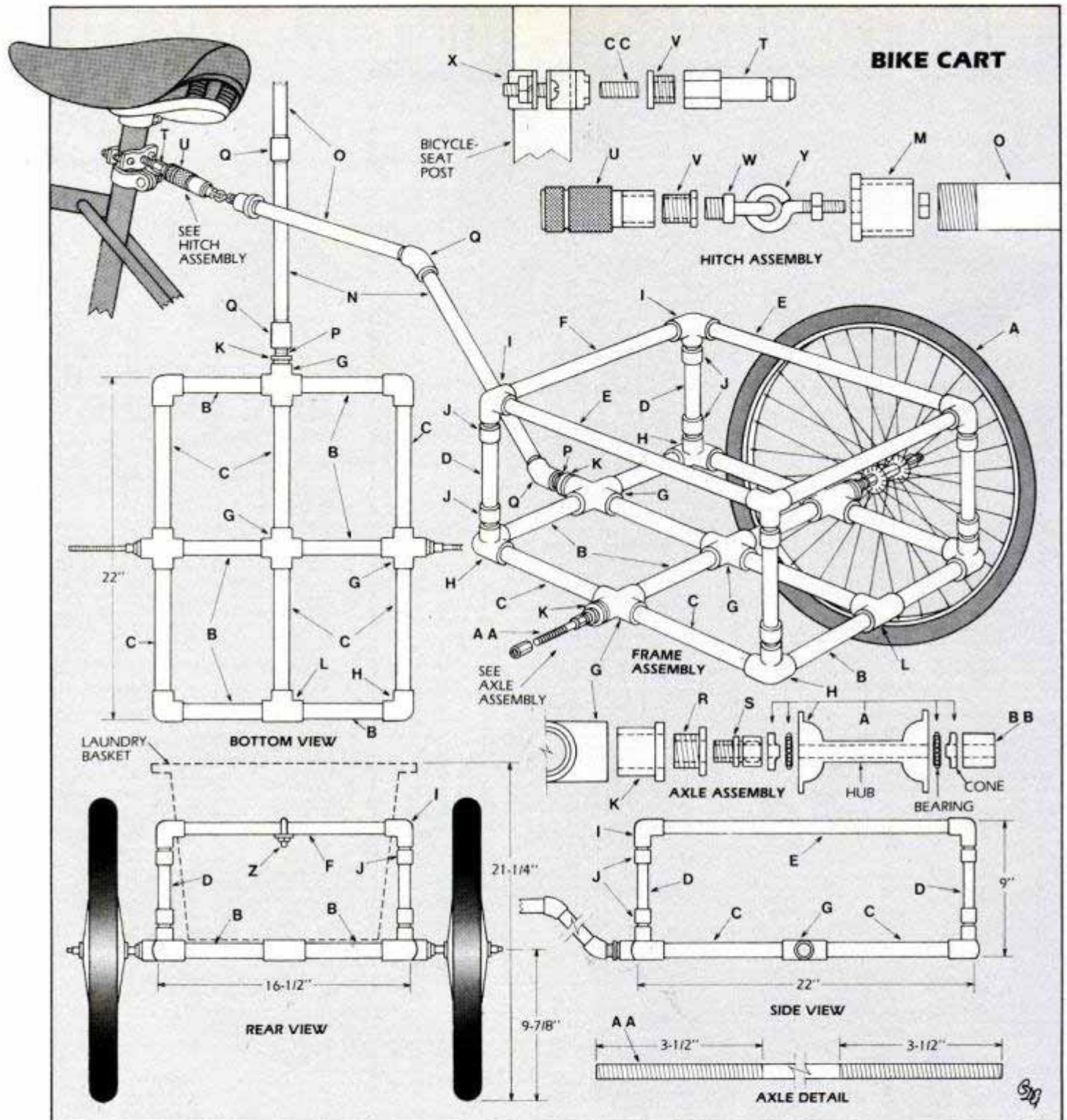
Address _____

City _____

State _____ ZIP _____

Phone _____

Sign Here _____



BUILD A BIKE CART

(Continued from page 64)

(U). Make the hitch bracket from a self-piercing tee (X). Remove the tee's valve to expose the 1/8-in.-dia. pipe threads. Screw the close nipple (CC) into the tee and bolt the bracket to the seat post.

Next, attach a plastic laundry basket to the cart using two U-bolts (Z). Be sure to put a steel support plate under the nuts. To hitch the cart, slide back the coupling sleeve (U) and push it onto the seat post connector (T). Pull back on the sleeve to release the cart. **PM**

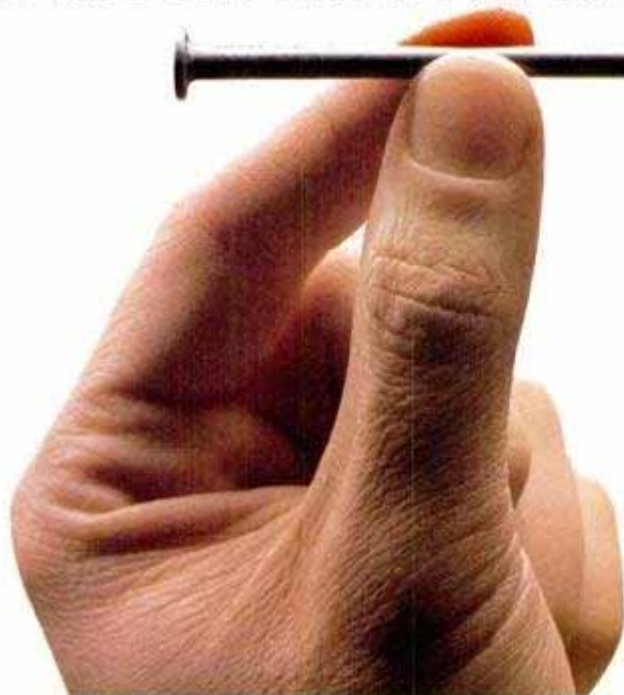
MATERIALS LIST—BIKE CART

Key No.	Size and description (use)
A	2 1.75 x 20" front bicycle wheel, tire and hub with bearings
B	6 3/4"-dia. x 6 1/4" PVC pipe
C	6 3/4"-dia. x 9 1/2" PVC pipe
D	4 1/2"-dia. x 4 1/2" PVC pipe
E	2 1/2"-dia. x 20 1/4" PVC pipe
F	2 1/2"-dia. x 13 1/2" PVC pipe
G	4 3/4"-dia. PVC cross
H	4 3/4"-dia. PVC elbow with 1/2"-dia. FPT riser
I	4 1/2"-dia. PVC elbow with 1/2"-dia. FPT riser
J	8 1/2"-dia. x 1/2" MPT PVC adapter
K	3 1/2 x 3/4"-dia. FPT PVC adapter
L	1 3/4"-dia. PVC tee
M	1 1/2"-dia. galvanized metal pipe cap
N	1 1/2"-dia. x 24" galvanized metal pipe
O	1 1/2"-dia. x 18" galvanized metal pipe
P	1 1/2"-dia. galvanized metal close nipple
Q	2 1/2"-dia. galvanized metal 45° elbow

R	2 1/4" FPT x 1/2" MPT brass bushing
S	2 1/4"-dia. MPT x 5/16" compression sleeve tubing fitting
T	1 Male quick-connect air hose coupling with 1/4"-dia. FPT
U	1 Female quick-connect air hose coupling with 1/4"-dia. FPT
V	2 1/8 x 1/4" brass bushing (lamp part, available at hardware store)
W	1 1/8"-dia. threaded ring (lamp part for hanging chandeliers)
X	1 3/4" self-piercing plumbing tee (remove needle valve to expose 1/8"-dia. female threads)
Y	1 1/4"-dia. eyebolt with two hexnuts
Z	2 1/4"-dia. x 1" U-bolt with two hexnuts and metal support plate
AA	1 5/16"-dia. x 27" steel rod
BB	2 5/16"-dia. self-locking nut
CC	1 1/8"-dia. close nipple

Misc.: PVC cement, sandpaper, laundry basket.
 Note: Use Schedule 40 PVC pipe throughout.
 *FPT: Female pipe threads; MPT: male pipe threads.

ONE THING YOU'LL NEVER FIND IN A DISCOUNT STORE.



Sure, discount stores carry hardware like nails, nuts and bolts.

Trouble is, you have to buy them in packages of 20, 30, or more. And usually in only one size.

But at Sentry Hardware, you can buy exactly as much hardware as you need. From one nail to fix your child's toy, to hundreds of nails to fix up your rec room.

Our sales clerks can even help you decide what's needed for your specific job.

So next time, shop Sentry. No one can sell you more hardware.

Or less.



Where hardware isn't a sideline.

Check the Yellow Pages under Hardware for the Sentry store nearest you. Sentry Hardware Corporation, Cleveland, Ohio 44113. Merchandise shown in this advertisement is available from participating dealers only. Offer expires May 31, 1984. All Sentry dealers own their own stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores.

MACCO
11 oz. Liquid Nails®
(LN-601-S) \$1.09

WD-40
WD-40® 9 oz. Can
(40011) \$1.49

WISE-GRIP
Vise-Grip® 6" "C" Clamp
(6 SP) \$6.66

kwikset
Door Set II
(690TXUS) \$13.99

Disston
Cordless Grass Shear
w/Free 24" Lawn Rake
(EGS-1P) (D24P-P) \$27.77

PARAMOUNT
14" String Trimmer
w/1¢ Replacement Spool
(SK140-01) (5165)
\$43.88 + 1¢ Sale

shop-vac
6 Gal. Vac
w/Free Accessories
(700-02-62) \$54.88

McCULLOCH
Gas String Trimmer
(MAC 60A) \$99.95

Warp's
10' x 25' Coverall,
Clear or Black
(12-4CH10) (12-4CH10B) \$4.99

3M
Sandpaper XF, F, M, C
(9000 thru 9003) \$1.19 Per 5 Pack

VERMONT AMERICAN
7-7/16" Carbide Blade
(150)M73714) \$4.44

SKIL
Cordless Screwdriver
(2000) \$29.99



Ford Escort



Ford LTD



Ford Country Squire



Ford Club Wagon

S, M, L, XL.

Ford people carriers come in four of the most popular sizes.

Ford Escort. A small wonder.

There's plenty to like about Escort, the best-selling wagon in America.* With front-wheel drive, four-wheel independent suspension and rack and pinion steering, Escort commands an easy confidence on the road. And Escort's unique CVH engine gives a performance with just the right amount of dash. Fold down the rear seat and you've got 58.4 cu. ft. of cargo space to fill as you like.† Escort Wagon. It's a small wonder.

*Based on most recent R. L. Polk & Co. registrations for '85 model year.

Ford LTD Wagon. Comfort and practicality.

From the smooth lines of its hood to an optional 2-way liftgate that makes loading and unloading easy, LTD Wagon has been designed for comfort, convenience and practicality. Inside, there's a spacious, well-appointed interior that offers 75.4 cu. ft. of

cargo room with the rear seat down.‡ And when you add an optional towing package, LTD Wagon pumps up its muscle to haul up to 3,500 lbs. That's power. That's LTD Wagon.

Ford Country Squire. Luxury at work.

Country Squire is the luxury wagon that's not afraid of hard work. Rich interior appointments, a 3-way Magic Doorgate and Automatic Overdrive Transmission are harnessed to a responsive 5.0 liter electronic fuel injected V-8 engine. When properly equipped, Country Squire can pull up to 5,000 lbs. And Country Squire has a work space that can take on 89.4 cu. ft. of cargo.‡ Add the optional dual facing rear seats and carry eight passengers comfortably in Country Squire luxury.

‡Based on EPA Interior Volume Index.

Ford Club Wagon. The winning club.

Handle big families

or big loads with spacious Ford Club Wagons that let you seat up to 12 people...15 in the Super Wagon. Roomy and comfortable inside, Ford Club Wagons generate power and performance under the hood, thanks to the standard 4-speed manual transmission with overdrive 4th gear.

Need an extra measure of power for heavy hauling? Properly equipped, Ford Club Wagons can tow up to five tons. That's strength you can rely on. And Twin-I-Beam independent suspension, a Ford innovation, helps take the bounce and jostle out of bumpy roads. For toughness, comfort, roominess and design, choose Ford Club Wagon.

Best-built American cars.

When we say "Quality is Job 1," we are talking about more than a commitment. We are talking about results. A recent survey concluded 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. And that commitment continues in 1984.

See the Ford people carriers at your nearest Ford Dealer. And try one on for size.

Get it together—
Buckle up.



As part of Ford Motor Company's commitment to your total satisfaction, 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.

Have you driven a Ford...
lately?





**Come to where
the flavor is.**



**Marlboro Red or Longhorn 100's—
you get a lot to like.**

17 mg "tar," 1.1 mg nicotine av.
per cigarette, FTC Report Mar. '83

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

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SCIENCE GOES TO BAT

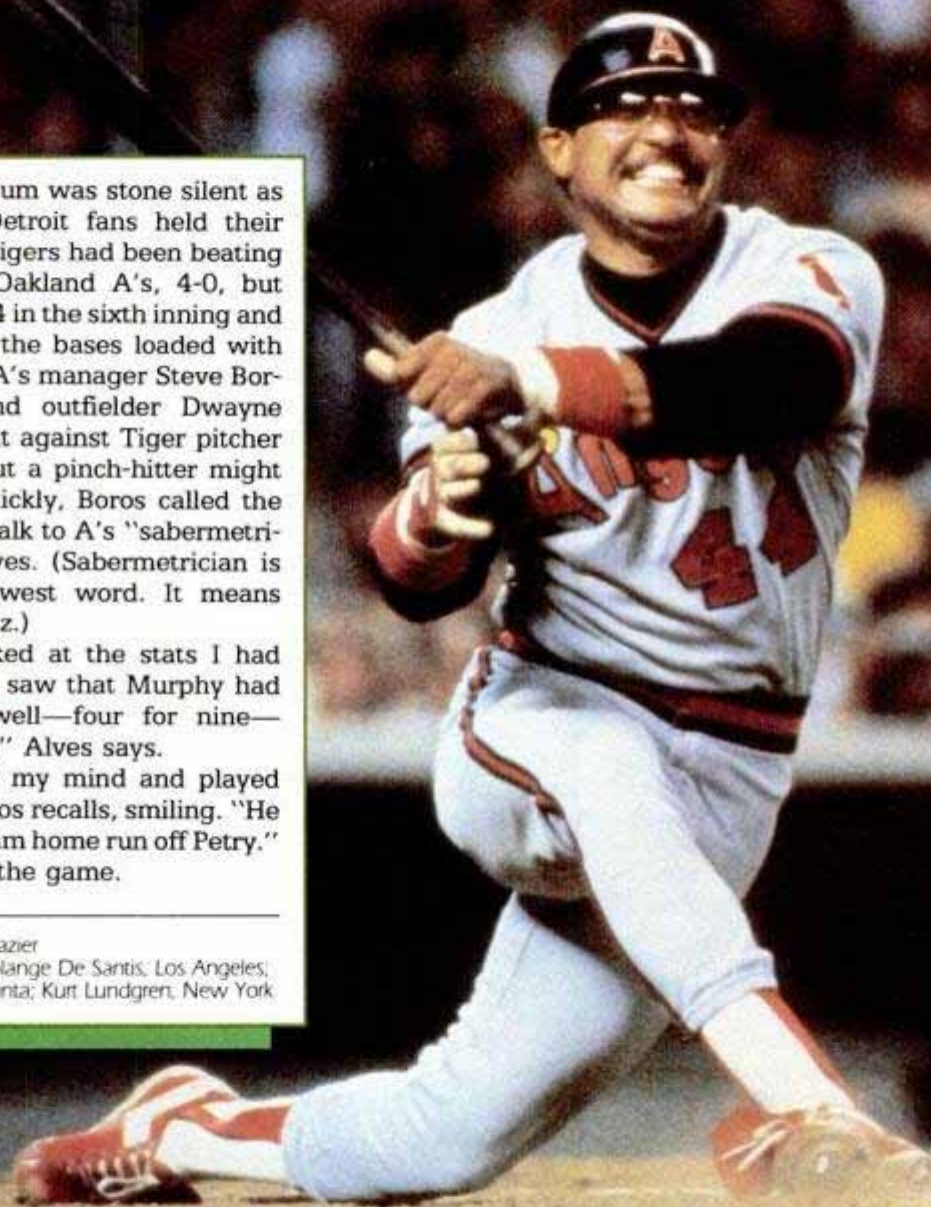
To win a pennant, you need strong pitching, good defense and solid hitting. And major league teams are learning that technology helps, too.

Tiger Stadium was stone silent as 28,536 Detroit fans held their breath. The Tigers had been beating the visiting Oakland A's, 4-0, but now it was 4-4 in the sixth inning and Oakland had the bases loaded with just one out. A's manager Steve Boros could send outfielder Dwayne Murphy to bat against Tiger pitcher Dan Petry, but a pinch-hitter might do better. Quickly, Boros called the press box to talk to A's "sabermetrician" Jay Alves. (Sabermetrician is baseball's newest word. It means computer whiz.)

"Steve looked at the stats I had compiled and saw that Murphy had done quite well—four for nine—against Petry," Alves says.

"I changed my mind and played Murphy," Boros recalls, smiling. "He hit a grand-slam home run off Petry." The A's won the game.

Written by Jack Grazier
Correspondents: Solange De Santis, Los Angeles;
Jack Messmer, Atlanta; Kurt Lundgren, New York



Angel outfielder Reggie Jackson takes a home run stride. The Angels and most other clubs are using videotape (sequence

above) to help build a hitter's confidence. Jackson videotape depicts components of his swing for study by scouts and coaches.

Winning baseball games is quickly becoming as much a high-tech pastime as it is an art and science. And the evolving baseball lexicon tells the story eloquently. Sabermetrician derives from the acronym for Society for American Baseball Research (SABR).

Add to that Cybex, Doppler radar, diode-equipped eyeglasses, sensory deprivation chamber, twin-wheel pitcher and video analysis and you have the makings of pennant race, 1984-style.

The electronic coach

"For me, the computer is like a sixth coach," says Dave Johnson, who brought his own computer with him when he took over the managing duties of the New York Mets this season. And that sums it up for many major league managers. As spring training got under way this year, more than half of the 26 teams in the big leagues had a computer connected to the dugout.

The Oakland computer stays in the press box and the New York Mets' terminal will sit in the locker room. But some baseball managers are warming up to the electronic brain in the extreme. At Dodger Stadium, a place has been set aside between the water cooler and the bat rack for a computer setup that will give manager Tommy Lasorda instant access to his sabermetrician.

In baseball, statistics have always been an integral part of the game, but never so much as they are today with the advent of the personal computer. Teams are keeping scouting reports, batting averages and other data to help decide everything from who will start tomorrow's game to the name of the player to be picked in the draft.

The Major League Scouting Bureau, which reports on over 2,000 prospects every year to 16 major league clubs, transmits its data daily via computer. Players from high schools and colleges are graded from one to eight, a five being the cutoff point that often determines whether a team will pick up a prospect. By the end of this season, all 26 clubs will be online.

If it's a game of numbers, baseball is also a game of the heart, and even the best sabermetrician can't account for everything that happens after the ump shouts: "Play ball!" Consider the Chicago White Sox, who used a computer throughout the 1982 baseball season.

It told them that 50 of the 83 fly balls

hit to the Comiskey Park warning track were hit by White Sox players. In 1983, the White Sox moved home plate 8 feet closer to the outfield wall. The idea bombed. The White Sox home run output in '82 was 136. It dropped to 128 in 1983.

Another case of the human aspect of baseball computers is made by the San Francisco Giants, who plan to equip every player with a personal computer by the end of this season. Gary Iacini, the Giants' associate athletic trainer, says the players will keep tabs on their own statistics. But more important, they will play video games. Iacini says video games improve hand-eye coordination.

Space invaders and sluggers

Donald S. Tieg of the Connecticut-based Institute for Sports Vision says the athletes with the best hand-eye coordination are video game freaks. He bases his conclusion on studies of over 300 major league ballplayers.

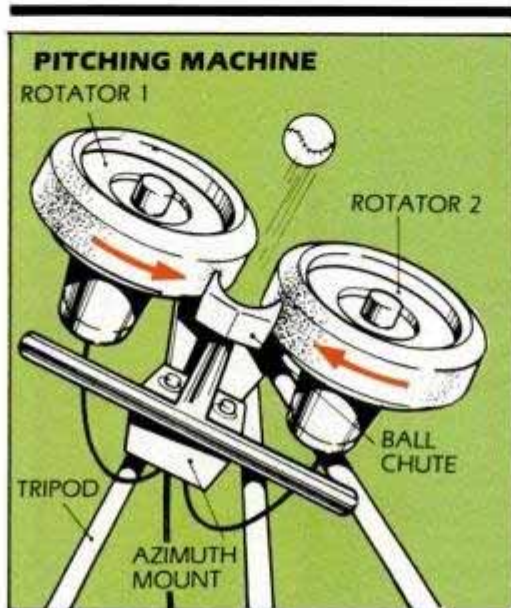
If computers have found their way into the dugout, a new machine called Cybex is finding its way into training rooms in an even more spectacular way. The machine, which looks like a computerized dentist's chair, measures strength and torque in a player's arm. The player sits in the chair and pulls on the Cybex "isokinetic strengthening lever." As he raises the arm, rotates the shoulder and lets go with the force he'd use in throwing, the Cybex uses electronic sensors to determine the speed and degree to which his muscles are tightening and loosening. Graphs that read like EKGs and computer graphics provide a picture of the maximum amount of resistance that the player

can handle in any joint or muscle group. In training with the Cybex, an injured player can learn to alter his throw to accommodate the injury. A healthy player can alter his throw to prevent injuries.

The Pittsburgh Pirates crow loudly about their Cybex. Pitchers Jim Bibby and Don Robinson say the machine has been instrumental in keeping them on the mound.

"The main reason why I got back again in '82 was because of the Cybex," says Robinson. "And if I come back in '84 after my shoulder operation it will be only because of that machine." Robinson had arm surgery in 1981 and again last year, the latest to remove scar tissue hampering full rotation of his pitching shoulder.

Steve Dickoff of the Jack Failla Sports Clinic in Pittsburgh



Varying the speed of rotators and changing angles on azimuth mount produce curves and knucklers.



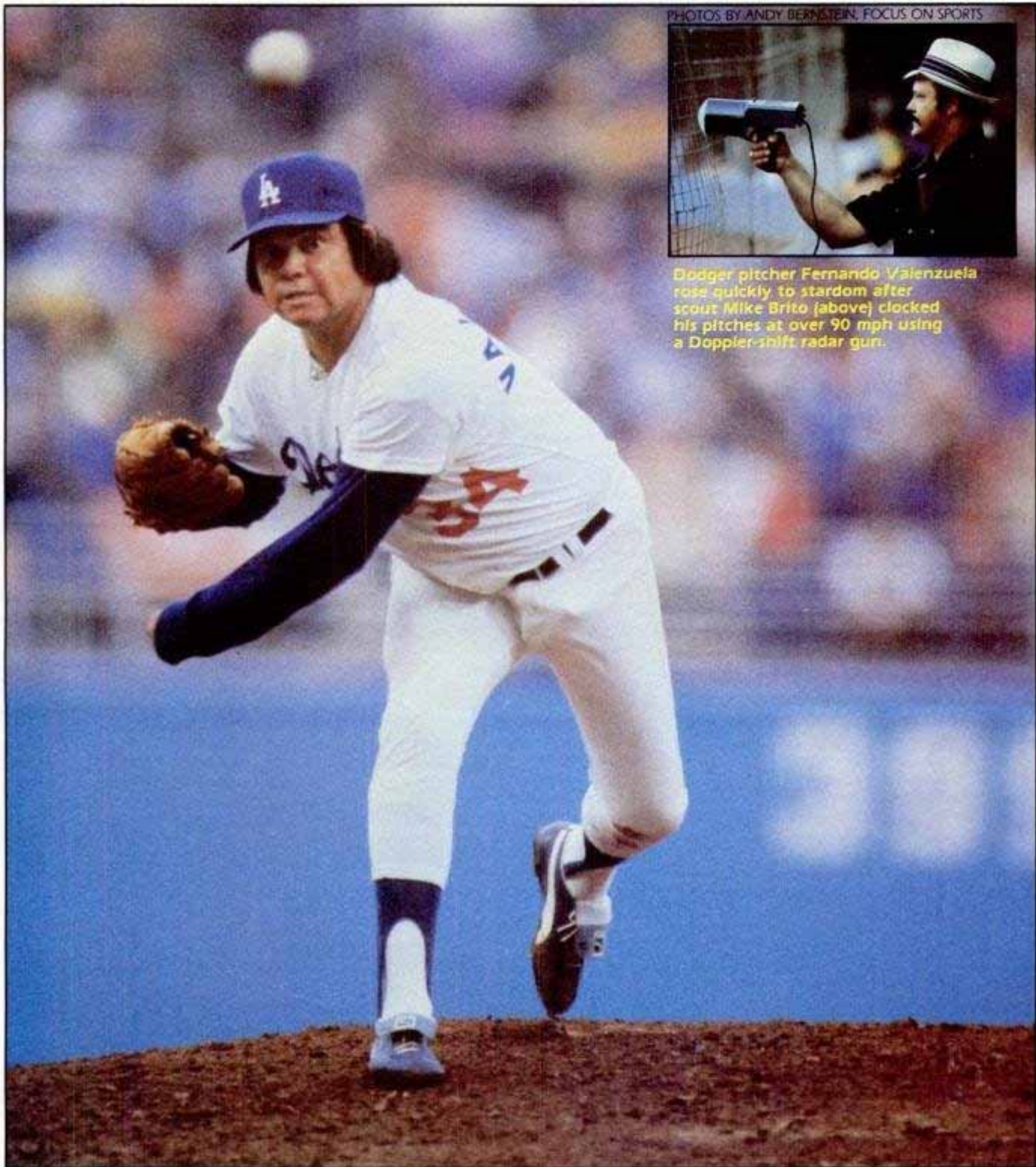
Former Yankee batting coach Charley Lau feeds a baseball into a twin-wheel pitcher. The machine throws all the major league pitches with extreme accuracy.



In Yankee Stadium's batting cage, Don Baylor takes winter practice. Steve Kemp and Willie Randolph also practice with the twin-wheel pitching machine.



A coach feeds a baseball into a catapult-type pitching machine at Phillies spring training camp. The "Iron Mike" sees limited duty because it only throws fastballs.



Dodger pitcher Fernando Valenzuela rose quickly to stardom after scout Mike Brito (above) clocked his pitches at over 90 mph using a Doppler-shift radar gun.

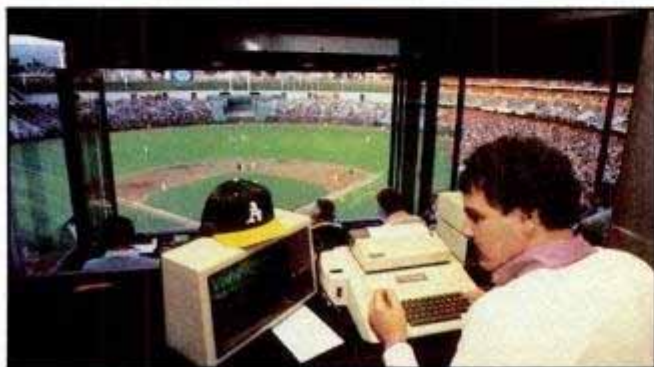


PHOTO BY TOM ZIMBEROFF, GAMMA LIAISON

"Sabermetrician" Jay Alves studies stats. Oakland A's manager Steve Boros credits computer whiz with helping win a game.

says of Robinson: "We want the right side at least 20 percent stronger in all major muscle groups compared to the left side. In a normal individual, the dominant side is 15 percent stronger. With a major league pitcher, we want excessive strength on the dominant side."

The Philadelphia Phillies have a Cybex connected to the team computer to help make on-the-field decisions about when a pitcher is ready to come out of a game. The Atlanta Braves, Minnesota Twins and Montreal Expos have a special Cybex with a "Sagedahl Axis."

The axis, named for University of Minnesota pitching coach Steve Sagedahl, adds a second lever to the Cybex. With it, complex motions of the wrist, arm and shoulder can be measured more accurately. It's being used to help pitchers determine how to throw their fastest.



Camera picks up Gaylord Perry, noted spitballer, rubbing hair before pitch.



Perry touches the bill of his cap, as if he's wiping off an illegal foreign substance.



PHOTOS BY RICHARD PILLING, FOCUS ON SPORTS

He goes into his motion, then hurls what looks like fastball, but drops like spitter.

The Dark Science Of Baseball

Ancient chemists had their necromancers and Jekyll had his Hyde. So it is with baseball, described by Ted Williams as "the physical science." There's a dark side to the science of baseball. Major league clubs have been known to fix the ball so it can't be hit, tamper with the bat to propel the ball farther and manicure the field so that only a member of the inner circle could know where a ball will bounce.

The most obvious of the dark sciences involves doctoring the baseball. Pitchers do it all the time to make the ball play tricks no batter can figure out. Most popular is the spitball.

Mechanical engineer Jay Hook, who won't say whether he threw a spitball when he was a member of the New York Mets in the early 1960s, says the spitball takes advantage of the most basic law of baseball physics. When a baseball is thrown, a layer of air molecules builds up around the porous hide of the ball. This "boundary layer" controls the direction in which the ball falls or breaks.

"If you put a slippery substance on your fingertips and throw a fastball, you get a slight over-rotation," Hook explains. "This shifts the boundary layer and the ball sinks quite unexpectedly."

The best known spitballer is Gaylord Perry, who drew an American League reprimand last year when a book he wrote described the throwing of the spitter, which was outlawed in the 1920s.

Doctoring the bat is quite another matter. The rule book says a bat has to be made of a single, continuous billet of wood with no filling inside. Several major leaguers have taken to gouging 6-inch sections out of the core of their bats, filling them with sawdust or cork and puttingty over the illegal contents. This way, the player gets a lighter, more resilient bat.

In 1974, Yankee third baseman Graig Nettles was thrown out of a game when his bat broke and debris came flying out. The Yankees were again embroiled in controversy last year when they protested a home run hit by Royals third baseman

George Brett. His bat had sticky pine tar up to the barrel. That tar gives the hitter extra grip, and it's allowed on the lower bat only. The home run at first was disallowed, then later re-entered into the record books.

The infield in most major league parks is watered and graded to give the advantage to the home team. A good bunting team will have the infield slightly muddied and the foul lines graded so a bunt will roll dead and stay in fair territory. No major league team will own up to field doctoring. But one former groundskeeper grudgingly admitted he'd seen other teams do it.

—John Kreiser and Dennis Eskow



PHOTO BY BILL LYONS



PHOTO BY THE LOS ANGELES DODGERS

Sports medicine expert Jack Falla tests the arm of Pirate pitcher Jim Bibby on the Cybex, a machine that measures muscle strength (far left). At left, Dodger pitching coach Ron Perranoski reviews a videotape with former Los Angeles pitcher Dave Stewart.

"Give me an athlete who wants to work toward ungodly speeds of movement under control, and I'll do it for him," Sagedahl boasts.

For those who already possess ungodly speed, there's nothing quite like the radar gun to establish a major league career or save an arm.

Fernando Valenzuela, the thick-set Mexican pitcher who was Rookie of the Year in 1981 with the Dodgers, was practically launched into the big leagues on a radar beam. Noted more

for the sharp break in his slider than for the speed of his fastball, Valenzuela nevertheless was clocked on occasion at 90 mph by scout Mike Brito, who discovered him. Most of the time opposing batters don't see quite as much heat as that from Valenzuela, but the high figure put the icing on the cake as Brito convinced the Dodgers to sign the pitching star.

The most popular radar device in baseball today is the Jugs gun, now owned by 18 clubs. Point the gun at a

player no more than 200 yards away and it fires a radar beam that strikes the baseball in flight. The ball reflects the beam back to the gun whose microprocessor determines the difference in frequency of the beam that left from the one that returns. That's called Doppler shift, a change in the radar beam's wavelength that the microprocessor translates into miles per hour for the ball.

In addition to using it to monitor the
(Please turn to page 220)

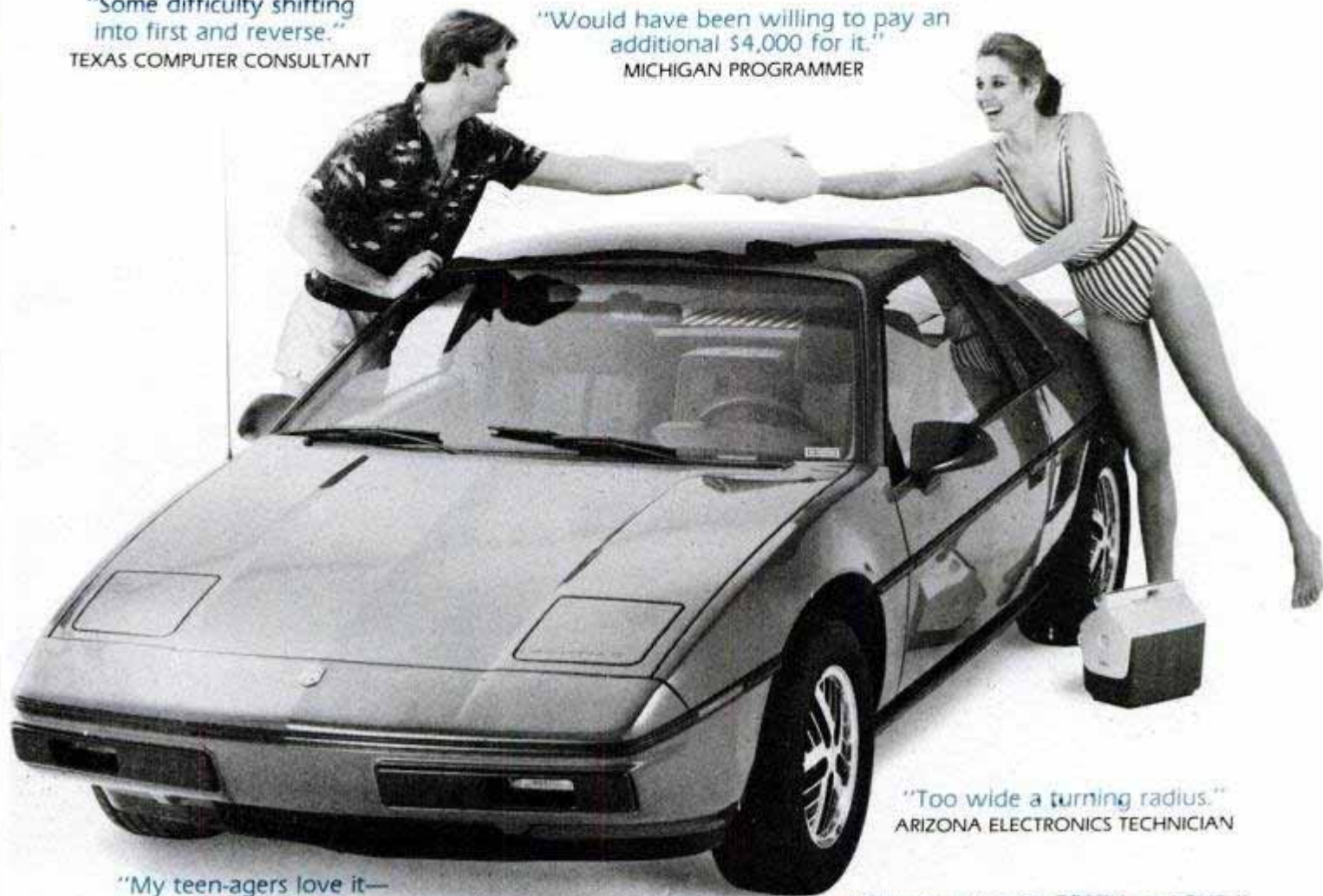
PONTIAC FIERO 2M4

"Some difficulty shifting into first and reverse."

TEXAS COMPUTER CONSULTANT

"Would have been willing to pay an additional \$4,000 for it."

MICHIGAN PROGRAMMER



"Too wide a turning radius."
ARIZONA ELECTRONICS TECHNICIAN

"My teen-agers love it—have to make an appointment to drive it myself."

ALABAMA REGISTERED NURSE

"19 mpg is rather disappointing."

CALIFORNIA CORPORATE VP

"Classier than the 280ZX and RX7."
NEW YORK ENGINEER

PHOTOS BY BILL ASHE

Many owners ordered Fieros sight unseen. And they weren't bothered by early production kinks.

Owners confessed to falling head over heels in love with the Fiero's styling, often before even seeing an actual car. Looks ranked No. 1 as the reason for buying, hotly pursued by price, patriotism, economy and handling, in that order.

"I saw pictures of the Fiero months before it went on sale," said an Ohio steelworker, "and instantly fell in love with the car. It's exactly the kind of two-seater I wanted. Besides, it's made in the U.S.A!"

A Colorado businessman: "Call it love at first sight, but back in August



Fiero owners praised the interior layout, but criticized the lack of power steering and difficult shifting into lower gears.

'82, up in the Rockies, I happened to come across a Fiero being tested during Pontiac's engineering shakedown. I ordered my car right after that without knowing what the price would be."

A Texas computer engineer: "It's the

sportiest *inexpensive* car around. It costs less than a Camaro, Trans Am or Mustang. On top of that, it's loaded with new technology, gets good gas mileage and is made in America."

"It's what the 1984 Corvette should have been," wrote a Michigan artist. "The Fiero's styling makes a more powerful statement than anything else on the road. My friends at GM say the Fie-

A NATIONWIDE SURVEY
BASED ON 863,922
OWNER-DRIVEN MILES

ro has outrageous potential, part of which will become evident in 1985."

Many owners noted the styling link between the Fiero and the Corvette—

(Please turn to page 203)

GM's NEW C-CARS:

Front Drive Hits Top Of The Line



BUICK ELECTRA T-TYPE

GM's big-car divisions downsize top models, but not so you'd notice.

BY WADE HOYT
Auto Editor and
DANIEL CHARLES ROSS
Detroit Editor

Photos by Randy Leffingwell

The new Buick Electra and Park Avenue, Oldsmobile Regency and 98, Cadillac Fleetwood and DeVille represent a new mindset at GM. These big luxury models are among the very last to receive attention from the downsizing surgeon's

scalpel. They are lighter by about 500 pounds and shorter by almost a foot than their rear-drive forebears. Prices will be in the range now occupied by the current-model cars: Expect C-body stickers to be in the \$13,000 to \$18,000 ballpark.

The Cadillacs show the biggest change—26 in. shorter and 640 pounds lighter than their rear-drive namesakes. This translates into much improved fuel economy ratings (we recorded 20.4 mpg on a 200-mile jaunt across flat Florida highways). The turning circle is 2.4 ft. less, as well, which should be noticeably welcome. And although the Caddy trunk is now down about 5 cu. ft. in total volume, the new trunk has a standup spare and gives much more usable room than the older models.

Whether or not this all will fly in

the showroom remains to be seen. As one wise guy said: "That's the new Fleetwood? Where did the rest of it go?" Obviously a big-car fan.

A Cadillac spokesman said that they intend to sell the old rear-drive models side-by-side with the new front-drivers "at about the same price, for as long as there is demand for the bigger cars." The new C-cars have the ride and luxury of cars in this class, without the high price of the foreign competition.

These companies know that hard cornering is not what their customers do much, so suspensions are tuned for the ultimate in smoothness. These are fully luxurious, well-thought-out automobiles of pleasing form as well as function. You barely know you are driving them; even the steering input required for curves is effortless.



CADILLAC FLEETWOOD



OLDSMOBILE REGENCY



The Buick lineup includes the popular Park Avenue plus the Electra 300, 380, 430 and T-type. The numerical designations represent Buick's engine options. The 3.0-liter V6 is available only in the Electra and is standard; the 3.8-liter V6 is available for Electra and standard on Park Avenue and Electra T-type; Oldsmobile's 4.3-liter V6 diesel is an option on both the Electra and Park Avenue.

Oldsmobile's Regency and 98 get the same engines, plus standard electronic ride height control.

Cadillac offers the Olds diesel or a 125-hp, 4.1-liter gasoline V8. All C-cars come with a four-speed automatic overdrive transmission.

All models of the C-body will be available as two-door coupes or four-door sedans, except at Cadillac, where the Fleetwood (which is virtu-

ally identical to the Sedan de Ville) comes as a four-door only. Although most models are called "full six-seaters," the unhappy sixth party must straddle the gap in the split front bench and wedge his torso between safety belt anchors that are only 7 in. apart.

There are distinct features on all three versions of the car. In a design borrowed from Saab, the Buick's hood opens by sliding forward a few inches, then pivoting up at the front. The Buick and Olds have little sun shades that pull out of the visors to block the annoying gap at the mirror. To facilitate servicing, Buick's taillights unlatch and flip upward on top-mounted hinges. Cadillac has many electronic innovations, along with the only V8.

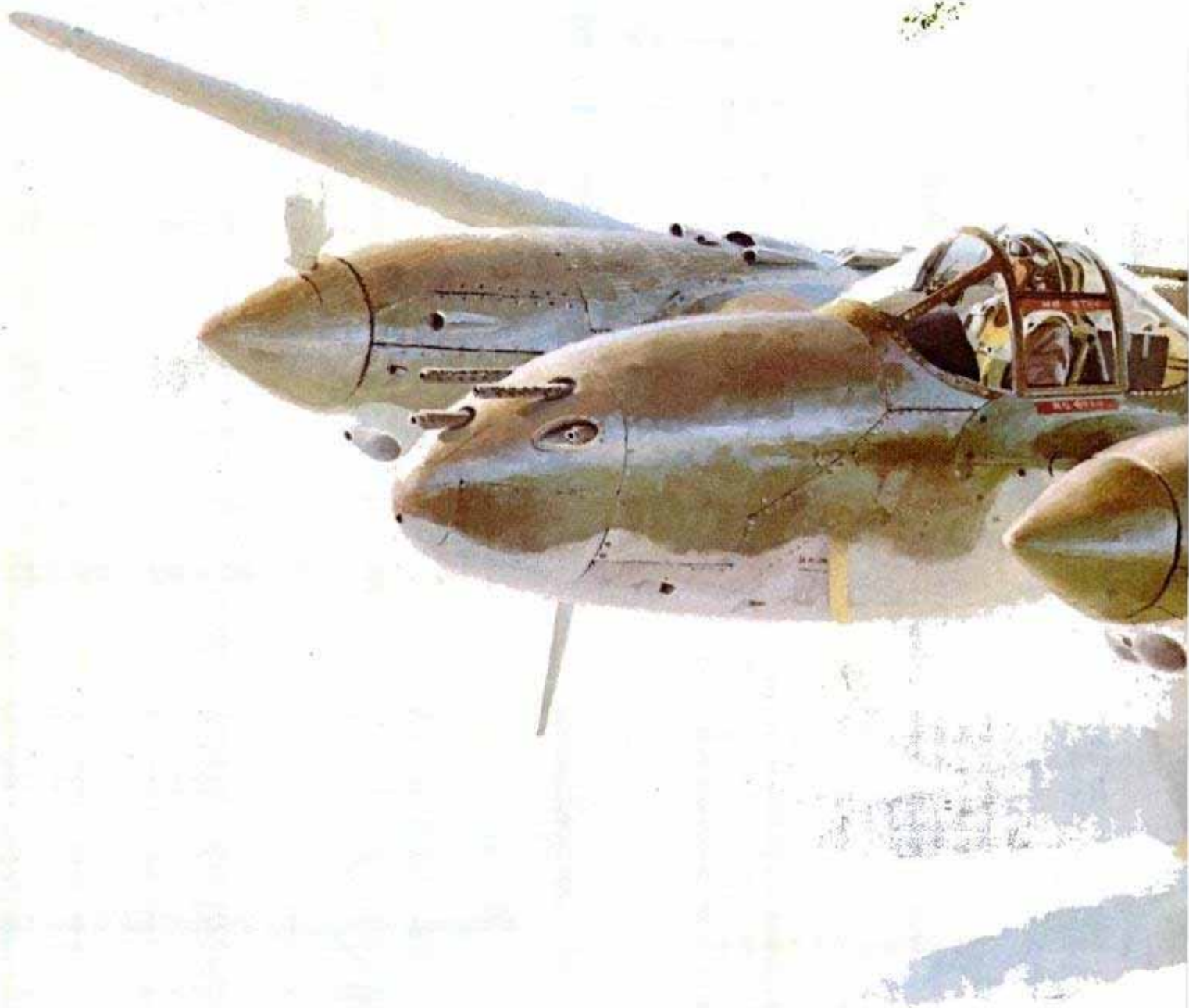
Buick's Electra T-type is the most

styling cues from the bigger, rear-drive versions are carried over on each division's cars. The trunks are smaller, but more usefully rectangular, while the spacious interiors will seat six in a pinch or five in traditional comfort.

fun of the lot. Adorned with blackout trim and dark gray metallic paint, it is the best-looking model. Its suspension receives a gentle firming up and quicker steering, which is a real improvement over the standard boulevard fare. Buick promises 12.5-second 0-to-60-mph runs. After a few tries, we had it down to 11.8 seconds. The T-type is powered by the 3.8-liter Six with multiport fuel injection, developing 125 hp and 195 lbs.-ft. of torque.

For passenger comfort, the C-body designers have done well. For appearance and driveability, I give them an-

(Please turn to page 200)

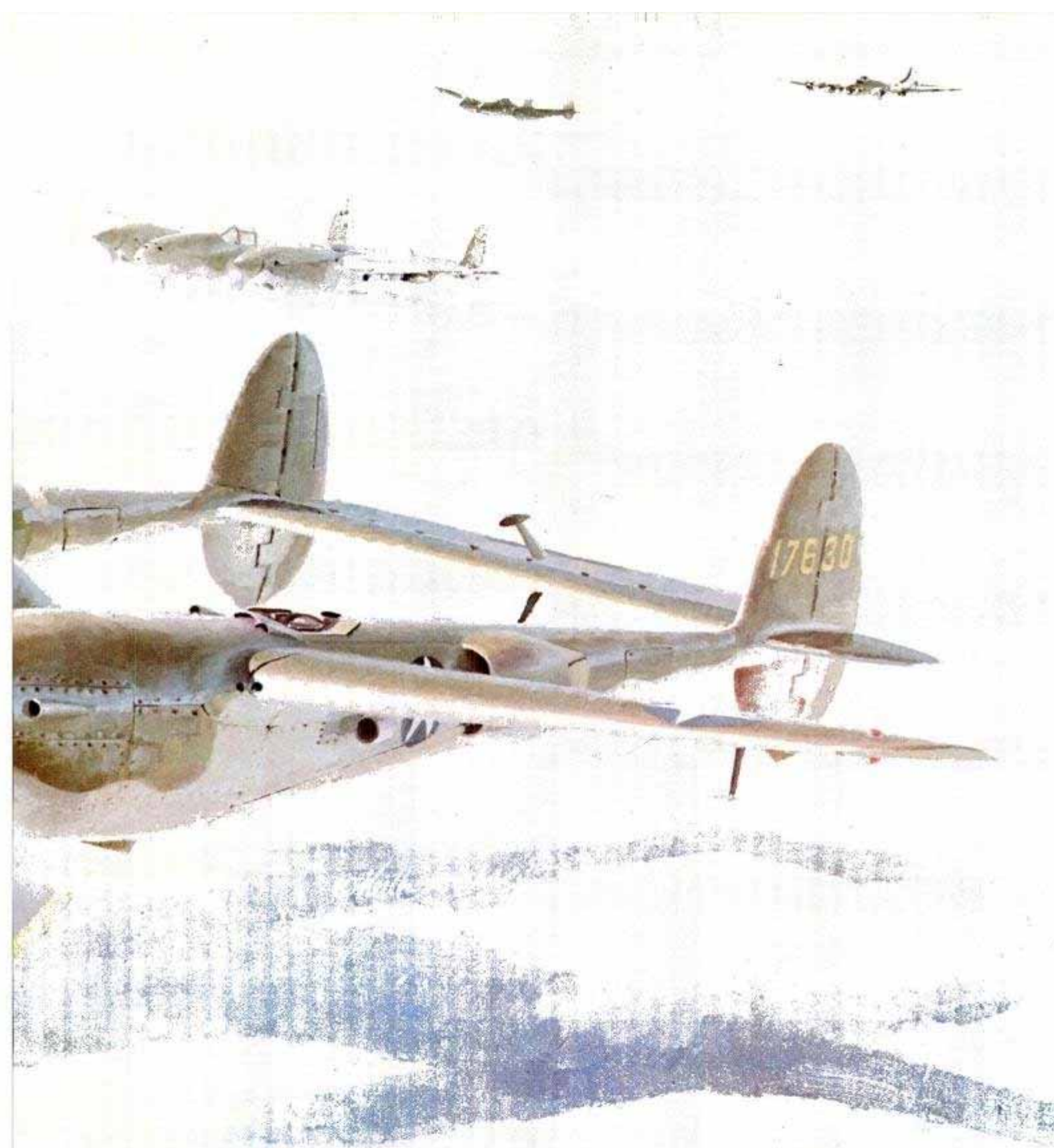


THE LOST SQUADRON ★

Six P-38s and two B-17s, ditched in 1942, have been spotted by radar 60 feet deep in Greenland's snow pack. Now the digging starts.

BY J.T. JOHNSON; Illustration by Keith Ferris

With fuel tanks nearly empty, the squadron had to put down in snow. The lead plane landed with wheels down and flipped over, so the others belly landed. The crews were rescued, but the planes remain buried under 42 years of snow.



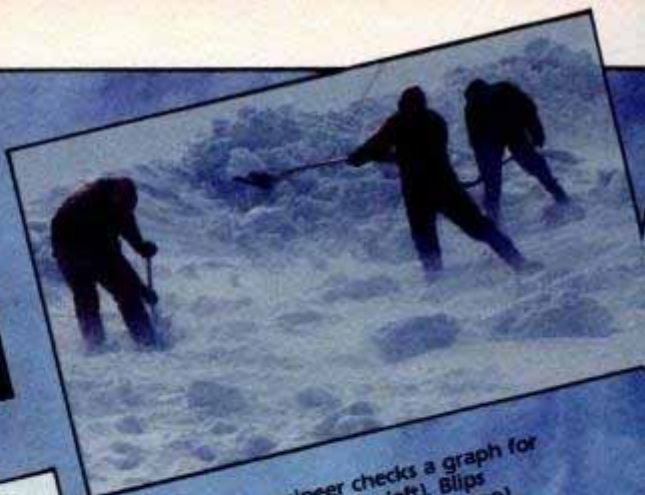
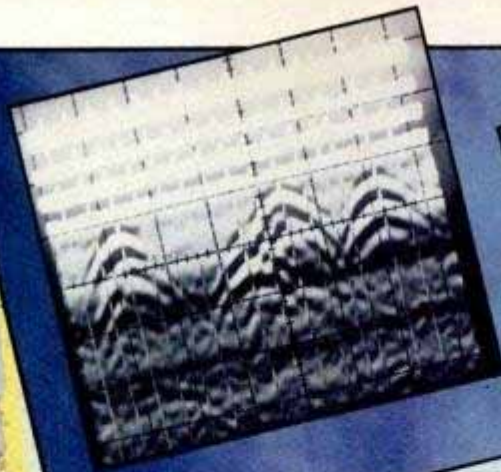
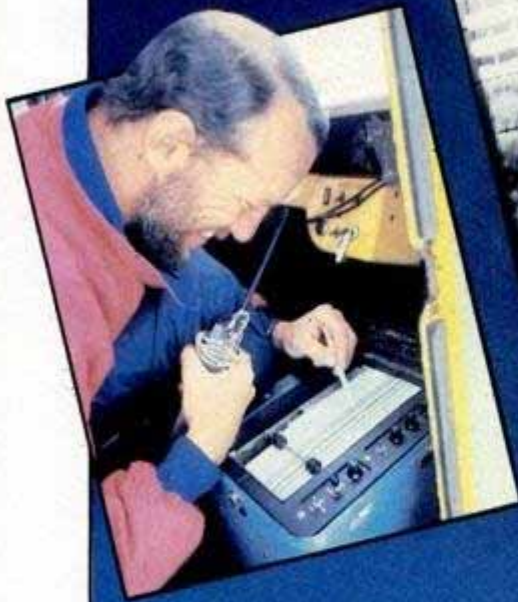
The first 24 hours were almost tolerable, but the wind and blowing snow didn't let up. After 36 hours in the small tent, Russ Rajani was starting to mutter to himself. Isn't there an easier way to pull this off? Or a better time of the year than July to come to Greenland? But he never doubted the sanity, or accuracy, of his team's mission.

When the windstorm—a "pitteraq"—finally broke, the 41-year-old Georgian unzipped the door and peered out. From the tent to the horizon, the view hadn't changed: bedsheet flat and with only

two unbroken colors—white below, blue above.

The 500,000-square-mile snow pack before him was Rajani's haystack. Somewhere under his feet were the eight "needles" he and his Winston Recovery Team had come so far to find—six P-38s and two B-17s forced down during the first attempt of World War II to fly fighters to England.

For nearly two and a half months, from June to August last summer, the 16-man team's search was stymied by equipment breakdowns and Greenland's worst summer weather in years. But now their effort to pinpoint the planes seems to have



Recovery team engineer checks a graph for radar blips of the P-38s (far left). Blips on specialized radar screen (center, top) are from four P-38s (two blips overlap). Radar is dragged across the snow by a tractor (left). The recovery team digs protective trenches around the camp (above) during a fierce summer storm on the Greenland snow pack.

paid off, thanks to a late-inning technological rescue by an Icelandic scientist and his special radar unit designed to map the terrain beneath glaciers.

How the planes came to be buried in Greenland and the efforts of Rajani and the Winston Recovery Team is itself a fascinating tale, but one only half told. The climax is expected this summer now that the team has returned to the icecap to salvage the historic aircraft. Radar mapping has pinpointed four of the P-38s. Their value, because they are so rare, makes them the real quarry; the two B-17s may be left unretrieved.

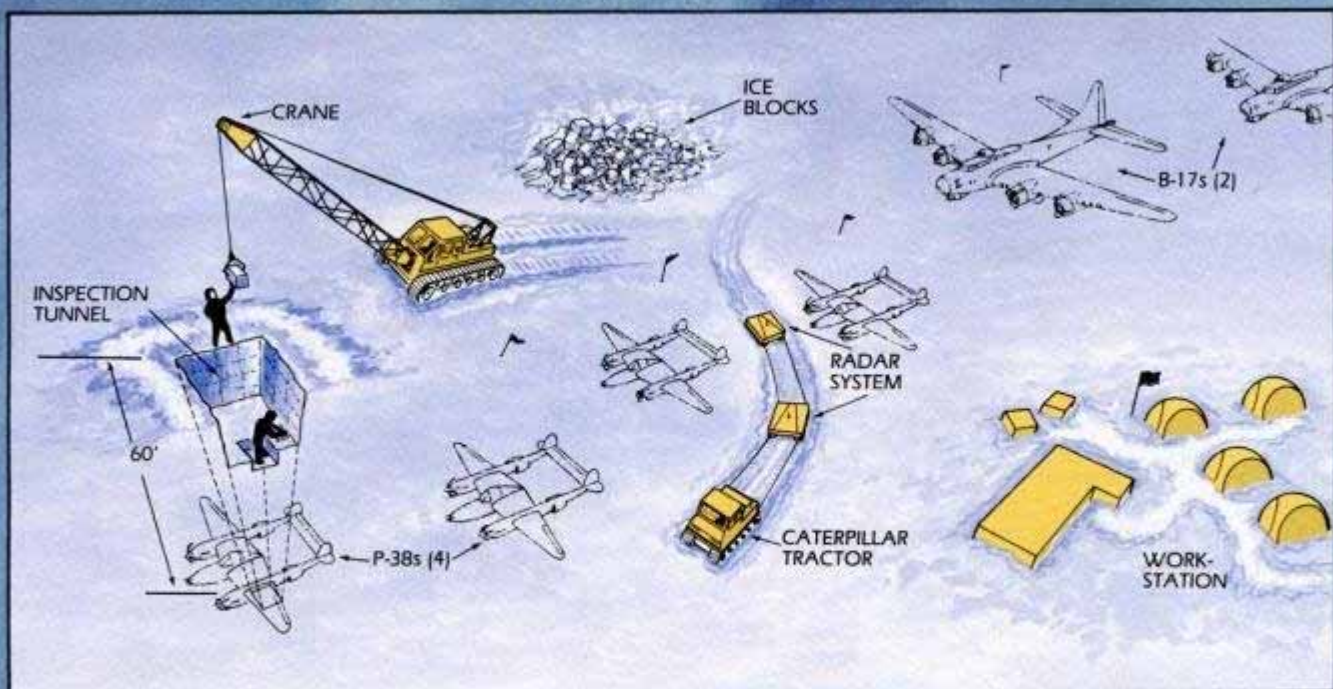
This year, the recovery team plans to return to the site with circular saws. With one eye on the radar screen to map their progress, team members will cut blocks of packed snow and a crane

will lift them out of what will be a tunnel big enough for two men to work inside. Digging one block at a time, the team hopes to reach a P-38 to inspect it.

"We'll look it over to see what kind of shape it's in," Rajani explains. "Our research indicates the planes were well protected in the ice pack and they may be in near-perfect condition." Later—perhaps next year—they'll dig out the P-38s, reopening a great tale of World War II.

By the spring of 1942, the North Atlantic sea lanes had been effectively blocked by German U-boats. It appeared the only way to supply the Allies with war material was by skipping from landmass to landmass through the rugged far north skies.





DRAWING BY HANK IKEN

Using circular saws, the recovery team cuts blocks of snow, which are lifted out with a crane. The team is digging a tunnel to one of the P-38s that was located by radar. A tractor drags radar over the terrain to follow the progress of the dig.

In early July 1942, the eight planes secretly took off from the United States bound for England. On July 14, taking advantage of a break in the weather, the planes loaded up with six hours of fuel and lifted off from station Bluise West-8 (now Sondrestrom) in western Greenland, bound for Reykjavik, Iceland.

As the young pilots reached the eastern Greenland coast, they were hit with arctic gales, ice building up on the wings and reports that Reykjavik was fogged in.

"The compasses were no good up there, and we'd been flying for hours on instruments," remembers P-38 pilot Robert B. Wilson, now a judge in Arizona. "But we were getting messages—in code—about good weather here and

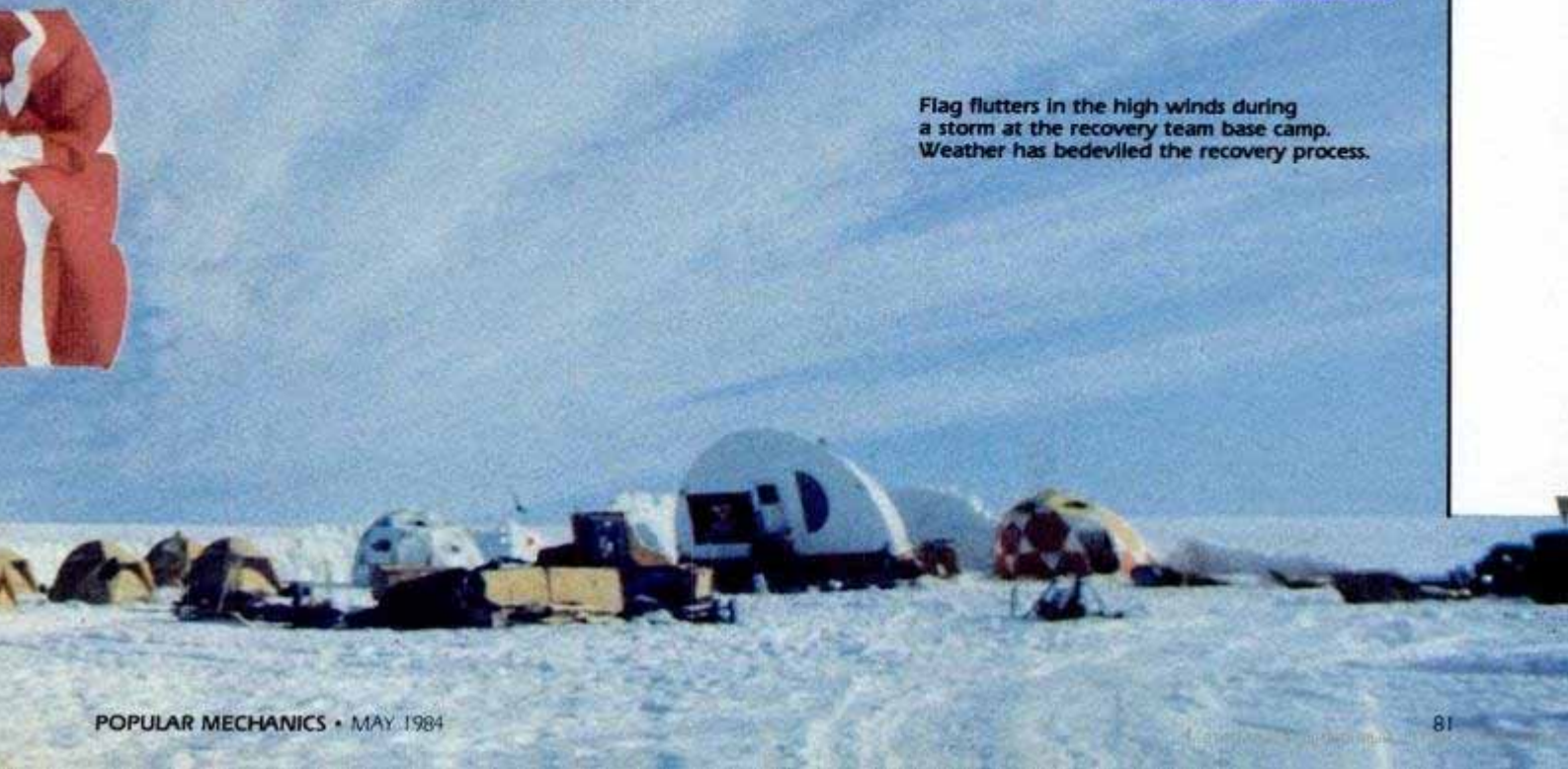
there, and we kept flying." The messages were bogus, it was later determined, broadcast by a Nazi submarine in the Denmark Strait or from secret German weather stations on Greenland.

When the flyers broke through the leaden skies, they were 400 miles off course, fuel tanks near empty and over the Greenland icecap. One P-38 pilot, Brad McManus, was running dangerously low on fuel. He had no choice but to set his fighter down. He decided to make a wheels-down landing on the snow, which looked firm and hard enough to take the impact.

As the other pilots circled above, McManus touched down and skidded. When the P-38's nose gear bogged down in soft snow, McManus's plane

(Please turn to page 196)

Flag flutters in the high winds during a storm at the recovery team base camp. Weather has bedeviled the recovery process.



NOW: The 20-mpg Motor Home

You can drive these compacts as if they were second cars.

BY ANGUS LAIDLAW

A motor home need not be a \$100,000 land yacht that drives like an interstate bus. It can handle like a large passenger car and include all the comforts of home in 20 feet. A compact motor home weighs less than 6,500 pounds all set up. There are three types: those built as motor homes from the ground up (like the LeSharo below), those

built on a lightweight pickup chassis (like the Mirage at right) and those that are van conversions.

The first surprise when you look at the range of compacts is the price. Sure, you can drop as much as \$30,000 on a motor home, but you can also have a livable and usable

(Please turn to page 198)



This self-contained Winnebago LeSharo (above) gets 22.5 mpg with front-drive turbodiesel. Inside, a bath with shower folds back for extra room when not in use. At just over 7 feet high, the vehicle fits in most garages, but it has standing room inside.

Odyssey Sprint (right) does it all in 20 feet of overall length and 4,650 GVWR. A marine toilet and hand shower are the bathroom facilities. The kitchen sports a three-burner stove and a three-way refrigerator that runs on propane, 12 volts d.c. or 115 volts a.c.



Photo by Frank Tuter



Mirage Eagle, built on a pickup chassis, is especially easy to drive. It combines the best features of live-in capability with usable space inside. By cutting washing facilities to a 3-gallon cold-water sink and reducing the stove to three 12-volt electric appliances, you swap full self-containment for a vehicle you can use every day to take whatever you need with you. Top-hinged tailgate (far left) has a smaller side-hinged inset door for everyday access. Sink and 12/115-volt refrigerator (top left) handle food and drink. Dinette and over-cab beds (bottom left) sleep four.

Photos by Frank Zagarno.

SOFTWARE- Now It Does Windows!

Throw out the cellophane tape and rubber cement. Window software, which is an extension of a computer's disk operating system, makes the screen your desk. It does this by creating actual windows on the screen, through which each program or datafile can be viewed and possibly manipulated. Each program or datafile becomes a file folder lying on the

desk, or "workspace," as it's usually called. Just as you might open a folder, even place it partially on top of another folder, or move papers or records from one folder to another, now you can open "electronic folders" and move information and records between them. Each open electronic folder appears as a "window" on the screen, thus the term "windows" for the software that simulates a workspace.

Assume that you're using word processing to prepare a report on



Lisa system from Apple was the first affordable computer to make great use of "windowing." Note that the screen is split into different sections. Each section is called a window. A different program may run inside each window and information may be shared between programs. A roller device called a mouse (upper right) moves information from one window to another. Move the mouse atop a desk to point at the data and an onscreen pointer moves.

Being able to put several files on the screen at one time lets you get more power from your computer.

BY HERB FRIEDMAN; Photo by Bill Ashe

your company's future manufacturing needs. You want to include a projection for 1984-1985 that you prepared with a spreadsheet program. Using window software, you create a window within the word-processing display, call up your spreadsheet program within the window, select the desired data and transfer it into the report, and then close the window so you have the rest of the screen available. Alternately, you might open two, three or more windows so as to compare different projections before deciding on the one to include in the report.

Your report and its printout will contain all

the information you transferred directly from the spreadsheet data.

Window software that permits concurrent operation, rather than simple data selection from each windowed program, allows endless variations in program usage. For example, it lets the user bring up the computer as a word processor, then open one or more windows into a running spreadsheet and experiment with different kinds of data. But that's not all. The user can open yet another window into a program that converts each change in spreadsheet

(Please turn to page 207)



4 Fences Your Neighbors Will Like

Any fence in this collection is a handsome way to enclose your property.

A handsome fence surrounding your property is a sure clue to a neat home within. Besides defining your yard, a fence can contain children and pets. Some fences help maintain privacy. Others protect against wind.

The fences shown here were selected for their visual appeal. They include

low and high fences, rustic and elegant fences, open and privacy fences and fences that require simple and sophisticated construction skills.

Wood that naturally resists insects and decay, such as cedar and redwood, is a good choice for a fence. Pressure-treated wood is even more durable. You

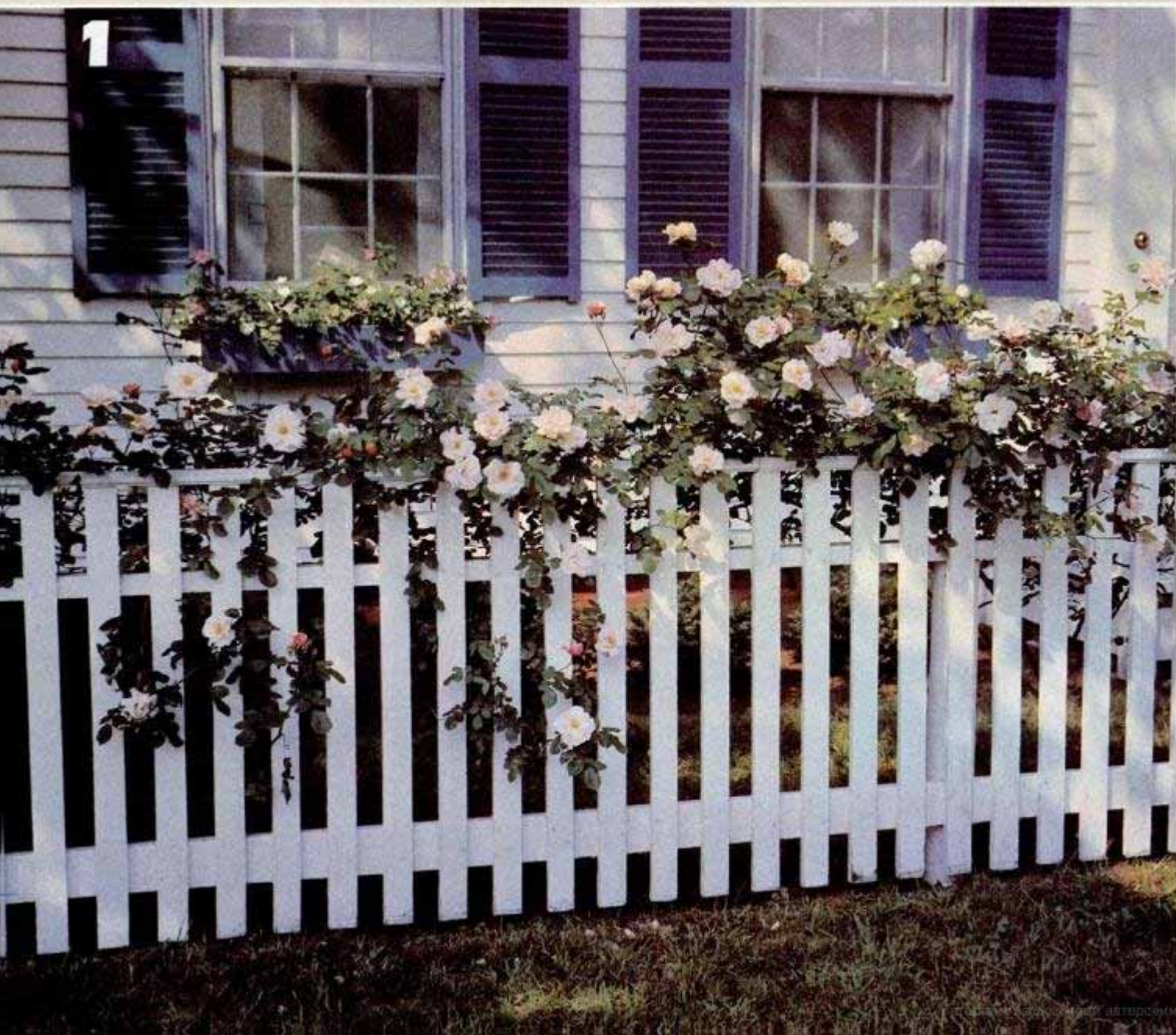
can also treat other types of wood with preservative.

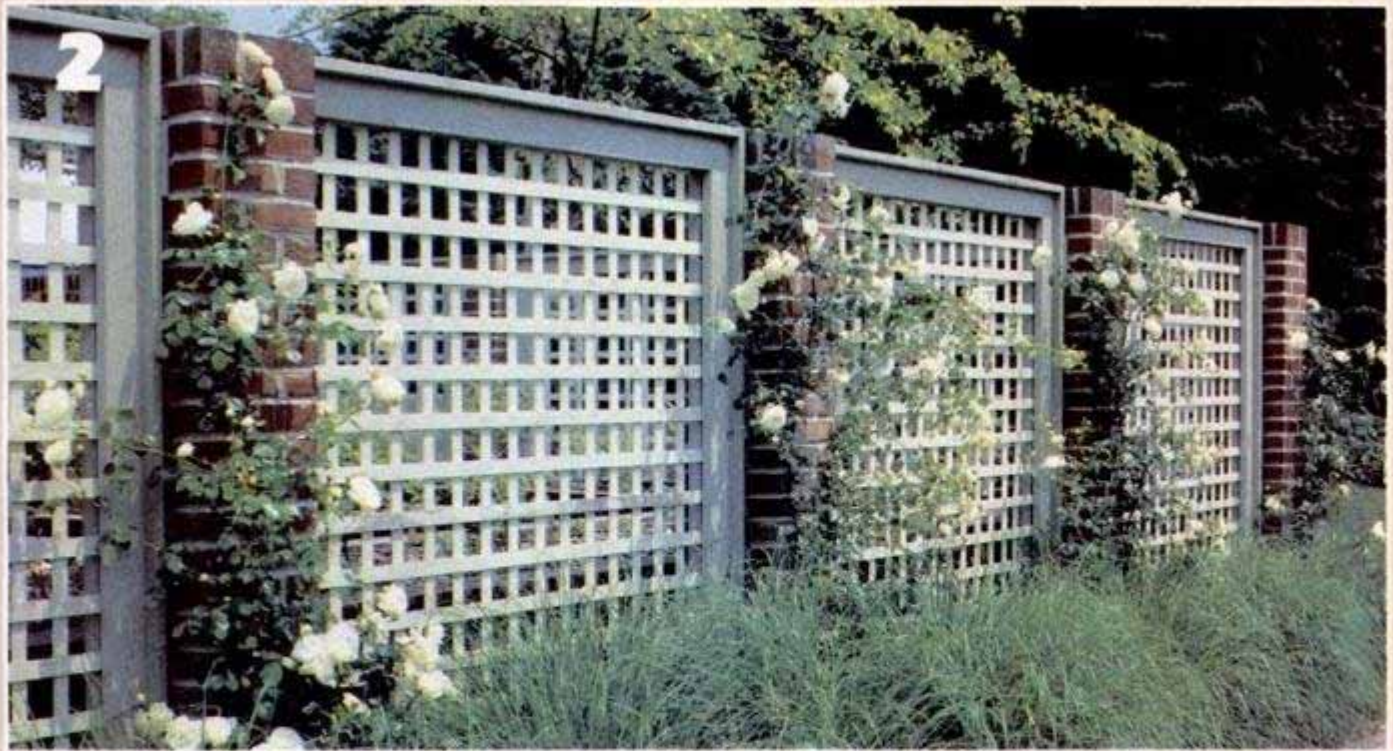
Posts, which come in contact with the ground, are particularly susceptible to insects and decay. Make sure the wood you use for posts is recommended for in-ground use. Or soak the posts for 24 hours in a 50-gal. oil drum or other container with a copper naphthenate solution. First pierce the post surface before soaking so the solution can penetrate the wood. Soak the posts to a depth 6 in. higher than their in-ground height.

The simplest method of treating above-ground wood is with a good-quality paint for outdoor use. However, brushing on a heavy coat of preservative, particularly on board ends where moisture most often penetrates, is a more effective means of preservation.

Use hot-dipped galvanized nails to prevent rusting. If glue is needed, use resorcinol, since it's for outdoor use.

You'll probably have most of the tools needed for fence construction, except a posthole digger. To dig posts, you can





use a two-handed clamshell digger (good for rocky soil) or an auger-type digger which works like a twist drill. You should also have a line level, carpenter's level, plumb bob, mason's line, shovel, heavy hammer, tape measure and a tamping bar (5-ft. length of about 1½-in.-dia. heavy pipe which is capped at one end).

Beginning work

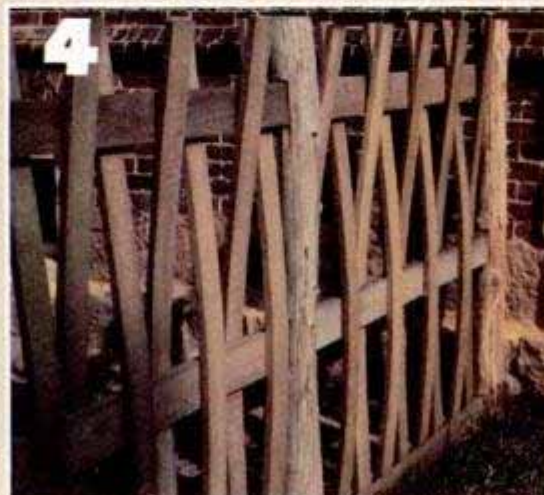
The first step in planning a fence is to become familiar with the local ordinances and regulations regarding fence building. These vary widely from state to state. Phone your city planning department or city or county zoning inspection department for this information. Locate your property lines to avoid building on your neighbor's property. Set the fence at least the distance required by zoning laws from the property lines.

Measure the proposed fence perimeter and estimate material needs. Consider posts, rails, slats, decorative parts, ground fill, preservative, hardware, fasteners and other items.

You can cut posts to length beforehand, or on site. Cut rails on site as you build the fence.

Dig the corner or end postholes and set these posts to the desired height first. As a general rule, sink the posts one-third of their height into the ground. For example, sink a 6-ft. post 2 ft. into the ground.

Set the post on a flat rock or gravel. Shovel in gravel, check for plumb on two sides and adjust the post. Then brace it with a diagonal 1×4 imbedded



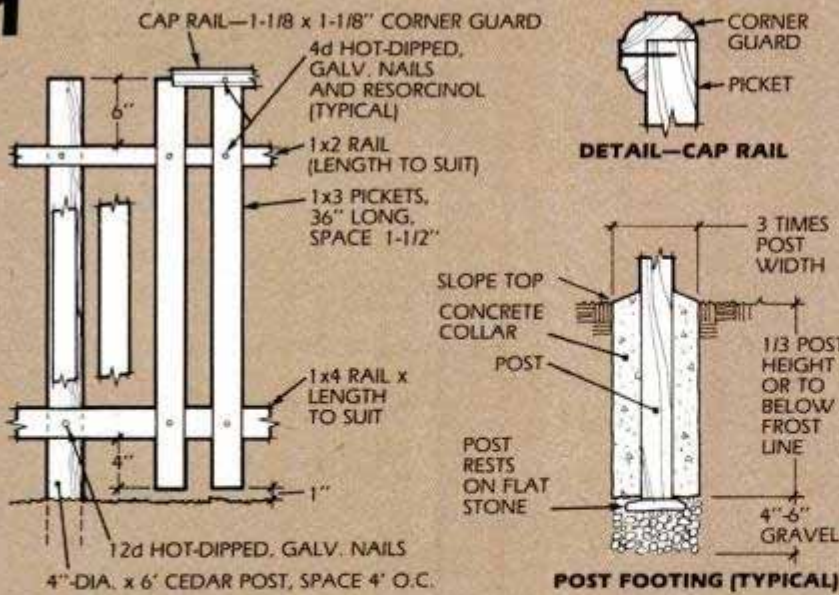
1 A white picket fence is the traditional country way to border property without obstructing the view. Cap rail helps support roses. Fence is of standard post and rail construction.

2 The durability of brick and light, airy appearance of lattice will make a pleasing combination in this graceful fence, which is constructed in stages.

3 Lattice border and post finials add decorative touches to board fence. It's not only nice to look at, it gives privacy.

4 This rustic fence is formed by winding slats through rails in a vertical basket weave. The fence is made of cedar.

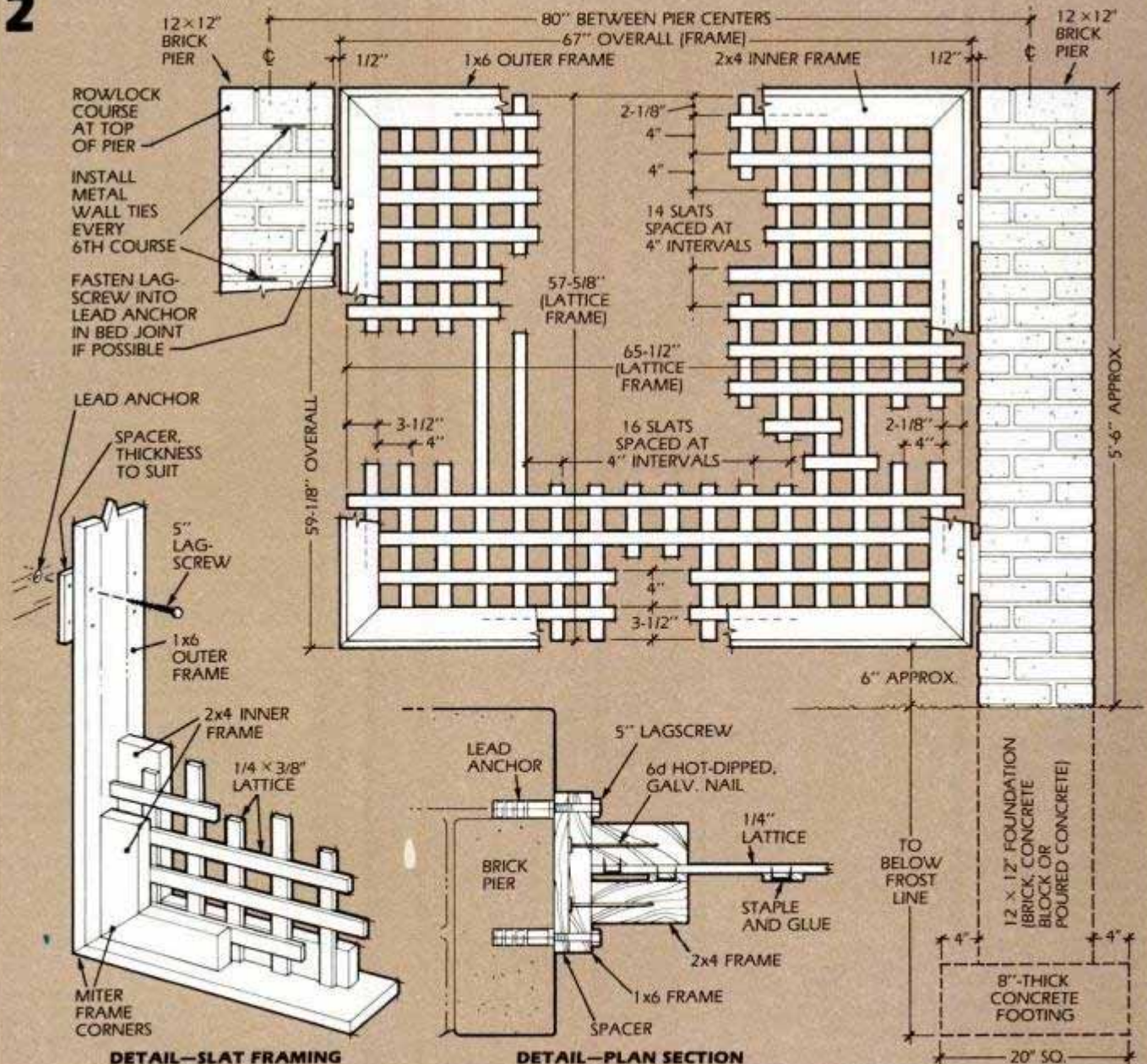
Photos 1 and 3 by George Talouris; 2 by Derek Fell; 4 by Pamela Harper

1

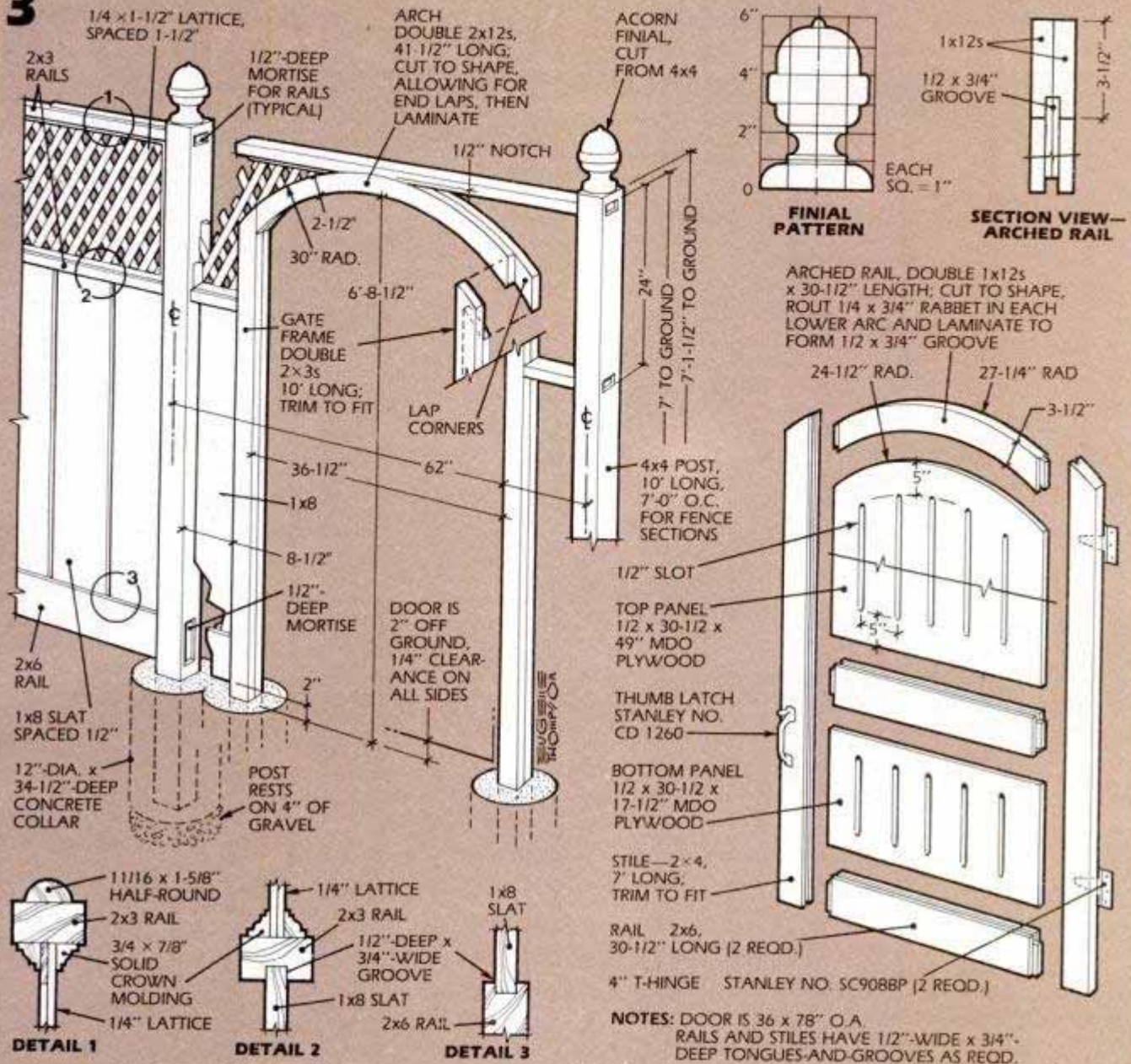
into the ground and bolstered with a stake. Tamp the gravel. Fill the hole with earth, concrete or a dry-pack mix (eight shovelfuls of sand, four shovelfuls of large 1 $\frac{1}{4}$ - to 1 $\frac{1}{2}$ -in.-dia. gravel and one shovelful of Portland cement) and continue tamping. Use a line level with a tape measure or ruler to level the height of the second post.

Aligning posts is the key to building a satisfactory fence. Stretch aligning strings between the posts at the top and bottom. Mark points on the top line to indicate where the centers of the intermediate posts will be. Posts are usually spaced 6 to 9 ft. apart on residential fences. Transfer the marks using a plumb bob to the lower line.

Dig the holes for the intermediate posts. Set each post in gravel, touching the aligning strings. Now fill the hole, tamping and checking that the posts don't move. Use a level when installing

2

3



the rails. A spacer block helps gauge distance between vertical members.

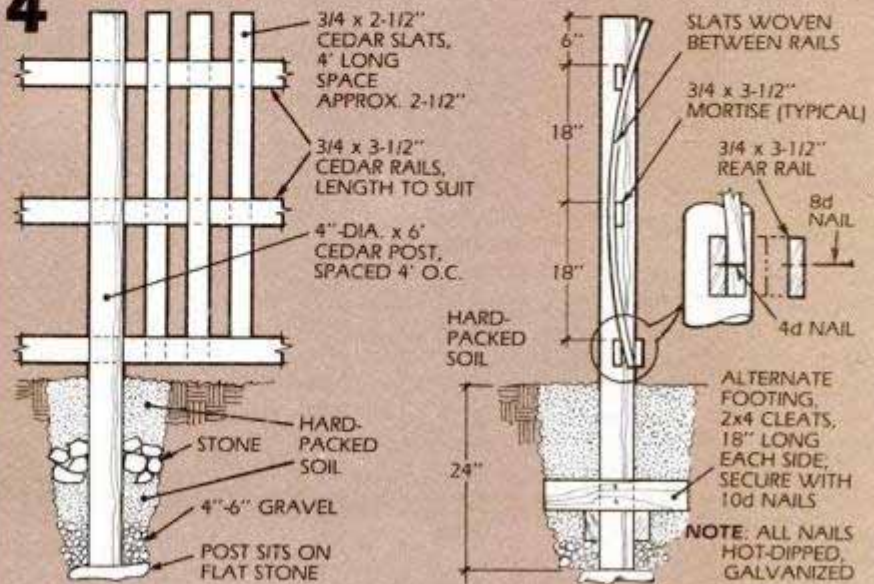
If there is to be a gate, you should pour a concrete collar around the base of the gateposts. Gateposts are often set deeper than line posts. Rest each gatepost on a stone about 4 in. high, centered in the bottom of the hole. Gateposts must be parallel to each other and perpendicular to the ground.

Now add the following: a 4- to 6-in. layer of gravel to fill around the stone and post, 6- to 12-in. layer of concrete, 4 to 8 in. of clean rocks, and another 6 to 12 in. of concrete. As an alternative, add a concrete collar resting on a gravel bed. Taper the collar away from the post to prevent moisture from being trapped around the wood.

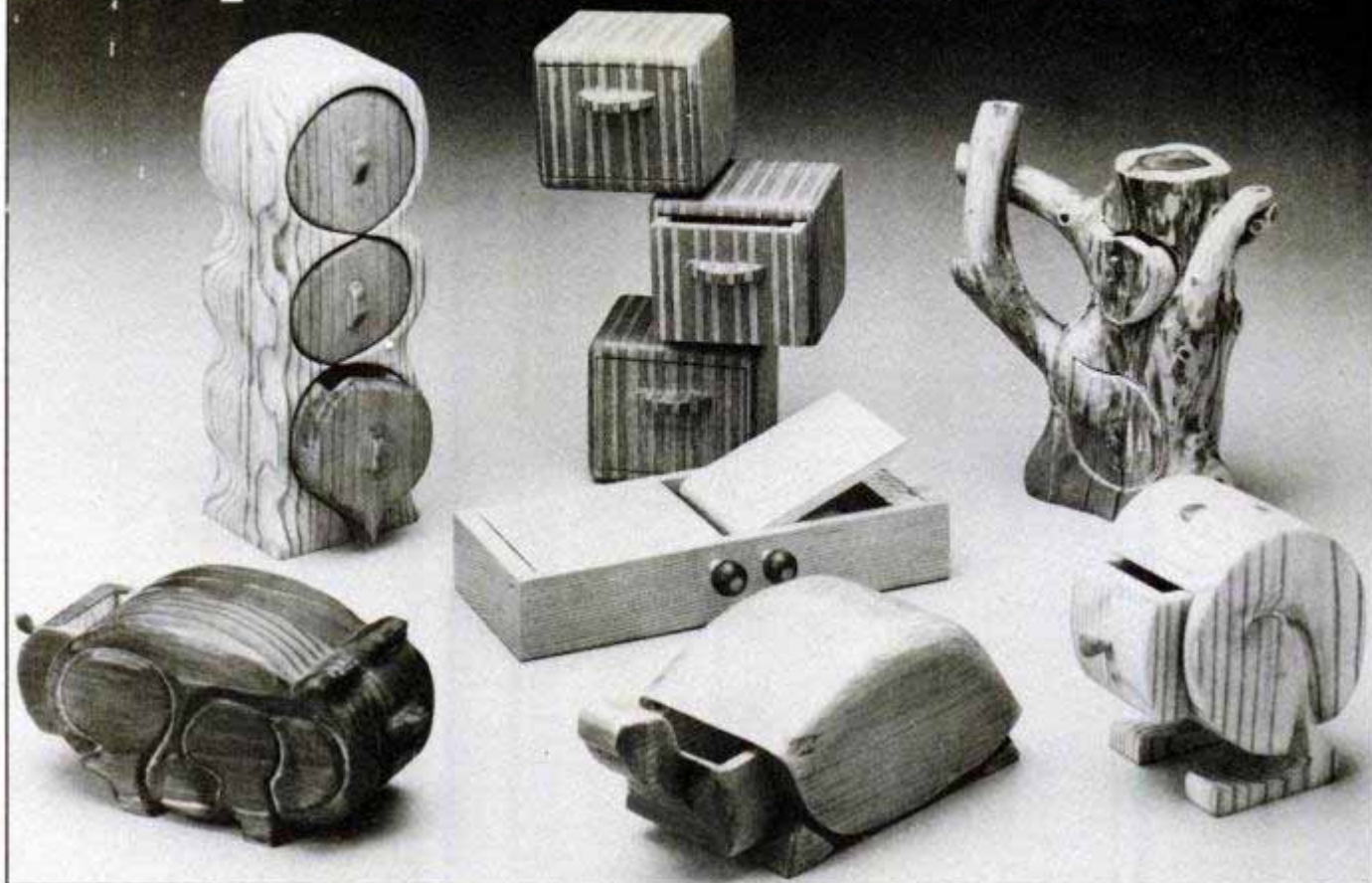
The fence gate must be built to withstand use and must be installed with heavy-duty hardware. Work with

[\(Please turn to page 210\)](#)

4



Sculpt Boxes With A Band Saw



Let your imagination take over and create ministorage boxes in any size and shape. These seven boxes were made with just a band saw.

You can create ministorage boxes similar to the ones shown above using just a band saw. The size, shape and function of these fun-to-make boxes are limited only by your imagination. And these band-sawed boxes are economical, too, since only scrap lumber is used. Most of the ones shown here are cut from a block formed by gluing together two short 2×4s.

For most of the work, use a 1/4-in.-wide, 14-tooth-per-in. band-saw blade. When it's necessary to cut a 1/4-in. radius, use a more maneuverable 1/8-in.-wide saw blade. There are two unique woodworking techniques used to build these ministorage boxes.

Technique No. 1

The first method produces free-form boxes with round corners and drawers, such as the triple figure-eight box and the two-drawer unit cut from a cedar stump shown above.

These boxes are made by first sawing 1/4 in. off the back of the doubled 2×4 block or other workpiece. To help guide the work, clamp a length of angle iron to the band-saw table to act as a rip fence. Next, outline the drawers on the face of the block and cut all of them out with a single, continuous cut. This usually means moving the blade in a figure-eight shape. Start cutting at the bottom center of the block and have the blade exit through the same point. Remove the drawer blocks and glue the back onto the block. Now, glue a 1/16-in.-wide wood spline into the entrance/exit kerf. If desired, shape the outside of the box using a belt sander, router or band saw.

Have fun making these unusual storage units—entirely of scrap wood.

BY TOM CRABB
Photo by Layman-Newman

Next, make the drawers by cutting 3/16 in. from the front and back of each drawer block. Be certain to use the rip fence to ensure straight cuts. Then execute a U-shaped cut to remove the drawer block center, forming the interior drawer space. Glue the drawer front and back to the blocks and sand the edges smooth. Add drawer pulls if needed.

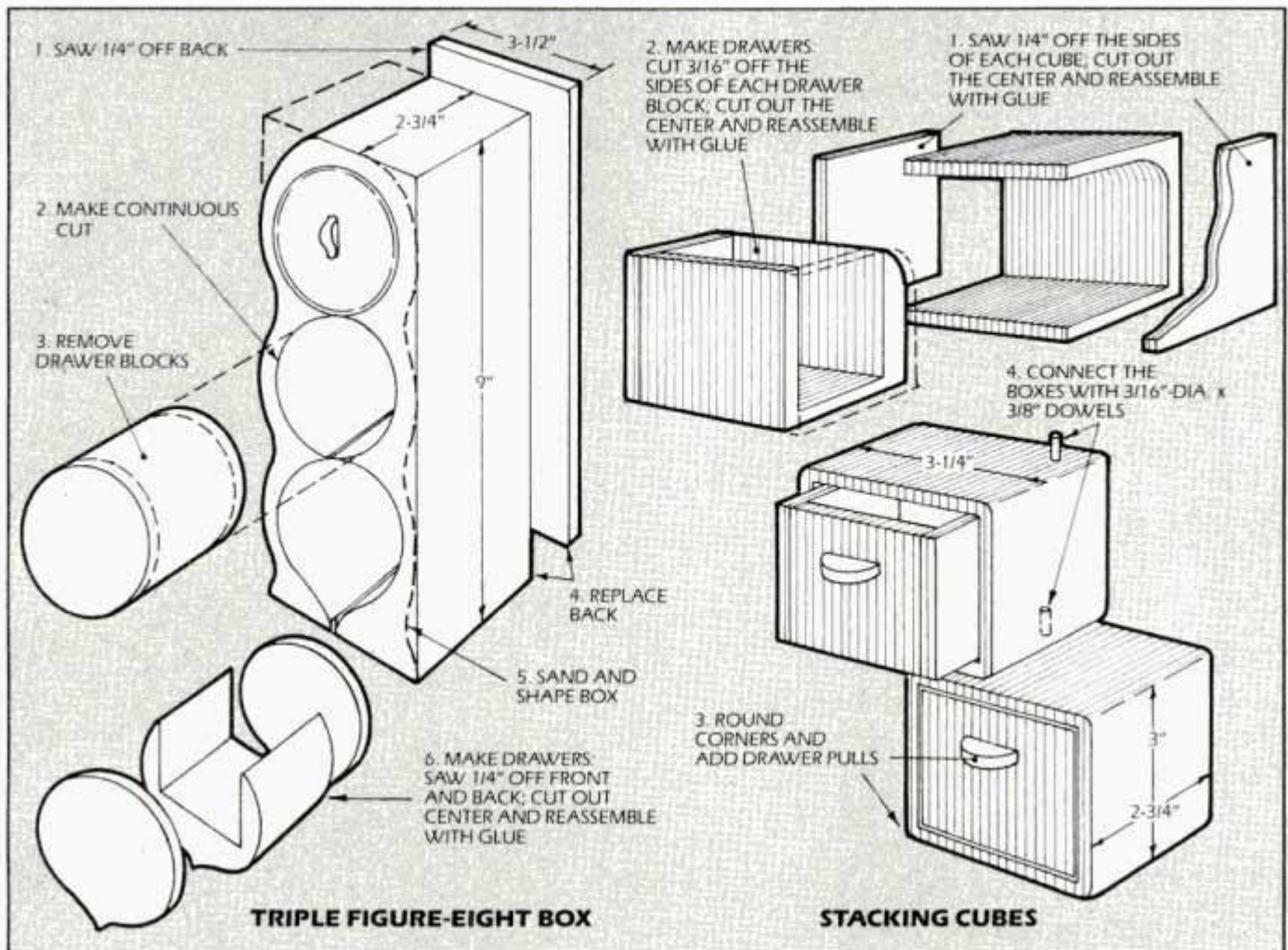
Technique No. 2

The second technique is used to make boxes with straight lines and square drawers, such as the three-tier stacking cubes and the double compartment flip-top box. It's also used for the figures shown in the foreground (left to right): the pig, turtle and Pac-Man-style boxes.

For these boxes, begin by sawing 1/4 in. off each side of the doubled 2×4 block using the band-saw rip fence attachment. Then outline the drawer or drawers on one side of the block. Cut out the drawer blocks with one continuous pass, then glue the sides back onto the block. Now, cut 3/16 in. from both sides of each drawer block. Saw out the inside of the blocks and glue the drawer sides in place. Finish the completed boxes with stain, varnish or linseed oil.

Construction details

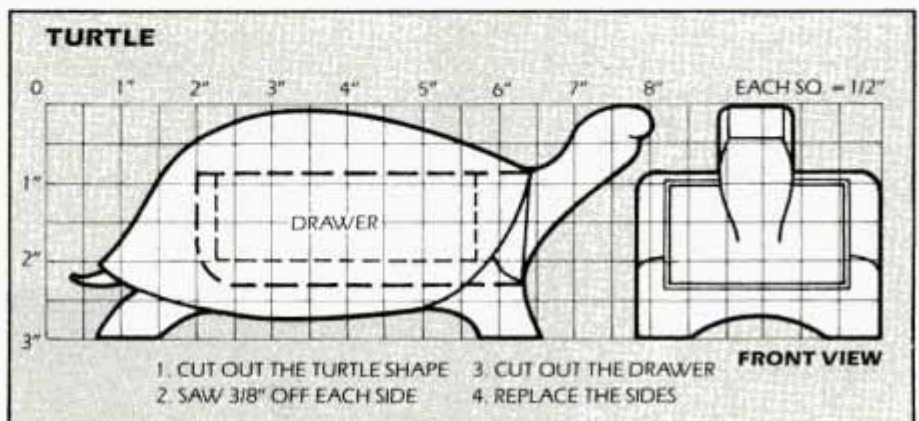
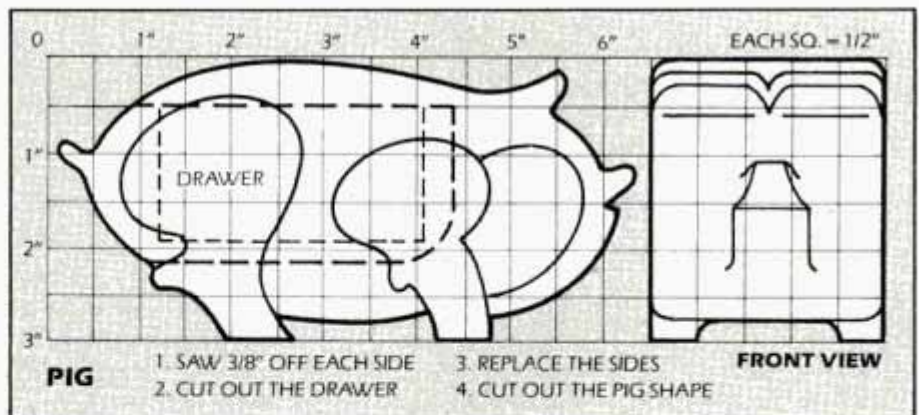
Flip-top box—Cut the box from a single 8-in. length of 2 × 4 using technique No. 2. A 1/4-in.-dia. dowel runs through each lid and into the opposite box side. To operate the lids, turn the wood knob that's glued to the dowel ends.



Stacking cubes—The cubes should be cut from laminated 1/4-in. plywood blocks. Glue short dowels between each cube to lock the three boxes together.

Turtle box—Saw the turtle box from a double 2x4 block that's 8 in. long. Mark the turtle shape on the side of the block and saw the figure. Next, saw 3/8 in. from each side of the turtle. Cut the head and tail off the sides and shape the feet. Then, saw out the drawer block starting where the base of the neck meets the shell. Glue the sides back onto the turtle body and cut the relief lines between the legs and shell with a sharp knife or disc sander. Cut 3/16 in. off each side of the drawer block with a band saw, then cut out the interior drawer space and glue the drawer sides back in place.

Pig box—Draw the pig's outline on a double 2x4, 7 in. long. Transfer the drawer location marks to the top, bottom and ends of the block. Saw 3/8 in. off each side of the block. Cut out the drawer block and make the drawer. Then glue the sides back to the block and, with the drawer in place, saw out the pig shape. Add the tail as a drawer pull.



Build PM's Unique TV Bed

Now you can outfit
your bed with more
than just a mattress.

BY ROSARIO CAPOTOSTO

The popularity of platform beds is growing, and there's no end in sight. You see them in mass-market retail stores, custom woodworking shops, even in expensive furniture catalogs. The great thing about these beds is their versatility. They make the most of occupied space by featuring large drawers and elaborate headboards for convenient storage.

We wanted to create something that worked even better. Our headboard has enough room for a stereo receiver and speakers, an alarm clock, a TV remote control, and books and magazines. It also features two low-profile, fluorescent light fixtures for reading in bed. The queen-size bed section has four large drawers that can hold a dresser's worth of clothing. And the chest at the foot of the bed has room for blankets, bed linens and a finely counterbalanced TV platform that allows you to lift the set by exerting only six pounds of effort.

Utility, however, was not the only consideration. We also wanted to create basic shapes that would be attractive, work well together and reflect some sophisticated construction techniques used in fine furniture building. So, we designed a headboard with a unique reverse tambour door (shown closed on a following page) and large rounded corners on the headboard and chest that are featured on much of today's contemporary furniture. We also show, in the drawings that follow, how to make a smaller headboard, a bed frame that accommodates a box spring and a chest with the TV omitted, all without radically changing the basic appearance of the furniture.



Made of solid maple, this elegant queen-size bed set was designed to hold a TV, audio equipment, clothing and bed linens—all with contemporary lines.



If your bedroom will not easily accommodate the full bed length, put blanket chest elsewhere. To use it this way, lid must be hinged on back side of chest.



The bed unit is made in two identical sections that are easy to separate for moving through tight doors, hallways or up stairs. Both have two large drawers.



The blanket chest has three separate compartments with individual lids. The center one is for the TV, but the other two can be used for storing linens and blankets.



Platform for built-in TV is counterbalanced with weight and pulley system. Force to lift or push down the unit is adjustable for the weight of the TV.

Construction details

This furniture is made of solid maple, usually one of the least expensive hardwood species. It can be difficult to work, but it is exceptionally stable and durable. And, when finished naturally, it has a light brown color that is warm and appealing.

Since many parts of this project call for wide boards, a great deal of edge-joining narrower stock is required. Because of this, your initial rough board selection is extremely important. Get the straightest and flattest boards possible. They are easier to align, and that substantially reduces your construction time.

There are several ways to edge-join stock. Some people use wood dowels, some use tongue-and-groove-shaped glue joints and others use nail pins, as we did here. All methods have the same basic goal: to keep the boards aligned properly so that, when glued and clamped, the joint will be flat. For those who have very wide jointers and can mill their stock flat on all four sides, such alignment devices are not necessary. Simple butt joints, glued and clamped, are sufficient.

To use the nail pins, just clip off 1/2 in. from the ends of some 4d finishing nails to make 1-in.-long headless pins. Then bore four or five perpendicular holes, spaced evenly along the edge of the board, the same diameter as the nails. Make the holes 5/8 in. deep and insert a pin in each hole, blunt end first.

Align the pinned board next to its mate and clamp the boards together temporarily to make registration holes in the second board. The pointed nail ends will easily penetrate the other board. Then pull the boards apart, apply carpenter's glue and clamp securely for at least one hour.

Headboard

Begin construction by cutting the headboard top, sides and corner blocks to size. Use a doweling jig as shown to bore 3/8-in.-dia. holes in the ends of the top and sides. Push dowel centers into these holes. Then align the corner block with a board end and press together to transfer the center marks. Using a drill

Furniture design: Rosario Capotosto and Steven Willson

Photo stylist: Gabe Herrick

Color photos: Harry Hartman

Black and white photos: Rosario Capotosto

Technical art: Eugene Thompson

Stereo equipment: Radio Shack STA-700 AM/

FM stereo receiver and two Minimus-7

speakers; Tandy Corp., Fort Worth, Tex. 76102

Television: Sony 12-inch Trinitron color TV

with remote control; Sony Consumer Products

Co., Park Ridge, N.J. 07656

Alarm clock: Wake Easy twin alarm clock;

Timex Clock Co., Waterbury, Conn. 06721

Rug: Dhurrie Rug; Rosecore Carpet Co., 979

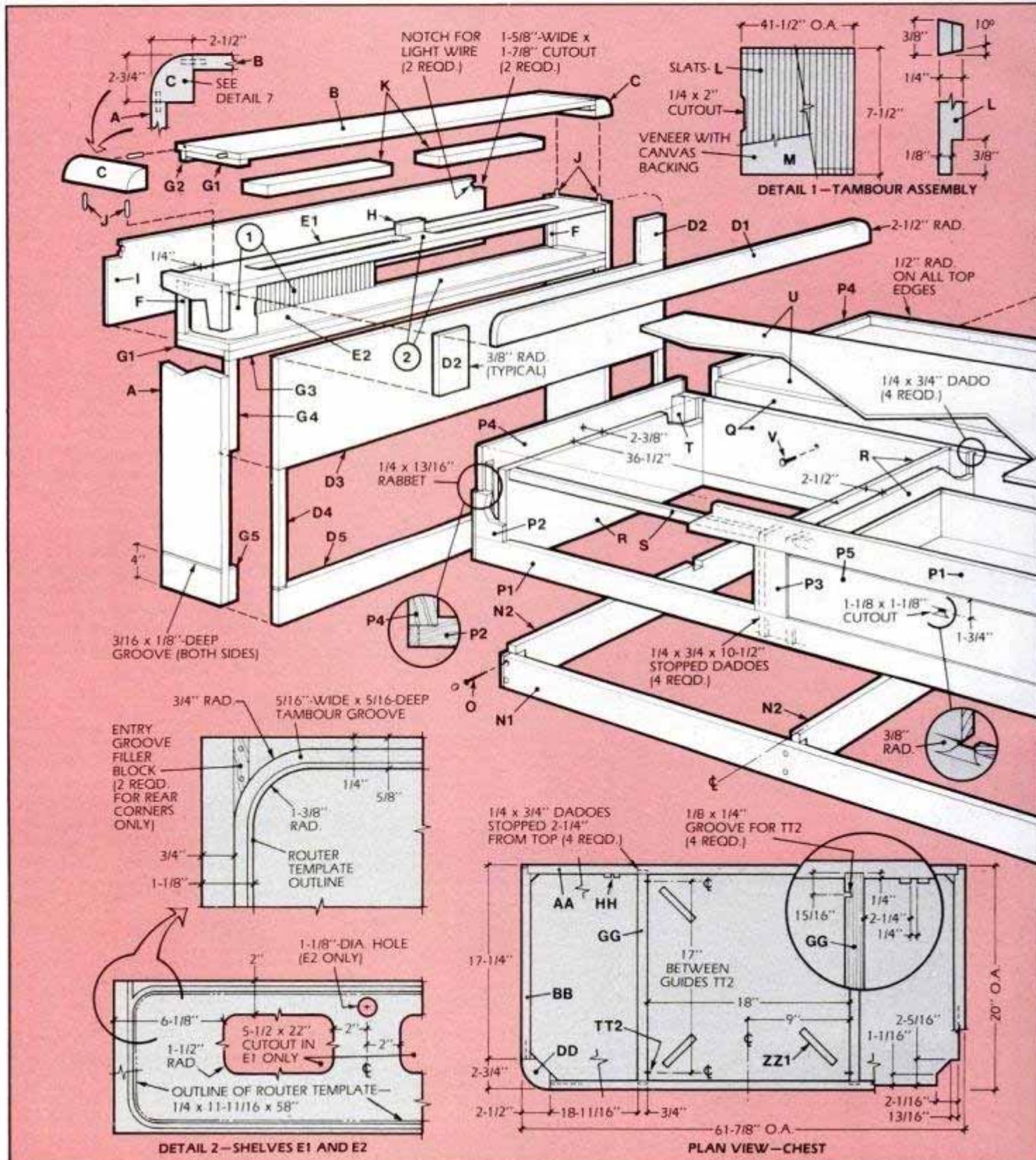
Third Ave., New York, N.Y. 10022

press, bore matching holes in the blocks. Then repeat the procedure for all remaining joints.

Next, draw an outline of the desired curve on the ends of the corner blocks and cut a series of saw kerfs over the length of the blocks, as shown. Position the kerfs so that each remaining slice is about 1/8 in. thick. Keep in mind that these cuts are made in the sides of the blocks, parallel to the top. Also, because the corner blocks for the chest are similar, you can kerf-cut them at the

MATERIALS LIST—PLATFORM BED

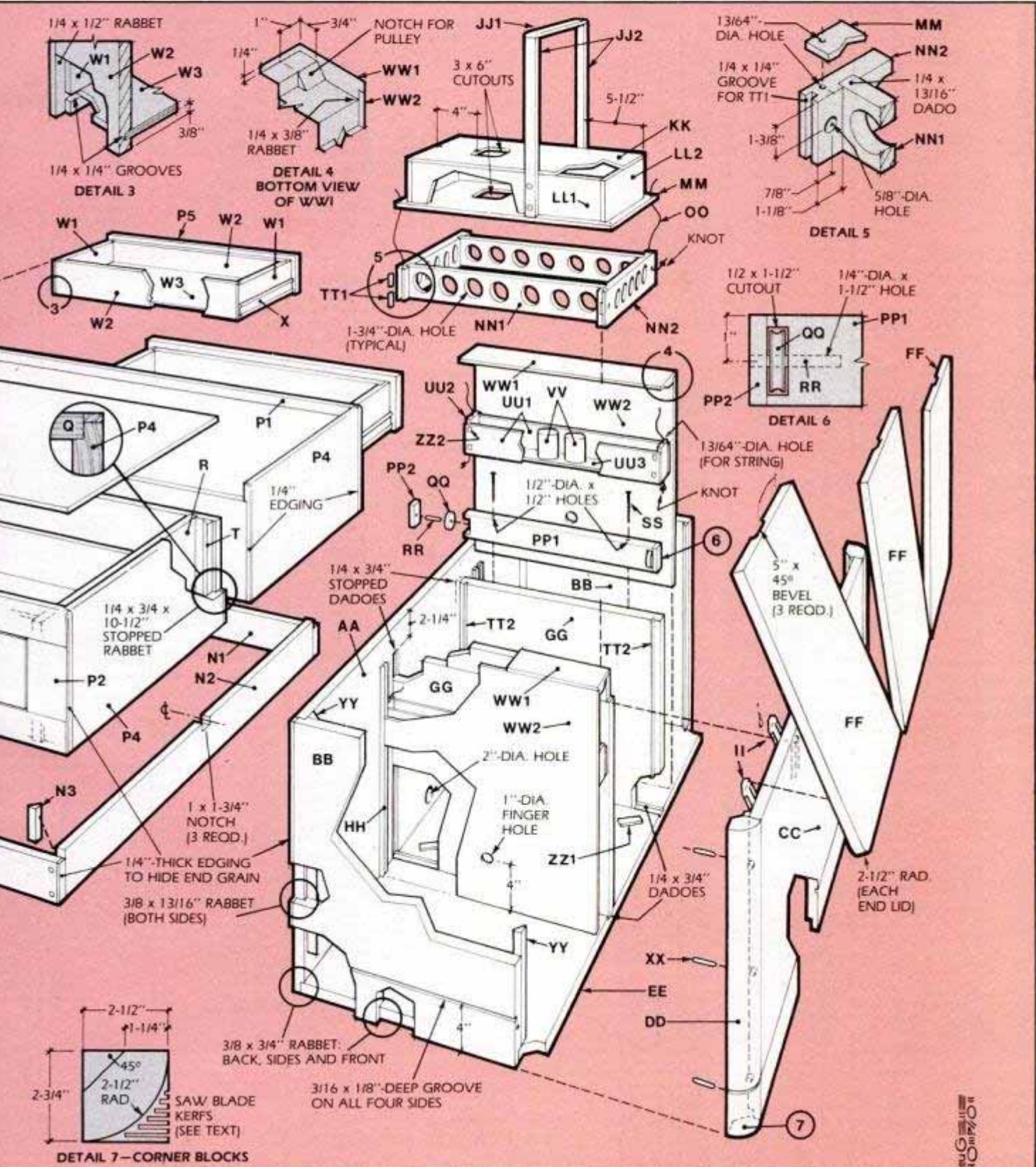
Key	No.	Size and description (use)
HEADBOARD		
A	2	1 3/16 x 13 3/16 x 40" maple (side)
B	1	1 3/16 x 13 3/16 x 56 7/8" maple (top)
C	2	2 1/2 x 2 3/4 x 13 3/16" maple (corner block)
D1	1	1 3/16 x 3 1/2 x 61 7/8" maple (facing)
D2	2	1 3/16 x 4 x 7" maple (facing)
D3	1	1 3/16 x 16 x 61 7/8" maple (facing)
D4	2	1 3/16 x 13 1/16 x 12 1/4" maple (facing)
D5	1	1 3/16 x 4 x 61 7/8" maple (facing)
E1	1	1 3/16 x 12 1/16 x 60 1/4" maple (upper shelf)
E2	1	1 3/16 x 12 1/16 x 60 1/4" maple (lower shelf)
F	2	1/2 x 1 3/16 x 7" maple (cleat)
G1	4	1 3/16 x 1 x 12 1/8" maple (cleat)
G2	1	1 3/16 x 1 x 56 7/8" maple (cleat)
G3	1	1 3/16 x 1 x 60 1/4" maple (cleat)
G4	2	1 3/16 x 1 x 14 3/16" maple (cleat)
G5	2	1 3/16 x 1 x 4" maple (cleat)
H	1	1 3/16 x 1 7/8 x 4" maple (support block)
I	1	1/4 x 10 1/2 x 60 1/4" plywood (back)
J	8	3/8"-dia. x 2" hardwood dowel
K	2	1 1/2 x 4 x 18" Lifeway 15-w. fluorescent light fixture
L	220	3/4 x 3/8 x 7 1/2" pine (tambour slat)
M	2	7 1/2 x 41 1/2" flexible maple veneer with canvas backing
BED		
N1	2	1 3/16 x 4 x 76 7/8" maple (base side rail)
N2	3	1 3/16 x 5 x 55 3/4" maple (base end, middle rail)
N3	8	1 x 1 x 4" maple (base glue block)
O	12	2" No. 12 fl. screws with wood plugs
P1	4	1 3/16 x 3 x 81 3/8" maple (side)
P2	4	1 3/16 x 3 1/16 x 6 1/2" maple (end block)
P3	2	1 3/16 x 4 x 6 1/2" maple (middle block)
P4	4	1 3/16 x 12 1/2 x 30 1/8" maple (end)



- P5 4 1 3/8 x 6 3/8 x 34 7/8" maple (drawer front)
 Q 2 3/4 x 10 1/2 x 80 3/4" plywood (middle rail)
 R 8 3/4 x 10 1/2 x 29 7/8" plywood (divider)
 S 4 1 3/8 x 1 x 35" maple (cleat)
 T 8 1 x 1 x 10 1/2" maple (glue block)
 U 2 1/2 x 30 1/8 x 80 1/4" plywood (bed board)
 V 2 3/8 x 2" hexhead bolt, washer and nut
 W1 8 1/2 x 6 x 24" poplar (drawer side)
 W2 8 1/2 x 6 x 33 1/2" poplar (drawer back, false front)
 W3 4 1/4 x 23 1/2 x 33 1/2" plywood (drawer bottom)
 X 4 pr. Grant 24" full-extension drawer slides
 CHEST
 AA 1 1 3/8 x 22 1/2 x 61" maple (back)
 BB 2 1 3/8 x 17 x 22 1/2" maple (side)
 CC 1 1 3/8 x 22 1/2 x 56 7/8" maple (front)
 DD 2 2 1/2 x 2 3/4 x 22 1/2" maple (corner block)
 EE 1 3/4 x 19 1/8 x 61" plywood (bottom)

- FF 3 1 3/8 x 20 x 20 5/8" maple (lid)
 GG 2 3/4 x 18 7/8 x 19 3/4" plywood (divider)
 HH 8 1/4 x 1/2 x 19 1/2" pine (track)
 II 3 pr. Surface mount spring-loaded hinge
 JJ1 1 1/2 x 1 1/4 x 16 1/2" maple (handle top)
 JJ2 2 1/2 x 1 1/4 x 18" maple (handle side)
 KK 1 1/4 x 15 1/2 x 16" plywood (platform top)
 LL1 2 1/2 x 3 1/2 x 14 1/2" pine (platform side)
 LL2 2 1/2 x 3 1/2 x 16" pine (platform end)
 MM 1 1/4 x 17 1/4 x 17 1/8" plywood (platform base top)
 NN1 2 1 3/8 x 2 3/4 x 16 1/8" maple (platform base side)
 NN2 2 1 3/8 x 2 3/4 x 17 3/4" maple (platform base end)
 OO 1 8-ft. nylon cord; cut as required
 PP1 2 3/4 x 2 x 17 3/4" maple (pulley board)
 PP2 4 3/8 x 3/4 x 2" maple (end cap)
 QQ 4 3/8"-wide x 1 3/8"-dia. wheel

- RR 4 1/4 x 2" steel pin
 SS 4 2 1/2" No. 12 ft screw
 TT1 8 1/4 x 1/4 x 1" plastic slide
 TT2 4 1/8 x 1/2 x 19 1/2" plastic track
 UU1 4 1/4 x 2 1/4 x 17 5/8" plywood (weight box side)
 UU2 4 1/2 x 1 1/8 x 2 1/2" pine (weight box end)
 UU3 2 1/4 x 1 1/8 x 16 5/8" plywood (weight box bottom)
 VV 22 1 1/2"-dia. x 1 7/8" lead weight
 WW1 2 3/4 x 3 1/4 x 18 3/8" maple (partition top)
 WW2 2 1/4 x 18 3/8 x 21 3/8" plywood (partition)
 XX 12 3/8"-dia. x 2" hardwood dowel
 YY 6 1 x 1 x 21 3/4" maple (glue block)
 ZZ1 4 1/4 x 1/2 x 4" maple (spacer block)
 ZZ2 16 1/8 x 1/4 x 1/4" self-sticking plastic slide
 *These parts require 1/4"-thick end edgings shown on the drawing. The dimensions given do not include the thickness of this edging.

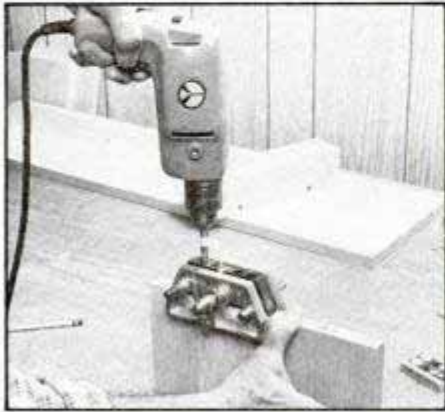




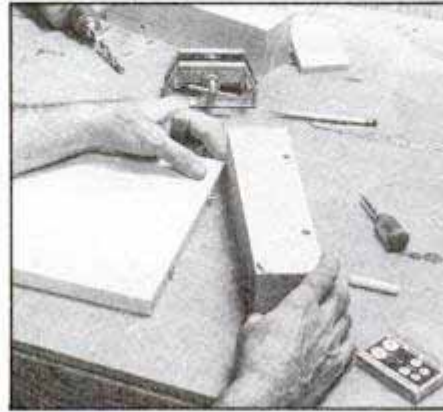
With chest lids and tambour door closed (left), bed shows contemporary lines. Headboard (above) has built-in lights and room for audio equipment, clock and TV control.

same time. Glue and clamp these corner blocks to the top as shown, let the assembly dry overnight, then shape the rounded edge. Do this by cutting off the waste slices with a sharp utility knife and planing to the correct radius with a sharp block plane. The finished curve is achieved with sandpaper.

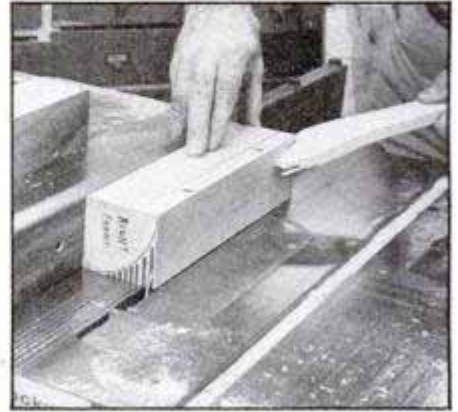
Next, cut both headboard shelves to [\(Please turn to page 212\)](#)



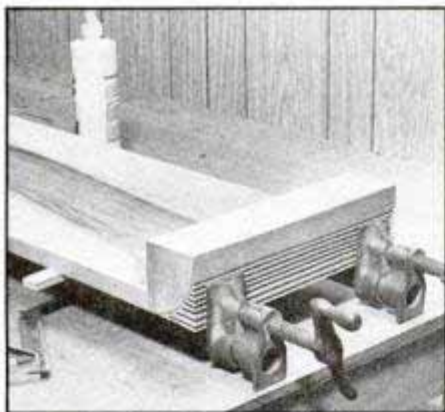
Headboard sides and top are joined to corner blocks with two dowels per joint. Begin by using a jig to bore perpendicular holes in the ends of top and sides.



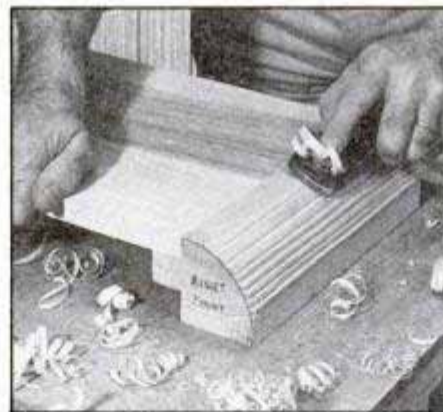
To transfer precise position of dowel holes to corner blocks, slide dowel centers into holes, carefully align parts, press together. Bore block holes using a drill press.



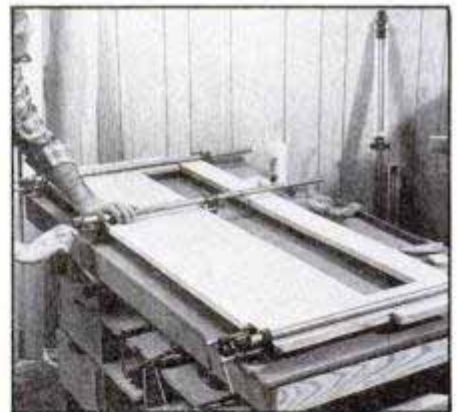
After dowel holes are bored, draw curved outline on block end, then make a series of saw cuts on table saw. Removing stock this way will make shaping blocks easier later.



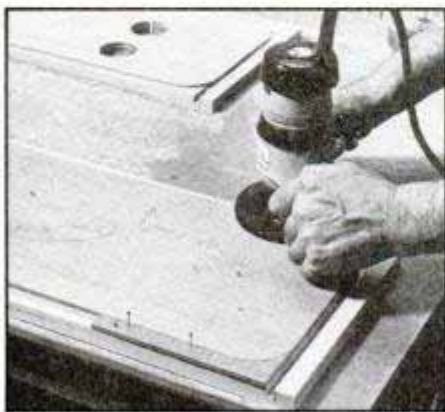
Insert dowels, apply glue and clamp both corner blocks to the top at the same time. With kerf cuts aligned as shown, slices are strong enough to allow tight clamping.



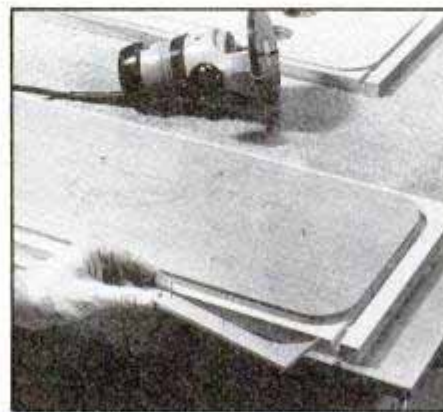
Allow assembly to dry overnight. Shape curve in three steps: Slice off most waste with sharp utility knife, smooth with block plane, finish with 150-grit sandpaper.



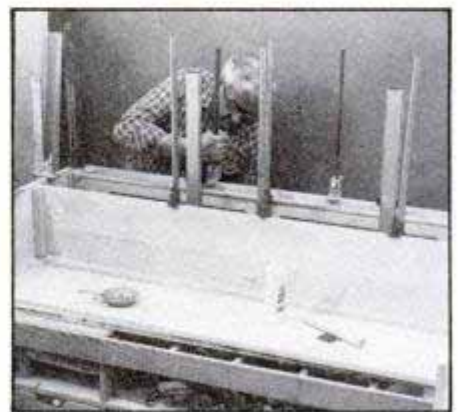
Assemble headboard facing pieces using glue and clamps. Make panel at least $\frac{1}{2}$ in. long so it can be trimmed later. Round inside end of small blocks before assembly.



Cut headboard shelves and groove template to size [see drawing]. Then tack-nail template to shelf and cut tambour groove using router with template guide in base.



Use small template piece on both ends of shelves to allow router to cut straight groove. This gives access for tambour. Remove piece to complete groove.



Join shelves to side and top assembly with glue and clamps. Let dry overnight. Scribe facing panel to fit and cut to size. Glue and clamp both assemblies as shown.

WORKSHOP MINICOURSE



Working with chisels

The chisel is a freehand tool—which means the results you get with it depend entirely on your manual skill. You can easily master its use with a bit of practice, provided you follow correct procedures and work only with a tool that is razor-sharp.

The chisel is essentially a long knife. It is shaped so the pressure applied to the handle is concentrated on a comparatively small cutting edge that easily enters the wood and severs the fibers.

Unless you are applying the driving force with a mallet, both hands are always in contact with the chisel. One hand grips the blade and controls the movement of the cutting edge, while the other hand applies pressure on the handle. The grip may be varied depending upon the nature of the cut and personal preference. A comfortable grip aids good blade control.

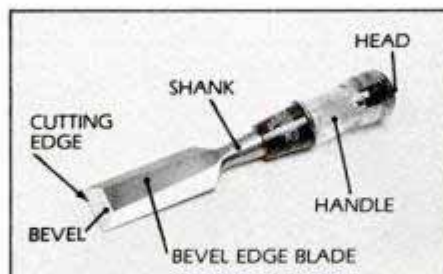
The blade is flat on one side and beveled on the other. In general, use the chisel with the bevel up for finish (paring) cuts and down for roughing cuts.

In some situations, however, you must make the finish cut with the bevel down. For example, when cleaning out a long groove the bevel must be down so that the handle will be elevated and will clear the workpiece. This also applies when working in confined areas, such as when cutting a mortise. Concave cuts are also easily made with the bevel down; these would be quite difficult with the bevel up.

Whenever possible, hold the chisel at a slight side angle in relation to the direction of travel rather than following a straight path. This presents a smaller leading edge to the wood, resulting in smoother shavings.

Unless you have no choice, always cut *with* the grain. Otherwise, the chisel edge will act much like a wedge and split the wood ahead of it.

Although the chisel can do aggressive cutting when necessary, there's no need to overwork it. Use other tools, such as saws and drills, when feasible, to remove the bulk of the waste before working with a chisel. **PM**



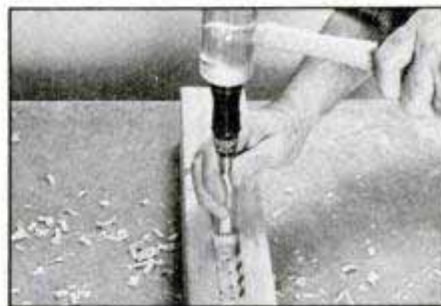
Parts of a chisel are shown above. Pressure is applied to the handle, either by hand or with a mallet. This drives the cutting edge into the wood fibers.



Good work with a chisel requires it to have a sharp edge. Honing on an oilstone maintains the edge. This Stanley honing guide ensures the correct bevel angle.



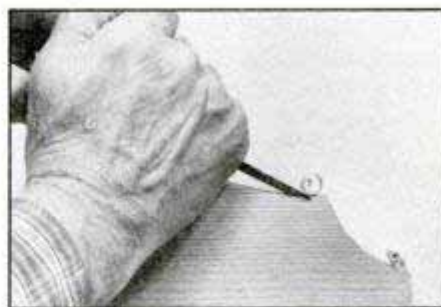
Outline hinge with knife; chisel vertical cuts on line with mallet, bevel toward waste. Make slant cuts on lines, bevel down. With mallet make score cuts; cut waste, bevel up.



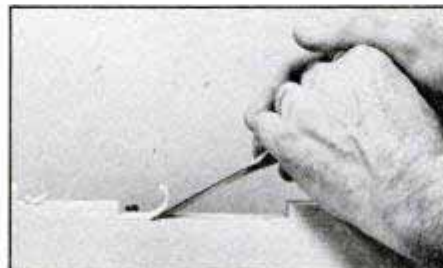
To cut a mortise, bore overlapping holes to depth and trim off webs between holes with a chisel. Bore tiny holes in the four corners to simplify squaring the corners.



To make a dado, cut sides first with a back saw. Chisel waste to depth, bevel down. Work toward center to prevent splintering. Bevel down gives hand clearance.



Hold the bevel side of the chisel against the work to cut a concave curve. Push the handle down while pressing blade forward. Work from the edge toward the end grain.



Direct the bevel down when working in confined areas. Here, the left hand is positioned far from blade for photo clarity; it actually should be closer to cutting edge.



To shape a round, chisel vertical paring cuts after rough-sawing the shape. Chisel shallow cuts with a side-to-side paring action, with the flat side tangent to curve.

3 Saw Fixtures That Help Cut Oversize Stock

You can cut bulky workpieces accurately and easily with these accessories.

1 Table saw cutoff box

This cutoff box helps you crosscut large panels of plywood without assistance. A carefully built box will help make perfect 90° cuts across the full 4-ft. width of stock every time. Clamps on the far side keep the stock snug against the back bar.

Begin by making the face and bottom of the back bar absolutely straight and square. Then trim the guide strips to the width of the saw slots and slightly shallower than their depth. Lower the saw blade beneath the tabletop.

Cut the plywood base. Then glue and nail one guide strip to the bottom of the base so one edge overhangs the table about 1½ in. Remove the base. Lay a shim in the second slot and place the second guide strip on top. It should be flush with the table. Apply glue to the guide strip, replace the base and nail it to the strip.

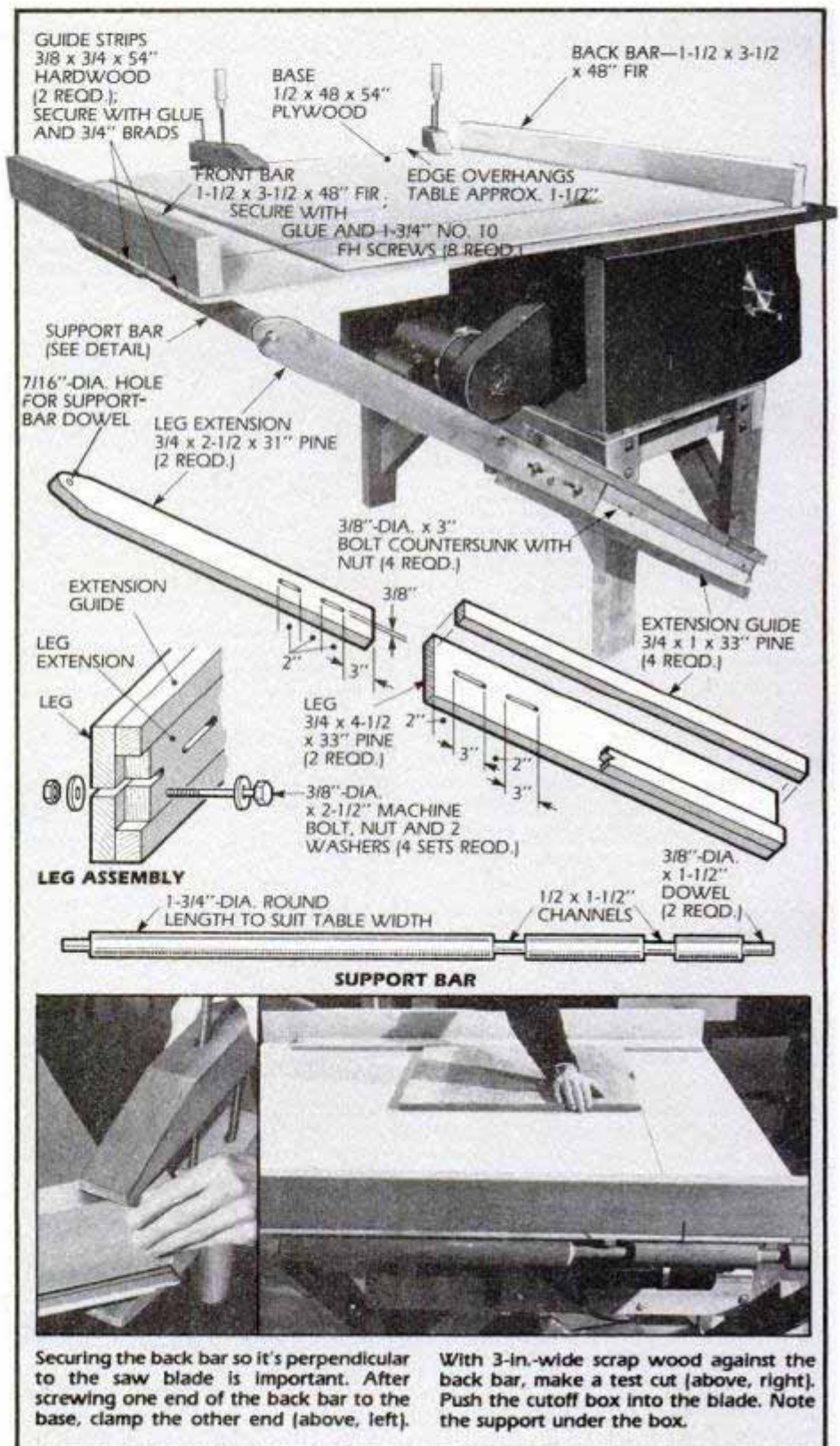
Next, cut a kerf through the base to within 6 in. of the back end. Attach the front bar to the base with glue and eight 1¾-in. No. 10 flathead screws. Don't place a screw where the kerf will run. Draw a line perpendicular to the kerf and about ½ in. from the back end of the base. Place the back edge of the bar against this line. Using a single screw, attach one end of the back bar to the side of the base that doesn't overhang the saw. Clamp the other end of the back bar to the base so the bar is perpendicular to the kerf.

Rip a straight ½ × 3 × 48-in. plywood stop. This prevents you from cutting the back bar while test-positioning it. Then test-cut a wide piece of scrap plywood in the cutoff box. In cutting, push only on the plywood base.

When you are certain the cutoff box is guiding the workpiece to receive a perfect 90° cut, mark the position of the back bar and secure it with glue and eight 1¾-in. No. 10 flathead screws.

The roller support holds the front end of the box. The support consists of legs with guides for the leg extensions. The adjustable extensions hold the bar that comes in contact with the box. Bolt the support to the saw table.

—Linda Freedman



2 Radial saw extension table

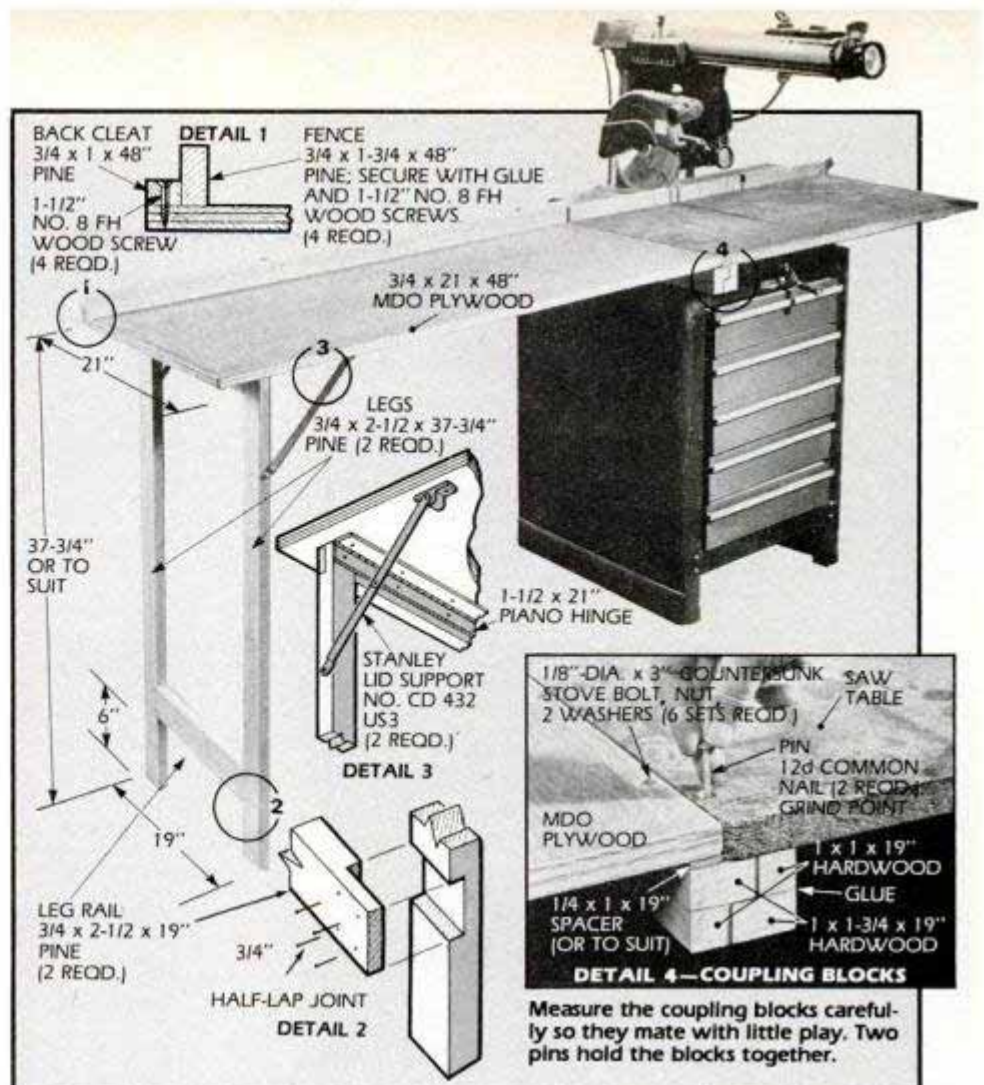
If space limitation prevents you from having a permanent extension table for your radial-arm saw, you can get by nicely with this knock-down version. It folds flat for convenient storage.

The top is MDO plywood. The back cleat, fence, legs and rails are pine. Attach the fence after the table is in place to ensure that the fence will be in exact alignment with the saw's fence.

Measure the legs so that the top surface of the extension is level with the saw tabletop. The legs and rails join in half-lap joints. The top is secured to the legs with lid supports. A piano hinge along the top rail joins it to the tabletop.

The coupling blocks are made of five pieces of wood. The blocks join the extension table to the saw table. Secure each block assembly to its respective table with three $\frac{1}{8}$ -in.-dia. \times 3-in. countersunk stove bolts, two washers and a nut.

Two 12d common nails serve as pins to hold the tables together. Grind off the nail points. Then clamp the tables together while you bore holes for the pins through the blocks. Holes should be slightly oversize so the pins can be removed easily.—Rosario Capotosto



3 Band saw extension table

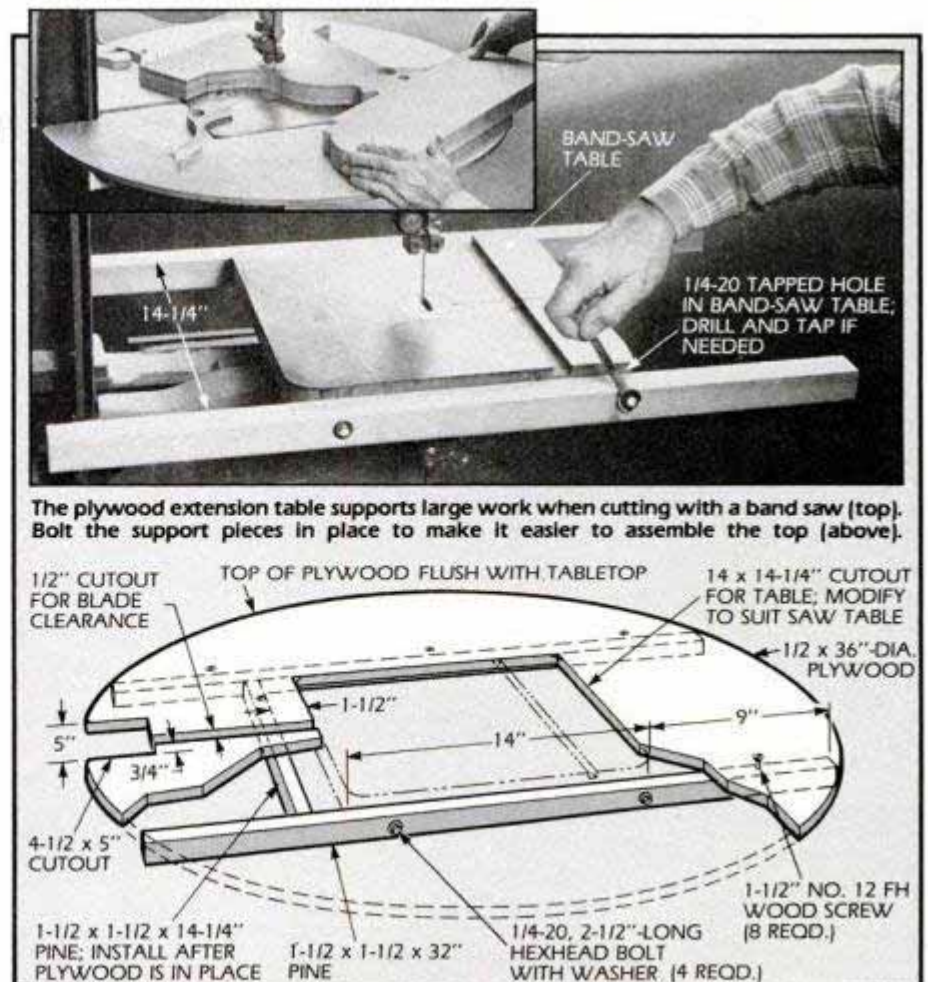
It's easier to make accurate cuts on large workpieces when you have support under the work. This extension table for oversize work attaches quickly to the saw table with four hexhead bolts. The bolts turn into the existing threaded holes found on most saws that can accept a rip fence.

Install the $1\frac{1}{2} \times 1\frac{1}{2}$ -in. pine frame members so their top surface is $\frac{1}{2}$ in. below the top surface of the saw table. In this way, the top surface of both extension and saw tables will be on the same horizontal plane.

Cut the 36-in.-dia. extension table of $\frac{1}{2}$ -in. plywood. Make a cutout for the throat, cut a $\frac{1}{2}$ -in.-wide slot and make a cutout for the saw table. Bore pilot holes for fasteners with the top in place on the saw.

Fasten the table to the frame with glue and six $1\frac{1}{2} \times 1\frac{1}{2}$ -in. No. 12 screws. Countersink the screws. Then fasten the back $1\frac{1}{2} \times 1\frac{1}{2}$ -in. member to the plywood with two more fasteners of the same size.

The table shown here is designed for use with a Rockwell 14-in. band saw. You may have to alter the dimensions to suit your saw.—Rosario Capotosto



Make These 4 TOOLS For Your Shop

These inventive metalworking projects will make your shopwork easier.

BY WALTER E. BURTON

Push-apart pliers

These ingenious spreading pliers can serve as an extra pair of hands for some difficult assembly and positioning tasks. Squeezing the handgrips pushes the jaws apart forcefully. The spreading pliers can be used to enlarge sheet-metal openings, set precise spacing between objects, pry apart crushed metal parts, open crates, and support objects at a predetermined height for work underneath. The pliers have a locking device that makes them useful in some clamping operations.

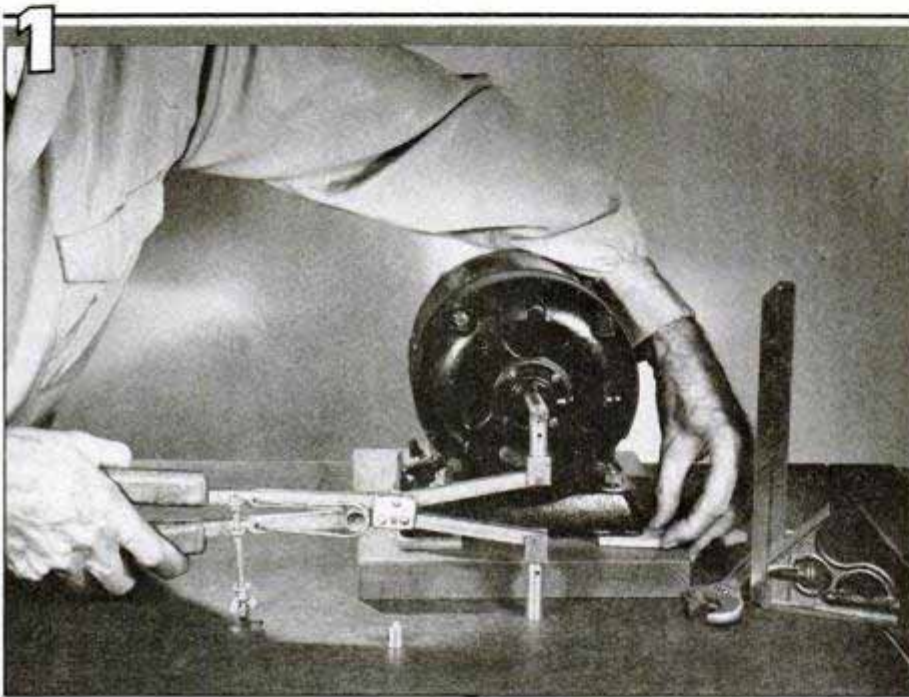
Begin making the pliers by cutting two 12-in. lengths of $\frac{3}{8}$ -in.-square steel stock. Place each bar in a bench vise and bend it 13° at a point exactly 4 in. from one end.

Make the plier jaws from $\frac{5}{8}$ -in.-square steel stock. Drill $\frac{1}{8}$ -in.-dia. holes through the side of each jaw block and use a No. 7 bit to drill a centered hole in the outside face of each. Tap the latter for a $\frac{1}{4}$ -20 bolt. Mill slots in the base of each block. The jaws fit over the bent bars to form knuckles. Make rivets from $\frac{1}{8}$ -in.-dia. drill rod to pin together the knuckles. The jaws must pivot freely so they self-adjust in any position.

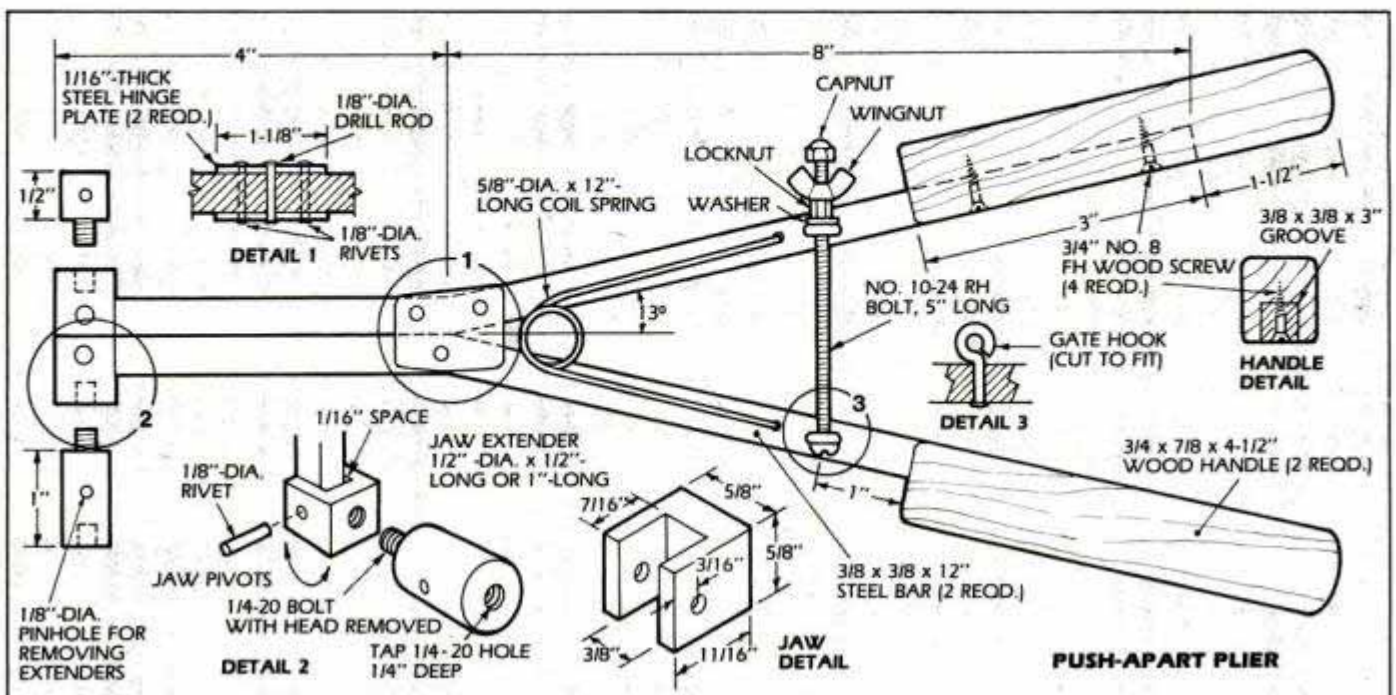
Cut two hinge plates from steel $\frac{1}{16}$ in. thick. Rivet both plates solidly on opposite sides of one of the bent bars at the pivot point. Pin the second bar between plates with a single rivet.

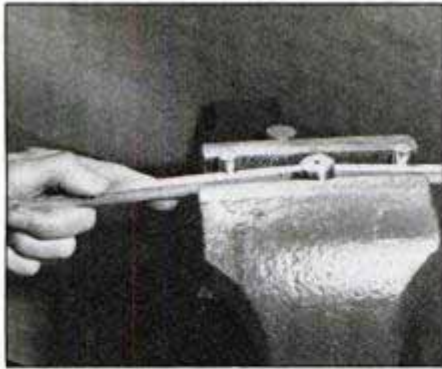
A spring keeps the jaws closed when no force is exerted on the plier handles. You can use a $\frac{5}{8}$ -in. coil spring to fashion one suitable for the tool. Heat the coil spring to bright red and while it is still in the fire, straighten two 4-in. segments on each side of a two-turn coil. Hammer out kinks in the straightened segments after the wire has cooled.

You can also make up a suitable

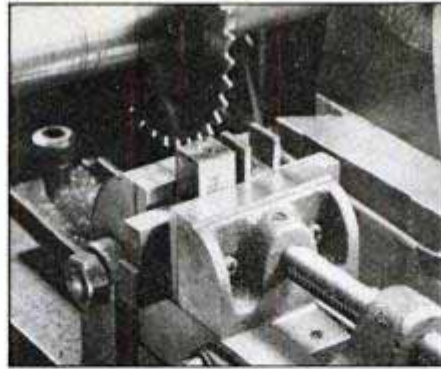


Spreading pliers can serve as an extra pair of hands in many tasks. Here, they're used to support a motor driveshaft at a set height above baseboard as shims are inserted.

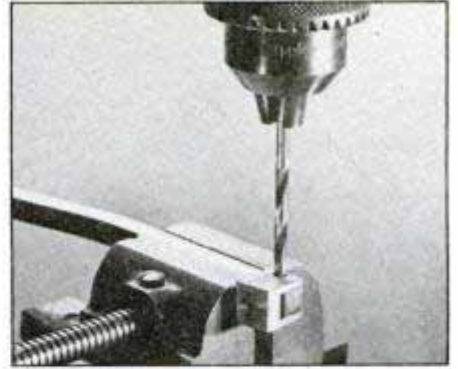




To bend arms, place two rods behind stock and a larger rod in front at the bending point. A tightening vise does the rest.



Cut grooves in the base of the jaw blocks. Here, a milling machine is used. A drill, saw and file will also do the job.



To ensure proper operation of self-adjusting jaws, drill a hole for a pivot pin through block and plier arm in a single operation.

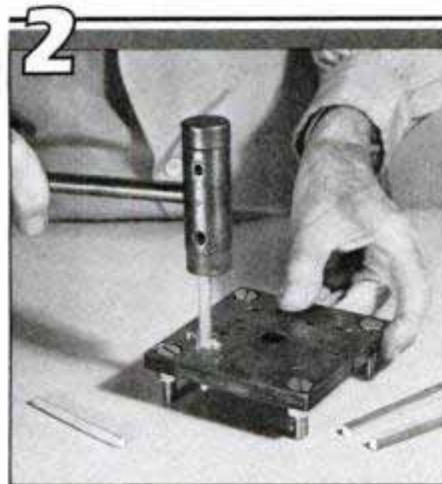
spring from No. 31 (.085-in.-dia.) music wire. After bending the wire to the proper shape, harden the coil and part of the straight segments leading out of it by heating them to cherry red, then plunging them into cold water. Polish the coil bright, then temper it by slowly reheating the metal until blue oxide appears in the polished area. Quench the piece again. When mounting the

spring, be sure the coil is centered when the plier jaws are closed.

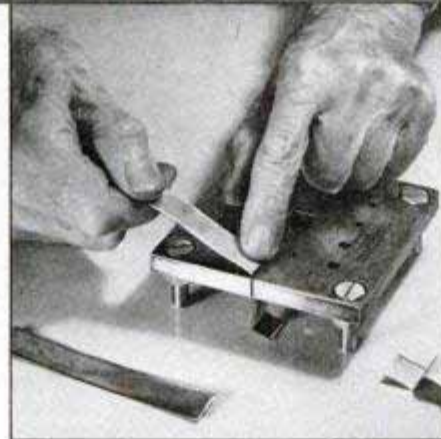
Cut the eyes off small gate hooks and rivet them on the tool as shown in the drawing. They must pivot. Assemble and thread the components on the 10-24 x 5-in. bolt that enables the pliers to be set and locked in the open position. Shape wooden handles and cut grooves for mounting them. Then finish with

oil or varnish before attaching them.

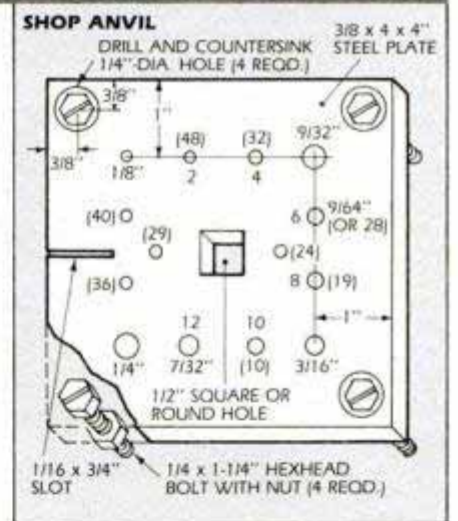
Make extenders to increase the 1½-in. spreading capacity of the jaws by using ½-in.-dia. steel rod. Drill holes ¼ in. deep lengthwise through the center of the rod ends. Tap the holes for ¼-20 bolts. Coat a bolt end with epoxy and thread it into the extender block. Cut off the bolt head to leave a ¼-in. stud. Add extender blocks when needed.



Drive wood through anvil holes to fashion dowels. Anvil can be clamped in vise or held by hand if longer pins are needed.



A slot in the anvil edge, cut with a milling machine, can be used for making sharp, accurate bends in sheet metal.



Shop anvil

While this 4x4-in. perforated steel anvil can't be used for heavy metal forging, it has many functions. Made from ¾-in. steel plate, the small anvil has holes and slots specially designed for a number of metalworking tasks. It is heavy and rigid enough to use for a hammering surface when working with

light metals. The hole sizes were selected to correspond with the shank diameters of common screws and bolts.

A screw can be inserted in the proper hole and held immobile while the head is brushed clean or the slot restored by filing. The holes can also serve to determine the sizes of screws and drill bits. Punching through a piece of sheet metal into a selected hole enables precise

control of the hole size. The narrow slot at the anvil edge is handy for making crisp bends in sheet metal and thin wire. The anvil's legs permit clamping of workpieces.

On the drawing, numbers in parentheses corresponding to holes indicate twist drill sizes. Other whole numbers are screw sizes; fractions indicate hole diameters in inches.

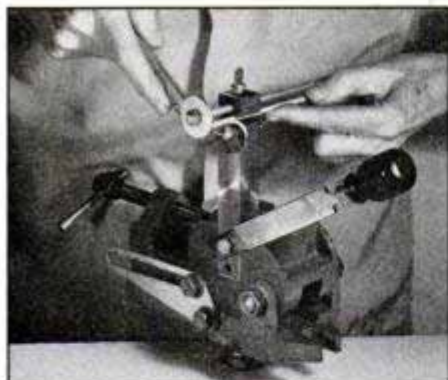
Round-stock cutter

There are several methods of cutting round stock like wood dowels, metal rods and wire—some of them better than others. Wire cutters and snips are really practical only for smaller diam-

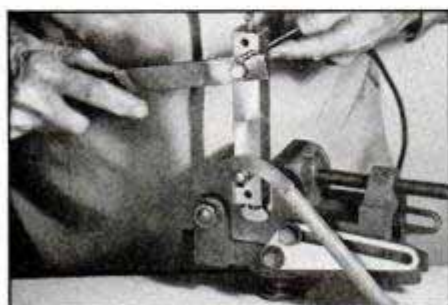
eters, and they tend to leave cut ends crushed or distorted. The round-stock cutter shown here is designed to alleviate these difficulties. Meant to be clamped into a vise, it has two blades—a curved one for wood and a straight one for soft metals—that produce

clean, shearing cuts. The tool cuts round stock up to ¼ in. in diameter. It has a limiting gauge that can be set for replicating lengths.

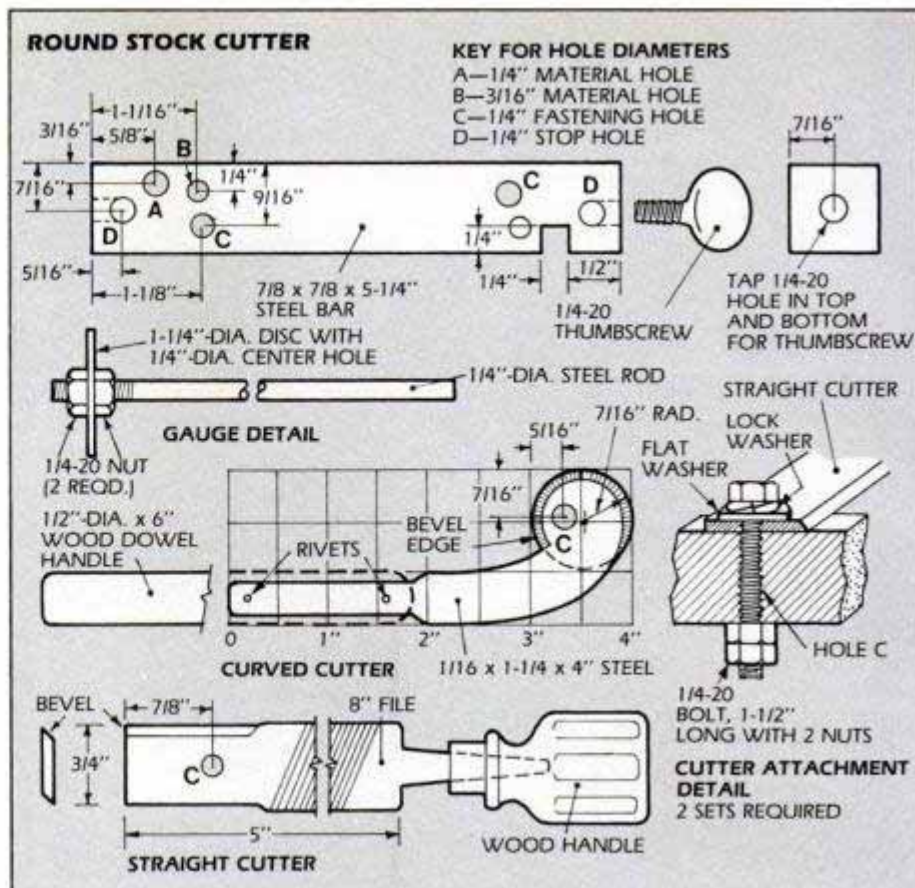
The first step is to find a piece of steel for the body. Because it's possible that the old parts and tools you use to



The curved cutter is used to cut wood dowels. A rod-and-washer limiting gauge serves as a stop for duplicating lengths.



Flipping tool over in the vise makes straight cutter available for cutting wire and other soft, round metal stock. The limiting gauge has been removed for this photo.



make the cutting blades will be of slightly different size than those used in the version illustrated, drill the blade-fastener holes first and attach the blades to the body. Lay out the material holes so that the stock inserted for cut-

ting will clear the blades. The rectangular notch near the wood-cutting (curved) blade proves more efficient for some dowel types and sizes.

Flat-ground steel 1/16 in. thick is a good choice for the wood-cutting blade. After laying out the blade shape based on the pattern provided, cut it out and bevel-grind the circular cutting edge. Harden the edge by heating it to cherry red, then plunging it into cold water. Polish the heated area, then reheat it slowly until a yellowish color appears, and quench the piece again. You can make a wood handle for the curved cutter by slitting a hardwood dowel lengthwise with a saw so the knife will fit inside. Rivet the handle in place.

If you use a worn file for the straight metal-cutting blade (I cut an 8-in. file

down to 5 in.), it will need annealing before you can shape and drill it. To soften the steel, heat it red-hot, then let it cool slowly. I removed the teeth from a 1 3/4-in. section at the end of the file by grinding and filing, then beveled both ground edges to create sharp cutting edges. Note that the beveled edges of the straight cutter are parallel and that the fastener hole is centered to allow the cutter to be reversed when one edge becomes dull. After shaping and drilling the straight cutter, harden the cutting edges. An old screwdriver or file handle makes a good grip. The length gauge, which acts as a stop for material being cut, can be mounted at either end of the tool. It is easily assembled from a length of threaded rod, hex-nuts and a broad washer or disc.



With cutter removed from vise, both blades are shown in place. It isn't necessary to remove a blade when using the other one.

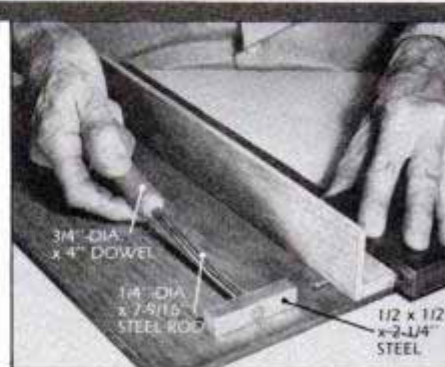
4

Offset hammer

A light hammer is essential for cabinet and finish work. The square-headed hammer with offset head is an especially useful adaptation for driving small fasteners close to corners.

Select square stock for the head. Steel is best, but brass, bronze or even aluminum can be used. Cut the head to the desired length and drill a hole through it using a No. 2 (.221 in.) twist drill. Cut a 1/4-in.-dia. steel rod to length for the handle. Machine a segment at

one end of the rod down to .221 in. in diameter. If you don't have a metal-working lathe, reduce the diameter by careful filing. The reduced segment should be about 1/16 in. longer than the thickness of the hammer head. Fit the head on the rod andpeen the protruding end like a rivet to fasten it securely. Bend the handle by placing the head in a vise and pulling on the rod. Bore a 1/4-in. hole lengthwise about 3 in. deep in a 4-in. length of 3/4-in. dia. dowel. Glue the rod into the dowel with epoxy and apply finish.



When driving brads in a corner, square hammer head guides itself on adjacent surface while offset handle allows knuckle space.

Car Care Guide

**PM's Guide For All Owners—
Whatever Year Your Car**



**How To Restore Your
Car's Body...**



...And Its Soul.

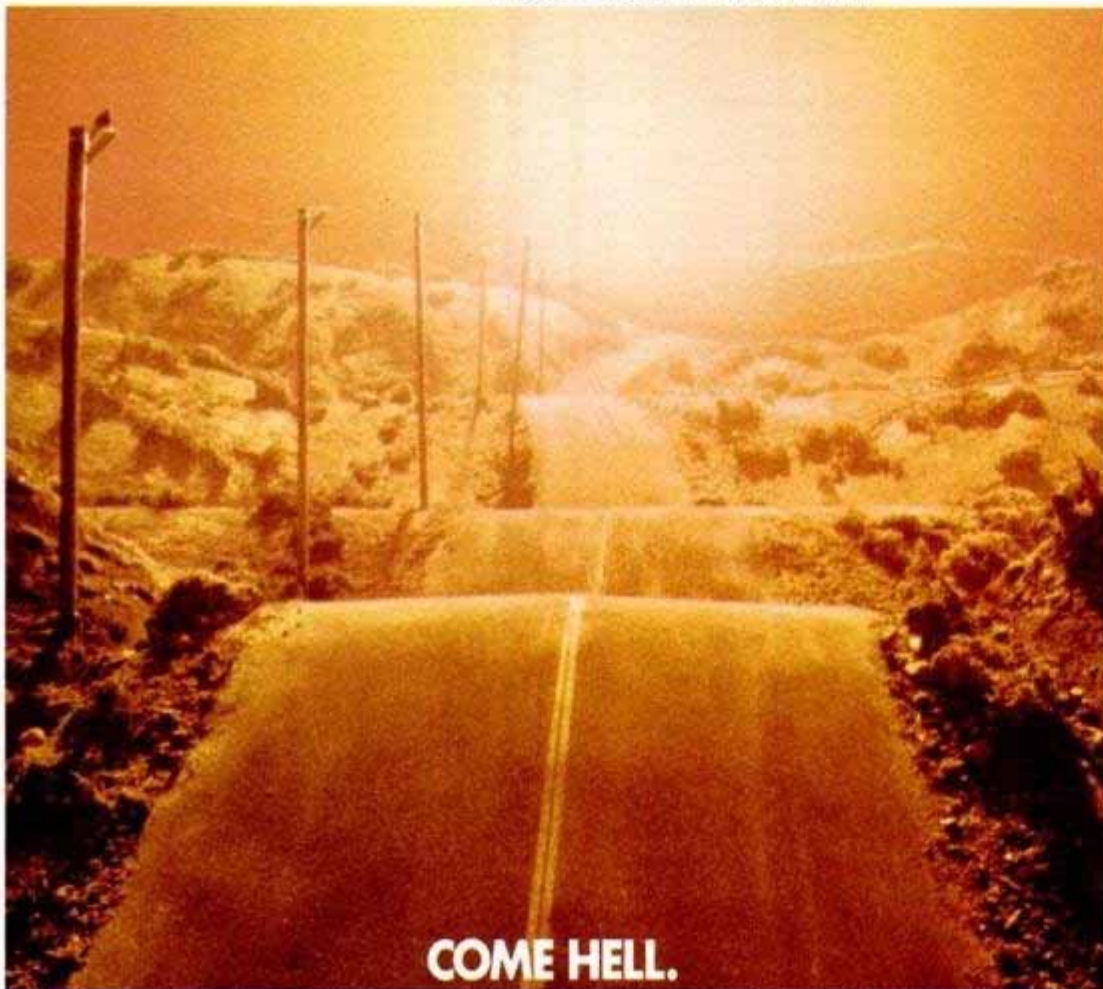


NEW LIFE FOR YOUR OLD CAR—How to tell how many miles are left.

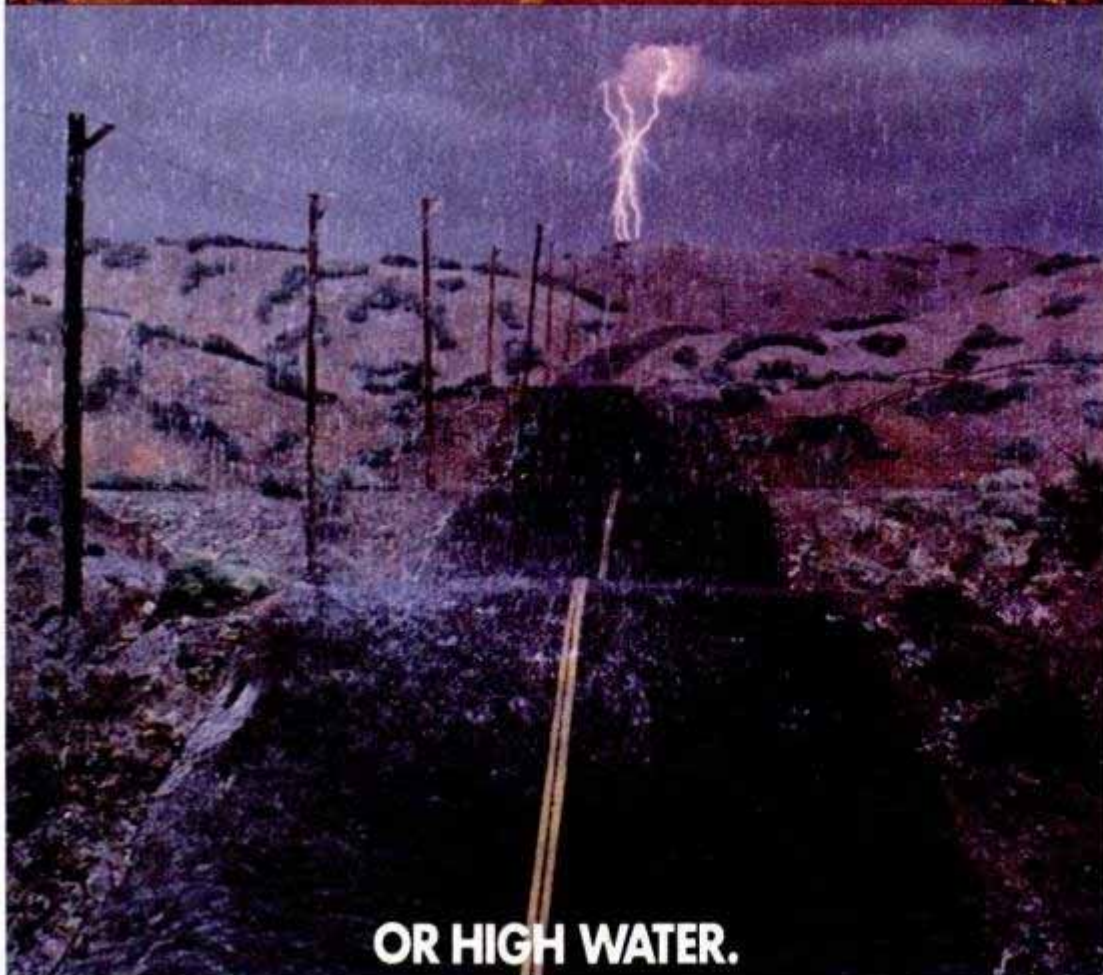
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are presently on your car.

No matter what they are.



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BECAUSE SO MUCH
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ON YOUR TIRES.**

Car Care Guide



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Cover: Gary Licko's immaculately restored 1964 Pontiac GTO coupe

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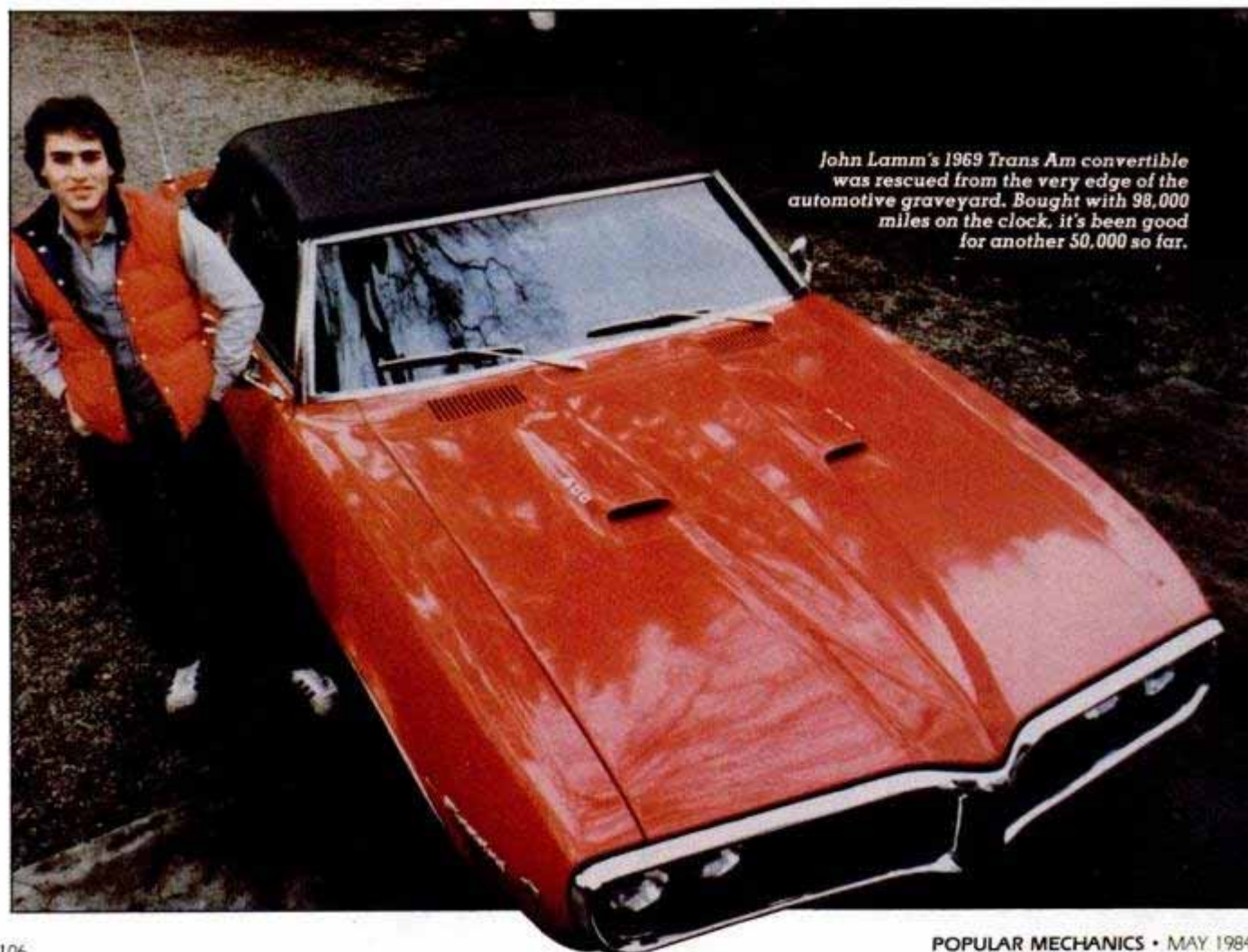
NEW LIFE FOR YOUR OLD CAR

Go ahead and rebuild that aging car—it's got more miles in it than you ever dreamed.

There are many good reasons for rebuilding an old car. Some cars are collector's items. Others are outrageous customizing jobs, such as Joe Alphet's Ferrari-like Datsun. Still others are resurrected for racing, like Larry Schwacofer's amazing '55 Chevy off-road racer. Most, however, are just plain fun.

But the most reasonable reason to rebuild a car is to provide cheap, practical transportation. Take John Lamm's '69 Trans Am convertible. John bought the car four years ago for \$1,800. It had 98,000 miles on the odometer and was on the ragged edge of retrievability. He had the transmission overhauled, ground the valves, replaced the carburetor,

When Larry Schwacofer rebuilt his '55 Chevy (top photo), he had a very definite use in mind—off-road racing. Larry's bright orange crowd pleaser won the 1983 SCORE stock car Class 6 championship with six victories, including a win in the grueling Baja 1000. Mike Lamm is more careful with his '67 Camaro (above). Tender, loving care and piecemeal rebuilding during the 16 years he's owned the car have put 135,000 miles on the odometer. It sure beats buying new!



John Lamm's 1969 Trans Am convertible was rescued from the very edge of the automotive graveyard. Bought with 98,000 miles on the clock, it's been good for another 50,000 so far.

shocks, brakes, top and front seat upholstery, and did a lot of tightening and tuning. The investment of time and money was certainly worth it, because he now has a perfectly good "special-interest" car for thousands of dollars less than the price of a 1984 convertible. The 400-cu.-in. V8 is reliable and quick, "a real pleasure to drive," says John, who has added 50,000 miles to its life so far.

John's father, Michael (our West Coast Editor), owns a similar car—a '67 Camaro that his wife bought

"It's better than a new car." And \$10,000 cheaper, too!

Read Rankin invested \$3,000 in parts and \$3,900 in labor to rebuild a \$1,700 '65 Mustang to better-than-new condition. He replaced virtually every body panel, reinforced the undercarriage with 1/8-in. steel and laminated floorpans, installed new carpeting and factory-optional disc brakes. All the bright parts were rechromed, all the rubber replaced, as well as many latches, locks and fasteners. It has a clear-coat acrylic paint job, and Read

Fix it or fling it?

Maybe the old buggy doesn't always start when you want it to—or it may not shut off when you want it to. Perhaps there's something underneath that goes thump in the night. When it does run, it idles roughly and balks or hesitates under heavy load. You've probably come to feel that replacement is the only solution.

You may be wrong. A lot of older cars that seem to be on their last legs can be saved—at a cost that's only a fraction of what you'd pay for a new car. Many vehicle systems can be restored to like-new performance, if they have been maintained in a reasonable fashion.

But partial restoration or rebuilding is certainly not the answer in every case. Any attempt to recondition an aging vehicle should be preceded by a careful evaluation of its condition and the approximate cost of rebuilding.

A car with considerable miles under its belt can be restored to acceptable condition if it was maintained in a reasonable fashion. However, if all the vehicle's systems and components have been ignored since the car first rolled off the showroom floor, rebuilding is probably not a practical solution, except for valuable collector's cars.



Only 39 Ferrari GTOs were ever built, and this is not one of them. It's Joe Alphabet's 72,000-mile 1974 Datsun 260Z, with Alpha 1 fiberglass panels bonded over the old body.

for him for \$2,500 in 1969. Mike had it repainted, then installed front-disc brakes and a four-speed transmission. Over the years, it's required the usual brake work, shocks, tires and other maintenance items. The two-barrel, 327-cu.-in. V8 has never had any major mechanical work, except for a valve job at 120,000 miles. The car now has 135,000 miles on it.

As Mike says: "I've always babied and over-maintained this car. It's really like new in every way—very tight and cooperative. Part of the reason I've never bought a new car is because I've never seen any advantage in one over this Camaro. I've seen lots of disadvantages, though."

Executive Editor Joe Oldham's '69 Camaro RS (see *Engine Swaps*, on a following page) is a similar case. Joe uses it to commute into the Big Apple when the weather is nice.

The reasons and the lengths people will go to restore an old car vary widely. Lois Velardi spent \$1,000 to put new paint, a vinyl roof and rechromed bumpers onto a '74 Chevy Malibu that she bought eight months ago for \$1,200. She uses it for daily transportation and says,



When Read Rankin bought this '65 Mustang in 1978, it had only 40,000 miles on it, but the turquoise body had lots of rust, poorly covered up. He's put \$6,900 and much hard work into a jewel-like restoration that he says he wouldn't sell now for \$20,000.

keeps it out of traffic as much as possible.

No matter what your motive or budget, a rebuild offers many advantages over a new car. The hardest part is getting up the nerve to do it. The second hardest is deciding which car to sink your hard-earned money into—your present old clunker, or someone else's.

Extremely high mileage—more than 150,000 on large domestic and European vehicles, or more than 100,000 on smaller domestics and most imports—might also rule out practical restoration, even if maintenance was fairly regular. There is a point at which metal wear on hard parts like shafts, bushings and gears may cause considerable



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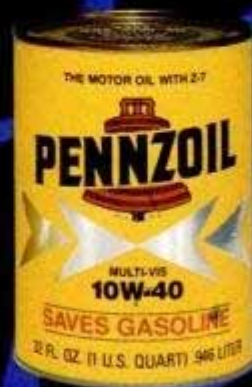
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problems a few miles down the road, even if all the obviously worn components are replaced.

Some people argue that every part of a car is replaceable. Which is true. However, you wouldn't want to restore a vehicle if most of the moving parts had to be replaced. A recent study found that a \$10,000 new car, purchased on a piece-by-piece basis, would cost about \$40,000 for the parts alone.

There are other factors that should enter into your decision.



If you find oil inside the air cleaner and the PCV valve is okay, suspect bad rings.

Remember that a new car is not the only alternative. In some cases, it might be practical to dispose of your car and find a good used model that is better suited to a partial restoration. Whether you do the work yourself or pay someone else to do it should also enter into the equation. Obviously, it's a lot less expensive to restore a car if you can do a lot of the work yourself.

Road testing

Vehicle evaluation is critical. If you fail to properly assess the condition of the car before you start, you may exhaust your entire restoration budget and find that you still have a turkey.

Evaluation can begin behind the wheel. Engine performance is the easiest factor to evaluate. If you are checking your own car, ask yourself if it seems as powerful as it once was. Does the exhaust smoke excessively? Does the car hesitate, surge or idle roughly? Does the engine produce tapping, rattling or pounding noises? Record any problems you notice.

While driving on a smooth, flat road (without a crown or rise in the center), note the position of the steering wheel and look for looseness in the steering, or any pull. Let go of the wheel momentarily. Does the car turn? Perform a weaving or S-curve maneuver. Are there any clunks or hitches in the steering? Again, record any observations so

you can consider them during your under-the-car inspection.

On that same flat, smooth road, listen for any howling, grinding, ticking, or chattering noises while driving at a constant speed with the wheel in a straight-ahead position. Notice any noises that occur and the speed at which they're most pronounced. Stop the car and, with the clutch disengaged or the transmission in NEUTRAL, run the engine through the speed range at which the noises are most pronounced. If you still hear the noise, it may be an exhaust or engine noise. If you don't hear the noise, it's coming from the wheels or drive train.

If the noise you heard seems to be coming from the drive train, try inflating the tires to 50 pounds or so and repeat the test. If the noise changes notably, it is probably just tire noise. (Don't forget to restore the tires to the proper pressure.) Rear axle noises usually change when you release the throttle and coast, but tire noise will not change noticeably. Front wheel bearing noise is usually not affected by the change from pulling to coasting.

Test the vehicle's brakes by applying them aggressively at a moderate speed on the same flat, smooth road. Does the car pull in one direction or the other? Does it stop in as short a distance as it once did? Do the brakes make screeching or grating noises? Does the pedal



Oil leaks from the engine rear main seal are difficult and expensive to repair.

pulsate or sink toward the floor? When you come to a stop, check the parking brake. Note any problems.

Check for worn universal joints or excessive ring and pinion backlash by shifting from DRIVE to REVERSE with your foot on the brake. If you hear a pronounced "ka-chonk" every time you shift, there's some slop in the driveline.

Under-hood inspection

With your notes in hand, proceed to an under-the-hood check. You can assess internal engine condi-

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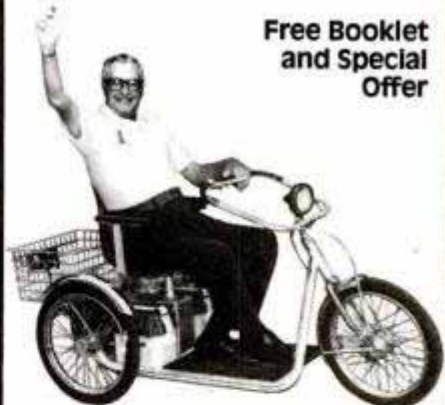
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tion with three basic tests—engine vacuum, oil pressure and cranking compression—and then relate these findings to your previous observations.

To check engine vacuum, attach a vacuum gauge, following the instructions of the instrument maker. Allow the engine to idle and note the reading. It should hold steady between 17 and 21 inches. If the reading is constantly changing or the needle appears to be vibrating, suspect bad valves. If the reading is steady but low, suspect retarded ignition timing or poor ring seal. (Adjust the timing and check again to determine which.) When you open and close the throttle rapidly, the reading should drop to a few inches of vacuum, then shoot up to 25 or so before resuming its normal position. (If it drops all the way to zero, then rises to only 20 inches, suspect a poor ring seal.)

To do a compression gauge test, remove all the sparkplugs and insert the compression gauge into the first plug hole. Crank the engine with the starter until the cylinder comes up on its compression stroke five times. Record the reading. Repeat the test for each cylinder. All readings should be within 25

percent or more below manufacturer's specs, suspect a worn oil pump, worn bearings or both.

Piston pin knocks (which disappear under certain speed and load conditions) and bearing knocks (which usually don't) are both indications of very serious engine wear. The clattering noise of piston slap is also an indication of serious wear.

Valve train noise and oil consumption are two other factors you should consider in your general assessment of engine condition. If there's a lot of valve train clatter and perhaps an accompanying poor vacuum gauge reading and rough idle, you can suspect a worn cam, faulty lifters and/or worn rocker arms. If the engine consumes considerably more oil than it did when it was new, suspect bad valve guides or oil rings.

If you find only one particular fault and you can trace it to a specific cause, your engine can probably be serviced in the car at minimal expense. However, if you find that it comes up poorly in a number of areas, you're probably faced with replacement or rebuilding.

Pressure-test the cooling system if you have any doubts about the condition of the radiator, if you suspect coolant leaks, or if the car has been overheating.

Under-car checks

The under-the-car inspection is next. This task is best performed on a vehicle lift, but it can be done on jackstands if you're very cautious. The car should be reasonably high off the ground to permit adequate inspection and all four corners should be up. If you don't know where to place the jackstands, or if you don't have four high-quality stands, don't attempt it.

The first thing to look for is frame or, in the case of unit-body cars, floorpan rust. If the structural members have rusted to the point of deterioration, forget about restoring the car. This type of corrosion is a problem that's particularly common to some earlier imported vehicles.

Once you've determined that the car is not in immediate danger of breaking in two, examine all the tires carefully. Rotate the front wheels and listen for wheel bearing noises. Grab all tie rods and steering arms and attempt to work them back and forth by hand, noting any excessive looseness. Note the condition of control arm bushings. Use a jack or a wedge of wood to take the weight off loaded control arms, then shake the wheels to determine



A compression test will tell you if the valves and piston rings are okay.

percent of each other. If not, suspect ring or valve problems. (You can narrow the problem down further by performing the engine diagnoses featured in our July, September and November '83 *Saturday Mechanic* sections.)

Before reinstalling the plugs, examine them for black soot that signals poor combustion or oily wetness, and heavy black deposits that indicate oil consumption. Take a look inside the air cleaner as well. If you find oil, and the PCV valve is in working order, the piston rings are probably worn out.

Oil pressure is another good indication of general engine condition. If your car is not equipped with a gauge, you can attach one temporarily in place of the oil pressure

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ball joint condition. Remove each wheel and check the condition of the brakes. Note any brake fluid stains on the inside of the tires. Check the condition of brake lines and hoses.

Look for engine transmission and differential oil leaks. Transmission front-seal leaks, engine rear main seal leaks and differential pinion seal leaks are difficult to repair if you do it yourself, and expensive if you don't.

Is it worth keeping?

Once the inspection is complete, sit down with pen and paper and evaluate the results. If you find that the powerplant suffers from poor compression, low oil pressure and other indications of extreme wear, it will have to be rebuilt or replaced.

A low-mileage junkyard motor is the other alternative. You can usually find one for 40 to 50 percent the cost of a rebuilt, but it's a gamble. You may end up with a jewel, but you also could find yourself with another clunker.

You have similar choices in the automatic transmission market. A rebuilt goes for \$300 to \$500, uninstalled. Junkyard boxes run anywhere from \$75 to \$275, depending on make and model.

To accurately estimate the cost of replacing an engine, transmission or differential, call some local merchants who deal in scrap salvage or rebuilt components. Most will give you a general cost estimate.

The cost of restoring brake or suspension systems depends on how

many components must be replaced. In general, if you wish to restore a vehicle to very good condition, you should replace the components that are partially worn, as well as those that are fully worn. Add up the cost of the parts needed, and the labor required to install them if you can't do it yourself. A complete brake system rebuild could cost more than \$500 if all the components need replacement. Estimate the cost of other necessary repairs in a similar manner.

The cost of restoring the exterior of the car must also be considered. Here you can save a tremendous amount if you can do it yourself. The amount of reconditioning you want to do may vary, as well. Do you just want the car to look acceptable, or do you want to restore it to like-new appearance?

If you don't feel capable of evaluating the condition of your car, have a pro do it. Many repair shops now offer vehicle evaluation services, with prices as low as \$39.95. These are generally aimed at the used car buyer, but they offer an excellent way of determining whether you should restore or replace your present car.

The final decision is strictly a judgment call: How much will it cost you to restore the car, and will you be happy with it when you're done? How does the cost of restoration compare to the cost of a good used car? Remember that any used car is a gamble, too. You may end up with a car that needs as much work as the one you have now. **FM**

In Search Of A Really Good Car

When I first caught up with him for our 1976 Car Care Guide, John Becker of Williamsville, Mo., had driven his 1970 Chevrolet Six sedan a trouble-free 333,000 miles. Since that time, he has phoned me every few years to keep me abreast of his car's rapidly advancing odometer.

In July 1979, Becker reported in at 516,735 miles, mentioning that he was averaging 21 mpg. And except for several valve grinds, 12 worn-out distributors and some surface body rust, his Chevy was still running strong.

Then, on June 25, 1983, John called me again, this time with the news that his beloved Biscayne had finally given up the ghost. "The frame rusted in two," he told me sadly, "and the welding shop says there's no more metal to patch together." His car's odometer registered 707,756 at the final mile.

I asked Becker, who travels more than 1,000 miles a week in his work, what he



Pictured in '79, John Becker's '70 Chevy had 500,000 miles, and 207,756 to go.

now plans to use for wheels. "This time," he replied, "I think I'll get me a really good car!" After I picked myself up off the floor, I asked him what he considers a really good car. "With the money I saved driving the Chevy," he answered, "I figure I can just about afford a Cadillac."

We'll keep you posted on just how things go with John Becker and his new Caddy. —M.L.



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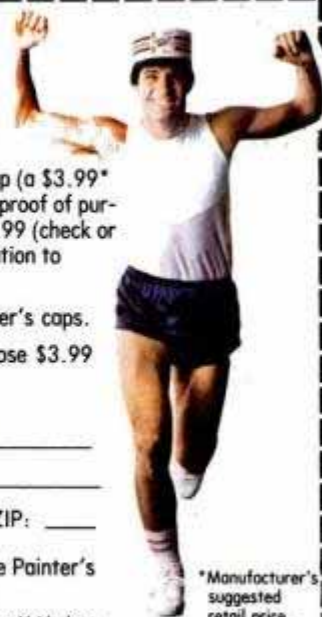
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GETTING RID OF RUST

REPAIRS YOU CAN MAKE YOURSELF



This type of damage can be repaired by a do-it-yourselfer, since the rust doesn't extend to the edge of the panel. Start by loosening and pulling away the decorative chrome molding trim. Enlarge the hole by prying off rusty sections that are ready to fall off. You should use a screwdriver, pliers or gentle taps of a hammer. By the time you finish preparation (step 2), the hole may be twice its original size.



1 Set up your electric drill with a No. 36-grit sanding disc and grind off the finish surrounding rust. Don't over-heat the metal—pull back disc for a second or two every so often.



5 Apply more body filler, building it up in thin layers until it's about 1/4 in. above the surrounding surface. Let it dry for 20 minutes, then rough-sand with No. 100 waterproof sandpaper.

WHEN YOU NEED A PRO



This degree of rust damage is difficult for most do-it-yourselfers to handle. The rust has eaten away the fender metal right to the end of the panel, leaving no biting surface for body filler and fiberglass cloth. The kind of do-it-yourself patch shown above would be unsupported along one edge, which would allow it to vibrate and crumble. New sheet metal must be welded in place for a proper repair.



1 The first step for professional and do-it-yourself rust repair is the same: The surface has to be properly prepared by grinding and cutting away the thin, rusted metal.



5 Welding marks must be ground away and the joint between the patch and fender covered with body filler. Sand the filler, then spray primer on the repaired area.

Auto body repair is an art that requires patience. Every blow you strike with a body hammer and every cut you make with a grinder has to be done deliberately and carefully to get a first-class job. The object is to repair damage without stretching and overheating the metal. Stretched and overheated metal is thin metal that's



2 Use tin snips to cut away remaining rust-thinned metal. Then clean all debris from the cavity with a brush and by tapping around the hole with a hammer. Don't dent the metal.



3 Use a squeegee to spread plastic or aluminum (shown here) body filler around the cavity. Press a piece of fiberglass cloth into the filler and let it dry in place.



4 Coat the area with plastic or aluminum body filler and let it dry. Then use the drill and No. 36-grit sanding disc to grind the filler smooth and to remove excess cloth.



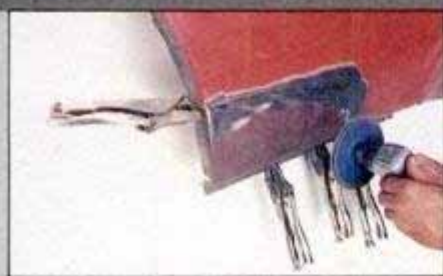
6 Finish-sand the body filler with No. 180 wet/dry paper until it's level with metal. Spray on primer, let it dry, then sand lightly, as shown, with No. 400 waterproof paper.



7 Spot-paint the repair. We used the Preval Sprayer. Fill the 6-ounce jar with paint and screw on the aerosol bomb, then use a smooth and even motion. Mask surrounding parts.



8 Protect the inside of the panel to keep rust from undermining the repair. The next best thing to welding on metal is to use undercoating—lots of it, built up in layers.



2 Next, a piece of metal is fashioned to match the missing panel. The metal extends around and under the fender to form a new edge. Clamped in place, it's sanded until it's shiny.



3 Using a powerful electric spot welder, the pro tack welds the metal piece to the fender. The welds are placed close together. Each inch of the patch is bonded to the fender.



4 The back side of the area must support the patch and keep rust from attacking the repair. A second piece of metal is fashioned to fit the fender and is welded in place.



6 No matter who repairs a rusted area, the result rests primarily on the surface preparation. Sanding to silky smoothness will make it look as if damage never existed.



7 A body repair professional is an artist with a paint gun. He uses a smooth, sweeping movement to apply paint in thin layers—a technique do-it-yourselfers should practice.



8 A look at the result explains why professionals get big money. This repair job cost the customer \$150. That's pretty much the going rate for just one rust spot or small dent.

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more likely to rust. A long-lasting repair job depends on the type of body filler you use. This material is the protective coating that goes directly over the repaired metal. Its main purpose is to fill irregularities in the bodywork with a material that can be sanded smooth. Another purpose is to make the repair water-resistant.

A cheap filler doesn't block water for long. Water seeps into crevices around the repair, causing metal to rust and the patch to fall out eventually. Using a high-quality filler is important if you're restoring a car you plan to keep for many years—maybe one that has the chance of becoming a classic.

The characteristic that distin-

guishes a better filler from one that's so-so is the amount of talcum powder blended into the product. Less talcum and more "heart" is the desirable feature. The "heart" of a filler is the base material—either plastic or metal. Fillers used by most do-it-yourselfers have a plastic base. A really top-notch professional filler has an aluminum base.

A repair made with a good-quality plastic filler (about \$8.50 a quart) will hold up approximately five years, if the job is done properly. A repair made with a good-quality aluminum filler (about \$20 per quart) can last indefinitely.

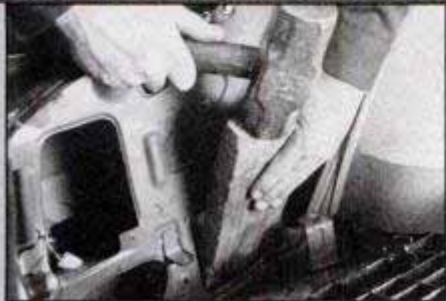
You can get either plastic or aluminum filler from an auto parts store that deals in body repair

Do It Yourself Or Farm It Out?

The decision here depends on the kind of tools you need for the particular repair. You probably won't spend the price for the welder needed to repair metal rusted to the extent shown on page 114. This type of rust has eaten to the edge of the panel, requiring that a piece of metal be tacked over the hole. Conversely, as long as metal around rust is intact (see page 114), relatively inexpensive do-it-yourself products are available.

There's another aspect to this do-it-yourself or farm-out question. Top body repair professionals are as meticulous as good artists. If you don't have the patience or don't wish to take the time required to do a job properly, farm it out.

GETTING RID OF DENTS AND DINGS



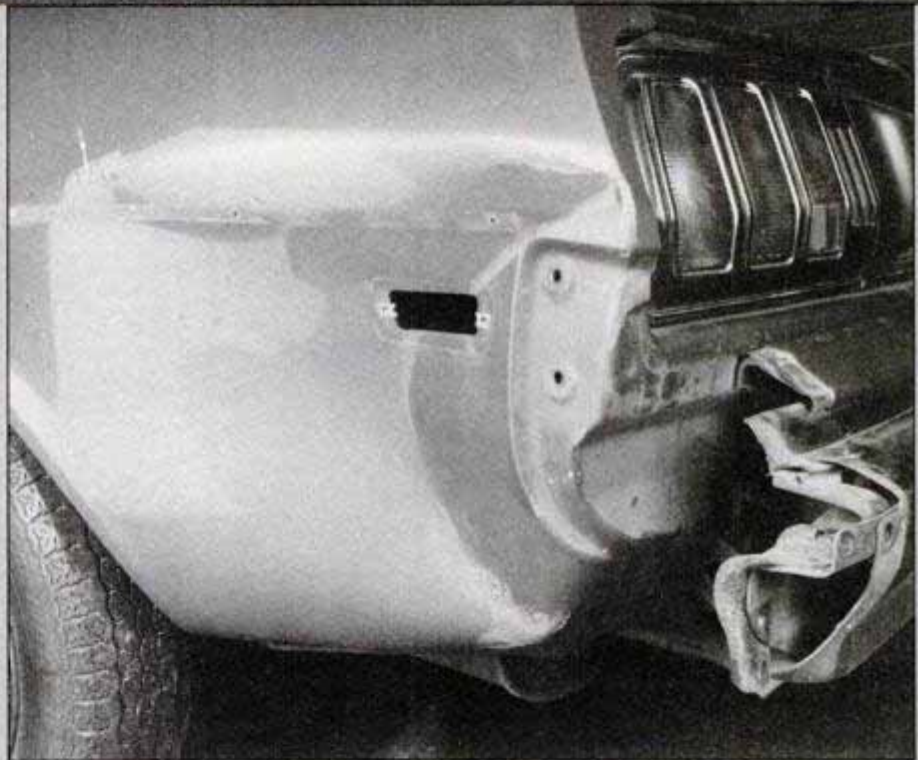
- 1** Clean dented area. Working from behind, use a 2x4 and a sledge to bang out metal. Be careful—if you hammer a dent into a bump, rehammering may crack metal.



- 2** To remove wrinkles, use a hammer and dolly. Hold dolly behind and against metal and tap edge of dent. Dollies—flat, heel-and-toe, all-purpose—fit different areas.



- 3** Tap out wrinkles by striking metal supported from behind with the dolly. Avoid hard banging. Touch spot to judge when metal is smooth enough for filler and sanding.



Dents are easy to hammer out if you can reach the back of the dented panel (see steps 1-4), and if you're careful not to stretch and wrinkle the metal. If you cannot reach the back of the dent, you will need a slide hammer (step 5). Before you start, remove trim and other parts on and near the mangled metal. Some parts are held by "blind" fasteners. Slide or pry trim away from body to reveal fasteners.



- 4** Use a slapper when wrinkles are spread over extended area. Hold a dolly in place and strike metal hard. Metal won't stretch because blow is spread over a wide area.



- 5** If you can't get dolly behind damaged area, drill 1/8-in. holes into dent 1 in. apart. Screw slide hammer into holes and slap slide toward you to pull out dents. Work in from edge.



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Valvoline[®] Motor Oil was created to protect. Engineered to go the distance. Across the country or just across town. So, next time you hear the call of the open road, do what millions of drivers do every day. Drive with the assurance that Valvoline Motor Oil, America's symbol of protection, is watching over you and your car.



SYMBOL OF PROTECTION.™

Valvoline Oil Company, Lexington, KY  Division of Ashland Oil Company

equipment. The aluminum filler may have to be special ordered.

Many new cars have fiberglass panels around the grille or headlights. Small holes and cracks in such panels can be easily repaired with fiberglass repair kits, sold in auto parts stores. The typical kit contains resin, hardener and fiberglass strands or cloth. A kit is fine for small repairs, but big repairs get unwieldy and it is often simpler to replace the entire panel.

Follow the instructions with the kit, but mix the resin in small batches. The resin dries very quick-

ly and some generate enough heat to start a fire. Resin fumes are toxic and flammable, so work in a well-ventilated area free of flames or electrical sparks. After sanding the patch, cover irregularities with filler.

Body repair tools shown in this section are common and can be purchased at auto parts stores. However, you may encounter trouble obtaining a small quantity of paint to match an older car.

Soon after a color ceases to be used by a car manufacturer, paint companies stop making small-size aerosol spray cans of this color. To

get the color for spot painting, find a body shop that stocks the paint in gallon containers. Buy a small quantity of the paint and some paint thinner. Then purchase an aerosol spray kit, which consists of two components—an aerosol bomb and six-ounce jar. The bomb will spray about 16 ounces of paint. You can buy replacement bombs.

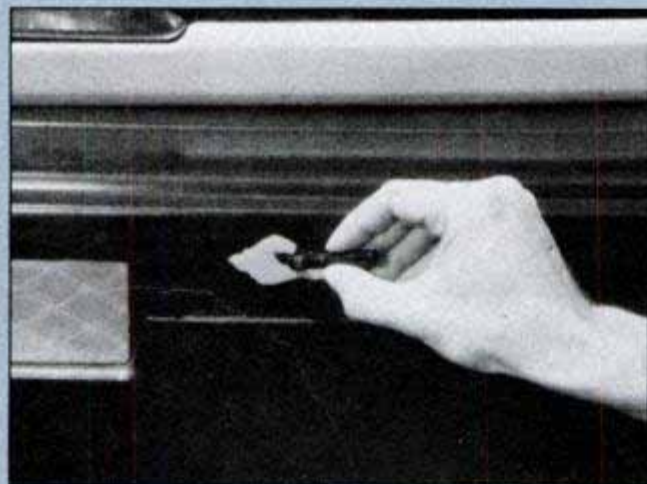
Caution: Body repair work can be dangerous. Wear a face mask when you're grinding, sanding or spraying paint. Also wear safety goggles when there's danger of flying debris. **PM**

PRODUCTS THAT HELP YOU WORK LIKE A PRO

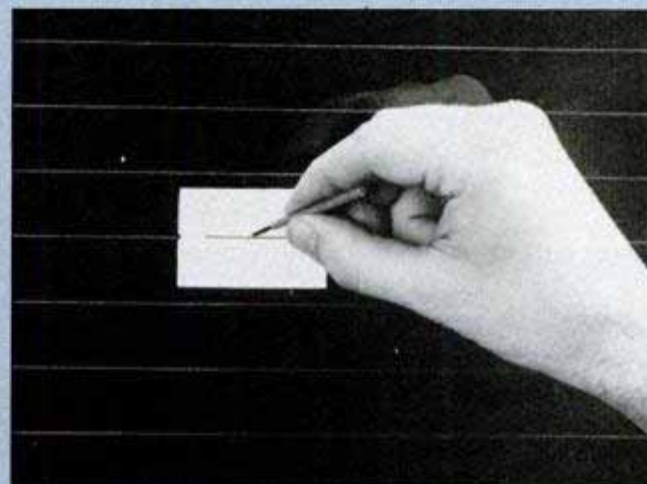
There's more to a car body than metal, and more to bodywork than fixing dents and rust. Windows chip, vinyl roofs tear, rear window defroster grids get scratched and don't work, and urethane bumpers seem to gouge rather than dent. The few products available to fix these common problems have either been hard to find, expensive, or sold in such large quantities that only a dealer or commercial shop would invest in them. Now Duro/Loctite

has brought out a line of these products for the do-it-yourselfer that is sold in hardware and auto stores.

The rear window defogger repair kit is a conductive coating that you apply with a brush. The hard part is finding the tiny scratches in the defroster grid. You have to check each wire with an ohmmeter; ones that register infinity are broken. The Bullseye Repair Kit is meant to fill in only shallow "bull's-eye" chips, not starlike cracks.



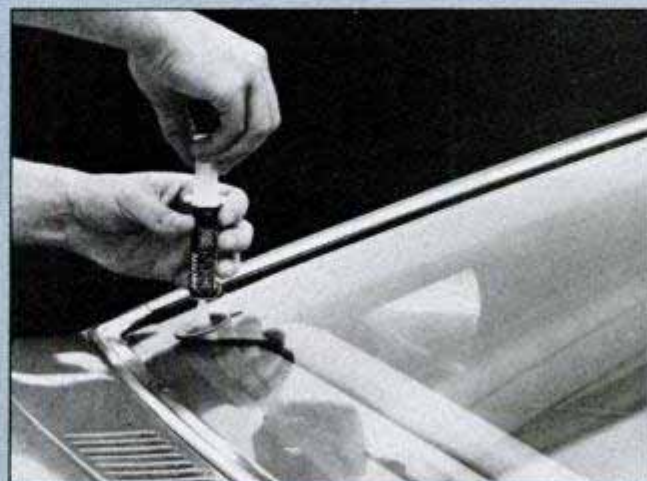
Duro's Easy Does It bumper repair kit includes a flexible repair compound in an applicator, woven fiberglass cloth, spreader, sandpaper and flexible paint. It lists for \$9.99.



Loctite Quick Grid rear window defogger repair kit contains conductive repair resin, a self-adhesive stencil and a brush. The repair takes about 25 minutes. The kit costs \$9.99.



Loose vinyl tops and deep cracks in dashboards can be fixed with Duro's Perfect Match repair kit. The repair material (\$10.25) is designed for tops and dashes, not seats.



Loctite's Bullseye Windshield Repair kit contains an applicator and clear, epoxylike material for filling in "bull's-eye"-type chips. Its \$9.99 price is a lot cheaper than new glass.

WAX, POLISH AND PAINT

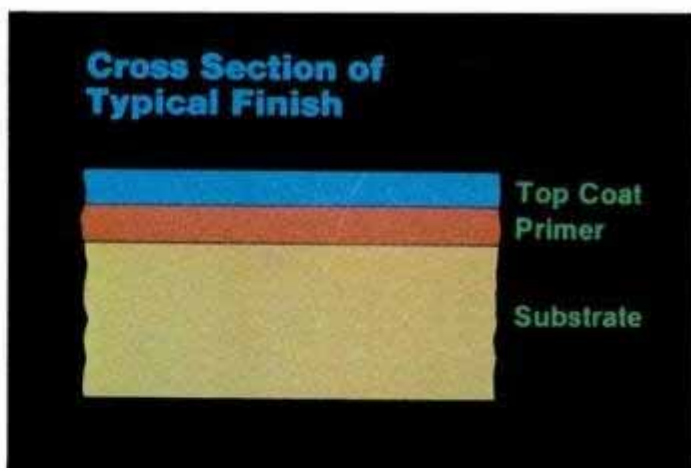
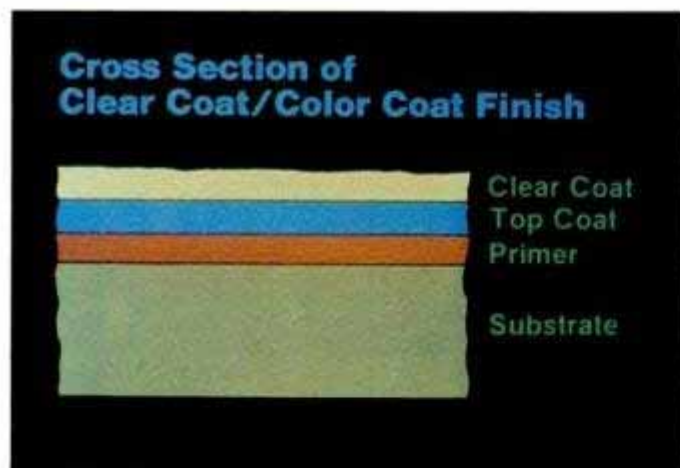
Here's how to sort through the confusing array of auto body care products on the market, and know what to use when.

The shelves of auto parts stores are stocked with row upon row of waxes, polishes and similar products. They fall into four main categories: straight waxes, straight cleaners (sometimes called polishes), combination cleaner/waxes and compounds.

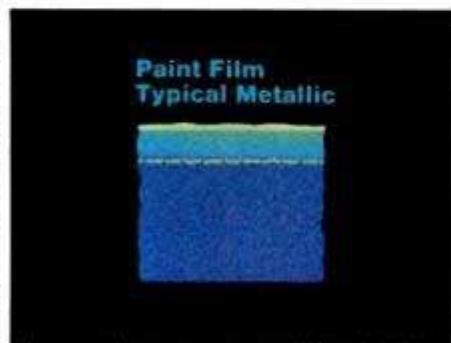
There are two ways to restore luster to a car's finish. One is to rub out weathered paint with a cleaner or compound which brings back gloss if it's there, and then apply a coat of wax to protect that gloss. This is referred to as a two-step process. The other way is to use a single product that combines a cleaner and wax—the one-step process.

A two-step process may provide more uniform results over the long run, but it's a lot more work. Many companies sell separate waxes and polishes only because there is still a demand for them from people who prefer to do it the old-fashioned way. Most experts agree that a one-step product is just as good as a two-step.

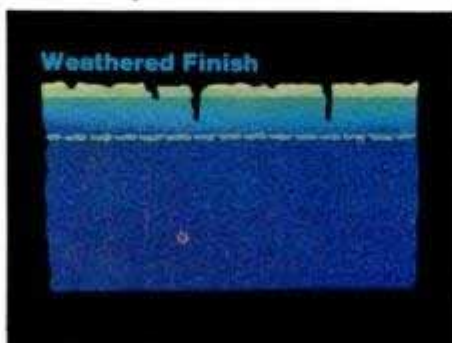
Most folks wash and wax their own cars, of course, but you can farm your car out to a professional "detailer" for a thorough going over. If you farm the car out, it's less expensive to have a professional detailer use a one-step process. Prices range from about \$40 to \$60, compared to between \$105 and \$150 for a two-



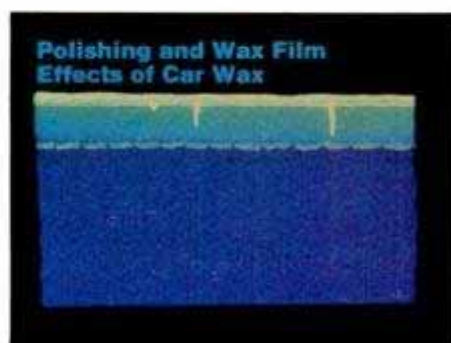
Illustrations show cross-sections of conventional paint (right) and new clear-coat paints. The substrate is the car body.



Typical metallic paint consists of metal flakes between a tinted top coat and pigmented base. This paint is chalking.



As weathering continues, chalking gets worse and paint film begins to get uneven and crack (see photos, opposite page).



Polishing with a mild abrasive removes some chalk and smooths surface. A cleaner/wax removes stains and fills cracks.

step process. The only optional task done by most detailers is cleaning the engine. Otherwise, in addition to treating the finish, prices for both the one- and two-step processes usually include cleaning bright work, wheels, tires and the interior.

Check paint condition

Many people who buy new cars keep them looking good by waxing every few months with a one-step product. The silica or clay cleaning agents, although classified as "mild abrasives," do a good job of removing slightly oxidized paint called "chalk." Also contained in these products are hydrocarbon solvents (naphtha or kerosene) and detergents that will dissolve stains.

But what about an older car? Can you use the easy one-step process or should you employ an abrasive compound? The answer to this question lies with the condition of the paint. If it's merely dull and discolored, try a liquid cleaner. If you find yourself rubbing like crazy to make the cleaner work, move up to a paste-type compound.

About compounds

Suppose the finish looks as if it's a goner—badly weathered, stained, scratched and covered with road film. You may think a paint job is in order, but before spending hundreds of dollars, try compounding. It just may bring back the luster.

There are two types of compounds—moderate-duty (polishing compound) and heavy-duty (rubbing compound). Polishing compound, which is often white in color, removes moderately weathered paint, moderate film and light stains. Rubbing compound, usually red in color, is needed to remove badly weathered paint, heavy film and bad stains. Try a polishing compound first. If it doesn't do the trick, use rubbing compound.

Put the car in a shaded area and follow the instructions printed on the compound can. Do not use a heavy hand and never use an electric buffer with rubbing compound. It is extremely abrasive and can rub off paint right down to the primer, at which point a paint job is unavoidable. Use light pressure and a back-and-forth motion. A circular motion leaves swirl marks on the car finish.

It will help to avoid overrubbing spots if you wash the car first and then get rid of stubborn stains like bug spatters, bird droppings, tree sap, tar and the like.

Next, wax it

After compounding the car, step back and take a critical look. If you like what you see, you've avoided the need for new paint. Now, apply wax.

Keeping the vehicle out of direct sunlight, start in the middle of a panel and work out toward the ends. Apply a little wax and use a circular, light-handed motion to spread it.

Don't assume that two coats of wax are better than one. As you apply a second layer, you'll remove wax

that was previously applied. Spreading on a second coat is work for nothing.

Borderline finishes

Suppose the paint on your car doesn't look all that bad. Is it advisable to use the one-step process to clean and wax at the same time? Experiment. Use a one-step product on the worst-looking area. If the results aren't good, turn to the two-step process.

Types of one-step products

There are three general categories of one-step products: paste, liquid and spray. Results produced by paste and liquid one-step waxes are equally long-lasting, while some spray products may not be as long-lasting, since they contain more fluid to permit sprayer application.

Tips about waxing

If you've ever waxed a car, you know that the sides are the most difficult areas to do. That being the case, you may want to tackle fenders and doors first, when you're fresh and have a full head of steam, before waxing the hood, trunk and roof.

Another trick is to know when your car needs waxing. What you do is check how water beads on the surface. On a freshly waxed surface, beads will be almost round. As your wax protection wears down, beads will flatten out. When a line from the surface tangent to a bead gets to be 50°, it's time to wax the car again.

In addition to restoring paint, here are other things you can do to make your car look sharp:

- Clean the engine with an engine cleaner/degreaser.
- Use a special tire cleaner to clean the wheels without marring the paint finish. A soft toothbrush is a good tool for getting into tight spots.
- Use chrome cleaner on bright work and a silicone-rich preservative to clean moldings and bumper strips.

- Give tires a new look with tire black.

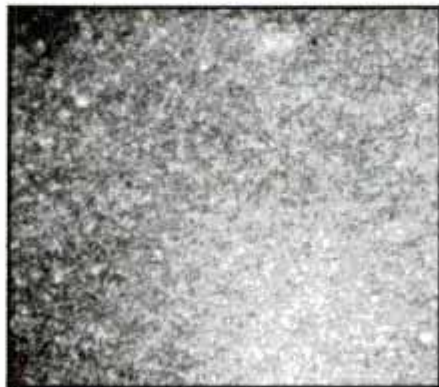
Note: Auto body corrosion generally begins on the underside of the body where wax is never applied. Therefore, periodically hose down the underside of the car to get rid of dirt and road salt.

Understanding paint

If compounding fails to bring paint luster to an acceptable level, it's time to consider repainting. On the surface, the task looks simple enough. Just turn it over to a body shop and have it "spritzed." Are you in for a surprise!

You'll find the job can cost \$100, \$600, \$700, \$900 or more. The price depends on the type of paint "system" used. In the economic pecking order, from lowest to highest, here are the systems you'll encounter:

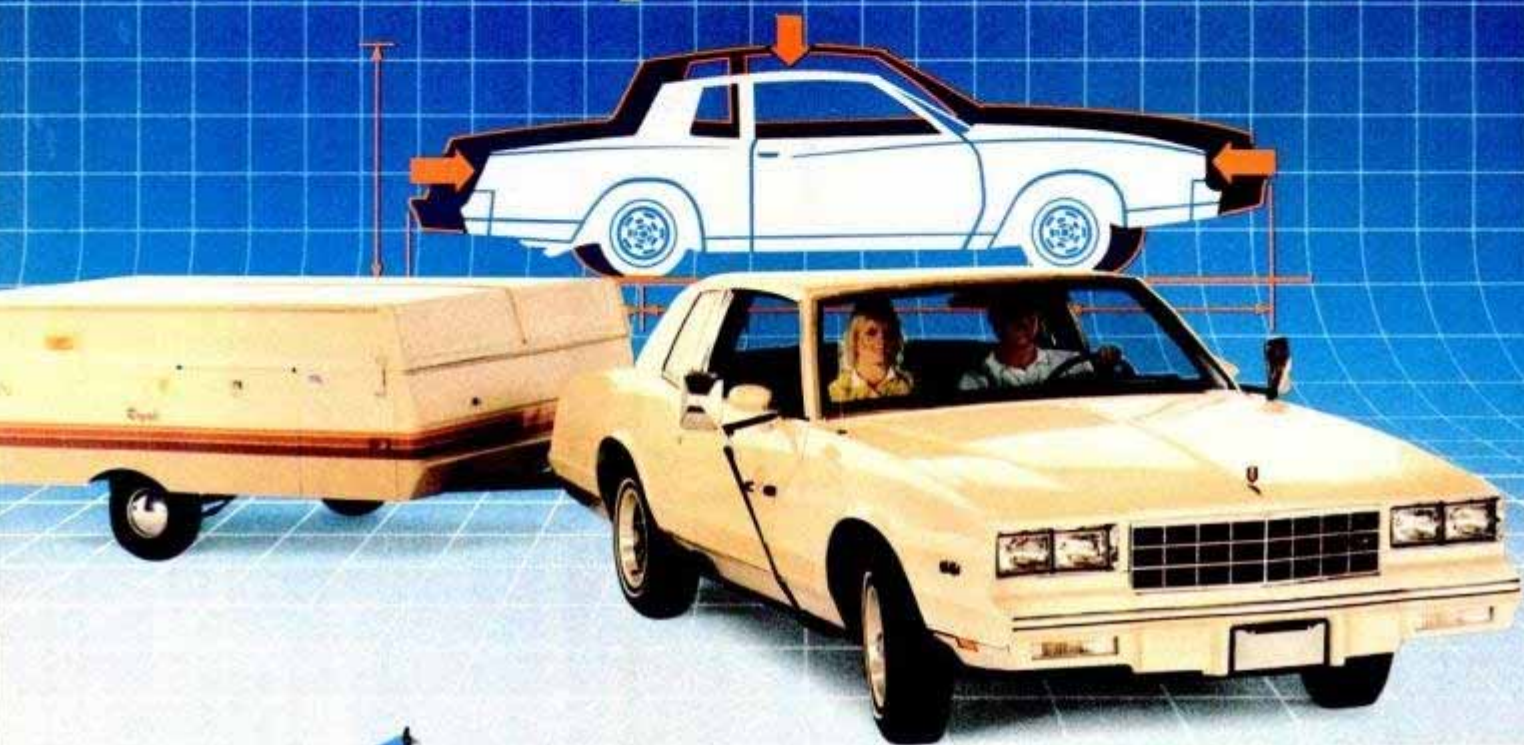
- **Baked enamel.** Enamel refers to the type of binder used in the paint. Baked enamel will begin to fade after one to three years if it isn't properly cared for. It



Electron microscope photos show a new metallic paint job (top) and same paint after accelerated weathering (bottom) equivalent to 2-3 years in Florida. Magnification is 2000x. Wax can slow damage.

How to Tow With Today's Car

and save up to \$15 at Hitch World



New cars and trucks have lighter bodies, transmissions and suspensions to save you gas. But if you plan to tow, you need added protection for these areas of your vehicle.

Here are a few basic tips to follow.

1. GET THE RIGHT HITCH.

All hitches are not alike. The wrong one can cause body damage. Or tear out.

Hitch World selects and installs the hitch that is designed to meet your towing needs. They carry top-brand names like Draw-Tite and Reese. Every hitch is backed by an exclusive nationwide warranty that is good for as long as you own your tow vehicle.

2. GET A TRANSMISSION COOLER.

When towing with a downsized car, heat builds up inside of your transmission. This added stress can burn its fluid and shorten the transmission's life.



Hitch World experts select and install the transmission cooler,

such as Hayden, that can extend the life of your transmission by releasing the added heat caused by towing.

3. GET 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.

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Take this ad to your nearest Hitch World. It 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).

Look in the White Pages under U-Haul Centers for the location nearest you.

Write for a FREE HITCH GUIDE:
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Phoenix, AZ 85306



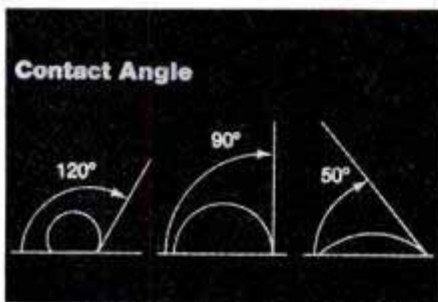
at your **U-HAUL** Center

has a tendency to fade rapidly because of the sun's ultraviolet (UV) rays. The cost to paint a full-size car is about \$100 at cut-rate shops.

■ **Acrylic enamel.** This is the system most widely used by paint shops. The term acrylic refers to the type of polymer (plastic) used in the binder to hold pigment particles together. An acrylic enamel paint job on a full-size car costs about \$600. Life expectancy of acrylic colors is approximately five years, with good care. Acrylic enamel has good resistance to UV rays and fades at a minimal rate.

■ **Acrylic lacquer.** This system uses lacquer as the binder. It has been widely employed by General Motors for painting new cars. It requires intense heat that is difficult for body shops to duplicate. Those body shops that can provide an acrylic lacquer paint job generally charge about \$100 more than for acrylic enamel.

The advantage of acrylic lacquer is that it gives a higher gloss. Its col-



Shape of water beads determines when to wax car. When tangent line of beads slumps to 50°, it's time to re wax.

or will last about as long as acrylic enamel and has good resistance to UV rays, but it requires more frequent waxing to maintain its gloss.

■ **Base coat/clear coat.** At about \$900 and up for a full-size car, this is the most expensive paint job you can buy. The paint is oversprayed with a super-tough urethane that protects the finish indefinitely. The urethane clear coat slows UV paint fading. If something scratches the car's surface, the urethane coat gets scratched—not the paint. Minor scratches are easily polished out. Once the clear coat is penetrated or degrades, however, the color coat fades rapidly, without the gradual dulling of traditional finishes. It is virtually impossible for the do-it-yourselfer to touch up chips and scratches on clear coat paints.

Clear coats were first introduced on imports, but they are showing up on more and more new domestic cars, too.

PM

Proven protection up front.

Saves gasoline in back.

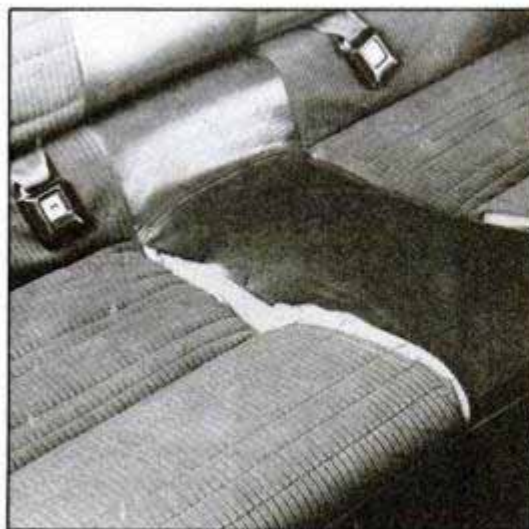
Havoline Supreme's formula blends nine Texaco-developed additives with highly refined base oils. It helps protect against friction, wear and harmful acid, sludge and varnish deposits. It also helps save gasoline.

All Havoline motor oils exceed tough API-SF requirements, and Havoline Supreme 10W-30 and Havoline single grades exceed the API-CC requirements for diesel engine oils. For high performance engines, there's SF/CC rated Havoline Super Premium High Performance 20W-50.

Get the Havoline that's right for you, and get proven protection you can trust.

TEXACO

REDOING UPHOLSTERY



Upholstery in this Accord shows what can happen if kids use a car seat as a trampoline. You must remove rear seat cushion to install the cover.

Seat Covers: The Quick Facelift



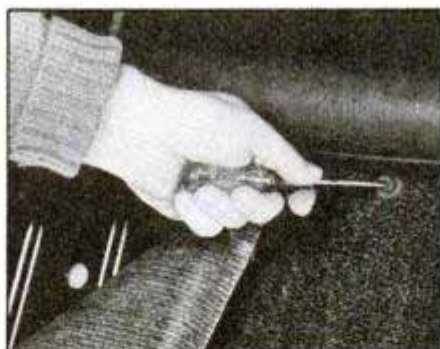
Time can do terrible things to a car's upholstery. At first, it's just a tiny split in a seam or a stain from Junior's fudge pop. But before you know it, the interior looks as if a flock of vultures has set up housekeeping.

The remedies range from mild (a set of seat covers) to wild (a custom reupholstery job). The remedy you choose may depend on the condition of your car's seats, how much you're willing to spend and how much of a perfectionist you are. We've illustrated each extreme here—the conservative job with a 1977 Honda Accord hatchback, the radical job with a 1957 Chevrolet sedan.

The front-seat upholstery on our Honda Accord was scuffed but intact. The rear seat had two split seams, but the padding and springs were sound. We decided on a quick cover-up job with seat covers—\$34.50 list for the two front seats, another \$34.50 for the rear. The striped covers we selected are from Poly Plush.

Installing seat covers in a sedan requires removing both the rear seatback and the rear cushion. But since our hatchback allowed easy

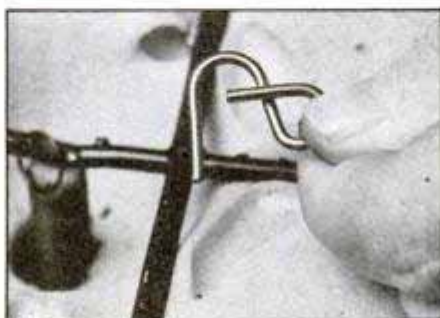
[\(Please turn to page 127\)](#)



1 We had to remove the carpeting from the rear seatback before we could install the seat cover. Six Phillips-head screws hold the carpeting.



2 Rear seat cushions can be held down with bolts or a wire loop. Some release by pushing in at the lower front edge and pulling straight up.



3 Stretch cover over seat and smooth wrinkles. Attach cover's elastic loops to spring assembly with S hooks. Close hook's open end.



4 New carpeting for the cargo area and rear seatback was the finishing touch in our budget restoration. Cost of the entire project was \$156.95.

AND CARPETING

Pro Work Gives The Best Look



The front seat of this 1957 Chevrolet looked like a battle zone. Remove seat and peel off upholstery and padding down to the bare frame and springs.

What if you'll settle for nothing less than a professional-looking upholstery job for your car? What you need, then, is an auto upholstery shop.

A professional job allows you to choose the material—vinyl, cloth or leather. You can specify whether you want pleats, diamond tufts or smooth panels.

If you're a purist, you can try to duplicate your car's original upholstery. Some popular upholstery materials, even from many years back, may still be available from suppliers and even car dealers. But such materials could be very expensive—as much as \$50 or \$60 a yard.

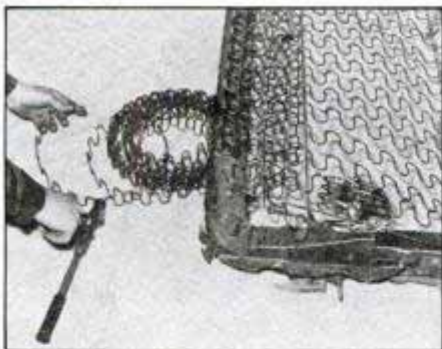
Alternatively, the upholstery shop may suggest another material that's very close to the original—and much cheaper.

To see what's involved in a professional reupholstery job, PM went to Jo-Lea Automotive Center in Peekskill, N.Y. There, a 1957 Chevrolet two-door sedan was getting the complete interior treatment with pleated maroon vinyl and black trim accents.

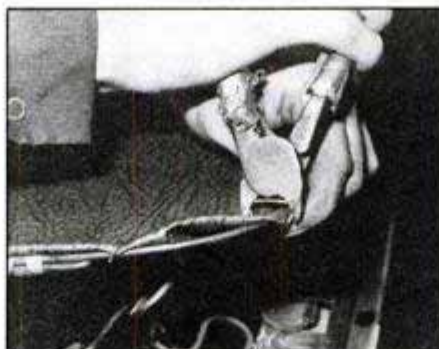
Jo-Lea's charge for the seats alone was \$400. The entire job, including headliner, door panels, dashboard and floor carpeting, cost approximately \$1,200.

Gary Schwadron of Jo-Lea first measured the seats carefully. Then he unbolted and removed both

(Please turn to page 127)



1 Broken springs must be replaced. The spring material comes in large rolls. Cut off the length you need and, using pliers, attach it to seat frame.



2 Stretching a sheet of vinyl over the springs keeps them in place. C-shaped hog rings, installed with hog ring pliers, secure vinyl to the seat.



3 Now for upholstery: Lines marked at 2-in. intervals on back of vinyl are guides for pleats when foam is sewn on. Polyester thread is best.



4 Upholstery panels are stitched together and secured to seat with hog rings. If original padding is sound, new upholstery can slip on over old.



**You may never need
an off-the-road tire
this good.**

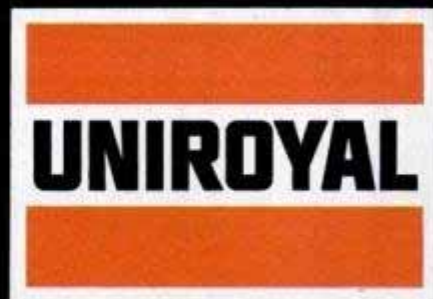
**Unless you also happen
to drive on the road.**

Uniroyal's Laredo S/R radial is one all-terrain tire that won't punish you on the toughest terrain of all: the street. It has been engineered for excellent all-weather traction and smooth, quiet operation both on and off the road.

Using advanced computer-aided design systems, Uniroyal engineers achieved an optimum tread design. With computers they were able to project

tread noise and traction capabilities before the first test tires were even constructed. The result is a design that delivers low road noise and promotes long tread life.

Thanks to Uniroyal technology, Laredo S/R is much more than just another all-terrain light truck tire. In fact, most of the time you may never need a tire this good. The only problem is knowing when those times are.



U.S. Olympic Committee contributor.



You may never need a tire this good. Laredo S/R.

REDOING UPHOLSTERY: THE QUICK FACELIFT

(Continued from page 124)

access to the rear of the seatback, we removed only the cushion.

However, the hatchback did present a minor problem: The section of carpeting behind the rear seatback and over the rear cargo area had to come out before we could slip on the seat cover. Since that section of carpeting was badly worn, we replaced it with a new polyester carpeting kit from Auto Mat for \$87.95. Velcro fasteners and screw eyes had to be transferred from the old carpet piece to the replacement.

Stretching the fitted seat covers over the rear cushion and seatback was a straightforward job. Working from the center outward, we smoothed out any wrinkles that developed.

Each cover has several elastic loops attached to its edges. The idea is to slip an S hook into each loop, stretch the elastic, and attach the hook to the spring assembly. We pinched the open ends of the S hooks closed with pliers for extra security.

The front seats didn't need to be removed. We slipped the covers

over the seatbacks and tied the elastic loops to the seat frame. The covers for the cushions were secured with S hooks from underneath.

Note that the covers weren't tailored specifically for the Accord. One size was designed to fit several models. Thus, the covers weren't a really precise fit.

The cover for the rear cushion, for example, was a bit skimpy and required some adjustments for proper coverage of the entire top of the cushion. The rear seatback cover, on the other hand, was much more ample. We had to tuck excess material into various nooks and crannies for a neat fit. Also, a few extra elastic loops all around would have been welcome.

If the seats in your car are contoured, as they are in the Accord, it's probably best to leave enough slack in the covers so they sag into the contoured areas. Stretching the covers drum-tight may look neater, but we think the covers may not last as long. However, on the whole, the covers appeared to be neatly and durably made. **PM**

PRO REUPHOLSTERY

(Continued from page 125)

seats, separated the front seatbacks from the cushion, and stripped away all the padding down to the frame and springs.

The front-seat padding was in a sorry state, and after Gary deftly stripped it away, he inspected the seat springs. Jo-Lea has a selection of seat springs on hand to fit nearly any car that comes in. Luckily, all the Chevy's springs were sound.

The front seat cushion once had a layer of burlap over the springs to keep them from working through the upholstery, but the burlap had rotted away. Gary replaced it with a sheet of vinyl. Working from the center outward, he stretched the vinyl tight and attached it to the spring assembly with C-shaped hog rings at roughly 6-in. intervals.

Next came a sheet of jute carpet underpadding, a light coat of aerosol trim adhesive, and layers of 1-in. foam padding, cotton batting and Dacron cloth. Hog rings, installed with hog ring pliers, secured each layer.

The most exacting task was stitch-
(Please turn to page 128)

WAIT TILL YOU SEE WHAT THIS BABY'LL DO.

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SUPER PAL™ THE TANKLESS AIR COMPRESSOR THAT WORKS LIKE A TANK.

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IT'LL INFLATE AND ROTATE.



IT'LL KNOCK OFF A MUFFLER.



**THE CAMPBELL HAUSFELD
TANKLESS AIR COMPRESSOR.**

**CAMPBELL
HAUSFELD**

a Scott Fetzer company

PRO REUPHOLSTERY

(Continued from page 127)

ing the pleated upholstery. Along the back of the vinyl Gary scribed guide lines at 2-in. intervals and stitched the vinyl to a layer of 1-in. foam. Finally, referring to his original seat measurements, he cut the various upholstery panels to the correct size and then sewed them together.

The seatback upholstery had to be a tight fit. Gary started with each cover inside out and unrolled it over the seatback. A portable steamer—a small boiler with a hose and a wand—softened the vinyl when necessary so Gary could adjust it for a perfect fit. Hog rings secured the upholstery to the seats.

The rear seat was much easier than the front. The original padding and springs in the rear seat were in good shape, so Gary simply installed the new upholstery over the old.

True, the Chevy's professional interior renovation cost several times that of the Honda's quick cover-up reupholstery job. But those rich vinyl pleats and thick padding make the Chevy's seats look and feel better than new. **PM**

DO IT YOURSELF OR FARM IT OUT?

If you can twist a screwdriver and squeeze a pair of pliers, you shouldn't have any trouble installing seat covers. The toughest part is removing the rear seat; if you can't figure out how to do it, check a shop manual or ask a dealership mechanic.

The actual installation of the seat covers is just a matter of patience and care. A complete reupholstery job, on the other hand, is best left to the professionals. Stitching heavy vinyl requires a commercial sewing machine; an ordinary household machine won't do. A steamer is also handy for positioning the upholstery.

Most important, the job requires considerable skill, the kind that takes years to acquire. You have to know how to cut the various panels for a perfect fit, how to run a straight and neat seam for the pleats, and much, much more.

Smaller interior repair jobs, though, are definitely do-it-yourself tasks. Cracks in plastic door panels and dashboards can be fixed with \$8 to \$12 repair kits sold in discount houses. They demand patience for good results, as thin layers must be applied to build up an even backing. The air-dry materials don't require the application of heat, but if you just try to ladle it on in thick layers, the results will be uneven and disappointing.

Heat-to-cure seat patches are unobtrusive when done right. Good color mixing is

important and you must be careful about the amount of heat applied with the tool in the kit. Practice in a nearby hidden spot first.

Tears in cloth upholstery can't be fixed with the kits, but you can glue the torn sections together with clear repair adhesives. Although the repair won't be invisible, the cloth pattern should provide reasonable concealment. Position a piece of material under the tear as a backing and to keep adhesive off the foam padding.

Recoloring kits for interior upholstery are a good bet if the problem is an uneven appearance from wear or scrubbing. Pre-clean with detergent and water, then use an aerosol because it can work into tight quarters.

If the front seat is beyond patch or recolor, seat covers are the best choice. Sheepskins are presently in vogue, and they not only provide protection for the seat but may appeal to a future buyer, too.

Installing new carpets can be a big job, particularly working it under the seats and floor console. If the carpet is just badly discolored, respraying is an alternative you should consider.

Auto trimming isn't a common skill these days, and there are few trade schools that offer courses in the field. That makes the professional upholsterer's services even more valuable.

For diesels only.

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ENGINE SWAPS: YOUR TOUGHEST JOB

One way to add years to a car's useful life and bring back its youthful performance is to take out a tired, high-mileage engine and drop in a new or rebuilt powerplant. Such engines are available from the parts departments of new car dealers, from local rebuilding shops, even from the Sears, Roebuck catalog.

Replacement engines are sold either with cylinder heads (called long blocks) or without heads (short blocks). In either case, the carburetor, exhaust system, distributor and other accessories must be transferred from your old engine to the new one. So must the cylinder heads with a short block. If any of these components need work, they should be repaired or replaced during the swap.

Chrysler, Ford and GM dealers sell new—rather than rebuilt—long block replacement engines, and they may be less expensive than a rebuilt unit since less labor is required to assemble a new engine at the factory than to rebuild an old one in a shop. In our project, a \$1,150 "Mr. Goodwrench" GM 350-cu.-in. V8 was installed in a 1969 Camaro. The general procedures of the swap apply to any car.

If you consider an engine swap some kind of monumental project better left to professionals, reconsider. Swapping engines may be more



Older cars suffering from nothing worse than a lot of miles on the engine get a new lease on life when the worn unit is swapped for a new or rebuilt replacement.

time-consuming than the normal repairs or maintenance you're used to, but it is not a complex operation and requires no extraordinary mechanical skill. The secret is to break down the job into bite-size mechanical tasks, take your time and proceed systematically.

Tool and equipment requirements include an engine hoist—either a chain and pulley unit that

you hang from an overhead beam or a portable hoist that comes with a stand and an extension arm. Hoists can be rented on a daily basis. You'll also need access to a lift, or you can use a jack and jackstands to get the car about 15 inches off the ground. You should also have a torque wrench plus the usual array of sockets and hand tools.

The first step is to remove the

Do It Yourself Or Farm It Out?

The high cost of a new car makes a replacement engine seem almost cheap by comparison. But the engine itself is not the only cost involved. While you're at it, you'll want to renew some hoses and belts, maybe even the carb, fuel pump and other auxiliary items. Then there are the gaskets and hardware that turn up missing and will have to be replaced.

The greatest potential for saving cash in the project lies in doing it yourself, provided you have the tools and time to do the job right. Look at it this way: A local rebuilder charges \$700 to \$900 for the engine alone; a new factory assembly costs a few hundred more. But the complete job, including the engine and installation, done by a competent shop will likely

set you back \$1,800 to \$2,100. It all boils down to whether you're ready to go beyond underhood tinkering, and just how much your time is worth to you.

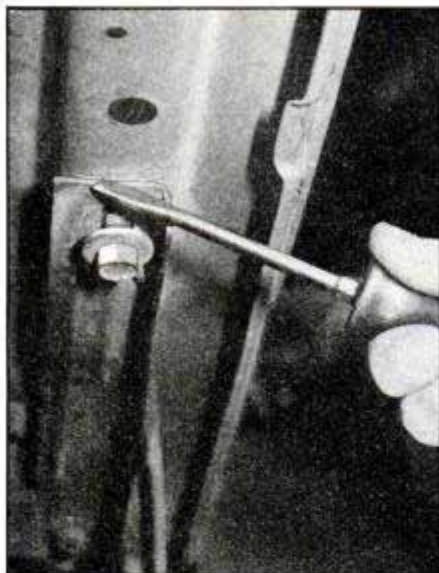
With an average set of hand tools and a rented hoist, an experienced Saturday mechanic can do the engine swapping job. But before you dive head first into the task, be sure that the problem really is in the engine. Many engines have been replaced unnecessarily because a fuel pump noise was diagnosed as an engine knock.

Compression and pressure leakdown testing can pinpoint the location of most problems. You may be pleasantly surprised to learn that the piston rings are sealing fine and that the oil burning can be

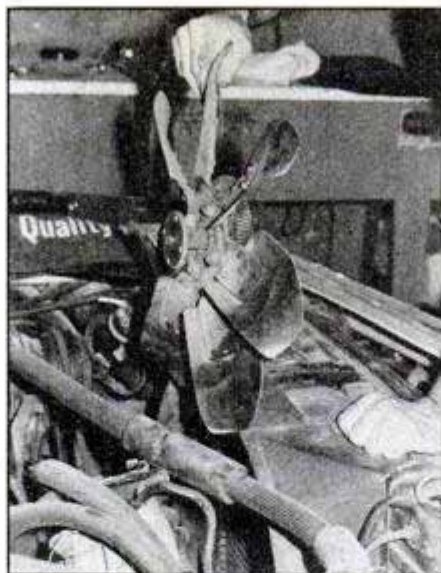
cured with a less expensive cylinder-head rebuild. Or a rebuilt short block may cure all the bottom end maladies and keep the overall cost within the budget.

If you take pride in the upkeep of your cars and can stand to have the swap candidate out of commission for awhile, by all means don't fear tackling the job yourself. You'll need a helper to actually yank the old motor and get the new one in place, and you must take the time to carefully tag each wire or vacuum line you remove.

However, if the guarantee of a reputable repair shop lets you sleep better and you can earn the cost difference by working overtime at your job rather than out in your garage, you might decide to leave the swap job to a pro.



1 Scribe a line around the edges of the hinge to simplify realignment when you bolt the hood back into position.



2 After unbolting a clutch-type cooling fan, be sure to store the unit upright to prevent the possibility of fluid loss.



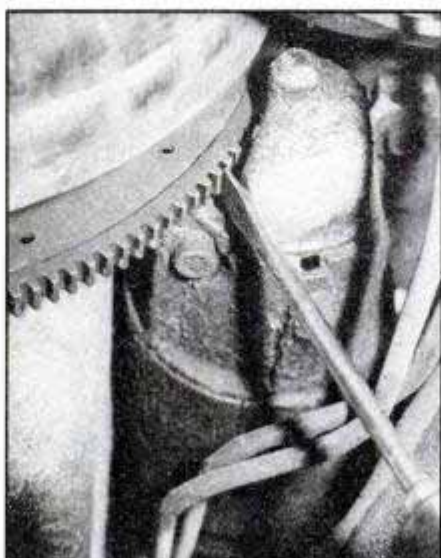
3 Position of the transmission kickdown linkage must be marked to ensure correct adjustment on reassembly.



4 Vacuum line to the power brake booster—and all others coming from engine—must be tagged and disconnected.



5 Drop the dust cover from the bottom of the transmission bellhousing section to reach the torque converter bolts.



6 Rotate the flywheel by wedging a screwdriver against the starter nose to bring the converter bolts into sight.

hood. Mark the position of the hood brackets and bolts on the hood with a marker or awl. This will help you line up the hood during reinstallation (see photo No. 1). If your engine is typical of a high-mileage powerplant, it will have accumulated a lot of dirt in its lifetime. Your job will be easier if you have the motor steam cleaned, or degrease it and hose it down yourself.

The mechanical work from here on involves detaching the engine from its moorings, removing components that would interfere with lifting the motor from the engine compartment and disconnecting everything that attaches the engine to the chassis.

Remove the air cleaner assembly, disconnect the battery cables and drain the engine coolant. If your radiator doesn't have a drain cock, remove the bottom hose at the water pump. Then remove the upper radiator hose. It's often not necessary to remove the radiator itself, but it's a good idea to remove the radiator shroud for extra clearance.

Taking out the fan

The fan is next to go. When removing a clutch fan, exert some pressure on the fan belt to prevent the fan from turning as you loosen the bolts. When the fan is out of the car, hang it up someplace in the upright position (photo 2). If you lay the fan down, the fluid inside the clutch will leak out.

Remove the fuel line at the fuel pump and have a rag ready to catch any gas that spills. The power-steering pump and air-conditioning compressor units can be removed from the engine, but do not disconnect any of the air-conditioning or power-steering pump hoses. Just lay the units down out of the way on the inner fender or cross member so you'll have room to work. If necessary, use some wire to secure these units in position so they won't slip back down into the engine compartment.

To take out the power-steering and air-conditioning drive belts, you'll have to slacken the tension on the alternator and remove its drive belt. It's not necessary to take out the alternator at this time. You can wait until the engine is out of the car. However, you should remove the alternator wires. When removing the battery wire from the alternator, hold the terminal with a wrench so you don't spin the post.

Now remove the heater hoses. This is a good time to check the hoses and replace any that are dried

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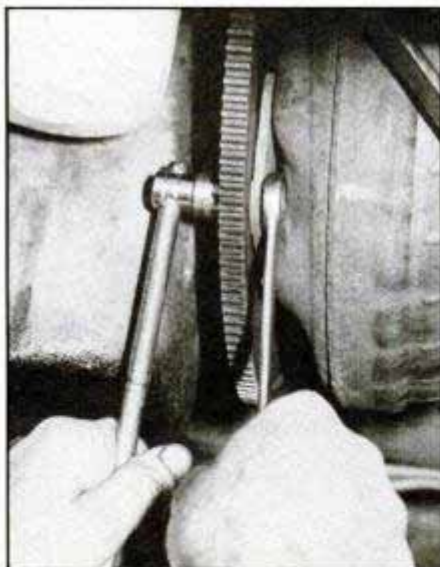


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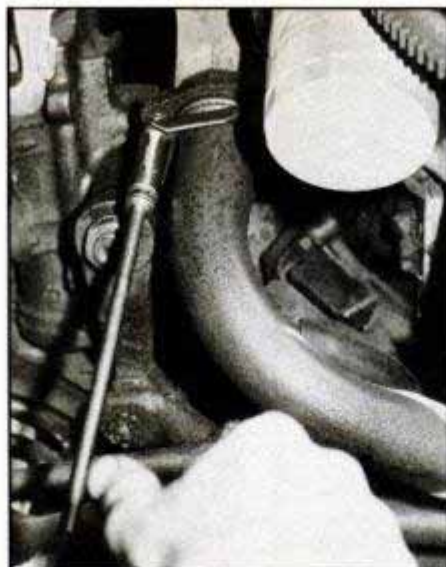
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7 Remove the converter bolts with a six-point socket and slide the converter toward the rear into the transmission.



8 Heat makes the exhaust manifold studs fragile, so remove the headpipe nuts carefully, turning each a little at a time.



9 After unhooking the wires, unbolt the starter motor from the block and bring it straight down, if there is room.



10 Hoisting chain should be attached diagonally across the engine to an existing hole in the block or head.



11 To gain lifting clearance, you should unbolt the lower pulley when you remove the water pump and alternator.



12 A bar laid between the frame rails will support the automatic transmission and allow the car to be rolled around.

out or cracked. Remove the starter cables and the distributor cap, then disconnect the sparkplug cables at the plugs. Mark each wire, cable and hose so you can hook them back up correctly. Disconnect all the vacuum lines from their fittings behind the carburetor and on the intake manifold. Don't forget the vacuum modulator line to the automatic transmission. Mark each vacuum line for easy identification.

Remove the throttle linkage at the carburetor and take off the transmission kickdown cable. This cable has a bracket for adjustment. Note its position so you can maintain proper kickdown operation when you reinstall the cable (photo 3).

Next, you should remove the power brake vacuum line from the booster unit (photo 4) and take off the ignition wires going to the coil. Also, disconnect the oil pressure sending unit wire.

As you disconnect wires and lines at the rear of the engine, move everything back out of the way on the firewall to prevent snagging when you lift out the engine. Don't forget to remove the ground wire that runs from the firewall to the block or valve cover.

Under the car

At this point you'll be shifting your theater of operation to the underside of the car. Jack up the car and support it with jackstands. If the car has a manual transmission, it's easier to remove the transmission at the bellhousing and pull the engine out with the bellhousing still attached. You can remove the bellhousing once the engine is out of the car.

On a manual transmission car, disconnect the U-joint and driveshaft. If you have an old driveshaft yoke, slide it into the transmission to prevent grease from leaking out. You can also tape a paper cup in place over the tailshaft to serve the same function. Next, remove the transmission mount and the frame cross member. Support the transmission as you do this with a small hydraulic or scissors jack. Disconnect the shift linkage, speedometer cable and REVERSE lockout. Remove the four bolts that connect the transmission to the bellhousing and lower the transmission out of the car on the jack.

Because the bellhousing is part of the automatic transmission case, the transmission stays in the car when the engine is removed.

Our Camaro was equipped with an automatic transmission, but the steps relating to exhaust-system and motor-mount removal also are

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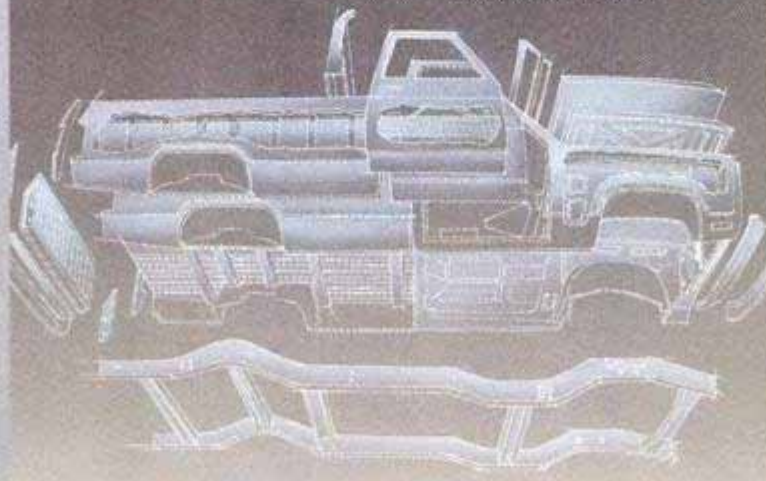
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applicable to standard transmissions. To take out the exhaust system, first remove the starter wires, then spray the headpipe attachment nuts with penetrating oil and let the oil soak in. Take off the transmission inspection cover to give you access to the torque converter bolts (photo 5).

Move the flywheel with a screwdriver braced against the starter (photo 6) until you have access to the bolts that connect the flywheel to the torque converter. Then remove the bolts (photo 7) with a six-point socket and a breaker bar.

The problem in removing the headpipe nuts is that there's a danger of breaking off the studs in the manifold. Loosen each nut a little at a time rather than removing one completely before loosening the next nut (photo 8). If access is good from below, remove the starter now (photo 9).

Automatic transmissions

On automatic-equipped cars, support the transmission with a jack, using a piece of wood between the jack and the transmission pan to prevent damage. Remove the transmission bolts from the bellhousing. In this job, you may need an extra long extension with a universal to undo the top transmission bolts.

Check for lines that run from the transmission and are attached to the engine. In this case, we had to remove a bracket that attached the transmission cooling lines to the engine oilpan. With all links between the engine and transmission disconnected, you can turn your attention to unbolting the motor mounts. You may have to put a

wrench on the motor mount nut on the front side of the engine to keep it from turning as you undo the through-bolt from the rear.

Now it's time to get the hoist rigged up. You'll need a 3-foot length of chain and two 3/8-inch bolts and washers to attach the chain to the engine. Attach the chain at two points on the engine, one at the front (photo 10), the other at the rear, with a diagonal hookup. The engine may have brackets already in place for this purpose. If not, attach the chain to a bolt hole in the cylinder head or block.

Once the engine is attached to the hoist, put a slight amount of lifting pressure on the engine. You may have to pull the engine forward slightly to free it from the dowel-locating holes in the transmission bellhousing. At this point, you can lift the engine free of the car.

In some cars, it isn't necessary to remove the fan shroud if you remove the alternator and its bracket, water pump and harmonic balancer pulley (photo 11).

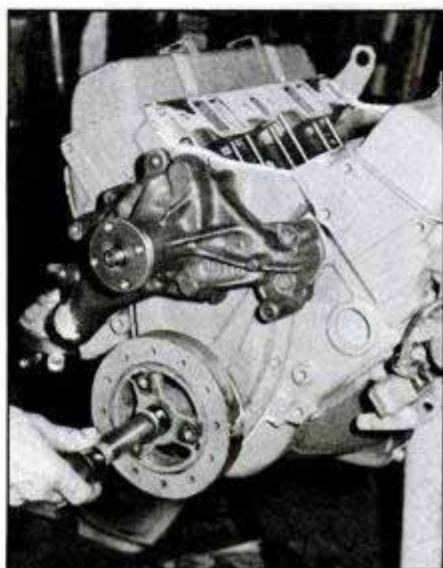
Rolling the car

After the motor is out of the car, and while the automatic transmission still is supported by the jack, put two bolts in the transmission dowel pin holes or bolt holes. Then you can rest the transmission on a wood or metal support laid across the frame rails at the rear of the engine compartment (photo 12). This will let you roll the car around if necessary while the engine is out.

Before dropping the new engine into the car, transfer your accessories to the vehicle. Make sure that the accessories won't interfere with engine installation. An engine

stand will make the job easier, but if you don't have one, bolt on components such as the starter, alternator, carburetor, manifold, water pump, and so on, with the engine still in its crate. Use the fuel pump plate and rod from the old engine if they are in good shape. Smear a dab of grease on the fuel pump gasket to keep it in position when installing the pump. Check the action of the fuel pump diaphragm by working the pump against the rod to make sure you've installed it correctly. You also might want to replace the factory nylon tooth timing gear with a more durable steel gear (photo 13).

Before installing the harmonic balancer from the old engine, check

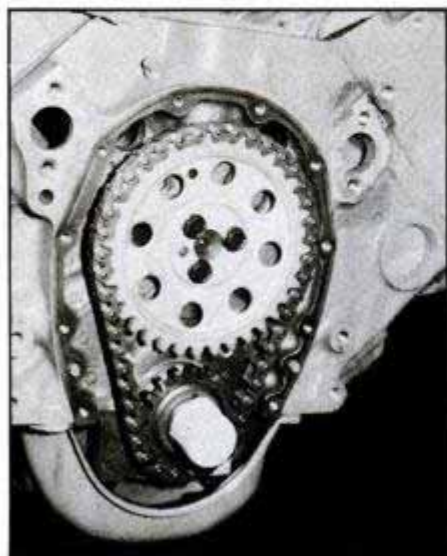


15 Whenever possible, the harmonic balancer should be pulled into position with a long bolt and large washer.

the unit for a wear groove which could cause oil leaks (photo 14).

When installing the harmonic balancer, try not to hit it directly with a hammer, as this can damage the thrust bearing on the crank. If the front of the crankshaft is threaded, pull on the balancer by using a 1/8-inch bolt, 4 inches long, with a washer (photo 15). Grease the threads with white lube and also lube the washer where it makes contact with the harmonic balancer. This will reduce friction and allow you to seat the balancer.

Once you've lowered the engine into the car (see page 129), install the motor mounts and hook up all systems,—exhaust, cooling and so on—and reattach all lines, wire and brackets. It's a good idea to have a shop manual, or at least spec charts, for your car to check proper torque values and tightening sequence for components such as the intake manifold. **PM**

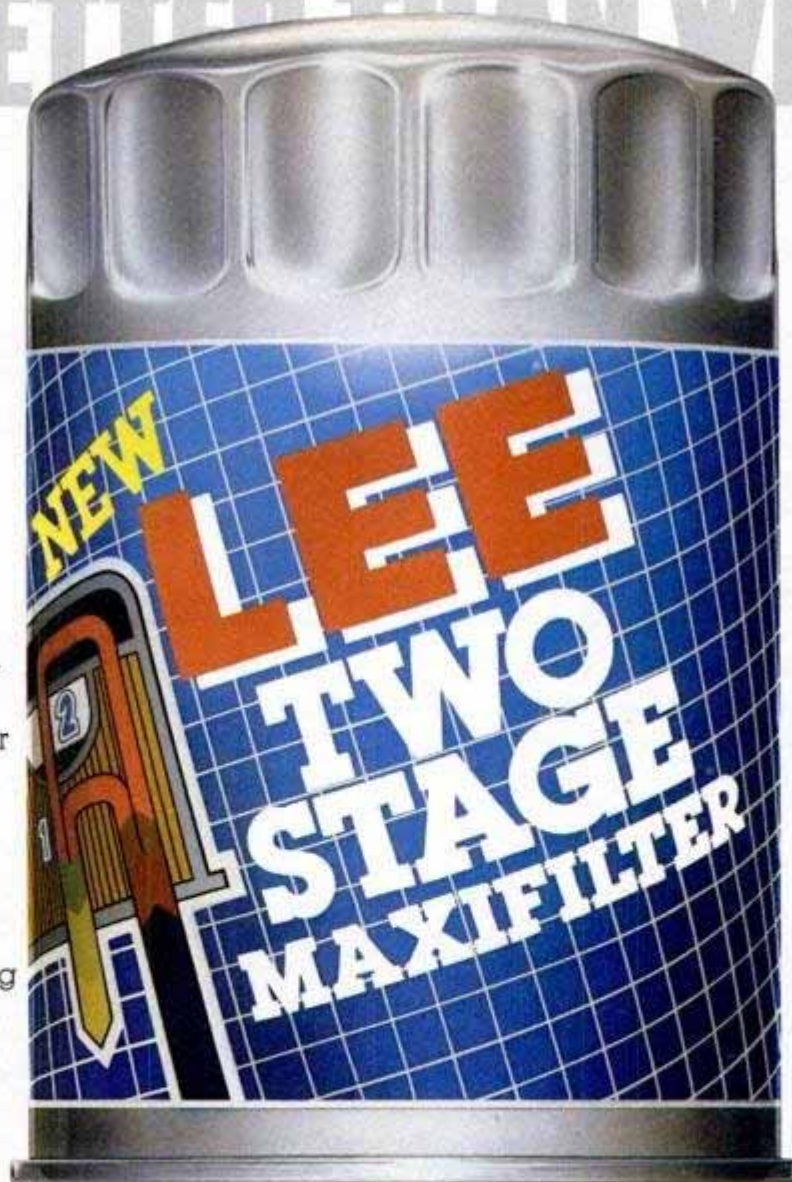


13 Some automotive engine rebuilding shops will routinely replace the nylon tooth timing gear with one made of steel.



14 Severe wear on the hub of the harmonic balancer could allow oil to leak past the front cover seal.

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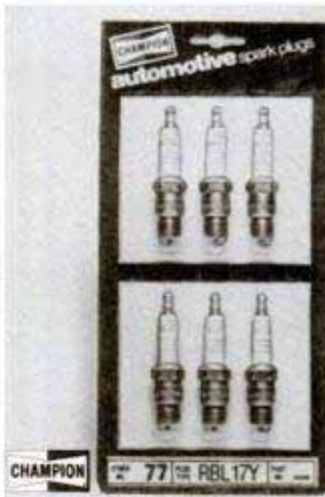
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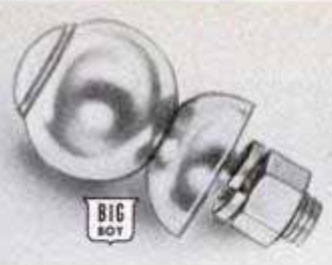
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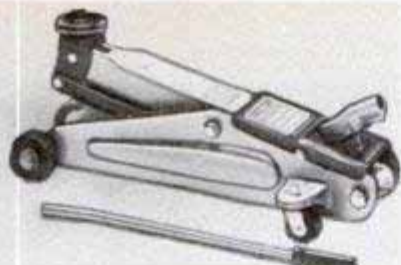
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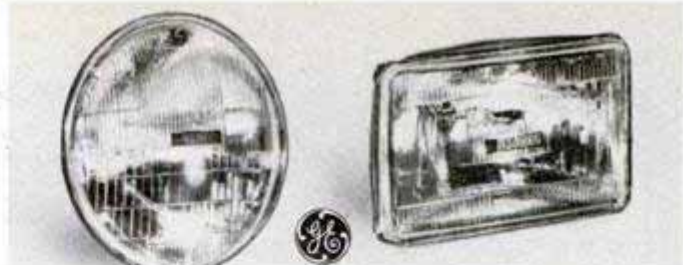
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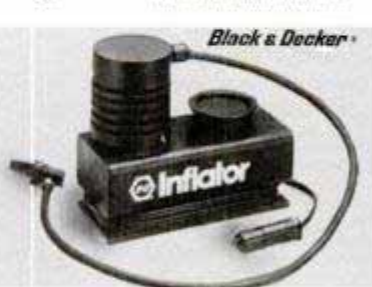
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CLUTCH RENEWAL

Here's how you go about replacing the clutch on a rear-drive car.

How often you have to replace your clutch depends on your driving habits and how heavily clutch components are stressed. The job should be well within your ability if you're an experienced Saturday mechanic, and it requires a minimum of special equipment.

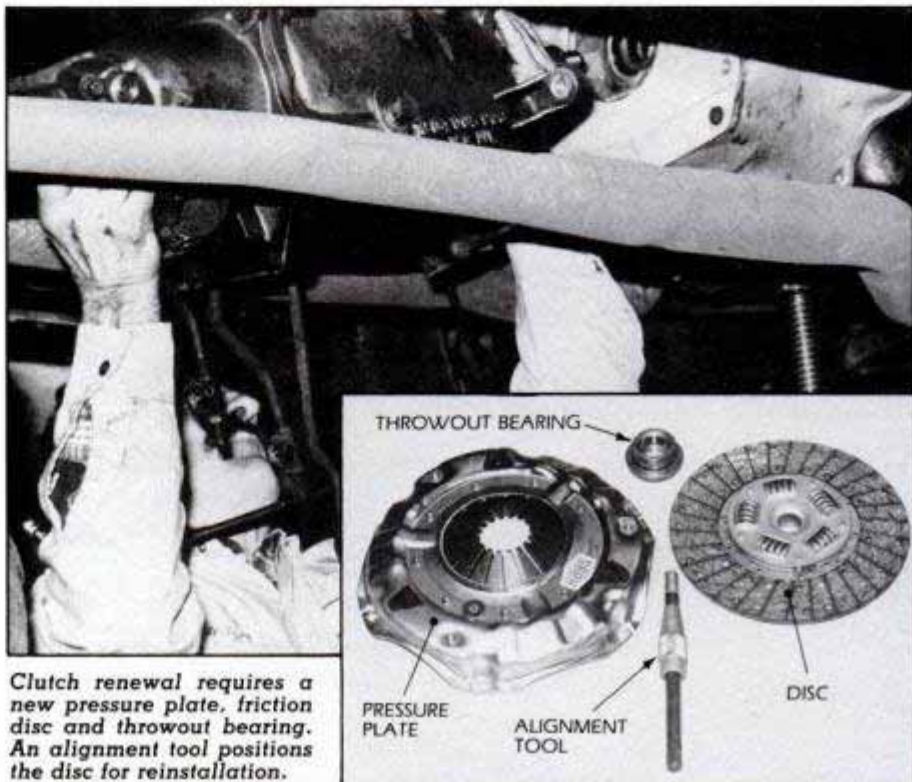
What you'll need, in addition to the usual assortment of sockets and hand tools, is a universal clutch-aligning tool, a large screwdriver or prybar and a small hydraulic or scissors jack.

The clutch replacement shown here is a Hays unit which was installed with an original-equipment throwout bearing. When it comes to a clutch, new (rather than rebuilt) components are your best bet. The work shown was done on a '78 Pontiac Trans Am with the 400-cu.-in. V8.

To start the job, raise the car with a jack and support it on jackstands. Using a screwdriver to keep the universal from rotating, remove the driveshaft bolts. Then, use a screwdriver to push the driveshaft toward the front of the car to free it from the rear end companion flange. Pull the driveshaft out of the transmission. If you have an old driveshaft yoke, insert it in the transmission tailshaft to keep grease from spilling.

The frame cross member is next to come out. Remove the transmission mounting bolts and lift the engine slightly with a hydraulic jack. Use a piece of wood between the head of the jack and the oilpan. Remove the bolts that attach the cross member to the frame. If you find it difficult to slide the cross member out, wedge a large screwdriver or prybar between the top of the cross member and the body. Press down on the cross member while tapping it out with a hammer.

Next, disconnect the speedometer cable and remove the gearshift knob. Drop the engine down slightly on the jack so you'll have access to the linkage bolts. Disconnect the shift linkage by popping off the clips or cotter pins that attach the linkage rods to the transmission arms. Now, remove the bolts that hold the shift tower in position and remove it. The



Clutch renewal requires a new pressure plate, friction disc and throwout bearing. An alignment tool positions the disc for reinstallation.



1 Use a screwdriver to hold the driveshaft still while unbolting the U-joint straps, then pry the shaft forward.



2 Jack up the engine slightly to take the weight off the cross member and use a prybar to help remove it from the car.



3 Speedometer cable unthreads from the transmission's tailhousing. Now, lower the engine for better access to shifter.



4 After noting the position of all linkage pieces, unbolt the shifter and remove it from underneath the car.

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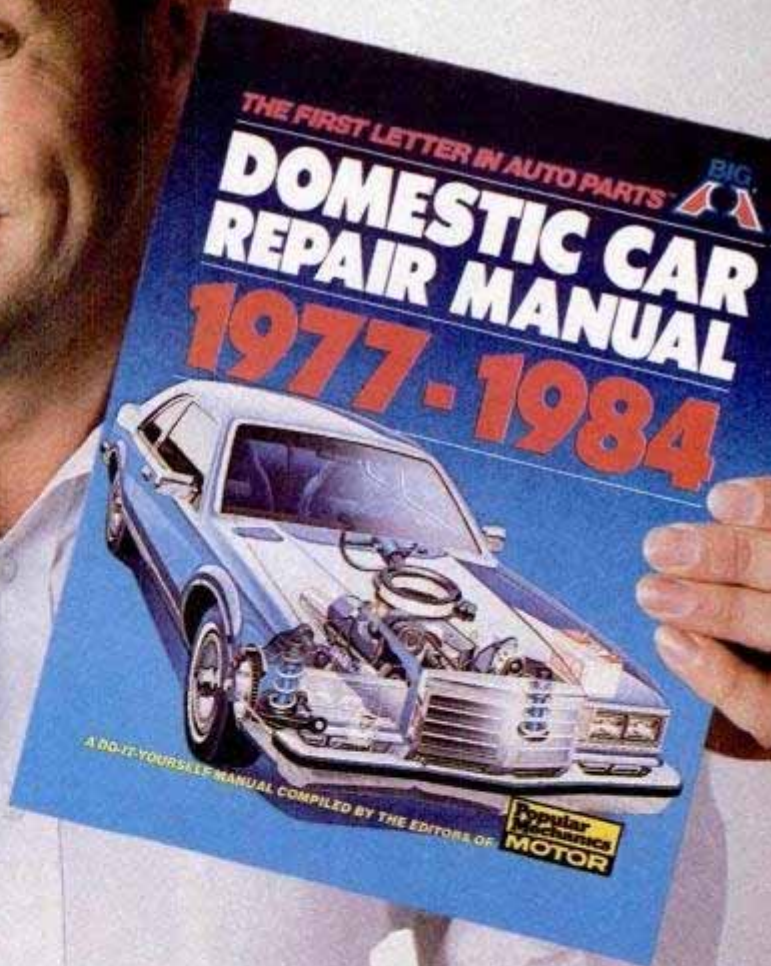
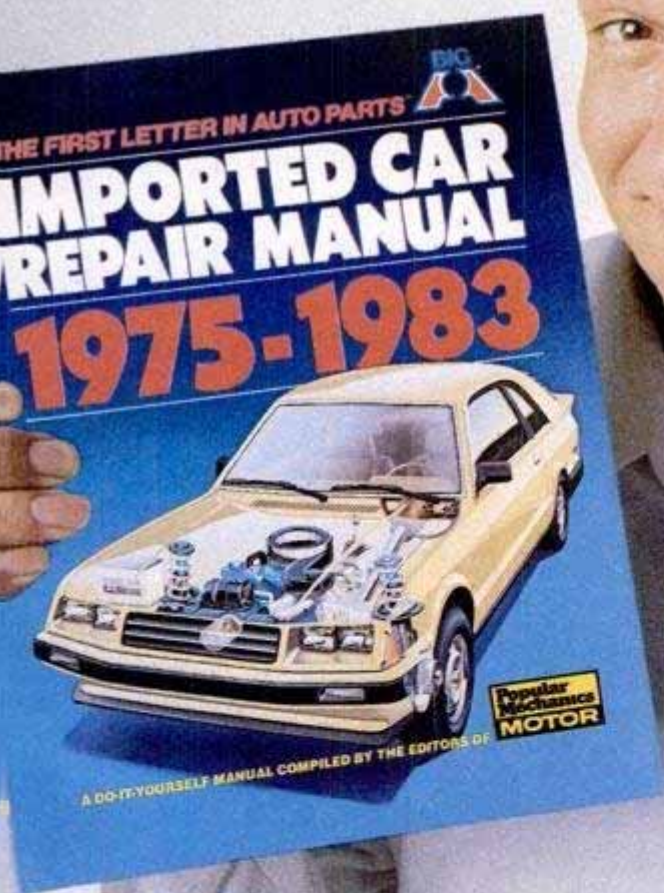
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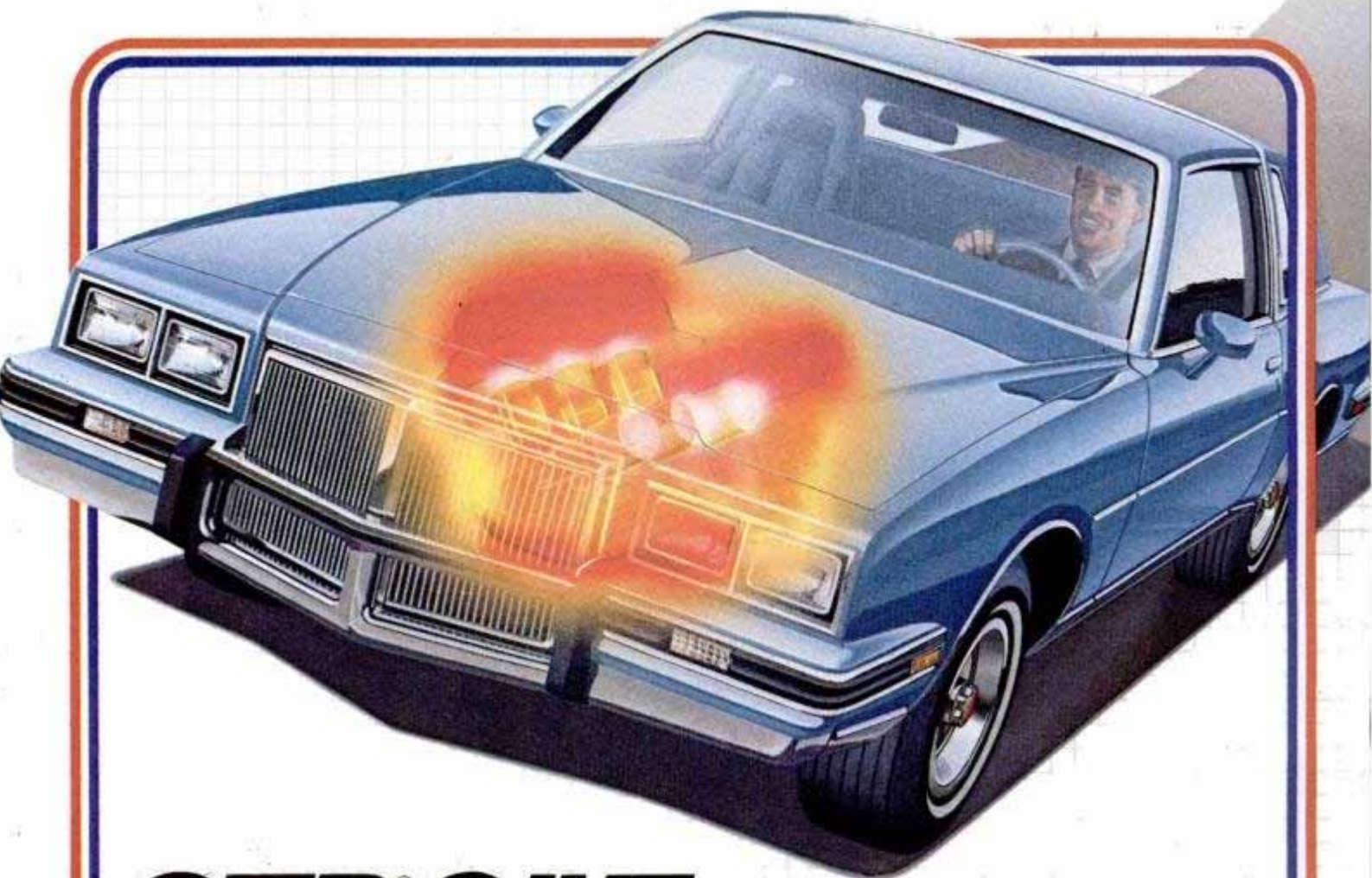
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transmission is usually held to the bellhousing by four bolts. Since the transmission weighs about 75 pounds, you'll need some help to support it when you pull it out.

To remove the clutch, first slide the throwout bearing out of the clutch fork. Remove the bellhousing dust cover and then the bellhousing bolts. You may have to use a long

ratchet extension and universal to reach some of these bolts.

Once the bellhousing is off, you can get the pressure plate out. It's a good idea at this point to insert the clutch-aligning tool to support the plate and keep it from falling while you remove the pressure plate bolts. Remove the pressure plate and inspect the pilot bearing or



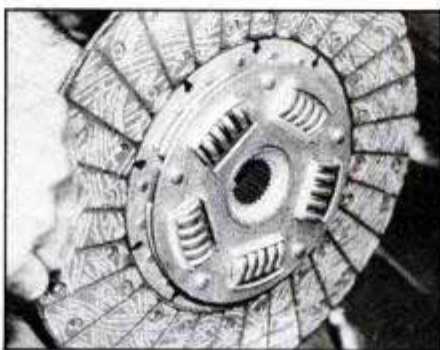
5 Unbolt the transmission and slide it out rearward. Be ready for a 75-pound load when the clutch spline disengages.



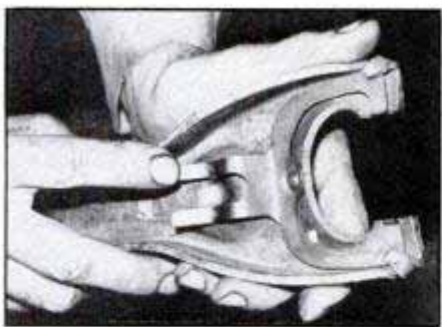
6 Slide the throwout bearing out the open side of the clutch fork and unhook the pedal linkage at the other end.



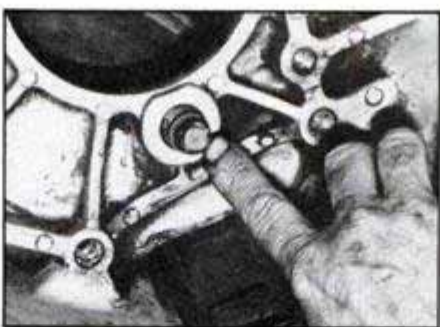
7 Clutch alignment tool centers disc for lineup with pilot bushing, and helps hold assembly in place for removal.



8 The clutch disc installs with the hub's flat side (shown) toward the flywheel and extended side toward transmission.



9 Check closely for wear at the clutch fork's pivot point and spring. Look for galling at throwout bearing end, too.



10 Inspect the clutch fork pivot in the bellhousing for wear and tightness. Use an Allen wrench to make it snug.



11 If the driveshaft yoke looks grooved or scored it must be replaced, along with the rear transmission seal.



12 Throwout bearing rides on the transmission's front bearing retainer; it must be in good shape for smooth operation.

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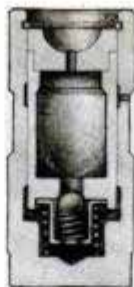
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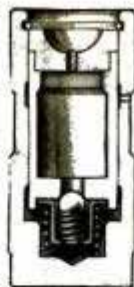


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bushing in the end of the crankshaft.

Check the flywheel gear for damaged teeth and inspect the face for grooves and heat cracks. Replace or reface the flywheel if you find these problems. Otherwise, smooth the face surface with fine sandpaper, and then wipe it with solvent to remove all traces of grease.

If you've unbolted the flywheel, retorque it to 100 lb.-ft. Put the pressure plate in place and start two or three bolts. Insert the clutch alignment tool all the way in so it lines up the clutch disc with the pilot bearing. Use a crisscross pattern and tighten down each bolt a little at a time to make sure the pressure plate seats evenly. Torque down the pressure plate to the specs for your particular car. Smear a small amount of white grease on the clutch fork pivot. Install the clutch fork in the bellhousing and then bolt the bellhousing to the engine.

Install the new throwout bearing.

Be sure to slide the spring clips on the clutch fork *underneath* the throwout bearing collar. Now, install the transmission, carefully aligning the front splines with those in the clutch disc; this may take a couple of attempts. If the trans won't wiggle in flush against the bellhousing, have someone operate the clutch pedal to help seat the trans-



13 The throwout bearing installs with the fork springs under the collar and the smaller end toward the transmission.

mission. If you should try to force the transmission into position by tightening the mounting bolts, you'll just break the ears on the transmission case.

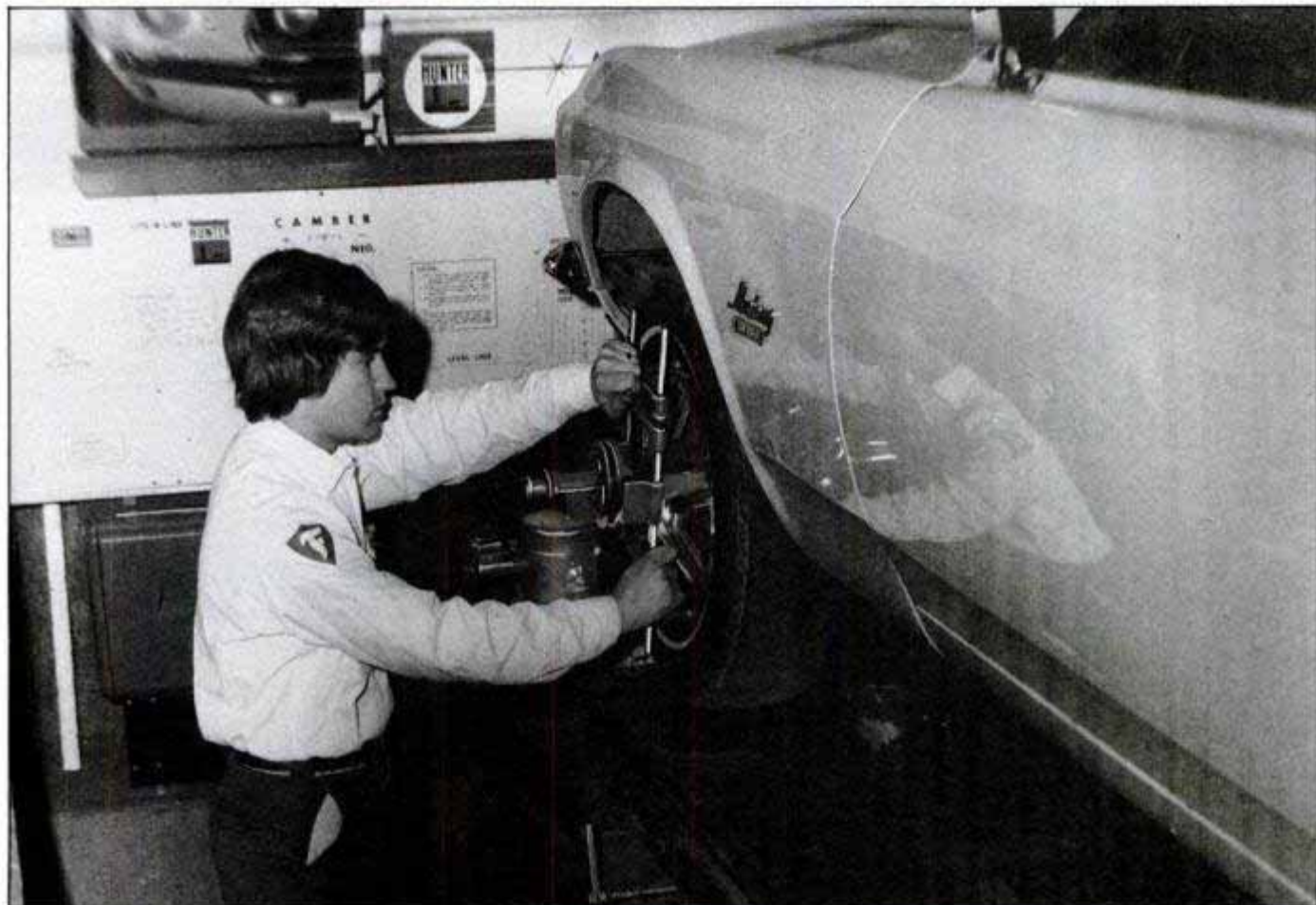
Install the shift tower and hook up the linkage rods. Adjust the shift linkage by lining up the levers. Many shift levers have an alignment hole. Insert a 1/4-inch drill bit through all the holes and hook up the rods while the levers are held in position by the drill bit. Adjust the rods as necessary by loosening the locknut and screwing the rod in or out.

Adjust the clutch pedal for between 1/2 and 1 inch of free play. On most cars, you screw the adjustment rod out to raise the engagement point (reduce free play).

You should finish up the job by checking the driveshaft universal joints, reinstalling the driveshaft and checking the fluid level in the transmission.

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A general test

Road-test the car to get an idea of the overall condition of steering and



For safety and comfort, suspension system springs, shocks, ball joints, wheels and tires must all be in good condition.

suspension components. However, before you do, see that the tires are properly inflated. If inflation pres-

sure information on the tire inflation placard is no longer readable, inflate the tires to the maximum pressure printed on the sidewalls.

Drive on a straight, flat road (no crown), holding the steering wheel lightly. If steering and suspension systems are in good condition, the car will track straight by itself. If the car pulls to one side, check individual steering and suspension components (as we will describe later in this story) until the faulty part is uncovered.

Now, turn left and right corners. The steering system should bring wheels back to straight ahead with little help from you. If steering binds and you have to do more than guide the steering wheel to get the car back on track, the steering gear may need replacing. First, though,



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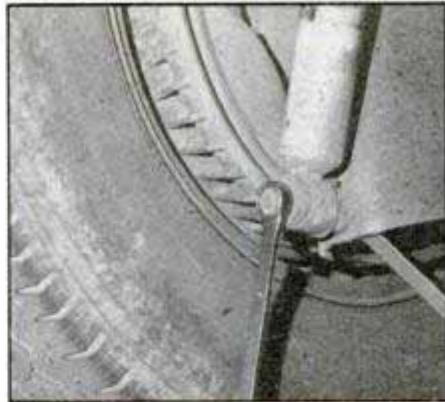
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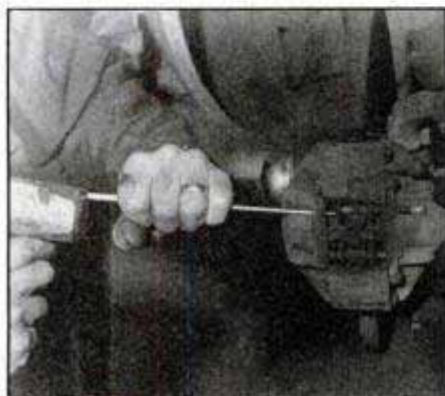
1 Shocks usually fail by spouting a leak and losing hydraulic fluid.



2 Rocking test is easy and may reveal bad shocks, depending on wear.



3 Penetrating oil will help unstick shock bolts that are heavily rusted.



4 Replacing disc pads isn't hard, but it is only part of the brake job.



5 Auto machine shops can turn rotors or drums for a nominal charge.



6 Steering linkage rods should be tight, with no free play in them.

have the steering-axis inclination angle checked on a wheel alignment rack.

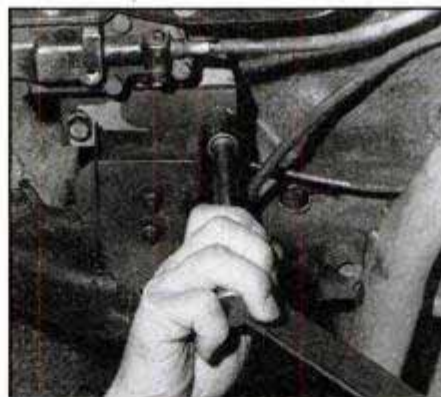
This angle, measured in degrees, indicates how much the spindle support center line of each front wheel is tilted from true vertical (0°). When set correctly, steering-axis inclination aids steering stability and allows wheels to return effortlessly to a straight-ahead position. If the steering-axis inclination isn't at the established spec, the spindle or spindle support arm may be bent, or a ball joint may be worn.

Continue testing by driving over small bumps (railroad tracks are ideal) at 20 to 25 mph to determine if shock absorbers are okay. If the car bounces instead of taking bumps firmly, replace the shocks. If you aren't sure shocks pass or fail this test, there are two other tests we will tell you about later.

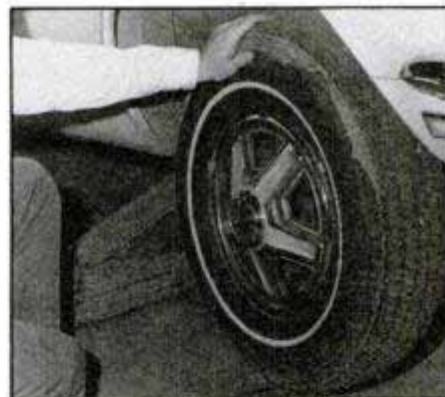
Now, drive slowly (less than 5 mph) over a steep dip, such as that formed where a sloping driveway and street meet. A crunching sound from the front may indicate a worn suspension ball joint.

Testing brakes

Put your foot on the brake pedal. If the car is equipped with power



7 Defective motor mounts are hazards. They can cause throttle to stick.



8 Ball joints without wear indicators are checked with pry bar (see text).

brakes, start the engine. The brake pedal will drop slightly. Whether manual or power brakes, however, the brake pedal should not move more than halfway to the floor, and then it should remain firm for at least 30 seconds.

If the pedal feels spongy, bleed air that's trapped in the brake system. If the pedal sinks to the floor, there is a brake fluid leak.

If brakes test okay to this point, drive at 10 to 15 mph and make several normal stops. Is excessive pressure needed on the pedal to bring the car to a halt? Do brakes grab? Does the car pull to one side? Do

you hear noise? If any of these conditions exist, make a closer inspection of the brakes (see below).

Testing steering linkage

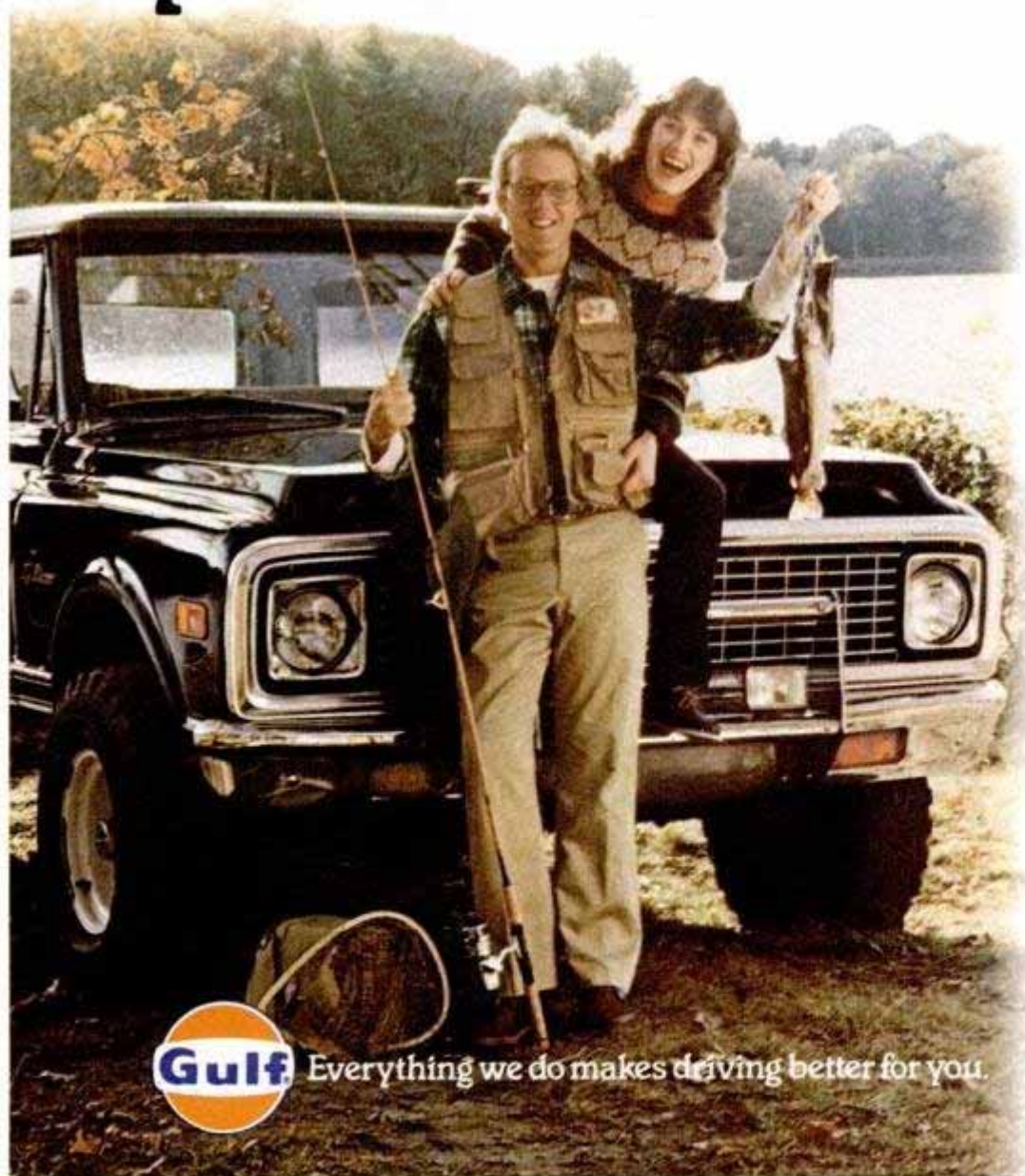
Raise the front of the car and check each steering linkage rod by pushing it up and down and by trying to roll it. Idler and Pitman arms should have no vertical play, and you shouldn't be able to see any movement in sockets as you test the tie rods (see photo 6).

Looseness indicates worn parts that need replacing. Farm this job out, since wheel alignment has to be adjusted to specification anyway

In '72, I drove this car to Lauderdale for Spring Break.

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when parts are replaced. Whether or not the steering linkage is to be repaired, use a wrench to tighten upper and lower control arm bolts.

Testing shock absorbers

If you still don't know the condition of the shocks after the road test, raise and support the car. Examine shocks for leakage and dented tubes. If oil is coming from a shock or a tube is damaged, replace the defective shock and its mate on the same end (front or rear) of the car.

To determine if shocks are worn internally, unbolt the lower mounting of each, in turn. Extend and compress the lower tube a couple of times to see if there's stiff resistance. You may want to find an auto parts and accessories store that has a shock absorber display so you can compare the feeling of your worn shock to a new shock. If a shock's resistance is questionable, replace it and its mate on the same end of the car.

Note: Before releasing the lower mountings of rear shock absorbers on a car that has coil springs in the rear, support the rear axle near each shock with a jackstand. This is also necessary when replacing rear

DO IT YOURSELF OR FARM IT OUT?

The secret to successful do-it-yourself chassis and suspension work is knowing how to be realistic about savings. That is, don't try to do everything as cheaply as possible, and you may save the most in the long run.

For example, let's say your springs are sagging a bit. If they're coils, spend perhaps \$7 more a shock for ones with overload springs and you may save half to a third of the price of new springs.

If the old springs are really bad, or if you're working on a MacPherson strut, you've got to take off the coil spring. Low cost coil spring compressors are available, but you're better off renting a professional tool. It will fit the spring better and be a lot safer to use. A compressed spring is like a loaded pistol.

With the right coil spring compressor, you not only might save \$75 or more on springs, but a similar amount on installing MacPherson struts, even taking into account the cost of wheel alignment, which is usually necessary after this job.

If you're changing an original equipment strut, don't waste time trying to cut it open to install an insert. You need a special cutter and the job takes a careful touch. Shop around for a good buy on a complete strut and the savings will be close to that of installing an insert. You can get aftermarket struts that include a provision for a

replacement insert. MacPherson struts for many imports have a screw-off top that allows easy installation of inserts the first time you need new shocks.

Torsion bars are trickier to handle than coil springs, so if your car has them, leave them to a pro.

Many suspension bushings require major disassembly to replace, but the ones that normally fail—on sway bars and conventional suspension strut rods—do not. However, strut rods can control caster, so when you take off the nuts to replace bushings, you must have the wheel alignment reset.

If bolts are missing at the sway bar, get the right replacements—don't use just any old hardware.

Most brake and wheel bearing service is straightforward, but you may run into special problem jobs.

If a disc is in bad shape, you normally can take it into a machine shop for low-cost resurfacing (\$12 or less). However, on some cars, removing a disc is a big job, especially on all but the later-model Hondas and some other Japanese front-drive cars. If you can't unbolt the disc from the flange, don't struggle. Find a shop that has an on-the-car grinder. It isn't the greatest approach, but it's the most practical. And it saves possible damage to wheel bearings.

shocks. Otherwise wheels will hang when shocks are released, which will put a strain on brake lines and cause springs to extend. This makes it difficult to attach lower mountings.

Tips for replacing shocks

- Notice how the old shocks are mounted. It's a good idea to make a sketch that will help you install the new shocks.
- Don't use so much force that you twist off the ends of the mounting bolts. If nuts are rusted to a point where they must be loosened with a

lot of effort, apply penetrating oil to the threads and let it work in. If you still can't budge them, use a nut splitter.

■ On front shocks, loosen the upper mountings first. Depending on the car, they are reached through wheel wells or inside the engine compartment. Then loosen lower mountings and drop the shocks. *Note:* On some cars, front shocks are removed from the top.

On rear shocks, disconnect the upper mountings first. Depending on the car, they are reached from under the car or inside the trunk.

■ Read instructions supplied with new shocks.

■ Hold each new shock in a vertical position and pump it up and down several times to work air out of the chamber.

■ Tighten nuts and bolts securely, but don't tighten them to the point that bushings bulge outside of washers.

■ Keep tools away from shock piston rods during installation. A nick or scratch in a rod may cut the seal as the shock compresses and extends, causing oil leakage and premature failure.

■ If you're installing heavy-duty or front stabilizing shocks to replace standard units, you may have to enlarge the mounting hole in the lower control arm. Use a rattail file and be careful not to enlarge the hole any more than necessary.

Checking springs, ball joints

With someone sitting behind the wheel, a full tank of gas, and a spare tire and jack in the car—nothing else—park on level ground. See that tires are inflated properly.

No corner of the car should sag. Front and rear bumpers should be an equal distance off the ground. A corner or an end that dips enough to be seen indicates worn or broken springs.

To test front suspension ball joints, first take weight off the load-carrying joint on the side of the car you're testing. The load-carrying ball joint is the one mounted on the control arm that's attached to the spring or torsion bar. Release weight by placing a floor jack under the control arm, as close to the ball joint as possible, and lifting up until the tire clears the floor.

Now, place a pry bar under the tire, put your hand on top of the tire, and check for axial (up and down) play (photo 8). You're safe if there's little or no play. If play seems excessive, check it with a dial indicator to see if it falls within the manufacturer's specifications.

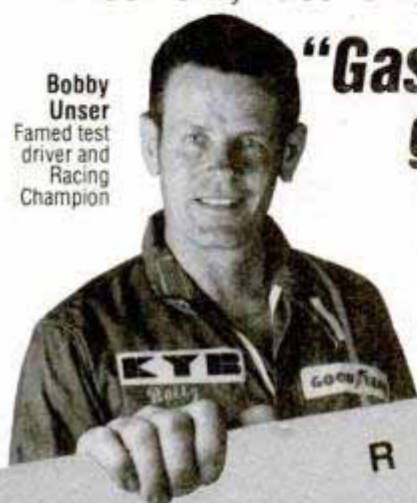
Some manufacturers equip cars with ball joints that have built-in wear indicators. The indicator is a grease fitting which has a base that protrudes $\frac{1}{16}$ inch from the ball joint cover when the ball joint is new. As the ball joint wears, the base recedes. When the base is flush with the cover, replace the ball joint.

Testing front wheel bearings

Short of removing front wheels to inspect bearings, the best way to find out if bearings are defective or require adjustment is to raise the

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front of the car and grasp one of the tires at the top and bottom. Rock the wheel. There should be no movement or only a slight bit between the wheel and spindle.

Rotate the wheel slowly and listen for a growling noise. Noticeable movement or noise indicate worn or loose bearings. After replacing defective front wheel bearings, you should use one of the following methods to adjust them:

■ *If you have a torque wrench—*

1. **Turn the wheel** as you torque the adjusting nut to 180 lbs.-in.

2. **Back off the adjusting nut** until you can turn it by hand. Then, torque it to 15 lbs.-in.

3. **Screw on the nut lock** and align a slot of the nut lock with the hole in the spindle. If necessary, back off the nut lock to the nearest slot that aligns itself with the hole. Insert a new cotter pin and wrap its legs around the nut lock.

■ *If you do not have a torque wrench—*

1. **Tighten the adjusting nut** as you turn the wheel, using a pair of water-pump pliers. Continue tightening the nut until pressure starts forcing the plier jaws open.

2. **Back off the adjusting nut** until you can turn it by hand. Then make it as hand-tight as possible.

3. **Same as step 3 above.**

Brake hydraulic unit

Check the level of brake fluid in the master cylinder. It should be within $\frac{1}{2}$ in. of the top rim. If not, there's a leak. Brake fluid doesn't get "used up."

Note: As disc brake pads wear, there is usually a transfer of some fluid from the master cylinder to the calipers. However, the drop in fluid level inside the cylinder is not enough to be termed "low."

A leak is most likely to exist at one of the flexible hoses entering the calipers (disc brake) or wheel cylinders (drum brake). However, no component that holds fluid is immune from leakage, so check the master cylinder and brake proportioning valve (if there is one). Also examine brake backing plates. Fluid on them means caliper seals or wheel cylinders are leaking.

Continue checking for leaks by pulling off the vacuum hose at the power booster of a car having power brakes. Twirl a screwdriver inside the hose. If it comes away wet, the power booster is leaking and needs replacing.

Brake repair

Replacing worn disc brake pads is the most common repair. Replace

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both outer and inner pads when the pad thickness of one is $\frac{1}{16}$ in. or less. If pads on one wheel have to be replaced, change the pads of the other wheel on the same end (front or rear) of the car.

The following tips will help make the job easier:

Make a sketch as you disassemble the brake assembly on one side of the car. It will help when you reassemble the unit. As a backup, do the job on one brake before tackling the other, so the one that's still assembled can be a guide if you need one.

To get at the pads, it's usually necessary to remove the caliper from the rotor. You'll probably have to push the piston back inside the piston bore. If you can do this with a long screwdriver, wrap the screwdriver with a rag to avoid scarring the piston. However, with most calipers, you will have to use a C-clamp.

Place the clamp so its back is against the back of the caliper and the screw jack is against the outer pad. Tighten the jack. It will press against the pad, which will push against the piston and drive it into

the bore. Release and remove the clamp.

Calipers are secured with lower and upper guide pins. Some pins are threaded into the caliper and have to be unscrewed, often with an Allen wrench. Other pins can be driven from the caliper with a drift and hammer (photo 4).

Before lifting the caliper off the rotor, release the flexible brake hose from the caliper bleed valve and tape the end of the hose to keep fluid from dripping out. Don't let the caliper hang by the hose or you'll ruin it.

In removing pads, note if they're equipped with support springs, commonly referred to as antirattle clips. If antirattle clips are on old pads, the replacement package you buy should contain new pads, antirattle clips, and shims if they're required by the caliper.

Before installing new pads and hardware and repositioning the caliper, inspect the caliper closely. Look for a cracked or torn dust seal and signs of fluid leaking from the caliper bore. Rebuild or replace the caliper if necessary.

Also examine the rotor. If it shows

any surface defect—even a slight score—remove it and the rotor on the other side and have them refinished by a professional.

Note: Some mechanics contend that when new pads are installed, rotors should be turned, even if they look good. They have a valid point. Rotor roughness that can damage new pads is not always visible.

Tires and alignment

Replace worn tires. A tire is worn when tread depth reaches $\frac{1}{16}$ in. With most tires, wear indicators (smooth bars) between adjacent grooves will appear across the tread when the tread is worn to $\frac{1}{16}$ in.

If you see abnormal wear on a front tire, you may have an alignment problem.

Excessive wear on one edge of a tire is often caused by incorrect camber (inward or outward tilt of a wheel at the top). In its early stages, the condition may not be seen easily, so run your hand around the tire to feel if there's more wear on one side than the other.

Also classified as abnormal wear is tread that's feathered. This is a sign that wheel toe-in or toe-out is not correct.

When wheels of a car toe-in or toe-out, tires scuff against the road. Wear may occur on one tire only; that is, if the outside tread of only the right front tire is feathered, excessive toe-in is the cause. Conversely, excessive toe-out usually causes feathering to the inside tread of the left front tire.

If you are putting new rubber on the car you're restoring, have wheel alignment checked by a professional. The cost of having the wheels aligned may be more than returned to you in the form of longer tire life.

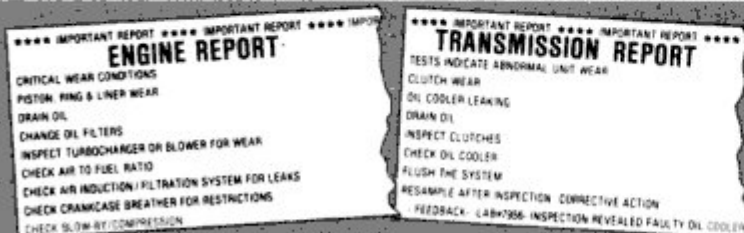
Motor mounts

The older a car gets, the more likely it is that a loose or worn motor mount will occur. In the least, this results in engine vibration. If the condition gets serious enough, the engine can shift and cause the throttle to stick open or the fan to hit against the radiator.

To determine if motor mounts are worn out, run the engine at a fast idle speed and have someone turn off the ignition switch as you watch the engine. Does it seem to rock side to side as it comes to a stop? If so, tighten motor mounts (there are two or three). If this doesn't eliminate the rock, have mounts checked for damage and, if necessary, replaced.

PM

WITHOUT OIL ANALYSIS, CAR LEASING COMPANIES, TRUCK FLEETS AND AIRLINES WON'T MOVE. NEITHER SHOULD YOUR VEHICLE.



"IF YOU WANT YOUR CAR IN TOP CONDITION, IF YOU PLAN TO GET MAXIMUM USE OUT OF YOUR CAR BEFORE YOU TRADE IT IN, OIL ANALYSIS CAN BE A USEFUL TOOL."...Popular Science Magazine.

You take care of your car, change oil regularly, and have routine maintenance performed. You treat your vehicle like the fine machine it is. Whether you do the repairs or pay for the work done, you need the least expensive and most efficient methods used by large corporations and governmental agencies — having engine oil and transmission oil undergo spectroscopic analysis. Then you will know what should be done and can tell your mechanic what is needed. No more unnecessary, costly work!

What is oil analysis? Just as a blood test tells the physician what is going on in the human body, spectroscopic analysis provides information for a computerized report on an engine or transmission. Oil is analyzed for metal content providing information on unit wear, coolant dilution, dirt, as well as fuel dilution and total solids. This information is translated into recommended maintenance.

Precision Diagnostics, Inc., specializing in top quality, accurate, scientific oil analysis makes **TWO** tests available to you — engine oil analysis and transmission oil analysis. Computer printouts provide information on needed work and explain the meaning of the spectroscopic findings. These are the same tests that have been provided to industry and government for twenty three years and are available to consumers for the first time.

WHO USES OIL ANALYSIS?

Car Leasing Companies
Agriculture & Farming
U.S. Army Corp.
of Engineers

Airlines
City of Chicago
Amtrak

Truck Fleets
City of Los Angeles
Insurance Companies
So. Calif. Rapid Transit District

WHEN TO USE OIL ANALYSIS

- Every 15,000 miles or sooner if your engine or transmission loses efficiency or sounds bad.
- Before you sell a car, to command a top price.
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- Before your new car warranty expires.

Order spectroscopic oil analysis kits now for your car, truck, boat and airplane — for their engines and transmissions. This small expenditure provides information that could save hundreds of maintenance dollars!

Mail to: Precision Diagnostics, Inc., 777 Silver Spur Rd., Suite 132
Rolling Hills Estates, CA 90274, Attn: Department 302

Ship to:

Your name (print) _____

Street address & apt. no. _____

City, state, zip code _____

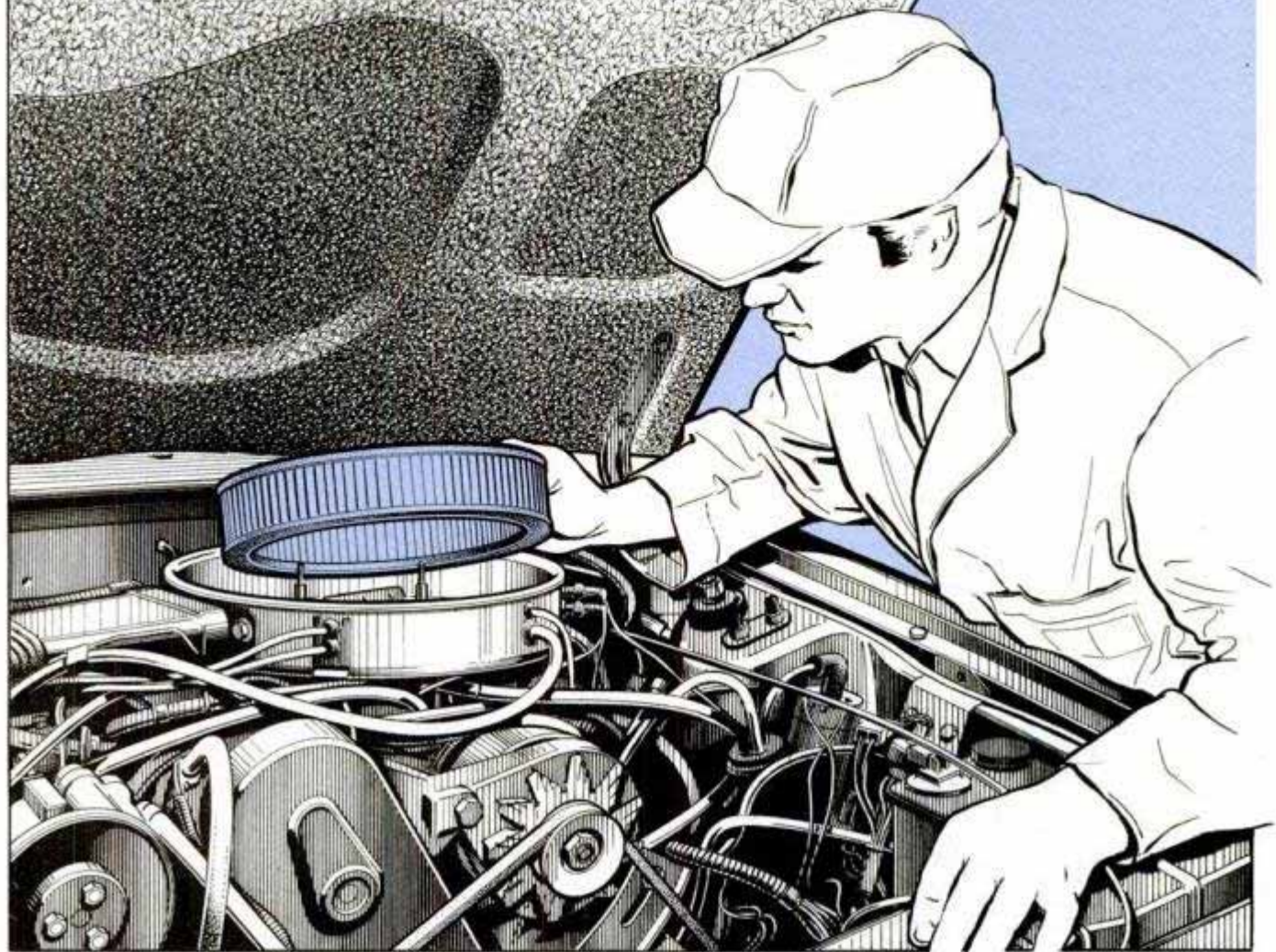
Enclosed is check or money order only for \$ _____

Charge my Master Charge Visa Card _____
(Charge card No.)

Expiration Date _____ (Signature charge orders)

Check No. of Kits Ordered	Price	Sub-total	\$
<input type="checkbox"/> 1	\$18.95	Add \$2 ⁰⁰ per kit for shipping & handling	\$ _____
<input type="checkbox"/> 2	\$35.00		\$ _____
<input type="checkbox"/> 3	\$51.00		\$ _____
<input type="checkbox"/> 4	\$67.00		\$ _____
		Total	\$ _____

How many of the tests ordered are for aircraft? _____



SAVING YOUR CAR WITH GOOD CAR CARE

How many miles can you squeeze out of a car? Theoretically, you can keep a car going just about forever if you replace parts and rebuild systems at certain intervals. We've all heard the stories about cars that have lasted over a million miles.

Practicality places certain limits on most vehicles. Most of us can't devote our lives to the maintenance of a car. However, its useful life can be significantly extended by practicing good car care.

Good car care is simply a matter of determining the useful life of normal maintenance items and replacing them before they fail, or before they have a negative effect on other parts. It's not a plan for saving an old, neglected vehicle. Good car

New, used or restored your car lasts longer if you treat it right.

care should start the day the machine rolls off the showroom floor.

The first step toward extended vehicle life is to determine the intervals at which maintenance should be performed. A manufacturer's recommendations can serve as a guide, but they can't be followed exclusively. A few years ago the cost of maintenance became a major sales point for carmakers. As maintenance cost estimates found their way into ad copy with greater frequency, recommended intervals suddenly grew by leaps and

bounds. The automakers, of course, claim that new lubricant and ignition technology is responsible for the increases. But it's a little hard to believe that the newest motor oils, for example, justify 200 percent extensions of oil change intervals.

Don't be confused by the manufacturer's distinction between "normal" driving and "severe use" for maintenance intervals. Unless you live on the Great Plains and use your car only in mild weather for extended trips, you probably qualify for "severe" usage.

The maintenance intervals that you choose to observe must be based on your own driving patterns and experience. Vehicles driven mostly on short trips, in various types of weather, and exposed to

high levels of dust and dirt should have a more frequent maintenance schedule than what's recommended for severe use.

Maintenance tuneup

A maintenance tuneup is a parts-replacement procedure that is performed at specific intervals. Hopefully, this service will prevent the failure of various powerplant components that last only a limited time, avoiding breakdowns and preventing the damage that can occur when ignition or fuel system malfunctions are allowed to continue.

On older cars, with contact breaker ignition systems, the maintenance tuneup should be performed every 10,000 miles or 12 months, whichever comes first. For most electronic ignition vehicles an interval of 15,000 or 20,000 miles

SWIVEL-HEAD RATCHET



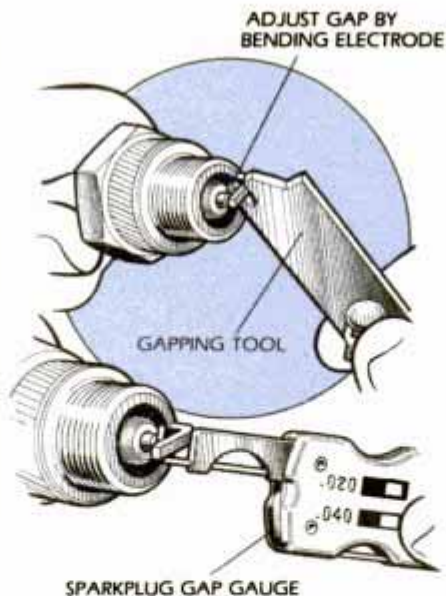
SPARKPLUG SOCKET

1 Use a sparkplug socket with rubber insert to protect insulator, hold the plug.

should suffice. Begin by removing and inspecting the sparkplugs. Be careful when removing the sparkplug cables. Don't pull on the cable. Grasp the rubber boot that fits over the plug and twist it back and forth a bit until it loosens its grip on the plug. Then pull the cable off while twisting the boot.

If your car is not equipped with cable looms that clearly define which plug goes on which cable, label each cable with a numbered piece of masking tape. Use a sparkplug socket, not just any socket that fits, to remove the plugs (see Fig. 1). Take care not to hold the socket at an angle or you may crack the plug's porcelain. As you remove each plug, place it on a tray or in a box to keep it in sequence.

Once the plugs have been removed, examine their electrodes. They should be light to medium white, brown or gray. If any are



2 Gap plugs by bending ground electrode. Check setting with wire gauge.

coated with wet fuel and oil, sooty black carbon, oily black grease, or heavy black deposits, a diagnostic check is necessary to determine the cause of the plug fouling. If the color appears normal, check for erosion of the sharp edges on both inner and outer electrodes. If they're rounded off or noticeably eroded, replacement is absolutely necessary. If severe erosion is accompanied by blistering of the insulator, further diagnosis is necessary to find the cause of excessively high combustion chamber temperatures.

On cars equipped with electronic ignition, if the plugs look good and they're only 15,000 miles old, you can clean and gap them and put

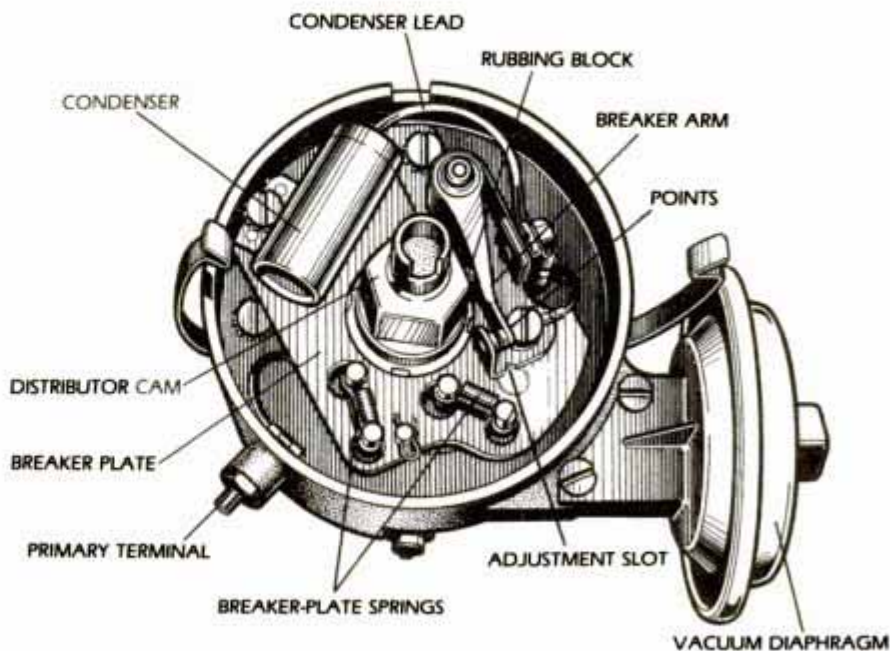
them back in for another 15,000. With breaker point ignitions, replacement is best, even if the plugs look fairly good.

Replace the plugs with the manufacturer's recommended heat range. Today's plugs have such a wide heat range that juggling of ranges for different driving conditions is usually unnecessary and can sometimes lead to problems. Gap each plug to the manufacturer's recommended spec. Use a gapping tool to bend the electrode if necessary (Fig. 2).

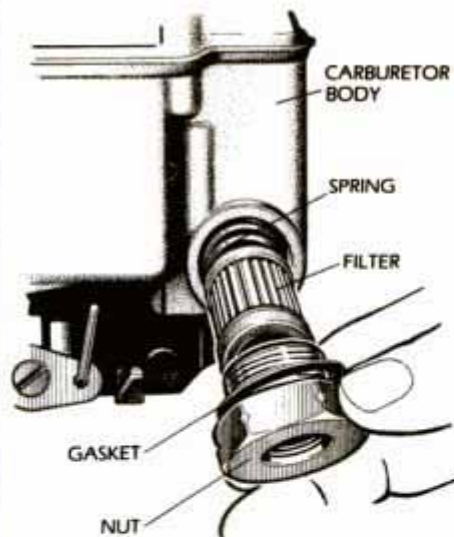
Reinstall the plugs and tighten them to 20 lb.-ft. with a torque wrench if possible. If you can't reach a plug with your torque wrench, tighten only until the gasket seats fully, using medium pressure. If you are reinstalling old plugs that have been cleaned and regapped, use new gaskets.

Examine the plug cables carefully for checking, burns, cracks or other damage. Clean any corrosion from the terminals. Make sure the boots fit tightly on both the plugs and the cap. Replace the entire set if the cables are in generally poor condition, or replace single wires if you find isolated damage.

Next, turn your attention to the distributor. Remove the cap and clean the inside with a rag. Check for fractures, cracks or evidence of carbon tracks on the surface of the cap. Replace the cap if any of these conditions exist. Clean the terminals inside the cap with a small knife. If corrosion cannot be easily scraped from the terminals, replace the cap.



3 To set points gap, loosen mounting screws and move the contact point mounting plate by twisting a screwdriver in the adjustment slot until gap is correct.



4 Some fuel filters are behind carb's inlet fitting. Don't lose spring and gasket.

Pull the rotor from the distributor and examine it carefully. Again, it should be replaced if it is fractured, chipped, or carbon-tracked. It should also be replaced if the tip is corroded or burned to the point where it can't be cleaned without removing metal.

If your car is equipped with a contact point ignition, turn the engine until the rubbing block is on the high point of the distributor cam (Fig. 3). Detach the primary lead and condenser wire from the points. Then remove the points and condenser, taking care not to lose any screws. (On many cars, the screws need only be loosened to remove the contact points.)

If the distributor is equipped with a lubricating wick that touches the distributor cam, replace the wick when you service the points. Don't attempt to oil it. Install the points and condenser, attach the primary lead and condenser lead to the terminal on the points, then adjust the point gap to manufacturer's specifications, using a feeler gauge. Lubricate the breaker cam with a very light coating of cam lubricant or white lithium grease. Don't overdo it. Reassemble the distributor, start the engine, and check the point adjustment with a dwell meter if you have one.

Electronic ignitions

If your car is equipped with electronic ignition, there is no specific interval for replacement of the control module and pickup, although the cap and rotor may wear out faster than they do in contact point distributors. Electronic pickup devices and control modules do fail, but a fault-finding diagnostic routine must be performed to pinpoint the fault when it occurs because

these components are expensive and they do not necessarily wear out at a certain mileage.

Handheld electronic ignition testers are now available at a relatively low price. They check whether the pickup is producing a signal for the control module, and then test the control module by providing a simulated pickup signal.

Before reinstalling the cap and rotor, check the centrifugal advance mechanism if the vehicle is so equipped. (The latest cars have fully electronic timing control.)

Start the engine and check the operation of the choke, intake hot-air system, and manifold heater or "EFE" system, as the engine warms up.

When the engine has warmed, adjust idle speed to spec and set the ignition timing with a timing light or meter. Specs and instructions are found on the vehicle information label under the hood.

Once the initial spark timing has been adjusted, check the vacuum advance by disconnecting it, accelerating the engine to 1,500 rpm, then reconnecting it to see if the engine timing advances. To check centrifugal advance, accelerate the engine to 3,500 rpm while watching the timing marks with your light or while watching the timing meter. Electronic advance mechanisms should also adjust timing as the engine is accelerated.

Air and fuel filters

Examine the air filter every time you perform a maintenance tune-up, and replace it if it is coated with dirt. Although most manufacturers recommend 30,000-mile replacement, air filters seem to last only about 15,000 miles in typically dirty urban areas, and even less where there's a lot of blowing dust.

While the air cleaner is off, apply carb cleaner to all moving parts of the carb's choke and fast-idle mechanism, and make sure they move freely.

Gasoline engine fuel filters should be replaced at 15,000 to 20,000-mile intervals or once a year, whichever comes first.

Don't ignore fuel filters that are hidden behind the inlet nut on the carburetor, as they are on most Ford and GM cars (see Fig. 4). Use two wrenches to remove the inlet line, one on the fuel line nut, one on the carb's inlet fitting. Then remove the inlet fitting itself. The filter is behind it.

Make sure you don't lose any gaskets or springs that are part of the filter assembly. Install the new filter

so that it faces the same way the old one did.

Chrysler products and many imports have fuel filters that are spliced into the fuel line, and held with hose clamps. To remove them, simply loosen the clamps, move them away from the filter and twist the neoprene hoses back and forth. Some imports have two fuel filters. Cars with electric fuel pumps often have the pump and filter near the gas tank. Check your owner's manual or maintenance schedule.

Fuel filter service is even more critical on diesel engines. Replace all diesel fuel filters at recommended intervals, or 20 to 30 percent sooner.

The PCV valve, filter and hoses should be cleaned and checked every 15,000 miles. The valve and filter should be replaced every 30,000 miles.

To check the valve, remove it from the intake manifold or rocker arm cover and run the engine at idle. Check for vacuum at the end of the valve with your thumb. If there is no vacuum, check for clogging of the valve or the hoses. Replace any hoses that are not in good shape. Then shut the engine off and remove the valve. Shake it and listen for the rattle of the needle within. If the valve doesn't rattle, it should be replaced.

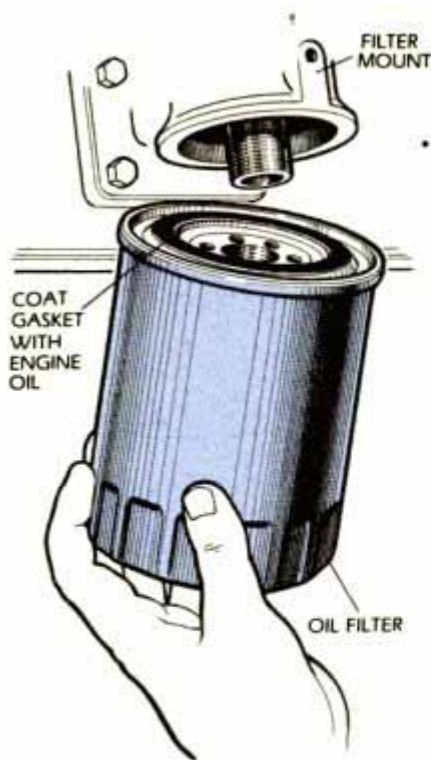
Examine all plastic and rubber connectors, tees and vacuum hoses that you find on the engine. If they are cracked, checked, loose or damaged in some other way, replace them. Remove vacuum hoses one at a time so as not to confuse the routing. Vacuum leaks are a principal cause of engine performance problems, and if allowed to continue, they can cause serious engine damage.

Fault-finding diagnosis

What do you do when your car develops a miss, a spark knock, a surge, a hesitation or another driveability problem? If you're due for a maintenance tuneup, you probably perform that service, and sometimes the problem goes away. What do you do when it doesn't?

If you want to prolong the life of your engine, you'll find the cause of a driveability problem before it gets more serious. When an engine doesn't operate properly, changes take place. Sometimes it doesn't burn all the fuel. The raw gas then washes past the piston rings, removing lubrication from the cylinder walls and diluting the oil.

An engine may run hotter than normal when a component fails to



5 When replacing an oil filter be sure to coat the rubber gasket with engine oil.

do its job, resulting in the hardening of seals and increased wear in many areas. Or, an engine that is not performing properly may run too cold, resulting in carbon accumulation and sludge formation.

The source of engine performance problems can usually be determined by a logical troubleshooting procedure. Unfortunately, a truly complete troubleshooting procedure requires a great deal of expensive equipment, including a voltmeter, oscilloscope, vacuum gauge, power balance tester, tachometer, an emissions analyzer that can be operated while the power balance test is conducted, a compression gauge and a cylinder leakage tester.

A knowledgeable do-it-yourselfer can sometimes arrive at a diagnosis with only a vacuum gauge and compression gauge, particularly if an internal engine problem is the source of the driveability complaint. On older vehicles without high-voltage ignition or catalytic converters, a power balance test can be performed by removing plug cables one at a time with insulated pliers, while noting engine speed change on a tach. (The speed drop for each cylinder should be within 5 percent of the others if the engine is operating efficiently.)

In most cases, however, the experience and equipment of a skilled professional will be needed to uncover specific fuel, ignition or emis-

sion component faults. Find a mechanic who is ASE- or NIASE-certified in engine tuneup and who has an up-to-date engine analyzer that can perform the tests indicated or a combination of testers that can do the same thing.

Oil change and lubrication

Nine out of ten professional mechanics will tell you that frequent changing of oil and filters is the best thing you can do for your car. A good supply of fresh, clean motor oil will prevent the kind of metal wear that can make your car old before its time.

An interval of 3,000 miles will provide maximum protection in most cases. Carmakers' suggested intervals are, of course, much longer—as long as 12,000 miles in some cases. The car companies claim that the new SF lubes have made this possible. But you can bet your last nickel that 3,000-mile oil and filter change intervals won't accelerate wear.

Warm the engine oil thoroughly by driving at least five miles before you prepare to change the oil and filter. Then raise the car on solid jackstands, which are securely located. Raise both the rear and the front of the car, so that oil will drain properly and so you can lube the chassis and inspect the underside of the vehicle while the oil is changed.

To remove your oil drain plug use a box wrench or socket wrench. Allow the warm oil to drain completely. You can change the filter while the oil is draining. Use a filter

wrench to remove the old oil filter, making sure the gasket comes off with it. Wipe the filter mounting surface with a clean rag. Partially fill your new, name-brand filter with some of the oil that you're going to use to refill the crankcase. Apply a bit of oil to the filter gasket (Fig. 5). Install the filter, tightening it according to instructions on the filter itself or on the box. If there are no instructions, tighten it about ¾ turn past the point where the gasket first contacts the mount or almost as tight as you can make it by hand. Don't use a wrench.

If the oil has stopped draining, replace the plug, tightening it to only medium-firm tightness with a wrench that is no more than 10 inches long. Don't overtighten. Refill the crankcase with the oil recommended by the vehicle manufacturer. For most conditions, multigrade oils are recommended and preferred. Manufacturers recommend SF oils for the latest gasoline engine cars and SF/CC or SF/CD oils for the latest diesel engines. GM recommends single-viscosity oils for diesel engines that are used for sustained high-speed driving. You can use SF oil in earlier gasoline engines for which SE oil was recommended, since it's an improved version of this type of oil. Do not use oils recommended for diesels in gasoline engines or vice versa.

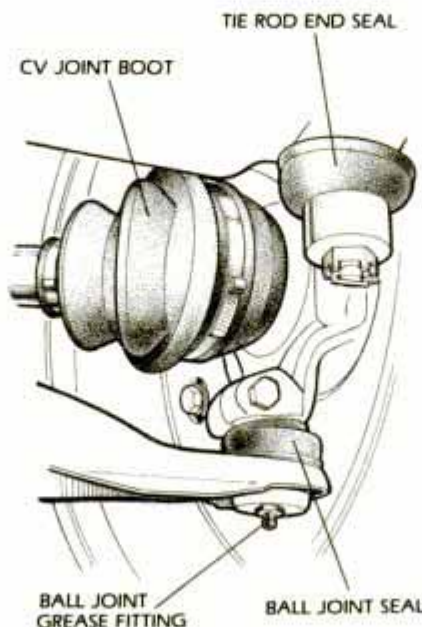
Run the engine

Once the engine has been filled with the correct amount of oil, start and allow it to run for a minute, check for leaks, shut it off and check the oil level.

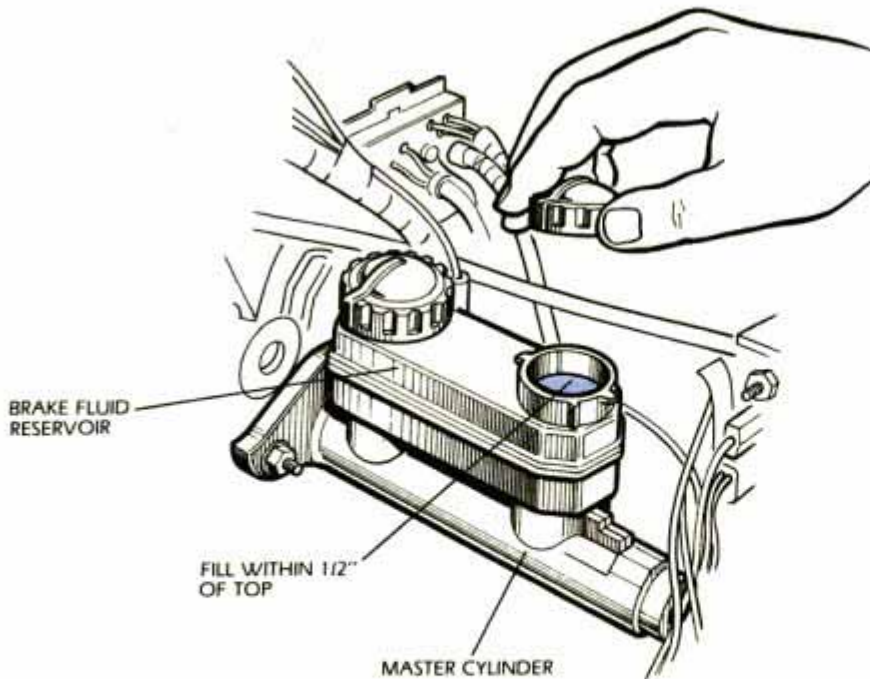
Lubricate all steering linkage and suspension fittings with water-resistant EP chassis lubricant every time you change the oil and filter. Check them for excessive looseness at the same time. Lubricate the ball joints. If your car is not equipped with grease fittings, you may be able to install them in some components.

On front-wheel-drive cars, inspect CV joint boots for deterioration or tears (Fig. 6). Replace boots before they tear if you want to avoid damage. Zipper-type boots, which can be installed without removing the driveshafts, are available.

Check the level of the rear axle lube, and add the recommended lubricant if it is low. Usually there's a plug in the side of the differential center section or in the rear cover to permit checking of lube level. It should, in most cases, come right up to the hole or to within ¼ inch of the hole. Most manual transmissions have a similar plug in the side



6 Check all seals for damage, including CV joint boots on front-drive cars.

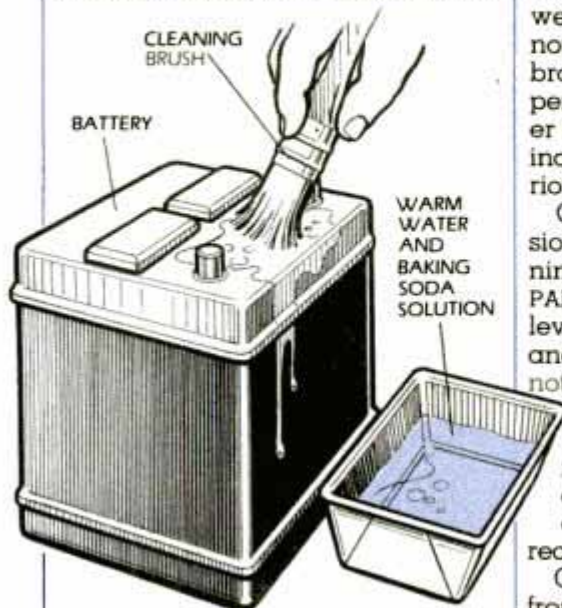


7 Fluid level in master cylinder should be within $\frac{1}{2}$ inch of top lip. Some fluid level drop is normal on cars equipped with disc brakes as the pads wear down.

of the case for checking lube level. Many rear-wheel-drive vehicles use the same lube in both the trans and rear end.

Before lowering the vehicle, check for exhaust system deterioration, chassis or floor pan corrosion, shock absorber leaks or other abnormal conditions.

Lower the vehicle from the jacks, open the hood and lube the accelerator linkage with a small squirt can filled with engine oil. Apply the same oil to pivot points on the hood hinges. Inspect the hood latch mechanism. If it's dirty, clean it and apply a light lithium grease. Apply a few drops of engine oil to trunk hinges and lock mechanism, and to



8 Prevent battery corrosion by periodic cleaning with baking soda solution.

gas tank door hinges. Check the level of the power steering fluid and top it off with the recommended product. In some cases, manufacturers recommend a special power steering fluid rather than the conventional automatic transmission fluid.

Check the fluid level in both brake master cylinder reservoirs (Fig. 7). Use fluid that meets DOT 3 specs. Don't use fluid if it hasn't been stored in a tightly sealed container as it may be contaminated with moisture. Don't use fluid when no indication of its spec can be found on the container. Brake failure could result. On disc brake cars fluid level will fall slightly as pads wear. But if abnormal fluid loss is noted on any vehicle, a thorough brake system diagnosis should be performed. Never use anything other than brake fluid in a master cylinder—even in an emergency. Serious damage will result.

Check the automatic transmission fluid level with the engine running, the gear shift selector in the PARK position and the vehicle on level ground. Pull the dipstick out and feel it. It should be warm but not hot when you check the fluid level. If it's cold, the level may be as much as $\frac{3}{4}$ inch below the full level. Wipe the stick and check the level. If you have to add fluid, make sure it's the type recommended for your vehicle.

Check the transaxle lube level on front-wheel-drive vehicles. In most cases, both automatic and manual transaxles use some type of ATF as

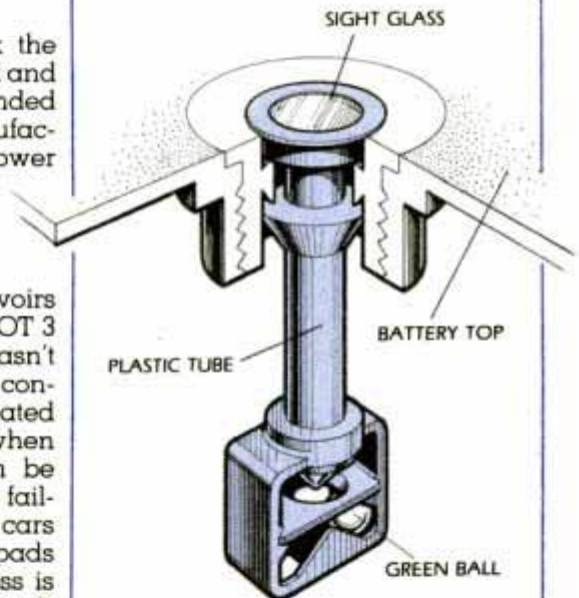
a lubricant. Check your owner's manual.

Battery inspection

Your battery should be checked every time you change oil. If battery maintenance is ignored, the increase in resistance that results from dirty connections might shorten its life considerably or, worse yet, leave you stranded.

Conventional, nonsealed batteries will lose fluid over a period of time. Fluid level should be checked even more frequently than your oil change schedule permits—every 1,000 miles is about right. If the fluid level is low, add distilled water. If the outside temperature is below freezing, drive the car for at least 20 minutes after adding water.

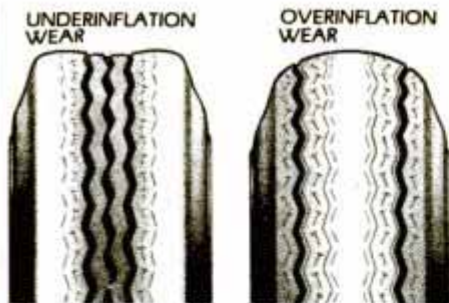
Clean the case, posts and terminals of any battery on a regular basis. A paste made from baking soda and a small brush will do a fine job (Fig. 8). Remove the nega-



9 Maintenance-free batteries indicate state of charge with built-in hydrometers.

tive cable first, then the positive cable and thoroughly scrub the battery, posts and terminals. Use a wire brush or a battery post cleaner to remove corroded metal from conventional posts. Use the post cleaner or a small knife to remove corrosion from the cable terminals. On batteries with screw-type connectors, use a wire brush and small knife as necessary.

If your battery is equipped with "temporary" cable terminals secured to the end of the cable by a strap bolted in place, replace the cables with new ones that have terminals molded on the end. At the very least, disassemble each terminal and clean the end of the wire



10 Check tire inflation pressures regularly to prevent premature wear.

and the terminal itself. If you have a maintenance-free battery, it might be equipped with a built-in hydrometer that changes color in respect to the battery's condition or state of charge (Fig. 9). A green hydrometer eye usually indicates that the battery is at least at 75 percent of full charge. A dark or black eye means that the battery is in need of recharge. A clear or yellow indicator means the battery is defective and must be replaced. Do not attempt to recharge, jump, or refill a maintenance-free battery that is defective. On the other hand, make sure that you're getting a true reading on the hydrometer eye. If the battery has a clear case, errant rays of sunlight could mislead you.

If you have a conventional battery, you can determine its condition with a hydrometer. Inexpensive battery hydrometers that use

floating plastic balls to indicate state of charge are widely available. The directions that come with these hydrometers usually tell you that the battery is fully charged if all the balls float when battery fluid is drawn into the glass tube.

The important thing in determining the relative health of your battery is that its various cells are at approximately equal levels of charge. If you find that four balls float in one cell, but only two or three in another, the battery is defective.

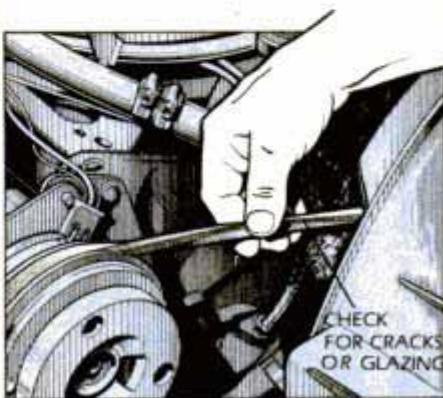
A voltmeter can also help determine the health of your battery and charging system, whether the battery is of conventional or maintenance-free design. At idle, your battery should produce between 12 and 15.5 volts when fully charged. The battery should also be capable of providing at least 9.6 volts while cranking the engine for 15 seconds. If the battery fails either of these tests and the hydrometer test, it is definitely defective and must be replaced. If it passes the hydrometer test, but fails the voltage test, test the charging system.

If the battery is three or more years old, replacement should be considered. Most batteries will not last more than five years, and many are exhausted after three years of tough service. Check battery condition periodically with a voltmeter to prevent getting stuck.

Tire checks

Tire inflation pressure is extremely critical to tire life and vehicle handling. Inflation pressure should be checked at least once a month or whenever you begin a long trip. Recommended tire pressures are determined on the basis of extensive testing and should be followed. GM notes that cold tire pressure ratings apply to vehicles that have not been driven more than one mile within the last three hours.

For heavy loads, such as a trailer or an overloaded trunk, tires can be inflated somewhat above the recommended normal-load level, as



12 Twist each belt. Check for cracking due to age, glazing from slippage.

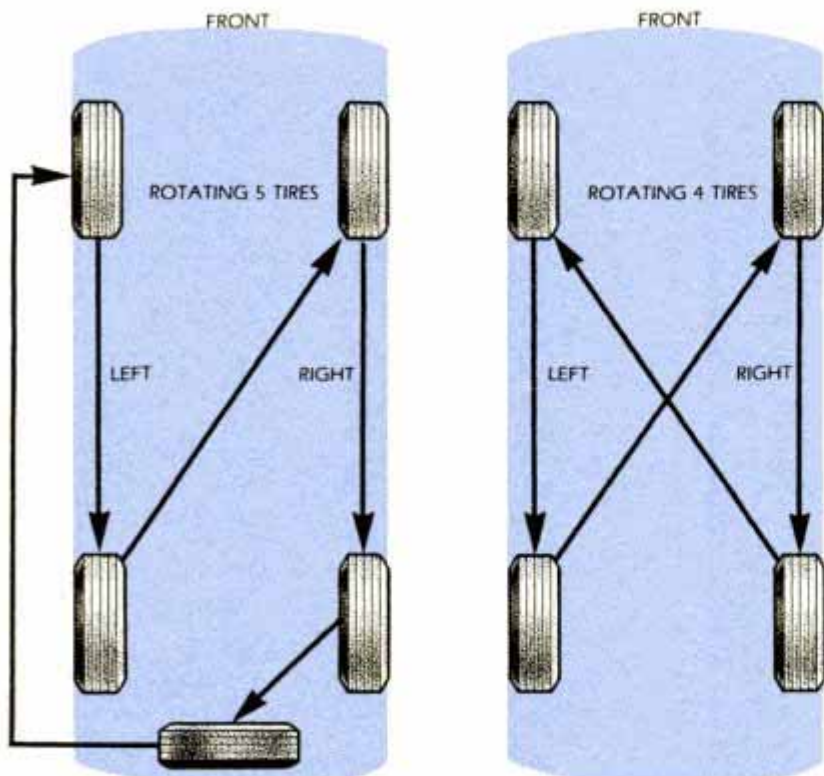
long as pressure doesn't exceed the maximum level.

Purchase your own tire gauge for checking inflation level, as the accuracy of service station gauges may vary. Keep the gauge in your glove compartment and determine a specific time for checking, such as when you check your oil.

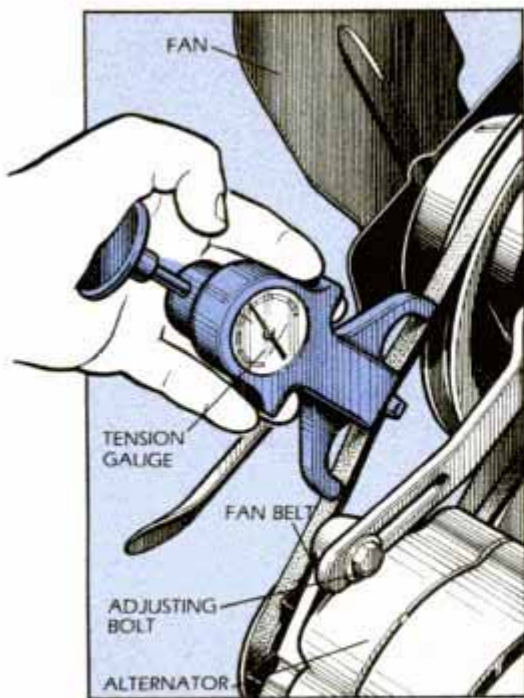
Examine all your tires every time you change oil. Look for unusual tread wear patterns. Feathered edges indicate improper adjustment of wheel toe-in. Wear on only one side of the tread indicates improper camber adjustment. Wear on the outer edges of the tread indicates that the vehicle was operated with the tires underinflated, while wear in the center of the tread is typical of overinflated tires (Fig. 10). Irregular depressions and spotty wear are the result of loose steering linkage components or imbalance.

Tires should be replaced if serious sidewall damage occurs, if tread depth is less than $\frac{1}{16}$ inch or if, in the case of vehicles that are used infrequently, the rubber begins to deteriorate.

Most automakers recommend tire rotation after the first 7,500 miles and every 15,000 miles thereafter. When radial tires were first introduced to this country, automakers



11 Same-side-only rotation of radial tires has long been recommended, but recent GM service bulletins state that cross-rotation of radials causes no problems.



13 A belt tension gauge will check tightness, solve squeal problems.

recommended that they be rotated only on a front-to-rear exchange basis, without switching them from one side of the vehicle to the other. Last year, GM issued a service bulletin indicating that its tire engineers no longer feel that cross rotation causes problems with radial tires (Fig. 11). So now we are once again back to the standard "X" plan for tire rotation, where the right front is switched with the left rear and the right rear with the left front. This is fine for GM, but always follow the recommendation of your tire manufacturer.

A check of brake system components and a renewal of wheel bearing lubrication should be performed when the tires are rotated.

Belts and hoses

Cooling system hoses and all drive belts should be carefully checked at least once a year, prior to coolant renewal. (Of course, you'll want to give them a quick inspection every time you change oil.)

Some motorists change all belts and hoses every three or four years, as tests have shown that many of these components begin to deteriorate at about this time.

Examine the hoses carefully. Heat checking, cracking, brittleness, swelling, tears and abrasion are all grounds for replacement. Swelling frequently occurs behind the hose clamp, causing the clamp to begin cutting into the hose material. Hoses may deteriorate on the

inside without external signs of failure.

V-belt failure can also be somewhat difficult to anticipate. At one time, most belts were covered with a fabric wrapper that would begin to shred before a failure occurred. However, the automakers changed their specs, and most belts are now made without the wrapper. This type of belt may snap without warning. If the belts are less than four years old, check for cracking on the bottom of the belt or glazing on the sides of the belt (Fig. 12). Replace any belt that's not in good condition.

Don't forget to check belt tension while you're at it. Use a tension gauge if you have one and adjust to manufacturer's specs (Fig. 13). If you don't have one, adjust so you can deflect the belt about $\frac{3}{4}$ inch in the center of its longest span when you apply pressure with your thumb. If you hear any belt squeak when turning corners or when there is a heavy load on the alternator, have a pro adjust your belts with a tension gauge. If the squeak continues, the belt will be ruined.

Multigroove or "serpentine" belts are now used on many new cars, particularly front-wheel-drive models. To check this type of belt, twist it so you can examine its underside. Look for signs of severe cracking and deterioration. Sometimes you'll find that big chunks of the belt have broken away. Any damage more extensive than minor cracking across the ribs is reason for replacement.

On many overhead-cam engines, you can inspect the timing belt by simply removing a loosely attached dust cover. Examine the belt for broken cogs, splits or cracking. Replacement can be rather difficult on some models, so check a manual before you start the job. Check belt deflection if you can reach the belt's longest span without tearing the whole car apart. It should deflect about $\frac{3}{8}$ inch on most models.

Cooling system maintenance

Any vehicle maintenance plan should include a yearly cooling system inspection and flush, as well as coolant renewal.

The system should be pressurized with a cooling system pressure tester before the

inspection begins. To do this, fill the radiator almost to the top with water, then attach the pressure tester to the filler neck of the radiator. Pump the tester up to the pressure rating of the radiator cap. If the system holds pressure, you can assume that there are no leaks. However, if the pressure reading on the gauge gradually falls, there is a leak somewhere in the cooling system. Examine all hose connections, gasket joints, freeze plugs and the water pump shaft seal. Look for coolant leakage wherever there is evidence of core damage on the radiator, or where the tanks are connected to the radiator core. Your mechanic can help you diagnose a leaking head gasket by checking for exhaust emissions at the radiator outlet with the probe of his emissions analyzer while the engine is running.

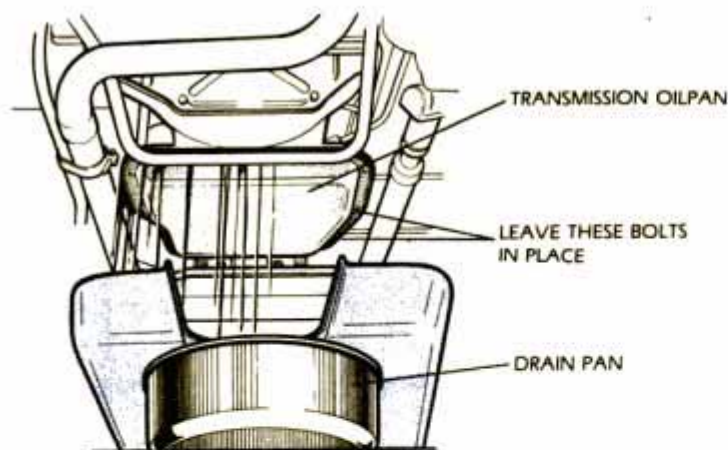
Once you're sure the system is leak-free, you can flush out the old coolant. A simple cooling system flushing kit is available from auto part stores. The kit consists of a tee that is installed in the heater's inlet hose (the one that's not connected to the water pump). The flushing tee kit usually comes with a restrictor that is installed into the radiator neck while the system is being flushed.

Once the flushing kit is installed, turn on the garden hose and allow water to flow through the cooling system until it runs clean for several minutes. Remove the garden hose, and seal the flushing tee with the cap provided in the kit (the tee can be left in place for future service). Once the flushing is complete, drain the radiator and coolant recovery tank.

It's time to add new coolant (Fig. 14). If your car has any aluminum engine or cooling system components, you must use antifreeze that's



14 Cooling systems of 2.8-liter V6 Fords must be filled through upper radiator hose to prevent air locks.



15 If the transmission oilpan has no drain plug, leave a loosened bolt or two in one corner and start fluid draining from the opposite corner. Then remove entire pan.

specially formulated for use in engines with aluminum components. The coolant should be a mix of at least 50 percent antifreeze combined with water. You can provide additional freeze protection by using as much as 70 percent antifreeze, but not more.

The radiator usually will hold only about half of the coolant. Once it has been filled, run the engine until the level drops and add some more.

You can also add some coolant to the recovery tank. When you think you've filled the system completely, replace the cap, allow the engine to run for a while, let it cool down, remove the cap and check the coolant level. Check the level in the recovery tank, too.

Automatic transmission

Automatic transmission fluid and filter service is one aspect of car care that is frequently ignored. Automaker suggestions regarding this type of service vary widely. Some recommend no change until 100,000 miles for normal service, yet suggest a change at 15,000 miles for vehicles that tow trailers.

If you plan to keep your car for more than a year or two, regularly scheduled transmission service is necessary. An interval of 25,000 miles is probably just about right for vehicles used in mixed city and highway driving with varying loads (our idea of "normal" driving), or 15,000 miles for vehicles that are frequently overloaded, used continually in heavy city traffic, or used to tow trailers.

To service the unit, warm the car to operating temperature by driving it. Raise the car on four jackstands that are securely positioned. With a catch pan standing ready, remove the drain plug from the transmission's oilpan, if it is so equipped. If it

is not equipped with a drain plug, begin removing the transmission pan bolts. Leave two or three bolts in one corner of the pan and, with the drain pan under the opposite corner of the trans sump, begin loosening them. Pry the pan loose and allow the fluid to pour out of one corner of the trans pan into the drain pan (Fig. 15). Continue to loosen the remaining bolts as the flow subsides, carefully removing them completely once the flow stops. There will still be quite a bit of oil in the pan. Pour it carefully into the drain pan.

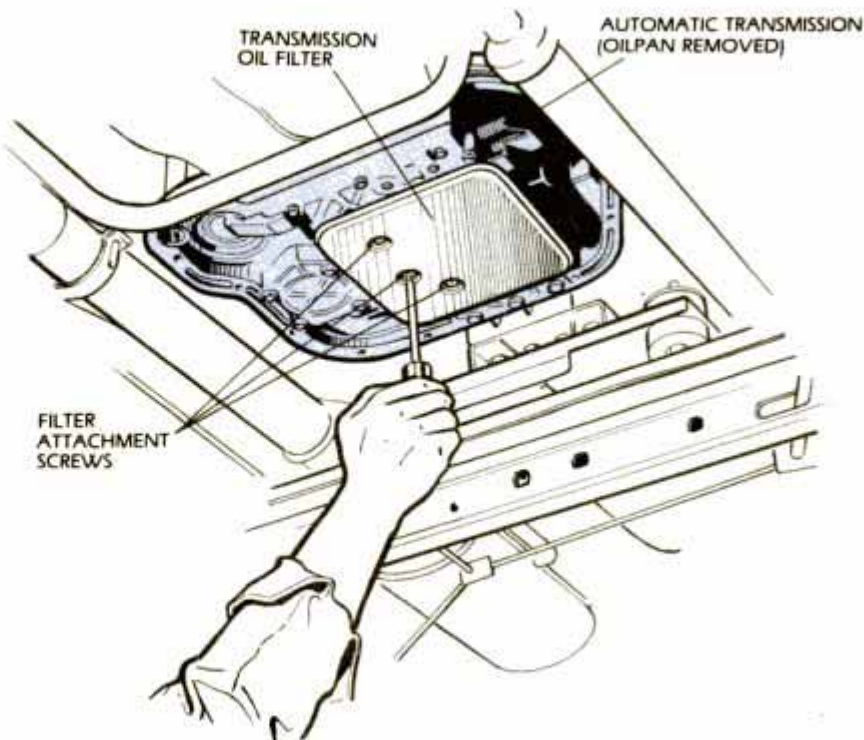
After the oilpan has been removed, clean it thoroughly. Check the pan: A certain amount of clutch dust is normal and even a small quantity of powdered metal might

be normal in some transmissions, but if there are larger chips or pieces of metal, suspect serious trouble. Inspect the fluid that you have drained. Some darkening is okay, but a rotten egg smell and brown or black discoloration are signs of internal problems.

Remove the filter from the bottom of the transmission (Fig. 16). It's held in place by one or more bolts or by clips. Replace the filter with the correct unit. Don't forget to reinstall any gaskets or O-rings you find between the filter and the transmission.

Clean the pan with solvent and a brush, and scrape the gasket surface clean. Install a new gasket on the pan with high-tack adhesive. Clean the transmission's mating surface before reinstalling the pan. Start all of the pan bolts with your fingers to make sure they're not cross-threaded. Then, in a criss-cross pattern, torque them to about 10 ft.-lb. with a torque wrench.

Refill the transmission through the dipstick tube with the amount of fluid specified by the vehicle manufacturer for refill. Use only the fluid specified in your owner's manual. Once you think you've added enough, start the engine, allow it to run for a while, shift the trans through the gears and return the selector to PARK. With the vehicle idling in PARK, check the trans fluid level and add more if necessary. Check under the car for any fluid leaks. **FM**



16 Transmission oil filter can be changed once oilpan has been removed. Note the condition of the trans oil and the correct placement of any gaskets and O-rings.

NEW PRODUCTS TO KEEP YOUR CAR NEW



The ultimate in luxury and convenience for Saturday mechanics is your own lift. The Autolift is a portable unit that requires no installation. It will raise a 6,200-pound vehicle to 42 inches and also tilt front or rear to a 25° angle. Power

comes from a 110- or 220-volt electrohydraulic pump. Priced at \$3,000, it's available through auto service equipment distributors. The unit is imported by Auto-Line Marketing Inc., 510 North Bloomington St., Streator, Ill. 61364.



TMP's Velour and Upholstery Cleaner will undo almost any kind of dirty work on your new car's seats. Just spray, allow the foam to penetrate the fabric and dry, then use a soft bristle brush to bring up the nap. A 14-ounce can costs \$2.75 from Taylor Made Products Inc., 3200 West Market St., Akron, Ohio 44313.



A product that claims to double engine and drivetrain life by reducing wear, Pro-Blend bonds to metal with a film that holds the oil normally squeezed out from between moving parts by heat and pressure. An 8-oz. bottle costs \$11.75 plus \$1.50 shipping from Promotion Marketing, Box 448, Bronx, N.Y. 10475.



Meguiar's Trigger Wash packs six car washes in one easy-to-use bottle. You simply spray the concentrated formula on one section of your car at a time and then wipe it off to remove dirt, grime and tree sap. Trigger Wash costs \$6.55 and is available from Meguiar's, 17275 Daimler, Irvine, Calif. 92713.



Tired of wrestling with flimsy cork gaskets, especially in vertical applications? Victor's Tuff-Cork gaskets (left) are rigid. Made of cork, urethane and steel, they are easier to install, especially in front-wheel-drive transmission applications. The gaskets won't shrink or wick, and they feature excellent torque retention and radial strength. They cost a little more than conventional cork gaskets. You'll find Tuff-Cork gaskets at auto parts outlets. They're manufactured by Dana Corp., Box 455, Toledo, Ohio 43692.



Clean automatic transmission fluid is essential to transmission life, and Hayden's in-line Trans-Filter increases filtering efficiency of the stock system by two to five times. The \$22.95 remote-mount filter takes about a half hour to install using common hand tools. The filter is sold in auto parts outlets and through RV dealers. Hayden Inc. is located at 1531 Pomona Rd., Corona, Calif. 91720.



How many times have you unintentionally washed the dog—or yourself—when hosing off your car? The Splash Eliminator Nozzle creates a controlled soft stream of water that will cut down on overspray. This "drier" wash nozzle is \$8.95 from the manufacturer, W.M. Shutok Co., 38 Lexington Ave., Uniontown, Pa. 15401.

(Please turn to page 160)

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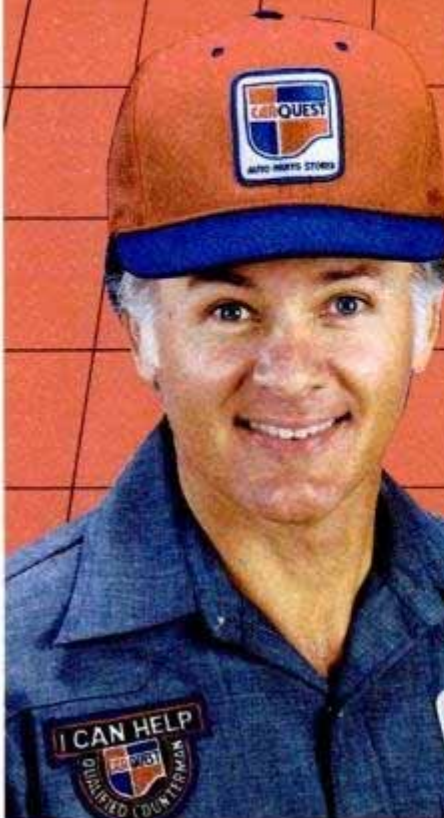
If you want your GM Computer Command Control system to open wide, say "ahhh," and tell you its troubles, the Autodata ECM monitor is your key to an electronic bedside manner. Autodata plugs into the computer diagnostic connector under the dash and shows the state of eight critical conditions of the engine control system. The unit is about \$400 from Microtron Products Inc., 2355 Avon Industrial Drive, Auburn Heights, Mich. 48057.



It's hard to know what kind of fuel mileage you are actually getting without keeping records. The Gasoline Saver log helps by recording your fuel consumption, repairs, trips, tolls, and reflects the life of replaced parts. The log also includes a liters-to-gallons conversion chart. The Gasoline Saver log is used in PM's long-term test cars. It's \$3.95 from Management Unlimited, 3103 Old Dobbin Rd., Montgomery, Ala. 36116.



While nothing about changing a flat tire is pleasant, struggling to remove the lug nuts can be especially frustrating. The job will go much easier with Black & Decker's Model 9518 12-volt Impact Wrench. The wrench features 1/2-inch square drive, ball and sleeve bearings and a 17-foot cord. The wrench's 100 lb.-ft. of torque and 1,100 impacts per minute puts only a light drain on the car's battery. It costs \$105 from Black & Decker, 701 East Joppa Rd., Towson, Md. 21204.



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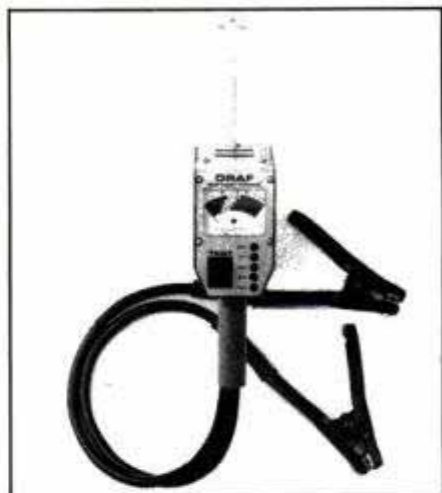
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*Manufacturer's suggested sale price. Prices may vary at participating outlets. Sale ends May 31, 1984.



With the push of a button, the Draff Model 680 automotive battery tester checks voltage and cranking power. It has circuitry to test batteries under load, lights to indicate the percentage of battery life remaining and a gauge that registers output. Model 680 costs \$99.95 direct from Draff Industries Inc., 333 Adams St., Bedford Hills, N.Y. 10507.



Instead of making sloppy electrical connections by twisting and taping wires together, make strong, neat ones with the correct terminal or connector. The Auto-Pak Scotchlok assortment gives you a variety of electrical items and works with wire sizes ranging from 14 to 22 gauge. The Auto-Pak assortment costs \$13.33 and is manufactured by 3M Co., 3M Center, St. Paul, Minn. 55144.



Domestically produced replacement turn-signal flashers for imported cars can sell for up to 80 percent less than their foreign-made counterparts that are purchased from an imported car dealer. Typical of the price difference is a more than 50 percent savings for Toyota applications. Replacement flashers made by Ideal Corp. are at auto parts stores. Ideal Corp. is located at 1000 Pennsylvania Ave., Brooklyn, N.Y. 11207.

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REBATE
BY MAIL
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on back of
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Follow rebate
instructions
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These products
are available where
automotive products
are sold.

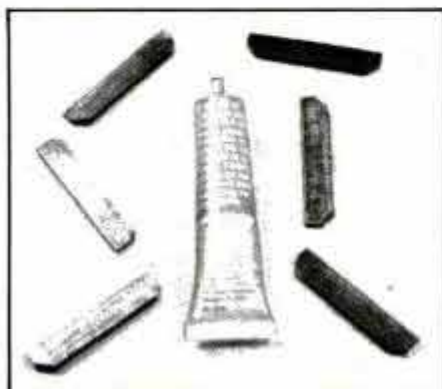
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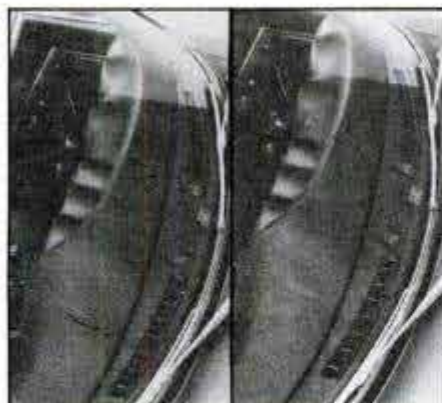
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P.O. Box 43526, Atlanta, Georgia 30378
One Bonus Rebate per Family. Void where prohibited by law. Allow 6-8 weeks for delivery of rebate. Offer expires on August 1, 1984.



We all know how easy it is to tear, rip and burn vinyl, so here's an inexpensive way to repair the damage. Magna's vinyl repair kit lets you match vinyl color, texture and grain. The kit also restores new luster to old vinyl. You can make over a hundred repairs with this \$39.95 kit available from the maker, Magna Sales Co., 2017 Montrose Ave., Chicago, Ill. 60618.



Here's a new way to repair radiator core leaks without pour-in radiator sealers. Custom Craft's repair kit uses special metal clips, preformed to slip over the leaking core section, and filler adhesive. You bend the radiator fins out of the way, apply adhesive to the metal clip and position it over the core leak. The repair dries in 20 minutes. For \$4.25, you get enough material for six repairs. The kit is from Custom Craft, 381 Craggy Creek Dr., 458 M.O., Chippewa Lake, Ohio 44215.



There are two things you can do about cracked instrument panel padding on a Datsun Z-car (left). One is to buy a \$125 plastic fitted dashboard cover from a Datsun dealer. A less expensive alternative is to order essentially the same dash cover (right) from Dash Cap Industries for \$59.95 plus \$2.50 for shipping. The Dash Cap cover is ABS, vacuum-formed in the authentic texture. It's from Dash Cap Industries, 2530 Mercantile Dr., Rancho Cordova, Calif. 95670. **PM**

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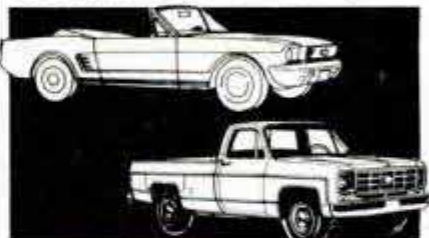
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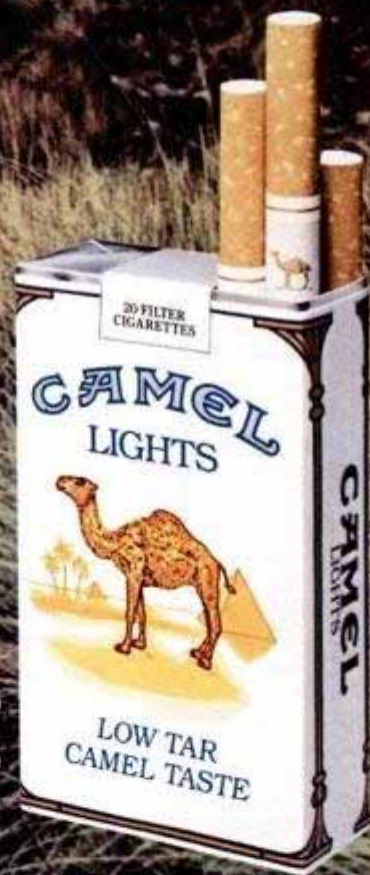
A man in a vest and light-colored shirt is crouching on a rock in a river, looking through binoculars. In the background, a Land Rover is parked on a dirt path. The scene is set in a natural, hilly landscape with tall grasses and a hazy sky.

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UPDATE



MARINE

Cruise ship for the future

The great luxury liners of the past may not be dead. By the turn of the century, exotic twin-hulled vessels like the one above may be treating ocean travelers to a splendor not dreamed of even on the lavish *Queen Elizabeth* and *QE II*. Called the *SWATH 2000*, the floating palace is an advanced concept proposed by Wartsila, a leading Finnish shipbuilder that is famous for its glitzy cruise ships and mammoth seagoing ferries.

SWATH stands for Small Waterplane Area Twin Hull. The 2000 refers both to the year 2000 and to the fact that the ship is designed to carry 2,000 passen-

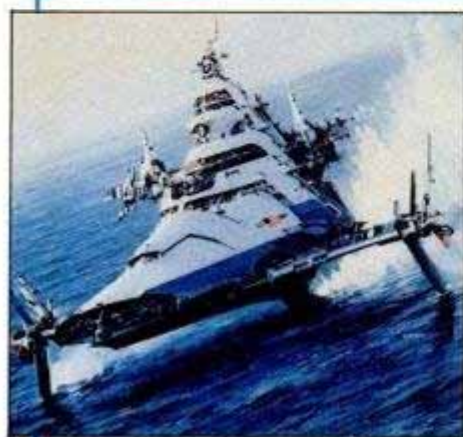
gers. Unlike a conventional catamaran using displacement-type hulls, the *SWATH 2000* employs slim, surface-piercing struts connected to long, thin underwater pontoons. These provide the stability of a catamaran but with much less drag, while the broad platform base permits a superstructure of tremendous area.

In the *SWATH 2000*, the cabin decks are arranged around a huge, open-air atrium that houses a swimming pool, shops, game rooms, snack bars, cocktail lounges, health spas and other recreational attractions. This layout enables all staterooms to have an outside view,

either toward the sea or overlooking the atrium. A sumptuous dining salon, sweeping upward through three deck levels, is capable of seating all 2,000 passengers at one time. In bad weather, a sliding roof will be used to enclose the atrium.

The *SWATH 2000* is expected to have a cruising speed approaching 30 knots. Her widely spaced twin engines, with adjustable-pitch propellers, will permit turn-on-a-dime maneuvering by throwing one prop into reverse—much the way a battle tank pivots on opposite-turning tracks.

Meanwhile, our own U.S. Navy is



'STAR WARS' WARSHIP

What a 21st-century warship might look like is shown in this dramatic painting by a U.S. Navy artist. While the Navy isn't saying just when we will see the new ship, it clearly incorporates known technology: hydrofoils for fast, agile maneuvering, streamlined "stealth" contouring to fool enemy radar, even vertical-launch fighters poised for quick takeoff.



A SHIP THAT TUGS 'BUGS'

The USNS *Stalwart* is the first of 12 T-AGOS-class surveillance ships that will drag electronic equipment in U.S. coastal waters in search of submarines. A large winch on the rear deck drops sonobuoys that pick up sounds. The *Stalwart* is stationed in the Atlantic.

ALTERNATIVES

Icing on the cake

Enerplex is a twin-building office complex in Princeton, N.J., that opens this summer with an array of energy-saving devices. But the icing on the cake is a half-acre domed "ice pond."

Prudential Insurance, financier of the project, will run tests on the pond this summer. An 8,000-ton, 20-foot-high mound of ice is built up layer by layer all winter. The plastic wall of the dome is layered with a chemically treated, subfreezing fog and the inside walls are coated with ice. Winter temperatures form the ice mound beneath the dome. In warm weather, the ice pond is sealed off from outside air. Fans will blow its cool air through the Enerplex buildings for air conditioning.



SWATH carrier would be highly stable.



Twin-hull frigate could look like this.



Sub hunter could operate in heavy seas.

also eyeing the SWATH concept for use in a new breed of high-speed, super-stable warships. Already on the drawing board at the David W. Taylor Naval Ship Research Center are plans for several twin-hull vessels, such as the mini aircraft carrier, frigate and antisubmarine patrol boat shown above. In addition to greater speed and maneuverability, the chief advantage of the SWATH design lies in its uncanny steadiness in heavy seas. Critical battle functions, like the launching of aircraft, could be carried out in seas too rough for conventional monohull vessels to operate.



Washing up the water supply

This summer, Denver will open the nation's first potable water reuse plant. The \$29 million complex (shown in the drawing above, right) will produce 1 million gallons per day of drinking water from treated sewage. Water treatment plants generally use four purification steps. But the municipal water in scores of cities has dwindled in quality over the past 25 years

despite those steps. The Denver plant employs 11 steps. There is an ion exchange to remove ammonia, a system to produce fertilizer, a three-step carbon adsorption process to remove organic matter, a reverse osmosis to remove viruses, a chemical addition to disinfect, and four steps of disinfection and aeration. An ionization tank is shown above, left.

AUTOMOTIVE

Hummer of a tire

The Army's new jeep replacements, nicknamed the Hummer, have already spun out something new for civilians. Motor Wheel Corp.'s run-flat tire copies the military version by placing a metal wheel within the tire. If the tire goes flat, a vehicle can still move at 30 mph for more than 20 miles. Bolts clamp the inner tire to the wheel so it stays in place. Fire trucks and ambulances will be using the wheels by the end of this year.



Wheel-within-a-tire (left), developed for Army's new Jeep (above), is now made for civilian trucks.

AVIATION



Strange new shape for tomorrow's SST

The twin-bodied jetliner above may not be as crazy as it looks. It might just be the answer to America's long-sought supersonic transport, a program killed by Congress in the early '70s. Now, despite the economic problems that have plagued the Anglo-French Concorde, there's renewed interest in a U.S. SST.

According to Lockheed, the key to an economically viable SST lies in a cheap substitute for costly jet fuel. One possi-

bility is liquid hydrogen (LH_2), which can be made from coal and other processes. The chief problem with LH_2 , however, is its very low density, requiring huge fuel tanks to carry a sufficient supply for transoceanic flight. As much as half the space in a conventional airliner would have to be given over to fuel storage (inset, above), leaving little room for passengers. The fuselage would then have to be made much bigger, and the result would be higher

drag and vastly increased power requirements.

One answer, says Lockheed, is the twin-fuselage configuration. The reason: Two long, slim fuselages are aerodynamically more efficient than a single fat one. They would permit more speed on less power and at the same time provide plenty of space for both fuel and passengers.

Lockheed has also found a way to reduce the objectionable noise level of

WEATHER

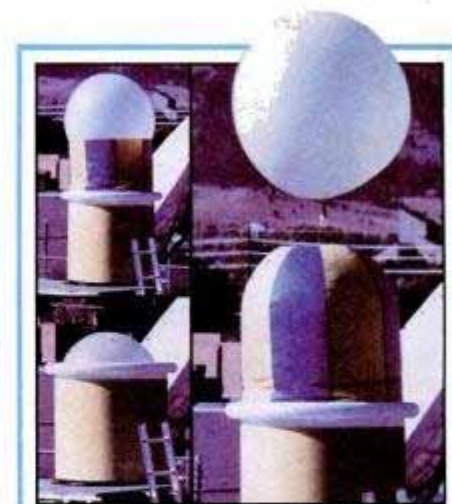


Struck by lightning

The old saying that lightning never strikes twice in the same place doesn't apply to NASA's F-106B test craft. The plane has attracted more than 250 lightning hits since 1981. The jet will help determine the best thickness for airline body material and will experiment with devices to protect avionics from lightning surges. In addition to sensors, the jet carries cameras to

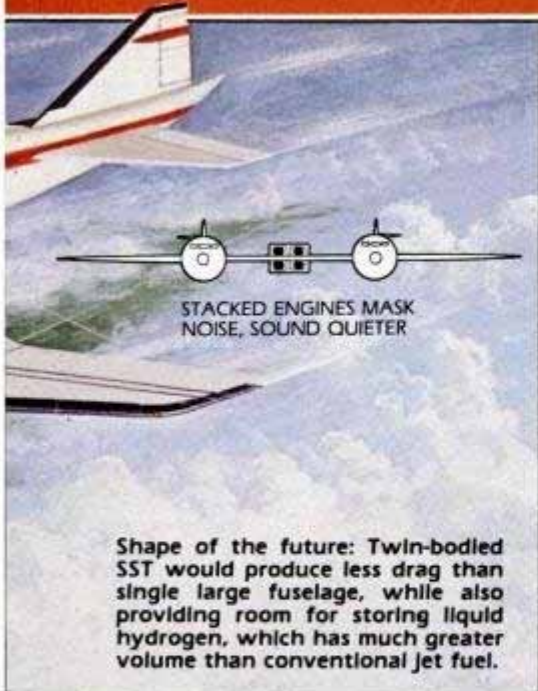
record the direction and shape of lightning strikes (inset). So far, tests have shown that lightning hits aircraft most in the nose and tail. The heavily instrumented F-106B flies out of the Langley Research Center.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager, Joel N. Shurkin,
Bruce W. Most, Angus Laidlaw, Paul E. Burd,
Douglas A. Hilton



WEATHER BALLOONS

The National Center for Atmospheric Research has developed a weather balloon whose 400-mHz transmitter sends data to three ground stations. As the balloon rises to the stratosphere, the stations receive different Doppler-shifted readings on temperature and humidity. A central computer then creates a three-dimensional storm chart for highly accurate weather predictions.



STACKED ENGINES MASK NOISE, SOUND QUIETER

Shape of the future: Twin-bodied SST would produce less drag than single large fuselage, while also providing room for storing liquid hydrogen, which has much greater volume than conventional jet fuel.

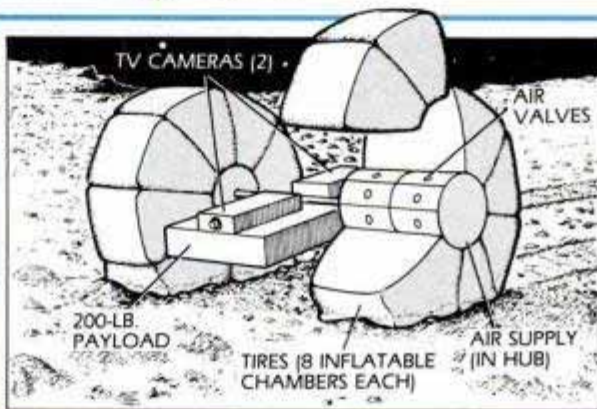
FUTURISTIC FLIGHT DECK

It's not the bridge on the starship *Enterprise*—it's a NASA simulator for testing out new concepts in cockpit design for tomorrow's airliners. All flight information is displayed on video screens and commands are issued by voice or keyboard. The object: to simplify control, reduce pilot fatigue and save fuel through more efficient navigation.



SPACE

an SST. The idea is to stack the engines one above the other instead of stringing them out in a row. Through a process known as acoustic shielding, the exhaust from the lower engines masks the roar of the upper ones, making four engines sound almost as quiet as two. Liquid hydrogen is not yet cheap, but it could be if efficiently mass-produced. When that day comes, twin-bodied SSTs, traveling at Mach 3, may whisk you to Paris or Tokyo in a few hours at no more than the price of a regular air fare for an all-day flight.



MARS BALL WILL ROLL

A University of Arizona team is developing a vehicle for possible use on missions to Mars. The tires on the Mars Ball have eight chambers. Each chamber deflates as it touches the ground, and the chamber behind it inflates, propelling the vehicle. NASA is studying a 1990s mission to Mars.

MEDICINE

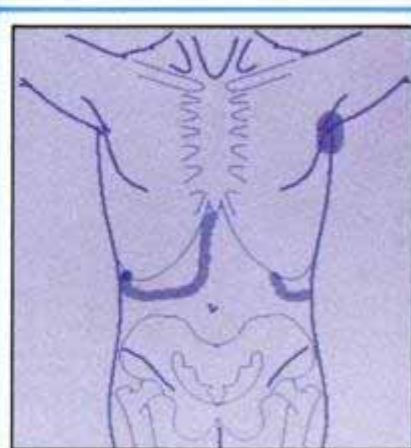


A neutron bullet for cancer

Some forms of cancer untreatable by chemical or X-ray therapy seem to respond to a bombardment of neutrons. The Fermi National Laboratory's Neutron Therapy Facility has been tapping neutrons from Fermi's physics experiments.

In the still-experimental treatments, protons are diverted from the Fermi accelerator to a beryllium target, scat-

tering neutrons in all directions. Tapered holes in the patient's room direct neutrons toward the patient, who is positioned to allow the neutrons to strike the tumor only (above, left). Laser beams are used to align the patient (above, right). It's still too early to tell whether the neutron treatment can be used at other institutions across the nation.



HEALTH PROGRAM

Stanford University doctors are testing a computer program that will eventually help doctors determine when to order tests and treatments. Dubbed Onocin, the program creates a graphic of the patient's lymphatic system based on information from the doctor, then the graphic points out warning spots (above) that require treatment. It could be in use by the end of the decade.

No mow

Lawn mowers are just wonderful for mowing lawns. But try pushing one any further and you'll run into problems.

Trees for one. Fences for another.

Two solid reasons for getting a McCulloch string trimmer. Not in place of your mower, but in addition to it.

Because McCulloch string trimmers get into all the hard-to-reach places that are simply out of a mower's reach. Not just around trees or against fences. But around flower beds and along walls.

And since our string trimmers also edge grass, they make all yard work almost no work at all.

Working hard vs. hardly working.

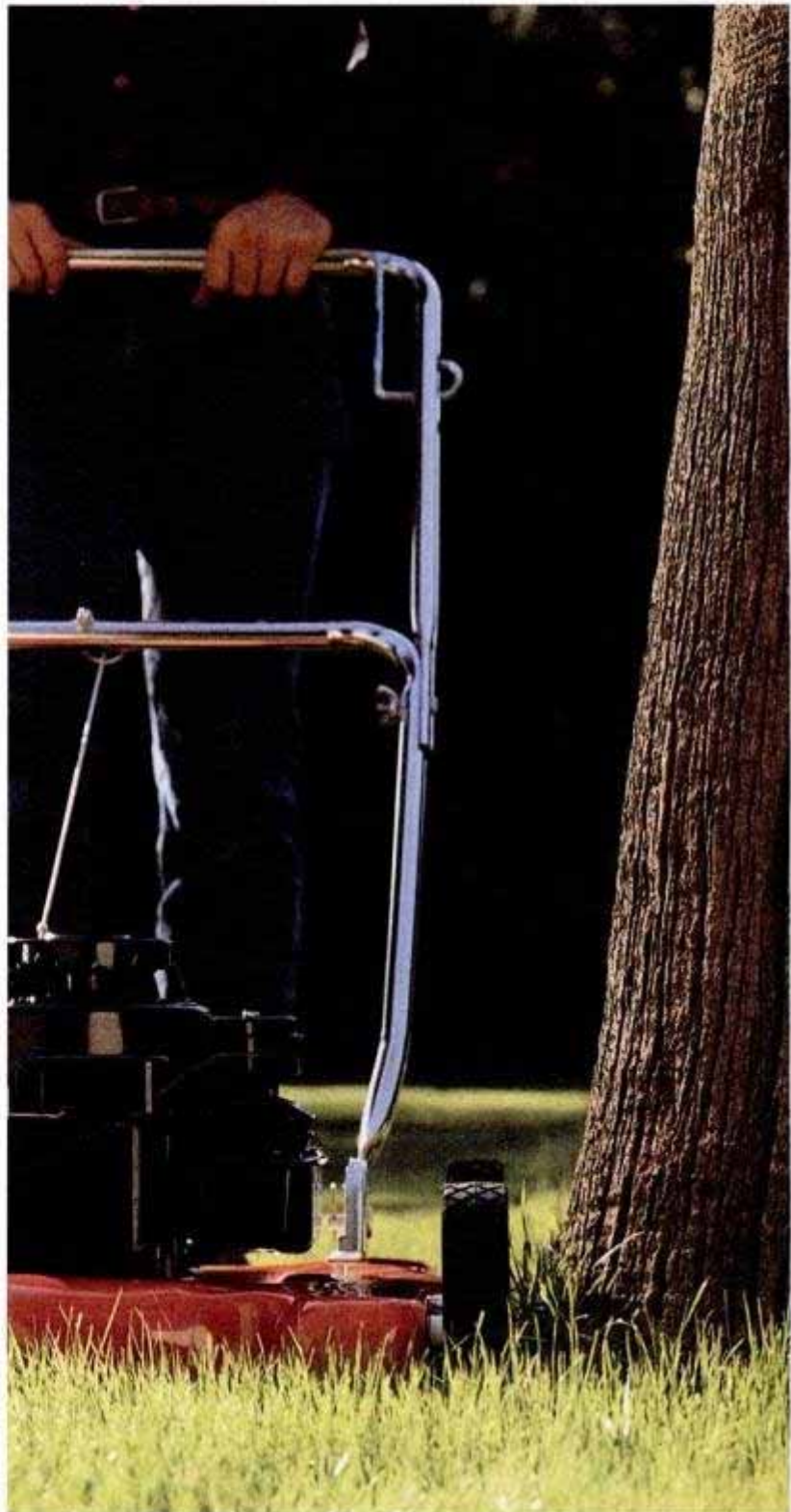
With a McCulloch string trimmer, you'll find yourself spending less time with clippers and shears. Which means less time bending and stretching.

In fact, the only bending you'll be doing is starting up your string trimmer.

And that's simple because all our string trimmers feature electronic ignition

for quick starts and less maintenance.

Along with a tough 2-cycle McCulloch gas engine that's mounted in the rear for better balance and easier handling. With the engine off the ground, dirt and debris won't get sucked up, either.



problems.



Both the MAC™ 60-A and 80-A have a semi-automatic feed head that trims the right amount of line when you tap the cutting head on the ground.

It's all part of the simple, functional engineering you expect from a company that's been pioneering new ideas in outdoor power products for 38 years.

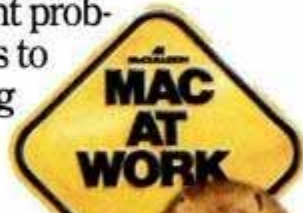


More mow-bility.

Since all McCulloch string trimmers run on gas, there's no need to worry about running out of electrical cord. A 16.9 ounce fuel tank gives you nearly one hour of running time.

Of course, we could go on and on about the many advantages of owning a McCulloch string trimmer, but that still leaves you with a slight problem. With four models to choose from, including a heavy-duty brush-cutter, which one do you buy?

See your nearest McCulloch dealer for the answer. And put Mac to work.



McCULLOCH®



Among Tip Sempliner's 67 patented inventions or designs are: **1**, starter's pistol; **2**, two-man bobsled (wind-tunnel model is shown); **3**, manicuring devices; **4**, portable polarizing light device to check for manufacturing defects; **5**, water-powered toothbrush [see patent drawing below]; **6**, polishing device for auto body work;

7, dispenser for chemical insect repellent; **8**, pop-up tissue package; **9**, machine that laminates rows of identification cards quickly; **10**, stationary polarizing light device to check for manufacturing defects. Tip is holding a patented runner blade for his Olympic bobsleds. Some patents are variations on a theme.

Tip's For Inventors

Tip Sempliner, who holds 67 patents, shares his thoughts on how to develop a marketable invention.

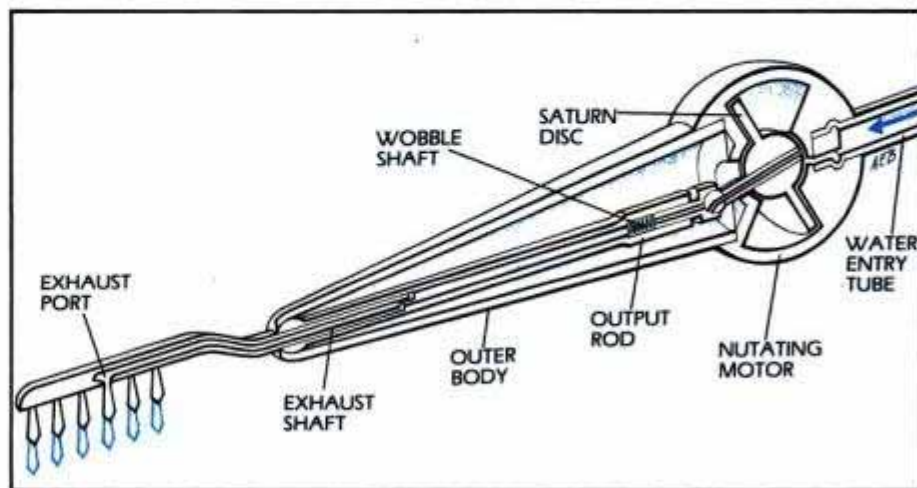
BY DENNIS ESKOW, Science Editor

"I don't think America has enough inventors. I think too many people worry themselves out of the market," says Tip Sempliner as he adjusts the cables on his latest two-man bobsled. Tip's sled design is one of 67 patents he holds by himself or with other designer/inventors. The sled was too hot to handle for America's Winter Olympic team, but the Russians ran a sled that closely resembled Tip's.

"I don't believe it when someone says big corporations want to suppress new product ideas. And I've never heard of anyone turning down a chance to make a profit. If your invention will sell, some company will buy it."

Tip runs Chelsea Design out of a home he built from a 19th-century barn and servants' quarters on the Douglas-

(Please turn to page 174)



Artist's conception of Sempliner's water-powered toothbrush taken from a patent issued to him and Walter D. Teague Jr. shows water flow into the unit. The water

pushes a Saturn disc, which wobbles a nutating motor, driving an output rod. The exhaust water comes out of the unit's handle or out of the toothbrush bristles.

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Our outboards have earned a reputation for reliability in some of the world's toughest waters. They've navigated ice flows along the bleak coast of Greenland and powered an expedition down the Amazon, Parana and Orinoco rivers.

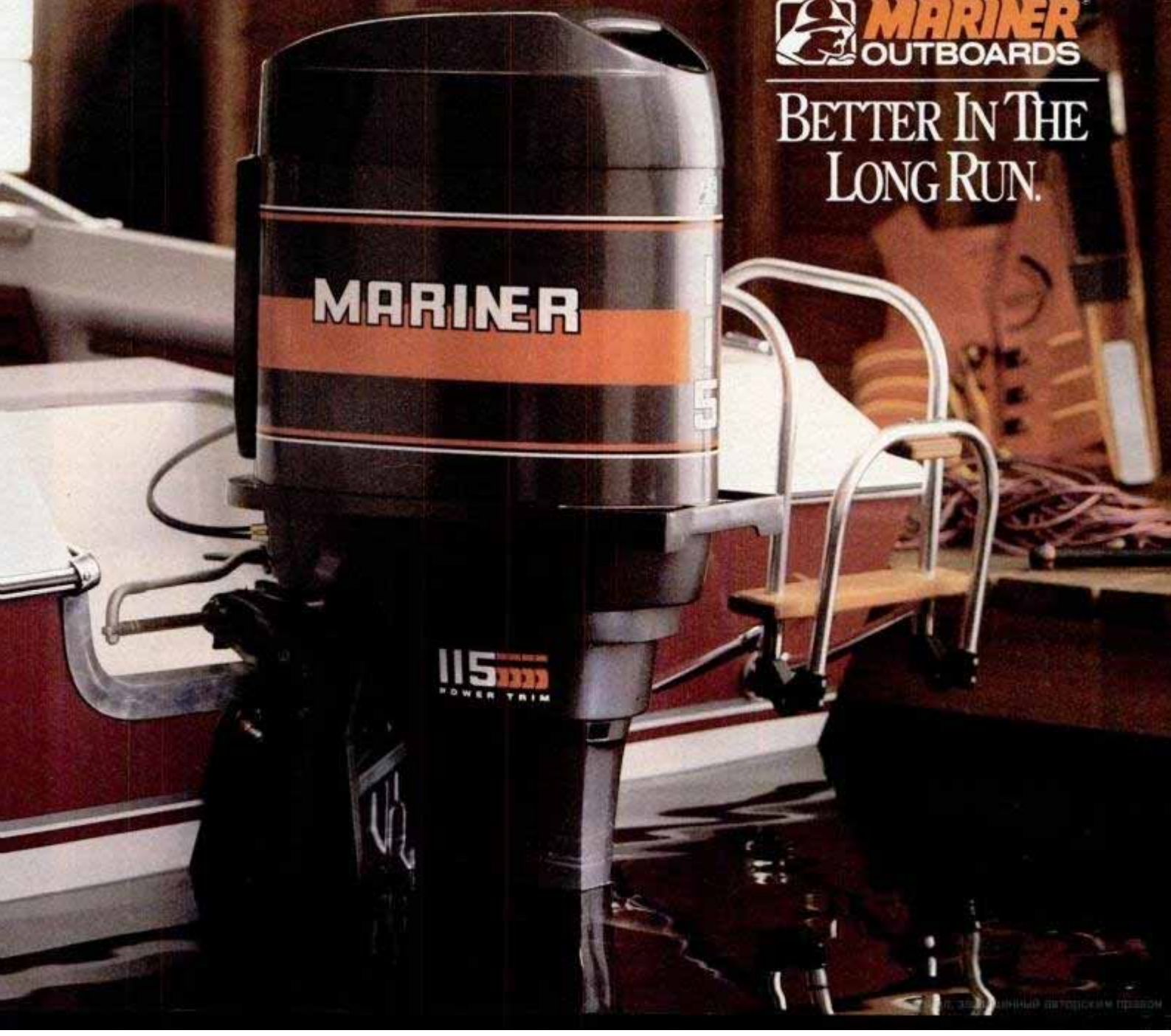
In short, you can't buy a more reliable outboard.

Which is why every year you see more and more old Mariners still running strong. And more and more new ones being sold.

For a free catalog of Mariner Outboards from 2 to 200 horsepower, write Mariner, Dept. 84, 1939 Pioneer Road, Fond du Lac, WI 54935.

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LONG RUN.





At his Thermoform plastic press, Tip can throw together a plastic model in a very short time. A boiler in the back of the press softens a sheet of plastic. Then a handmade pattern is pneumatically pushed against the softened plastic to create the final plastic model.

TIP'S FOR INVENTORS

(Continued from page 172)

ton peninsula in Queens, N.Y. And he can come up with a new gizmo even while he's talking to you. He is, in fact, surrounded by devices of every conceivable size, shape and purpose, most of which have been fashioned or improved by his busy hands.

The bobsled is the third he's built in the last 18 months, all of them for corporate sponsors. One of the sleds ran so fast at last winter's pre-Olympic trials in Lake Placid, N.Y., that the American bobsled team opted for a different sled, finding it difficult to keep Tip's model on the ground.

On a nearby table, assorted inventions are spread out for inventory. There's the water-powered toothbrush and the scrubber that also works on a small hydropower engine. The Nail Machine, one of the nation's most popular cosmetic appliances, sits nearby. It lets a consumer run his own manicure center at home. A portable polarized

inspection light and a similar stationary model are testimony to Tip's ability to create precision instruments.

"With the help of a strobe light and a modeling light, the polarized inspection system can filter out glare or any level of light you want to filter out," Tip explains. "It uses a pair of precisely aligned filters to remove what you want. You focus it on a subject to find very slight cracks in a surface, or produce highly accurate fingerprints for crime labs."

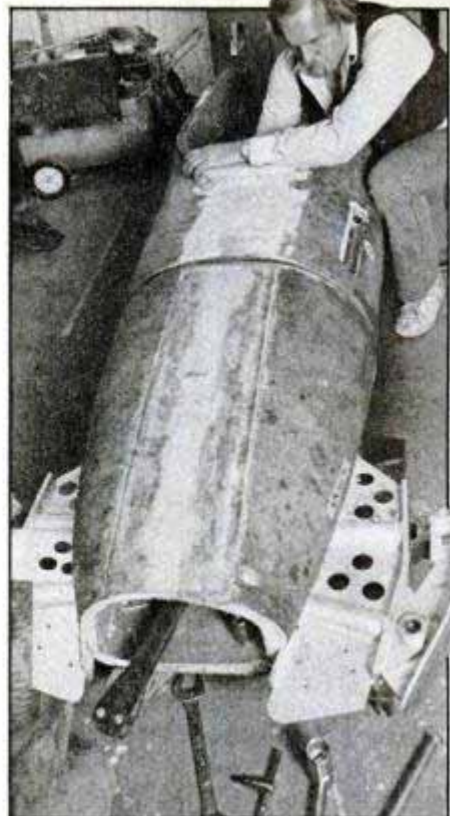
The range of products seems endless. From cosmetics to optics, all the way

to the Olympic Games, Tip Sempliner is a veritable wizard.

"I don't do anything that any ordinary do-it-yourselfer can't do," he insists. "You start off by being observant. Is there a particular problem you have doing a certain job? Is there a way to make the job easier? Is there a really neat machine you can make work on any power source or under varied conditions?"

One of his designs, an insecticide dispenser, was inspired by flea collars for dogs. He fashioned a lightweight plastic basket that fits in the palm of a hand. Inside, you place a strip of flea collar material. Then hang the little basket from the ceiling on a string or wire and you've got a quiet, odorless insect repellent.

"Once I get an idea, I run to the library," Tip says. "I look through the *Thomas Register* and take down the names and addresses of the marketing directors for companies that might sell my product. I read a couple of trade magazines to see what the market



Bobsled has a lightweight Kevlar body, might be like. You know, who buys this kind of thing and how many units are sold each year."

If he's satisfied that there might be a place for his prospective invention, Tip writes letters to knowledgeable people in the business and asks more questions. Who would manufacture my product? What would it cost to make? How much could they charge per unit?

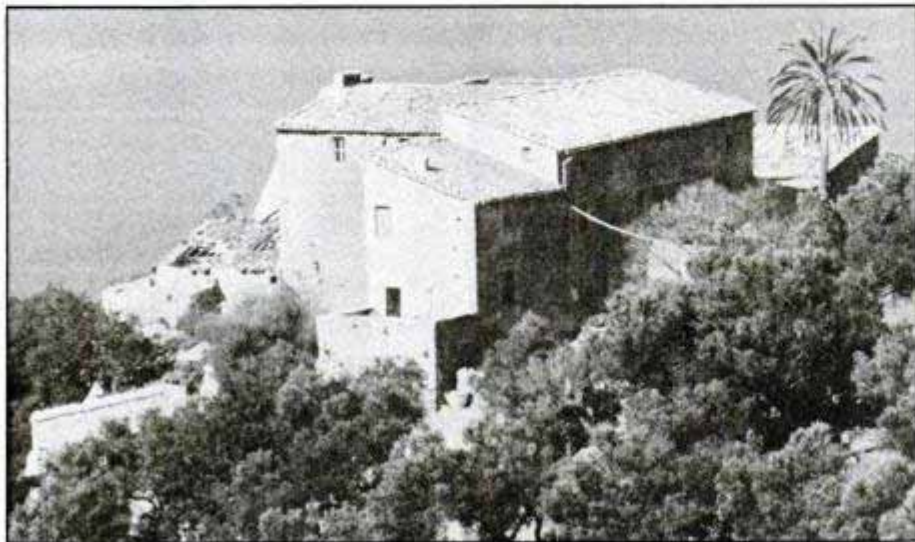
"That's all marketing work and the company that buys your invention will wind up doing it themselves anyway," Tip admits. "But it's easier to get in the front door if you know what you're talking about."

Meanwhile, Tip uses a reputable patent lawyer to do a patent search on his prospective invention. The lawyer will farm out the work to a patent search company. From the inventor, the searchers get drawings and descriptions of the device to help them search through thousands of files for similar inventions.

"While they work on the patent search, I usually go down to the basement and begin to fiddle around with the pieces," Tip says. He has more wherewithal than most of us when it comes to "fiddling around." In fact, the rooms in Tip's basement are lined with tools and metering devices and filled with worktables, benches and drill presses. He keeps an old Bridgeport milling machine and a jigsaw in addition to dozens of hand tools.

"I like to redesign the tools I have,"

(Please turn to page 177)



Tip's first villa project started out as stone ruins. He rebuilt it in only two months.



Ralph, you should have bought a Genie[®] Trac-Drive.[™]



Chances are, you've made up your mind to buy a garage door opener. In the past, that decision might have led to one big hassle. Because most openers are driven by a messy bicycle-type chain that is hard to install and requires regular grease and adjustment.

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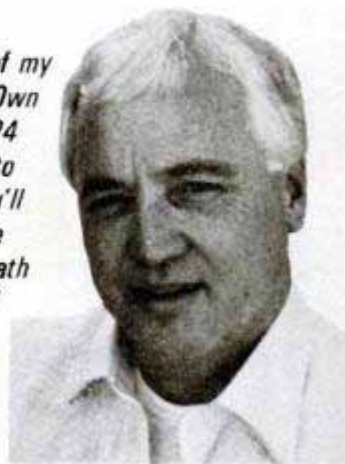
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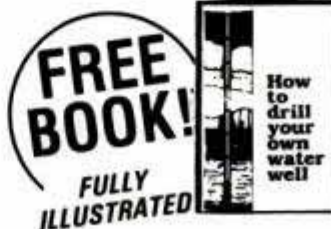
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Bob MacElvain
Inventor of the Hydra-Drill



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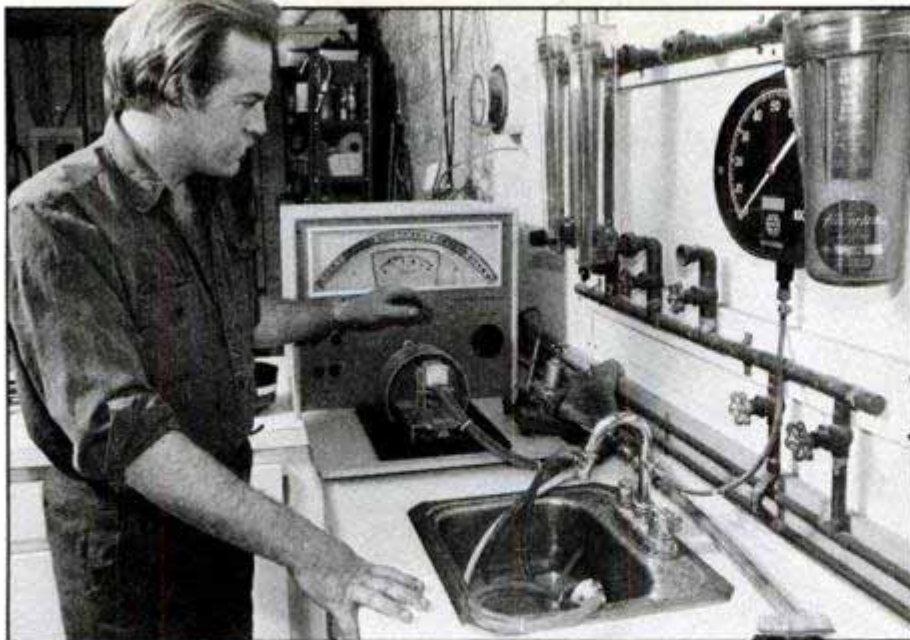
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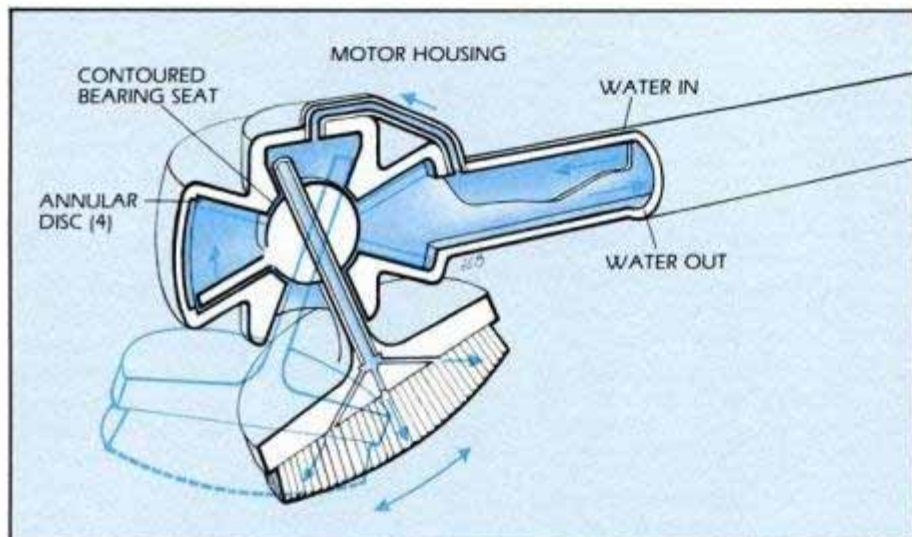
© 1984 DeepRock Mfg. Co.



Tip watches the pressure gauge as water flows into an experimental device in his hydrology lab. To his left is a flow dynamometer that's used to measure wheel revolutions.



Using a timing light with a strobe range from one pulse per minute to 30,000 pulses per second, Tip can stop action on a tiny water-powered motor so that he can tell what angle will be the best for a scrubber that has to cover wide surfaces.



In his water-powered scrubber, also patented with Walter D. Teague Jr., the water flows in through a tube that travels over the motor housing. Water spray pushes the

annular disc, which rocks a free-floating bearing that pushes the brush in an orbital motion. As with the toothbrush, the scrubber exhaust flows out two ways.

TIP'S FOR INVENTORS

(Continued from page 174)

he says, picking up a vise grip with an odd-looking squared-off nose. "I've replaced the noses on several grips to use them as table vises. I like to replace the handles on some tools, especially files, to make it easier to get into corners and behind guarded areas in a machine so you don't have to dismantle the whole thing."

In the next area stands his Thermoform plastic press. Ask Tip Sempliner to fashion anything at all out of plastic and it's likely to come popping out of the press within two days.

"The hardest thing is to carve or mill a mold. I use wood or metal," he notes. "You put the mold into this machine's pneumatic section, then you turn on the

boiler in the back. Drop a sheet of plastic onto the frame and you close the press.

"The Thermoform cooks the plastic until it's a little soft," Tip adds. "A vacuum powered block behind the mold pushes it suddenly against the soft plastic and makes the impression. When the ready light goes on you push a button and a solenoid opens a valve that gives you a shot of air at 80 psi. That neatly separates the finished plastic piece from the mold."

Wood lathes, machine lathes, table saws and other power tools round out Tip's collection. But his real pride and joy is his hydrology lab. "I originally set up the lab to help develop a scrubbing device with a motor that runs on water. The motor had to be very tiny—small enough to fit inside the handle of the

scrubber—and yet it had to move in an orbital motion for scrubbing.

"That meant we needed a very high level of accuracy, and so I built the lab," Tip recalls. The lab consists of several sinks. The water flow is metered at the faucet to provide data on pressure and volume of water. With the help of a dynamometer, Tip can change the way a wheel spins while observing how it interacts with the rest of the machine. He also uses a timing light with a strobe range of one pulse per minute to 30,000 pulses a second. "This way, I can stop action on a machine no matter how small the parts and no matter how quickly they're moving. I can tell if the whole scrubber will touch the object it's trying to polish. And if it doesn't, I can adjust the angles slightly to make it work."

Once Tip's patent search is completed and he has a convincing report on the potential market for his invention, he can make the final product. "The idea is to make the invention look the way it would if it were being packaged." Then he writes to the company officials.

"Most first-time inventors don't know how to walk in the front door. They don't want to try for a Fortune 500 company because it's too big, and they don't know where to find a small company with a reputation," Tip says. "Actually, there really aren't any big companies. When I want to sell a chemical device, I don't go to the parent corporation, I go to the subsidiary. Subsidiaries act like independent companies anyway," he points out.

"If the marketing director likes my brief introductory note, I'll get invited to bring in my model and a plan for its

(Please turn to page 178)

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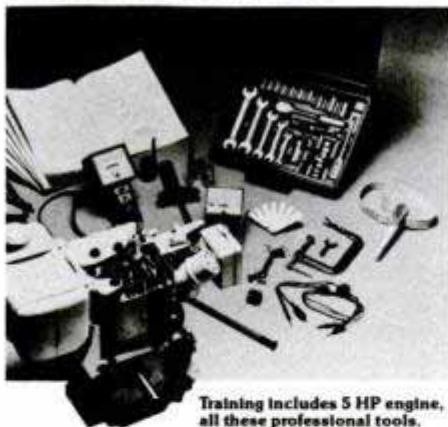
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TIP'S FOR INVENTORS

(Continued from page 177)

use," Tip says. "If he can't use my invention I'll either get a terse thank you note or a business letter referring me to another company.

"Frankly, those referrals have led to a few sales," Tip says. "If the marketing director likes your invention, either he'll want to sell or will send it along to someone else if he wouldn't sell your kind of device."

How do you keep the company from stealing your idea? Tip says there are few hard-and-fast rules. "The best bet is to show them how your device works, but don't tell them how you made it."

As Tip comes back upstairs from the workshops, an assistant is packing the newest bobsled for its trip to Lake Placid. The large, bright room that has served as a construction studio for more than a year will soon be bare. Tip rubs his hands like a hungry man viewing a banquet as he eyes the room that was once a horse stable.

"I'm going to turn this room into a country kitchen," he says. "First, I'm going to lay out the floor in wood and then I'll install some island worktables in the middle. It's going to be fun turning this place into a showroom."

A house rebuilder, too

Tip Sempliner, the inventor, also rebuilds houses. Back in the late 1960s, after he decided that teaching design at Pratt Institute in New York was not his cup of tea, Tip accepted an invitation to go to the island of Palma de Mallorca, a dreamland in Spain where dozens of American and English citizens retire in fair luxury at a bargain price. "A friend of the family had purchased the ruins of an old stone mansion and he wanted to revive it as best as he could," Tip says. "I spent the first couple of weeks just studying Spanish villas and looking for other stone ruins. Then I started cannibalizing stone and wood from abandoned buildings hundreds of years old. In a couple of months, the owner had a pretty well-restored villa."

While restoring several other villas over the next few years, Tip came across several ancient kitchen appliances, which he also restored. "The neatest one was a dough warmer. It was a wrought-iron thing with a little flame beneath a hot plate. Inside, you stored your dough and let it rise."

His reverie breaks as Tip goes back to surveying the spot where his future country kitchen will be built. "You know, I'll bet I could put together a pretty nice wrought-iron dough warmer for this room. It would go here—next to the wrought-iron stove."

That's Tip Sempliner, a man who tries to do everything by design. **PM**



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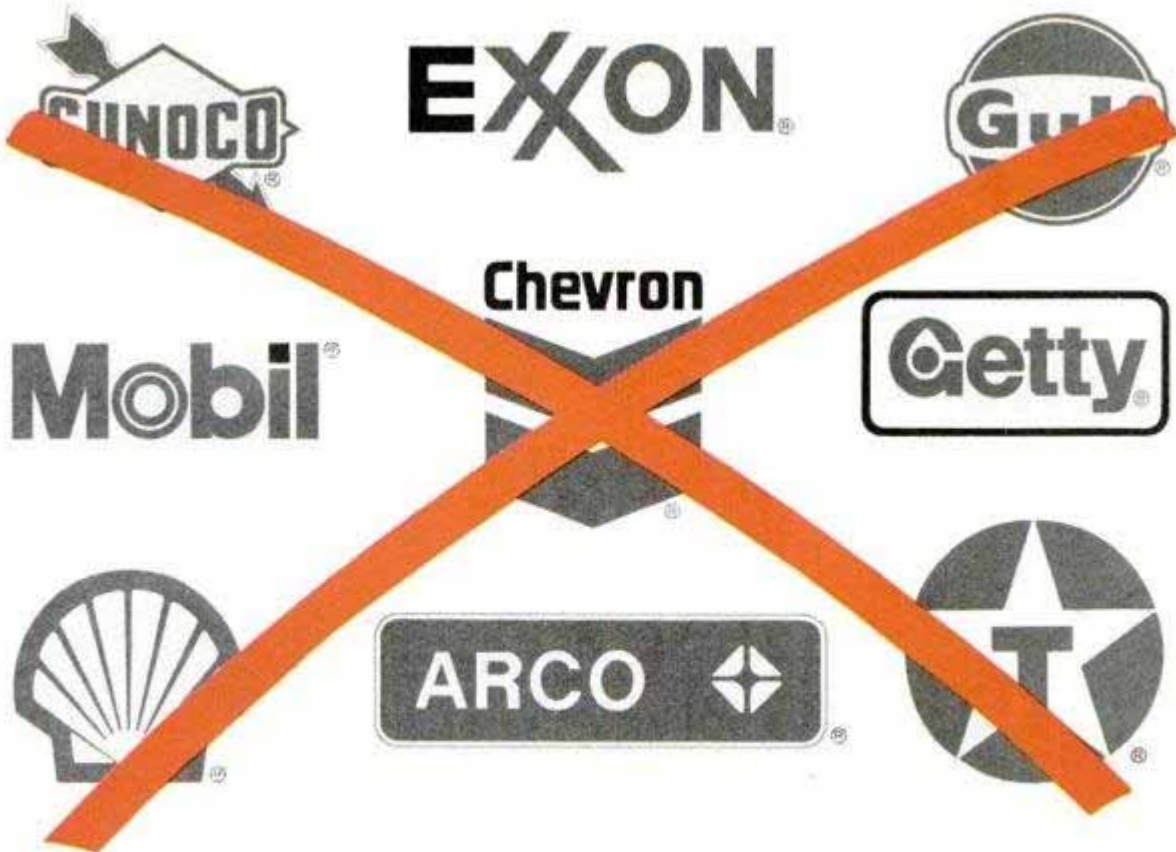
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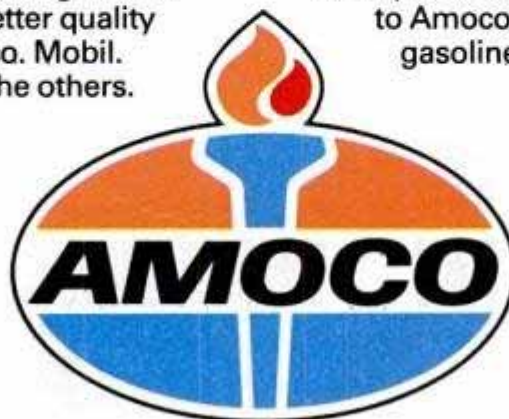
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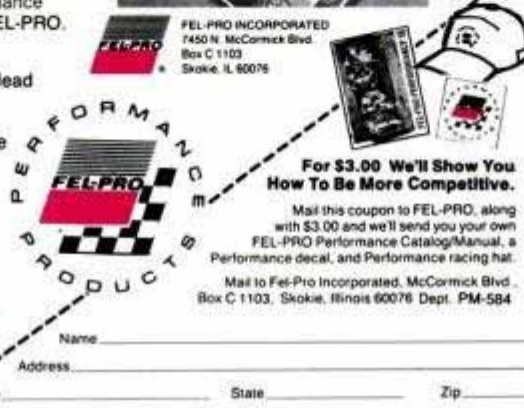
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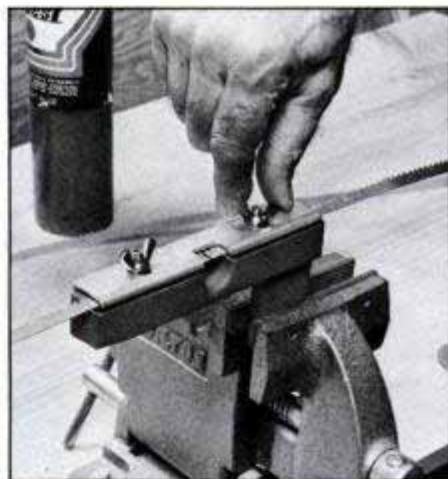
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After grinding a 20° bevel on mating blade ends to form a lap joint, tighten wingnuts to hold blade for soldering.

shear strength of silver forms a strong splice that usually outlasts the blade.

First, grind a 20° bevel on mating blade ends to form a lap joint. Then secure the blade ends into the splicer. Line up the two beveled ends. Next, insert the silver solder into the joint and then add flux to prevent the bonding surfaces from oxidizing. Now, apply slow, even heat from a small-tipped propane torch until the blade turns a dull red color. Hold this temperature for a few seconds, then allow the blade to air cool.

Two splicer models are available: one for 1/8- and 3/16-in.-wide blades, and another for blades from 1/4 to 3/4 in. wide. Each model costs \$39 postpaid and comes with 10 in. of silver solder and flux.—Rosario Capotosto



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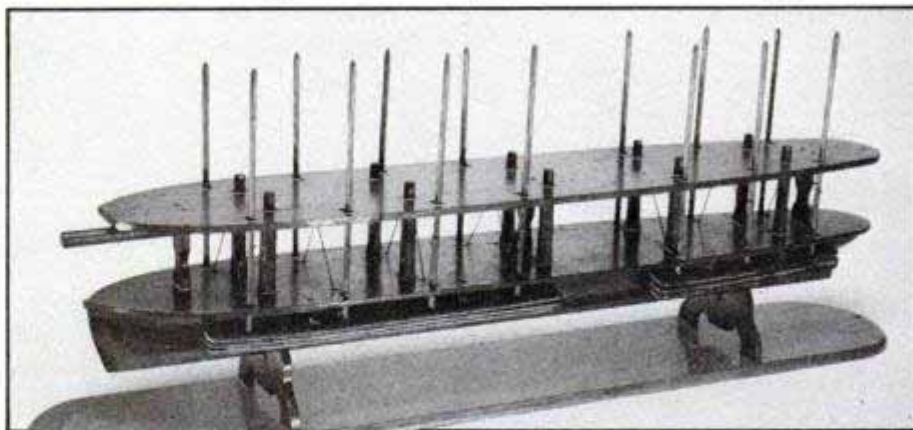
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PATENTLY UNUSUAL

Now They Belong To The Ages...



Abe Lincoln's patent model for a new riverboat.

Imagine, if you will, a young lawyer named Abe Lincoln sitting before the fire whittling a piece of pine. With store-bought dowels and tiny scraps of wood, he fashions the body of a miniature riverboat. For Lincoln, and hundreds of 19th century inventors, such whittling was not just a hobby.

From 1836 until 1880, the United States Patent Office required every

turned in a model of his steam engine and pump system. His model called for a conical valve in the pump, but in the patent application, Westinghouse, father of the appliance and engineering company that bears his name today, reserved the right to go with a cylindrical valve instead. A cylindrical valve, he noted, might be more efficient. Indeed, it eventually became the standard shape for such valves.

John Leedy, who was granted over a score of patents during the Civil War, introduced a patent model for a sugar evaporator in 1862. There was a shortage of sugar in the North back in those days, and his evaporator was designed

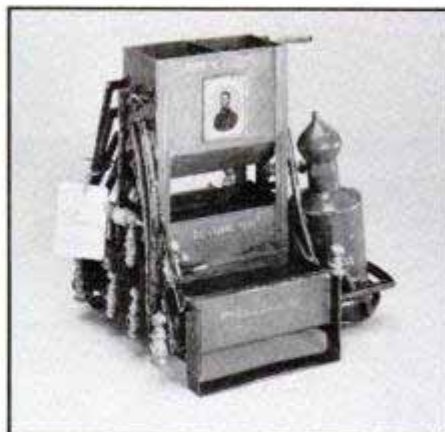


The Westinghouse pump, patented in 1870, looked ahead to efficient cylindrical valves.

inventor to submit a scale model with his patent application. Lost records and passing centuries have made it difficult to state the exact number of patent models built in those years, but a conservative estimate of 50,000 draws few arguments. Today, fewer than 1,000 of these models are accounted for, about 500 of which are on exhibit this spring at the Smithsonian Institution's Cooper-Hewitt Museum in New York City.

Lincoln's 1849 model of a steamboat contained tall, thin air-filled "buoyant chambers." When the piston in the buoyant chamber moved down, it would drive air out, causing Lincoln's boat to sit higher in the water and pass over sand bars. A production model was never constructed.

In 1870, George Westinghouse



John Leedy's sugar evaporator was to overcome a Civil War whiskey shortage.

to draw the sweetener from sorghum for the efficient manufacture of whiskey.

If you think you've come across an old patent model, send me a photograph and a brief description and we'll try to verify it for you. The Smithsonian would be interested in your find.

—Dennis Eskow

PHOTOS BY KIM NIELSEN, SMITHSONIAN INSTITUTION

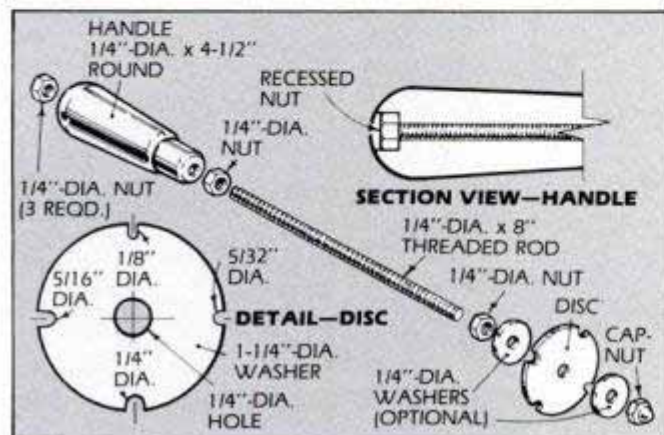
POPULAR MECHANICS • MAY 1984

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Make A Barbecue Grill Scraper



This scraper makes it a snap to clean off your barbecue grill.



The hardest part of barbecuing is cleaning the grill. But with this grill scraper, the job is quick and easy. The grooves in the end disc are designed to fit most commercial barbecue grills. Burned-on food can be easily scraped off by pulling the tool over the cooking grate.

You can make the scraper with scrap parts such as an old broom or shovel handle, nuts, washers and a length of screw rod. If you have to purchase a round for the handle and a screw rod, make extra scrapers for friends.

Drill a 1/4-in.-dia. hole through the center of the dowel. An easy way to center the drill is to use a 1-in.-dia. washer with a 1/4-in. center hole as a drill guide. Drill from both ends so that the hole goes completely through the dowel.

Make the recess holes in the handle, if desired, for the two nuts that fasten the screw rod; use a 7/16- or 1/2-in.-dia. drill bit. Bore holes 3/8 in. deep.

Round one or both ends of the handle if you want a fancy scraper. A router or a wood file will do the job.

Sand and finish the handle. I used a walnut stain and finished it with clear lacquer.

Cut the screw rod to length. Put one nut on the screw rod and push through the handle. Tap the nut into the end of the handle so it is flush. Screw the second nut on to secure the handle. Use an end wrench to work the nut into the base of the handle if you made a recess. Place a nut, washer and end cap nut on the screw rod.

Make four grooves on the washer in varying sizes. You can use a fiber or abrasive metal-cutting wheel on a radial-arm saw, or a 1/8-in. fiber grinding wheel on an electric drill. Remove burrs with a file or sandpaper.—Jan Baxter

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PM-5



Is This The Next Great Indy Engine?

The Ford-Cosworth V8 has a lock on Indy today, but Callaway, Buick and Chevy have better ideas.

BY MARK WALLACH

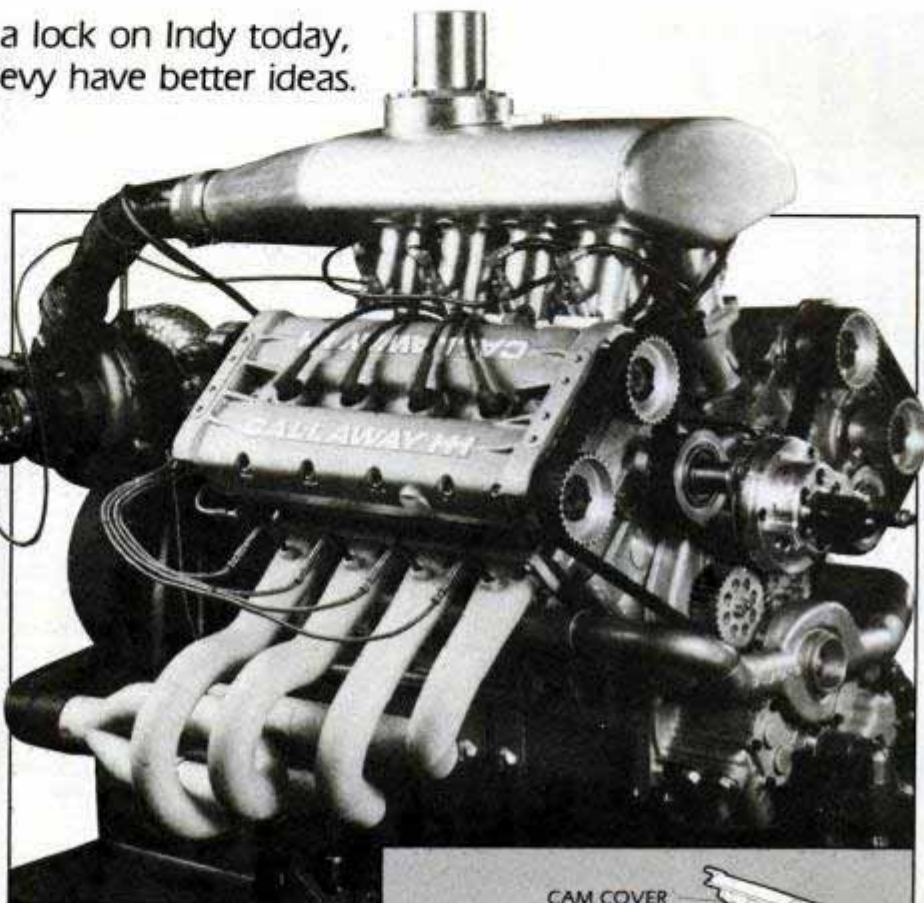
The Indianapolis Motor Speedway has always been a hotbed of automotive innovation. Every kind of engine you can imagine—and some that you can't—has been tried at Indy: rotary valve, turbine, diesel, straight Six twin cam, straight Eight twin cam, straight Eight pushrod stock block, supercharged straight Eight twin cam, V16 four-cam, V8 four-cam supercharged, V12 four-cam twin supercharged, four-cylinder twin cam turbo, V8 four-cam turbo, and, of course, your run-of-the-mill stock-block pushrod V8s and turbo V6s.

About the only racing engines that haven't raced at Indy are two-cylinder twin-cams, and six-, eight-, 12- and 16-cylinder pancake designs. But that doesn't mean they haven't been built and raced. They just haven't shown up yet in the Brickyard.

Since World War II, however, not much of that innovation has made it to Victory Lane. The Meyer-Drake-Offenhauser twin-cam Four had a lock on the race in the early years until it was displaced by Ford's four-cam V8. The sentimental Offy made a brief comeback in turbocharged form before being overwhelmed by the turbocharged Cosworth-Ford four-cam V8, an engine originally designed for European Formula One grand prix racing. When the 3.0-liter Cosworth was reduced to 2.6 liters and turbocharged, it proved unbeatable at the Brickyard, winning the last six races.

Imports at Indy

One little-known aspect of Indianapolis is that nearly all of the front-running cars for the last several years have been made in England, and use March, Penske or Lola chassis and Cosworth engines. Several American challengers would like to see all that change. One of the most interesting sits on a dyno room test stand with proud, polished names on the valve covers: CALLAWAY HH. Sleek, uncluttered and brand new, it's serial No. 1 of a hoped-for



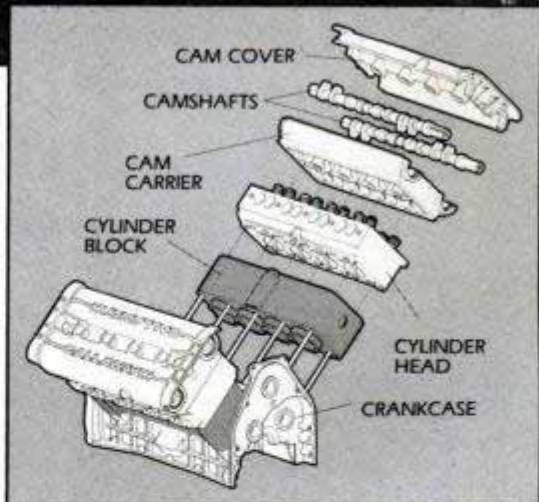
Callaway's clever modular engine (above) produces over 700 hp at 10,000 rpm. Cylinder blocks are interchangeable (right) to provide displacements from 1.5 to 3.6 liters that meet the requirements of various racing classes.

series of turbocharged V8 racing engines built by Callaway Engineering in Old Lyme, Conn.

The HH stands for Hans Hermann, the Dutch-born engineer who designed the engine and the all-important cylinder heads. Hermann did the four-valve cylinder heads for the 2.0-liter BMW Fours that dominated European Formula Two racing in the '70s and were the basis for the 1.5-liter turbo Four that powered a Brabham grand prix car to last year's Formula One world championship.

At 2.6 liters, the Callaway HH V8 weighs only 277 pounds and puts out over 700 hp at 10,000 rpm.

Callaway is dead serious about the engine and has put money and time



DRAWING BY BOB MARIANI

into it in big batches. You need lots of both to go from design drawings to first running prototype in 11 months.

State-of-the-art modular design and a very advanced computer-programmed machine shop typifies the Callaway approach. The modular concept of the Callaway HH V8 uses a set of aluminum building blocks, like a big Lego set. The oilpan casting is bolted to the crankcase. Separate cylinder

(Please turn to page 188)

DREAM MACH



MERCURY

OIL INJECTED
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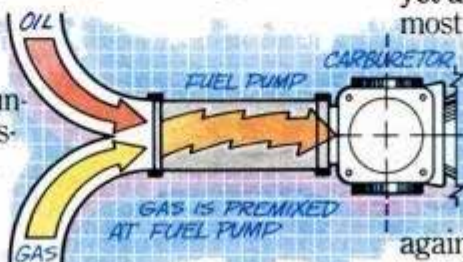
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There's more. There's the aerospace-quality stainless steel shafts. The protective coatings lining every water passage. And a 14-stage paint process, with long-lasting Mercury Phantom Black™ acrylic enamel as the final coat.

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This new Power Trim—available on the Mercury 75, 90 and 115—offers a full 20 degrees of trim, five degrees more than any other make. That's five degrees that will help you get on plane faster, snap up skiers more easily, and respond to any situation more quickly.



It's 75 degrees of trim and tilt—10 more than the competition—makes

beaching a breeze, too. Plus, this Power Trim is entirely self-contained. No hydraulic lines, fittings or external pump to worry about.

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The Mercury Outboards System is the marine industry's strongest manufacturer-to-dealer-to-customer network ever. It's your assurance of satisfaction from your investment and of pride in your outboard.



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The possible dream.

IS THIS THE NEXT GREAT INDY ENGINE?

(Continued from page 184)

blocks, ranging in displacement from 1.5 liters to 3.6 liters, are bolted onto the crankcase. The blocks don't have liners. Instead, they are plated with nickel carbide to enhance heat transfer and reduce cylinder wear. The cylinders are siamesed, with water passages around them. But solid metal between the cylinders allows machining of bores in several sizes. Belt-driven camshafts (as opposed to the Cosworth's gears) allow blocks of varying height to be used.

Four steel camshafts operate 32 titanium valves through bucket-shaped titanium cam followers that are hard chrome plated on the contact face. The camshafts are driven by special Good-year toothed belts. Polished titanium

connecting rods roll on plain bearings. The crankshaft is machined from a solid billet of steel, not cast like passenger car crankshafts.

Adaptable engine

At 2.6 liters turbocharged, the Callaway HH fits the Indy rulebook perfectly. At 1.5 liters turbocharged, or 3.0 liters normally-aspirated, the engine can be raced in Formula One. Almost any other size, with or without a turbo, fits into one classification of sports car racing or another.

Like all modern racing engines, the Callaway HH V8 can be used as a load-bearing part of the chassis. It is a compact package, with the intake manifold built into the center of the V-block. Its

narrow profile, compared to the Cosworth engine, will allow larger under-chassis downforce tunnels.

It wasn't chance that the engine and transmission bolt circles match the Cosworth's exactly. The new engine can drop into any existing Indy and many Formula One chassis. The Callaway is about 80 pounds lighter than the Cosworth DFX and the reduced weight will lower the polar moment of inertia and increase chassis response in turns on road racing tracks.

This project is no draftsman's daydream, and the proof is stacked in neat piles and in labeled boxes ready to be assembled into first series prototypes for testing, testing and more testing.

Even Callaway's famous turbocharging business of over \$1 million a year can't support a racing engine project, so he and Ray Caldwell, a racing car builder with over 1,000 cars to his credit, have set up research and development limited partnerships to fund the project. There are no sweet promises, but if the engine is a winner, they estimate a \$5 million a year market for the engine in all of the possible racing classes. It's a risky business, but the returns could be in proportion to the risk.

It may seem like a contradiction to say that the most advanced engine builders are the most conservative, preferring to make one-at-a-time changes to a design and follow them to the maximum output before trying to go to the next step. But that's the way successful racing engines are developed and then raced into shape. If all goes well, 1984 will be used to get the engine ready for the 1985 Indy race.

Detroit enters the race

Two GM divisions—Buick and Chevrolet—hope to be represented at Indy this year. The Chevy Indy engine, which is being prepared by Ryan Falconer of Salinas, Calif., is a 90° V6 of 209 cu.in. (3.4 liters), as allowed for stock-block pushrod Indy engines. Based on Chevy's race-proven small-block V8, it sports a 4-in. bore and a 2.75-in. stroke.

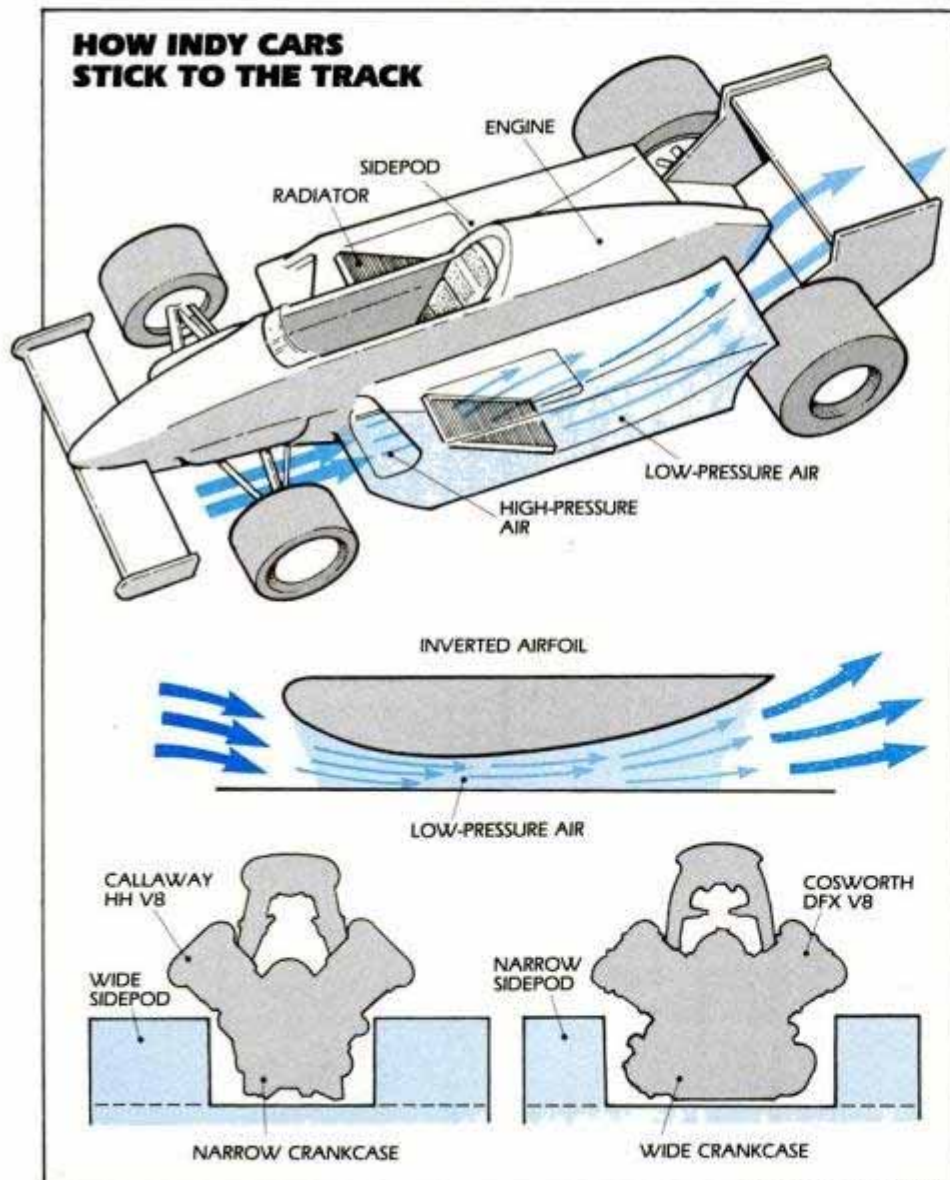
The all-aluminum engine is odd-firing, with its cylinder firing times spaced unevenly through the crankshaft's rotation. This configuration allows crankpin journals to be ground as they are for a V8, with two rods riding in tandem on each journal.

The engine has a compression ratio of 8.5 to 1 and uses the 57 in. of turbo boost that USAC allows for stock blocks. Initial dyno tests indicate that it's capable of 725 hp at 8,500 rpm.

Although the Chevy does not use any

(Please turn to page 190)

HOW INDY CARS STICK TO THE TRACK



DRAWING BY ED LIPINSKI

Air flowing through the hollow sidepods of a modern Indy race car is used to cool the engine and to develop downforce. The bottoms of the pods are shaped like inverted airfoils. The venturi effect of air rushing between these airfoils and the ground can

generate 3,000 pounds of downforce at 200 mph, pressing the car onto the track and allowing higher speeds in the turns. Because the Callaway V8 has a narrow profile, it will permit 100 percent larger sidepod tunnels for increased downforce.

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

Lights Kings, 9 mg. "tar", 0.7 mg. nicotine; Filter Kings, 17 mg. "tar", 1.1 mg. nicotine av. per cigarette, FTC Report Mar. '83.



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one way to
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Wherever the music is hot, the taste is Kool. At any 'tar' level, there's only one sensation this refreshing.

IS THIS THE NEXT GREAT INDY ENGINE?

(Continued from page 188)

Cosworth components, it does use the same type of constant flow fuel-injection system that has been employed on most Indy racing machines for more than 30 years now.

Buick officially disavows any involvement with an Indy engine project. However, Buick spokesmen do admit that McLaren Engines of Livonia, Mich., is conducting a "heavy-duty parts test program" and they agree that Indy-engine development happens to be part of the program.

Interchangeable engine

The Buick/McLaren V6 Indy engine is designed to be interchangeable with the Cosworth V8. An accessory drive system on the front of the engine is virtually identical to the Cosworth's. The engine is lubed by a Cosworth dry-sump oil pump and cooled by Cosworth water pumps.

The thinking at Buick is that racing teams are more likely to make the switch if an engine manufacturer can provide hardware that the teams are familiar with. The Buick/McLaren sells

for \$27,000—about half the price of a Cosworth.

The engine is built primarily with over-the-counter Buick heavy-duty Stage II parts, and will probably be fitted with all-new Stage II+ aluminum cylinder heads. The Buick is an even-firing 90° engine and utilizes a factory-forged 5140 steel crank. The crankpins are split and staggered to achieve the even-firing configuration. TRW pistons on Carillo steel rods produce a compression ratio of 9.5 to 1.

The iron-block engine achieves the 209-cu.-in. stock block limit with a 3.8-in. bore and 3.07-in. stroke. McLaren sources indicate that the engine has already achieved over 750 hp in dyno tests.

Both the Buick and Chevy are one-race engines in that CART, which sanctions all of the other races on the PPG Indy Car World Series calendar, does not provide the 10-in. boost advantage that USAC allows at Indy. McLaren and Buick engineers say that they are working on a CART version of their Indy engine and hope to make it competitive

with only 47 in. of boost. This engine will use a higher compression ratio—probably 10.5 to 1—and different valve timing.

Ford fights back

Ford, meanwhile, is not standing by idly. It's planning a replacement for the veteran Cosworth V8, although the project remains shrouded in mystery and speculation. The engine isn't expected until 1986. Like the Callaway and Cosworth, the new engine will be adaptable to both Indy and Formula One GP racing.

Ford hopes to apply the same kind of computer-controlled engine management to this racing engine that is now commonplace on production cars. It appears that Ford will buck the current trend to 1.5-liter turbo engines in Formula One and produce a 3.0-liter, normally-aspirated update of the current Cosworth, which can easily be reduced to 2.6 liters and turbocharged.

Which of these prospects will be the next great Indy engine? Only time—and racing luck—will tell. **FM**

'84 Indy 500: A Wide-Open Race

Picking an Indy 500 winner used to be easy. Just look at past form. If a guy had won the big Memorial Day classic once, then he was a top contender to do it again. In the eight races from 1975 through 1982, there was only one first-time winner—Rick Mears in 1979. Indy was dominated by A.J. Foyt, Al and Bobby Unser, Gordon Johncock, Johnny Rutherford and Mario Andretti.

All that has changed now. Eight drivers scored wins on the 13-race PPG Indy Car circuit last year. Tom Sneva won his first 500 last year after a terrific duel with Al Unser Sr. The three-time Indy winner now has a son racing alongside him: Al Jr. Mario's son, Michael, is set for his rookie year in Indy cars, too.

It's a sign of the times. The old order is changing. Bobby Unser has retired and the legendary A.J. Foyt seems to be slowly easing himself out of the cockpit. The field at Indy is wide-open, so don't be surprised if there's another fresh face swigging milk in Victory Lane come May 27.

For instance, Teo Fabi, a young aeronautical engineer from Milan, Italy, won more races than anyone else last season. Fabi, who set the all-time qualifying record at Indy last year at better than 207 mph, has to rate as the early favorite.

The fastest car around, and the most

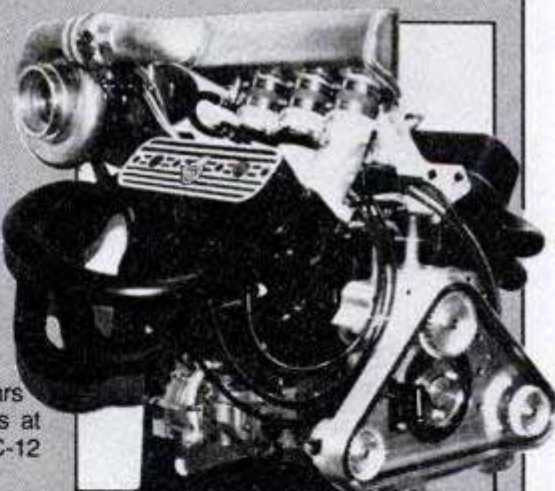
numerous, has been the English-built March. And the new 84C model is even better than its predecessors. Fabi spoke about the possibility of 210-mph laps come May. No wonder Indy Car teams have ordered more than 40 of the new Marches.

Not everyone will drive a March, though. Roger Penske's team, which has won the Indy Car championship in five of the past six seasons, had little luck with its PC-11 model last year. So drivers Mears and Unser are pinning their hopes at the Speedway on a new Penske PC-12 model.

Pat Patrick's drivers, Johncock and Chip Ganassi, also hope that improvements made to their Mk 9b Wildcats over the winter will boost them back into a competitive position.

Mario Andretti will again drive a Lola for Paul Newman and Carl Haas, although his son Michael will be teamed with Geoff Brabham in a pair of Marches for the Kraco team. Doug Shierson, who used to be the March distributor in this country, is building his own car for 1984—the DSRI—which will be driven by former Formula One driver Danny Sullivan and Trans Am star Willy Ribbs, who is looking to become the first black Indy racer.

The Ligier team will field the first



McLaren/Buick V6 puts out 750 hp. The belt drives Cosworth water and oil pumps.

French cars in the Indy 500 since the 1920s. American Kevin Cogan will be the driver.

Newcomers to watch include Roberto Guerrero, a Brazilian F1 driver; Ed Pimm, the reigning Super Vee champ; and midget racing veterans Stan Fox and Sleepy Tripp.

There are some veterans you might be missing from this year's 500. Johnny Rutherford, who has won Indy three times, found himself at press time without an offer for a good car, as did defending champion Tom Sneva.

—Steve Potter

Weather or not. Lucite resists cracking and peeling longer.

This is a picture of an actual test house. One of many that show the results of an ongoing nationwide test: Lucite® House & Trim vs. five leading house paints. The results? Dramatic. Lucite's exclusive acrylic formula resists cracking and peeling much longer than the others. So you don't need to paint as often.



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**THE PAINT THAT LASTS
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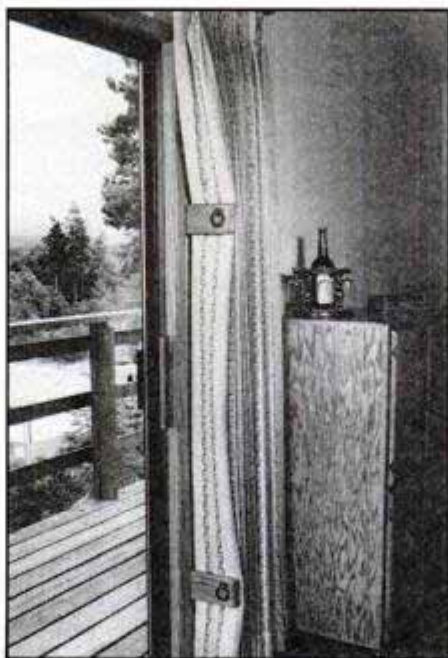
Drapery Retainers For Patio Doors

A pair of retainers next to sliding glass doors keeps draperies out of the way and protects the fabric from soiling. The retainers are mounted on the wall with cabinet-door hinges. When not in use, they rest flat against the wall. A ring pulls them forward.

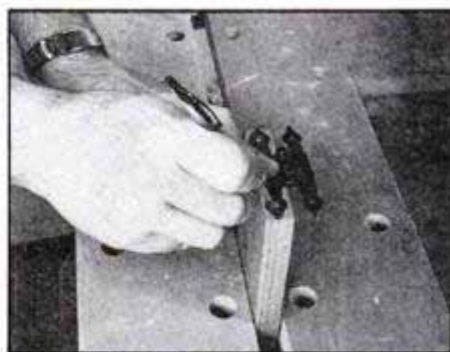
These retainers are $\frac{3}{4}$ x $3\frac{3}{4}$ x 7-in. oak. Use a miter box and backsaw to cut each piece, square at the hinge end and mitered 45° at the front end. Secure wood in a vise, rear edge up. Mark, punch and bore hinge screw holes.

Sand all wood surfaces with medium, fine and extra-fine grit abrasive, easing the edges. Dust and tack off.

Apply stain according to the maker's directions and let dry. Seal the wood with a mix of equal parts 3-lb. cut shellac and denatured alcohol, or use a commercial sealer. Rub all surfaces with 3/0 steel wool. Apply two coats of polyurethane varnish. Locate a hole for the ring-pull screw 5 in. from the rear and 1 in. from the top of the retainer. Attach the pull. Then mount the hinges with the screws provided. Install the retainers with $1\frac{1}{2}$ -in., self-tapping screws.—*Kenn Oberrecht*



Drapery retainers reduce the handling and soiling of draperies used on sliding doors. Two hinged retainers—one 12 in., the other 60 in. from the floor—mounted on the wall near door casing hold back drapes. When not used, retainers fold against wall.



Secure each 1x4 retainer in a vise, rear edge up, and use a hinge as a guide to mark for drill-starter holes (top). Mount the completed retainer on the wall with $1\frac{1}{2}$ -in., black, self-tapping screws, or screws that will match the hinge finish (above).

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HINTS FROM READERS

Paint can plant duster



Drill holes in the bottom of a paint can for use in dispensing garden insecticide.



A jerk of the hand will send a shower of insecticide downward toward the plants.

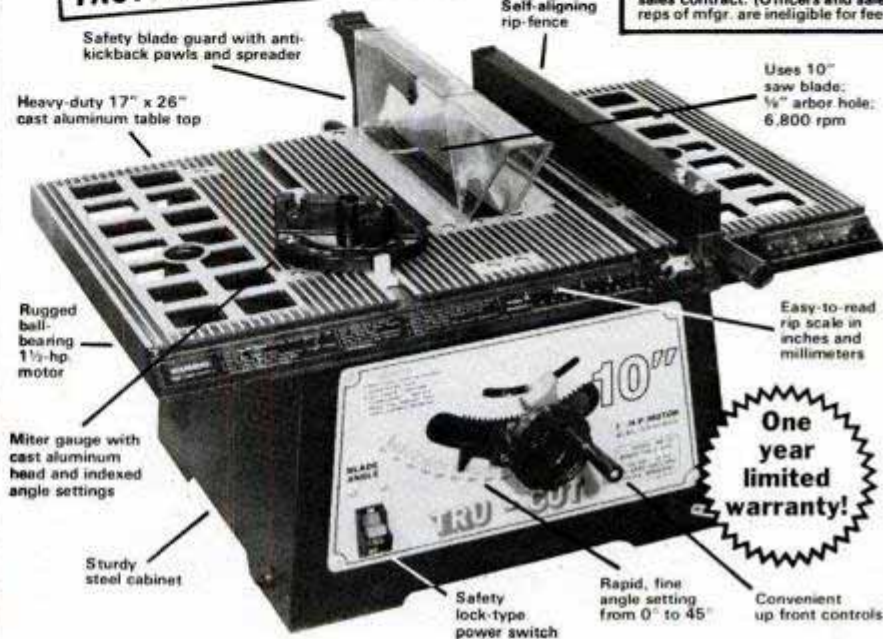
If your garden is too big to cover with the small insecticide dust dispensers sold at most garden centers, but too small for the more expensive mechanical models made for professional growers, this homemade duster may be just what you need. The insecticide duster is made from an empty gallon paint can. Drill about 30 holes, $\frac{3}{16}$ in. in diameter, spaced equally around the bottom of the paint can. The holes will provide an outlet for the insecticide when the can is shaken. To use the plant duster, fill the can with insecticide and replace the lid. A shower of insecticide dust will come out each time you jerk the paint can handle.

—David W. Roberts

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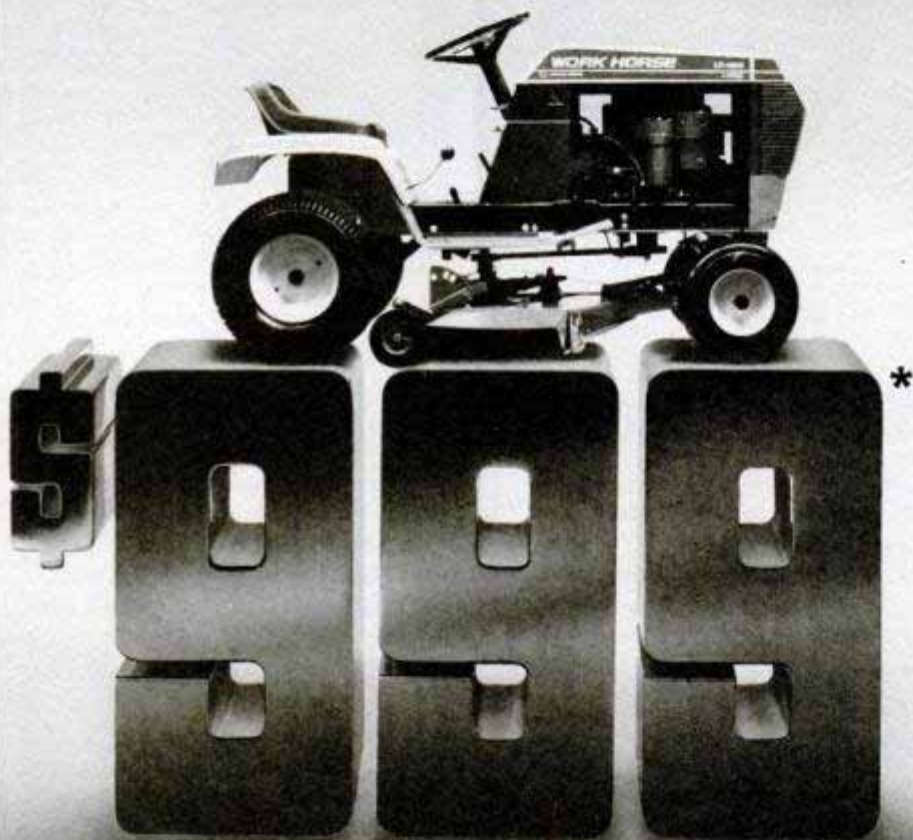
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LOST SQUADRON

(Continued from page 81)

flipped over. He suffered only minor injuries.

Following McManus's crash, the order was given to all crews to land wheels up and as close together as possible to facilitate any rescue attempt. The belly landings would also prevent the planes from being easily flown off the snow—by the Americans or Germans. "I slid in on the snow like a big sled," said Wilson, now 62.

Before the B-17s went in, their crews sent out SOS signals, but the storm pre-

vented the message from being heard. For three days, the 25 men survived on their meager rations. On the fourth day, their radio signal was heard and their position determined. Later, a plane circled and dropped food and supplies.

Walk to the coast

It took six more days for a dog sled rescue team to find them. The men walked to the east coast of Greenland, 17 miles away, and were picked up by the U.S. Coast Guard cutter *Northland*. Before they left the site of their emergency landing, they photographed their downed aircraft.

Because of the generally foul weather in the region, the planes were left untouched on the icecap—thousands of square miles of snow without habitation, save an occasional off-course polar bear.

In 1977, Rajani, a former Navy flier and now a Republic Airlines pilot, read a book on the romantic "war birds" that briefly mentioned the planes downed in Greenland. Nearly 10,000 P-38s were built during the war. Today, only five or six are flying. Rajani vowed to locate and salvage the six irreplaceable aircraft.

Historical quest

"It's certainly not a stunt, it's a historical quest," the tall, dark-haired pilot says. "I want to go back into history and bring something of that time into the present."

Rajani spent four years collecting scraps of information on the flight and, most importantly, trying to pin down the location of the abandoned aircraft. Ultimately, he would find the logbook of the cutter *Northland*, and two B-17 navigators who had taken sunshots with a sextant when they were forced down. All three sources agreed on the planes' longitude, but their latitudes differed 1½ miles on the Greenland ice pack.

In the summer of 1981, Rajani and a colleague made a trip to Greenland to get a better fix on the location of the planes. "We used ERROS satellite pictures of the region, and in August of '82 went back in with subsurface radar," he said. "We got enough information back to narrow the crash site to an area 1 mile by 2 miles square."

Hundreds of volunteers

By that time, word of Rajani's quest was getting out and he was besieged with hundreds of volunteers for the mission. Eventually, he and partner Roy Degan picked 14 men, including a couple of small-engine mechanics, a doctor, cooks, arctic survival experts and surveyor Larry Seabolt, 33, and mechanic John Neel, 27.

Team member Jay Fiondella contacted R.J. Reynolds Tobacco Co.'s Winston cigarette division, which agreed to foot the bill for the venture, and plans were made to assault the icecap in early June, when the summer weather was supposed to begin.

The operation called for ferrying 53,000 pounds of equipment from the United States to the site 90 miles from Kulusuk, a tiny village that is Denmark's emergency airfield on Greenland's east coast. Several DC-3 flights to the icecap brought supplies: a 20×40-foot "weatherport" building with plywood floor, tents, subsurface radar equipment, snowmobiles, fuel,

generators, welding equipment, 1,000 bamboo poles to mark a search grid, food and medical supplies—and one exercise bicycle. ("You have to bring your own entertainment up there," one crew member said.)

As soon as camp was set up and a snowblock windbreak constructed, Seabolt began surveying a grid for the radar survey. Using a theodolite—a transit-like device that measures angles and distance to the nearest one-thousandth of a foot—grid lines were established every 50 feet across an area 8,000 feet by 5,000 feet.

Once the grid was laid out, the snowmobiles pulled a radar across the terrain in a pattern, sending waves down through the snow and, it was thought, receiving reflected signals from the metal-clad planes.

"Some days we could work 16 hours," Seabolt said, "Other days we couldn't go out at all. The wind would come up at 30 to 35 mph, with gusts up to 80 mph. The snow—really ice crystals lying on the surface—would be picked up just like a sandblasting gun. It would blister bare skin."

Few results

By late June, the team had few results and lots of discouragement. The weather was tougher than expected and the radar failed to give any solid indication of any objects buried beneath the snow.

But Rajani, who had gone back to Sondrestrom to coordinate some equipment repairs, was still sure they were on the right spot. Then a U.S. Navy flight crew confirmed his belief.

"The crew of a Navy P3-Orion, with magnetic gear to detect submarines, had stopped over in Sondrestrom," he said. "I said, 'Look, guys, we need help. If, if you might find yourself at the end of your patrol in this (crash) area, would you mind swinging by just for a few minutes and taking a look?'"

On June 22, the Orion trolled the crash site for a half hour. "They told us they got four good hits (magnetic reflections) right where we told them to look," Rajani said. "And that's what kept me going."

Then the weather got even worse. For nearly two days, the pitteraq blew in with 90-mph winds. "It was like trying to sleep with someone constantly shaking a sheet over your head," Rajani said of those long hours he had to spend in his tent. "Because it was so light outside, you had to blindfold yourself to get some sleep."

Radar doesn't work

When the weather lifted enough to work, the wind tipped over the magnetometer, soaking it in snow. "When we went out in the morning and when we

came back at night, we would test the radar," Rajani said. "We buried a strip of tinfoil under 3 feet of snow and would make a pass to see if everything was working. One night, it just didn't function." And the machine couldn't be fixed.

While attempts were being made to line up another stateside crew to come in with a new radar rig, an Icelandic glaciologist and geophysicist in Reykjavik heard about the team's problems. Prof. Helgi Bjornsson is the designer of the "icescope," a type of radar which he uses to map the terrain beneath Iceland's glaciers to predict the direction of snow melt, which is valuable information for his nation's hydroelectric industry.

Waves on an oscilloscope

The icescope, pulled along the glacier by snowmobile, sends electromagnetic waves down through the ice and reflects objects below. The reflections show up as waves on an oscilloscope, where they are photographed for later study.

Bjornsson contacted the R.J. Reynolds representative in Reykjavik and within a week was at the crash site, equipment in tow. Four days later, on August 1, he confirmed a find of two planes in the same location where there were earlier reflections. Within three more days, he had found what he believes are all eight planes. The plotted locations fit the arrangement of the planes shown in the crews' 1942 photographs.

What was wrong with the recovery team's first efforts? "They were using a high-frequency radar," Bjornsson said, "which was not made to work in snow and ice. The icescope works similar to a depth recorder on ships—a long-wave frequency which is able to go through ice and snow." The icescope cannot immediately pinpoint the depth of the planes. Subsequent mathematical analysis, however, indicates the planes are probably under 60 to 70 feet of porous snow.

No time to dig

By the time the planes were precisely located in early August, winter was already coming to Greenland. There was no time to dig down to even one of the fighters. Their locations were marked so the team can return this summer and begin the salvage operation.

Rajani still doesn't know how the P-38s will be lifted out of the snow once their location is reconfirmed and the team is sure the craft are intact.

"When we've actually touched one of those planes," Rajani says, "I figure the rest of the job will be somewhat academic."



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20-MPG MOTOR HOME

(Continued from page 82)

vehicle for half that—about the delivered price of most full-size cars these days. Also, fuel mileage hovers around 20 mpg.

The turbodiesel in the Winnebago LeSharo produces over 21 mpg on trips and some versions of the Mirage will also deliver more than 22. The sample we drove, built on a Toyota chassis with 2.4-liter gas engine and five-speed manual transmission, got 19.3 in 2,616 winter miles of mixed local and long-distance driving. This included turnpike cruising at an effortless 65 mph. We drove it hard to check performance and handling, not gently to maximize fuel economy.

How much comfort?

Motor homes in the compact class differ in how they compromise between live-in features and all-around utility. The fully self-contained design gives you washing and cooking facilities, plus bunks and toilet. Those compacts with fewer live-in features leave more space and weight-carrying ability for moving things as well as people. They can become more general-purpose vehicles, second cars for the family.

With the fully self-contained com-

pacts, you can go anywhere and live in them with a fair degree of comfort. But these vehicles are usually closer to \$25,000 than \$15,000. And, while you can live comfortably in them, you may not want to live with them the rest of the year. The built-in furnishings and appliances that make them so comfortable take up almost all the space. Most are too grand or too furnished to haul anything large, and too big themselves to run errands.

The compacts with fewer live-in features are great for short vacations and weekend excursions. They combine driveability with sufficient comfort at prices that are affordable, and give great mileage. Here's a rundown on some of the compacts we've looked at, and one we drove for a couple of months.

The ground-up design

The only built-from-the-ground-up compact motor home is the LeSharo by Winnebago and its upscale twin, the Itasca Phasar '84. We inspected both at some length. The power comes from a two-liter turbodiesel driving the front wheels for up to 22.5 mpg; and there's a slightly livelier gas-engined version. With the turbo, the diesel gives the 5,800-GVWR (Gross Vehicle Weight Rating) LeSharo easy hill-climbing per-

formance and sufficient passing ability for confident driving.

Neatly packed into its 19-foot-8-inch overall length, you get seats for eight, beds for four, galley with two-burner cook-top, dual-voltage refrigerator, stainless-steel sink, six-gallon electric water heater, 20,000-BTU furnace and lots of other standard features.

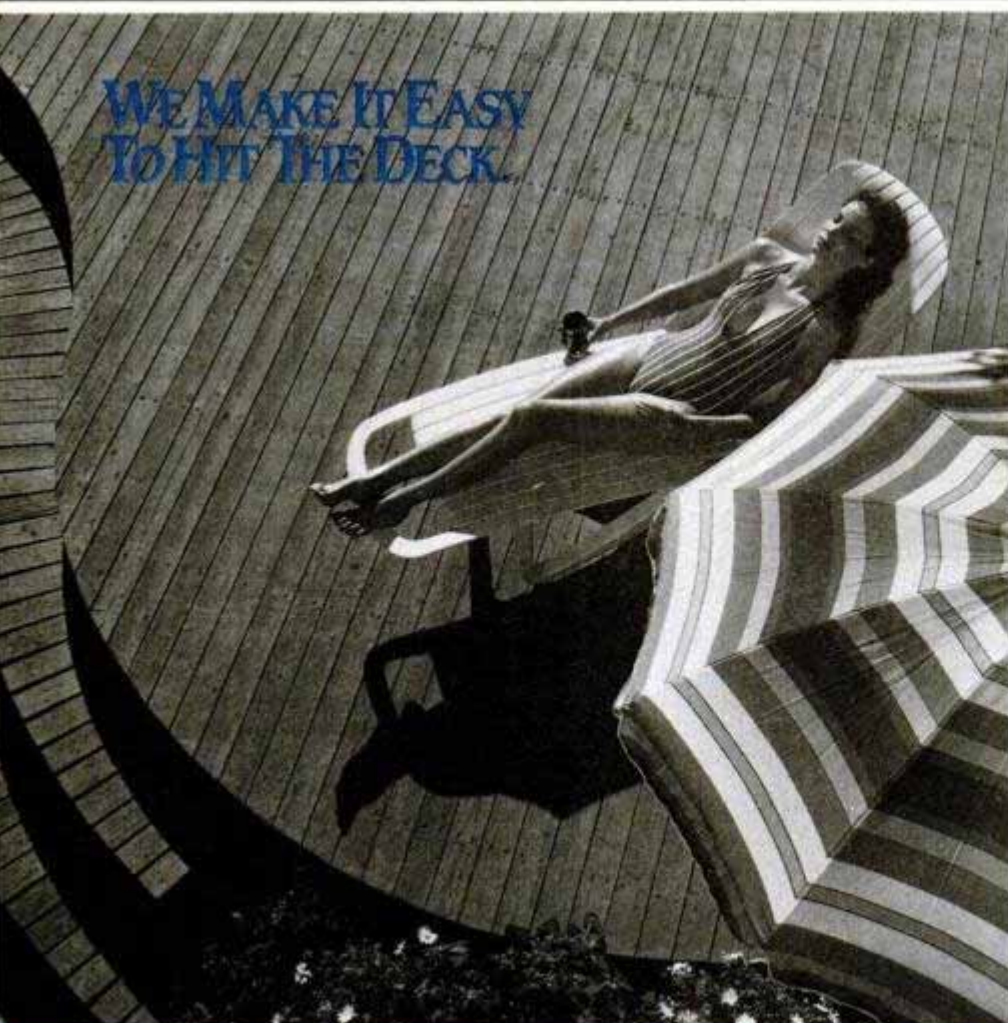
One of its cleverer design tricks is the pull-out telescoping lavatory/shower. You just pick up a floor panel to expose the drain and extend the walls for enough space to shower in comfort. When not in use, the walls fold inward and the floor panel fits back in place to enlarge the passage to the rear dinette.

Base price is about \$22,500 and options like the turbodiesel, shower, cruise control, air conditioner and others can run that price up another \$4,000 or so.

Winnebago Industries Inc. is at Box 152, Forest City, Iowa 50436.

Home on a pickup

The other way to go is to choose a motor home built on a mini-pickup chassis. The Mirage we drove is representative of this type of compact, as is the Odyssey Sprint shown on page 82. The Sprint is manufactured by General R.V. Industries Inc., 2362 South Garde-



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na Ave., San Bernardino, Calif. 92408.

We put several thousand miles on the Mirage and found it to be an easy-to-live-with vehicle that did whatever we asked of it, and attracted a lot of favorable attention. Driving across the George Washington Bridge with a 40-mph crosswind, it tracked true and was easy to control.

PM editors who drove it loved it, and they had to conduct tours of the interior for passersby. The curious, who at first found much humor in its shape, stopped chuckling after seeing the layout inside.

Our kids liked it every bit as much as we did. They spent several winter nights in it and were thankful for its effective 6,000-BTU catalytic heater.

In addition to the double bed in the nose over the cab, the dinette right behind the cab converts to a second bed. To make it easy to enter the cab from the body, a hatch cuts into the roof and back of the cab. Lift out a section of the overhead bed and there is a workable pass-through. For privacy or to heat only the cab during bitter weather, you could snap a curtain in place behind the cab.

Driving, though, was better without the curtain. The window in the rear door comes down low enough so you can use the central rear-view mirror to see what's directly behind you—which you can't do in most motor homes.

Overhead storage

On both sides of the living area overhead storage cabinets extend to a full-length closet—in the right rear corner. Next to the closet is a Porta-Potti with privacy curtain. On the left side is the kitchen sink—actually a small bowl supplied by a hand pump from a six-gallon plastic jug under the counter.

The second battery and converter live under the counter with the water jug, as does the two-way (12- and 115-volt) electric refrigerator. The back corner has a ceiling-height cabinet for the electric cooking appliances and other gear. These 12- and 115-volt appliances include a one-slice toaster, small fry pan and coffee pot. For more extensive cooking, you can always bring along your camp stove, though the basic idea is to make breakfast and, perhaps, lunch easily on the theory that by supertime you may well want to go out to dinner anyway. With the whole back end opened up, the Mirage is an ideal tailgate party vehicle.

Mirage prices start at \$13,400, depending on the choice of pickup chassis and options. The basic unit includes a fiberglass interior, 5-inch foam cushions, three two-way electric appliances, icebox with cube storage and drain, water tank, three 12-volt lights, shades,

carpet, and fiberglass rear bumper/step.

Our Mirage had \$2,874 in options to make it drivable and livable. They ranged from dual wheels with wide tires (\$335) and cruise control (\$203) for drivability to Porta-Potti (\$85) and catalytic furnace (\$355) for livability. It's easy to run the typical price up to about \$16,000.

Mirage of Elkhart Inc. is at 55241 Jay Dee St., Elkhart, Ind. 46514.

The van conversions

Finally, there are compact motor homes based on vans. Those built into full-size vans tend to jump out of the 6,500-pound weight class that defines the compact. Many of these conversions are actually plush travelmobiles or business buses, rather than motor homes, and only a few can get 20-mpg fuel economy.

The latest camper version of the VW Vanagon is an excellent example of a van conversion. It has a garageable 77-inch overall height, but with the pop-top open when at a campsite, you get full headroom. A curb weight of 3,560 pounds makes it light enough, and it's fully equipped except for toilet facilities. It sleeps four in two full-size beds (one in the pop-top, one in the back), has running water, propane stove, three-way refrigerator and storage for food, clothing and gear. At a suggested price of \$15,800, its cost is comparable to the pickup-chassis compact motor homes.

Volkswagen of America Inc. is at 888 West Big Beaver Rd., Troy, Mich. 48099.

Minivans on the way

While the full-size, V8-powered vans may not convert well into 20-mpg motor homes, the new crop of minis have excited quite a lot of interest from conversion companies. Motor home versions are already starting to appear. The Chrysler T-115, Toyota Van, Mitsubishi Vista and VW Vanagon are here now (see *PM's Minivan Test: T-Van's The Tops*, page 92, Apr. '84) and GM's M-Van and Ford's Aerovan are in the wings.

Rent first

One of the best ways to learn whether you and yours would really enjoy a motor home enough to own one is to rent before buying. Many dealers have rental programs for motor homes of all sizes, including the compact.

If possible, find a motor home show near you where you can see a number of different sizes and types. For general information or a listing of dealers in your area, contact the Recreational Vehicle Industry Assn., Box 204, Chantilly, Va. 22021.

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GM'S NEW C-CARS

(Continued from page 77)

other A; quality, however, was spotty on the cars we drove.

The Buick Electra T-type showed obvious depressions in its hood where

you push to close it. Elsewhere in the hood and side panels, the paint bore unmistakable ripples and waviness. One Fleetwood had wind whistles around its rear window. These were regular cars, not handbuilt prototypes.

In sum, though, GM's big new front-

drivers are worth an examination. They continue a long GM tradition of good value for big-car money and a high level of creature comfort. There are few real surprises here for traditional big-car buyers, who have not been short-changed by this fwd downsizing. **FM**

LOOKING UNDER THE HOOD OF GM'S C-CARS

Their wedge shape makes them look like stretched intermediates, but under the skin the new GM transverse-engine, front-drive C-cars are very different engineering packages.

Cadillac's models are the engineering leaders, with a two-computer system far ahead of anything else in monitoring and diagnosis. Push the right buttons and a mechanic sitting in the driver's seat can tell as much in a minute as if he spent a day

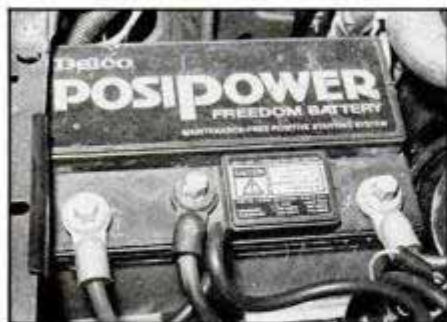


Master ground post for two-wire electrical system is located at Buick/Olds firewalls.

tearing apart the dashboard. He can also tell if many under-hood parts are working without making under-hood connections, and without electronic testers costing thousands of dollars.

Cadillac calls the two computers the engine control and body control modules, and they "talk" to each other because each has information the other can use.

The body computer controls the radiator's dual electric cooling fans, and with inputs from the engine computer it knows exactly



Buick's two-in-one battery has two positive posts and a common negative post.

how fast it should run them. Also, the body module runs the a/c, and it thoughtfully tells the engine computer when it's going to turn it on, so the engine computer can hold engine rpm smoothly against the additional load.

An a/c protection circuit warns the driver when the system loses a pound of refrigerant. If the refrigerant level drops to a point

where compressor lubrication is threatened, the computer shuts down the system to prevent a \$300 compressor replacement.

An optional, three-terminal battery on Buicks is actually two batteries in one case, a boon to parkers who forget to turn off their lights. One battery section has 400 cranking amps., the second 230, for a total of 630 amps.

Normally, the car uses both to start. But if you leave the headlamps on, all you kill is the 230 part. You can start on the 400 amps., and then both sides will be recharged.

Buick, Olds and Cadillac have another chassis electrical improvement: a single ground under the hood for all body wiring. This means all lights and accessories have two wires, one from the current source and a second into that ground post. If the ground is clean and tight, no one has to search all over for corroded connections and/or loose grounding bolts and sockets. The single



A silicon-filled clutch in the Cadillac transmission masks torque converter lockup.

ground is at the upper right of the engine compartment on the Buick and Olds, on a front engine mount stud near the starter solenoid on the Cadillac.

Cadillac didn't simply shoe-horn its 4.1-liter, aluminum V8 sideways into the C-car. It reworked the engine, shortening it by more than 3½ inches to provide a serviceable fit.

One step was to install a single serpentine drive belt to replace the original four-belt setup. It also built an ultrathin water pump of steel.

Clever new transmission

The engines are coupled to a new four-speed-overdrive automatic transmission called the 440. This lightweight, compact box has only two planetary gearsets, instead of the three normally used for four forward gears.

The introduction of the C-cars is months behind schedule due to premature wear of the transmission band that controls 3-2 downshifts.

The solution was to increase the band surface area at the servo end by widening the band. The load remains the same, but the greater area reduces the unit loading, for longer life. The servo end of the band now has a triangular look, something unique in transmission band design.

The transmission has the now-standard lockup clutch. But Cadillac has an innovative addition that makes the lockup something



Engine compartment on 3.8-liter Buick V6 is so uncluttered you can easily remove the valve covers—a modern rarity.

you can't feel while driving. On the Caddy V8, power flows not through a rigid mechanical connection, but through a silicone-filled housing, much like a cooling fan clutch. There's a 40-50 rpm loss through the coupling that's enough to eliminate harshness, so Cadillac can engage the clutch at speeds as low as 20 mph—half that of other C-cars—which improves city fuel economy enough to more than compensate for the loss through the coupling.

Backwards brake adjuster

The self-adjusting rear drum brakes are basically a standard design, but instead of turning the star wheel when you're braking in reverse (the usual way), this adjustment occurs when you take your foot off the brake pedal. At this time, there are no spring loads and braking forces to compensate for, so adjustments can be more consistent. There's less likelihood of the old overadjustment problem, which not only affects brake performance, but lining life, as well.

—Pete Warren

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The Model 25 has a powerful 60 watt motor which produces 2500 psi nozzle pressure to deliver up to 9 ozs. of paint per minute! A patented ball joint transmission ensures durability and long life. And a special new pump design enables you to use this gun for almost any job!

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There are all kinds of ways to make money. Good golly, Molly — if anyone knows that, I do! For the past 20+ years I've concentrated on finding, investigating, creating and specifically singling out only the very finest legal and ethical methods for carving out a mass of wealth in a hurry. But believe me, in all those years never have I experienced anything remotely as exciting as this one!

Recently, I came across a fairly new way to make big bux, but after a thorough study I discarded it because it required too much investment of time, money and personal effort. But my study did serve as inspiration to develop yet another fantastic and unusual wallet-fattener — something that until now has never been done — yet fully complies with the tough set of standards I'm noted for demanding of any potential wealth-producing concept:

- Must be able to be started with minimum investment
- Must be possible to start at home and not interfere with family life.
- Must be able to be started and run initially by one man or woman
- Must require only a few hours of spare time per week
- Must have realistic annual profit potential of \$40,000 or more

Well, this one goes way beyond my usual rigorous test. Get this: This extra-ordinary money-maker® allows you to:

- Start at once — within 30 seconds of studying my report
- Invest not a single cent
- Accomplish everything without leaving your home — heck, you can do it from your favorite easy chair whilst eating pizza or petting the dog (or vicey versa!)
- Have a potential net profit (not gross ... net!) of \$100,000.00 by the end of 90 days — tops. And that's cash, not theoretical or paper profits.

Naturally, you're wondering what all this is — but I'm not going to tell you here. No, it's going to cost you ten

For the past two decades Du Vall has captured the imagination of men and women the world over by providing solid, unique direction for their quest for financial freedom. His firm is headquartered in Michigan with international marketing offices in Hong Kong (known as DAX International, John W. Lane, President). In addition to producing some three dozen publications on money-making/self-improvement themes, DuVall is also the creator of the popular Derek Dax adventure/mystery/romance series and the author of the political intrigue novel, "The Big Dream" (published by Lyle Stuart, Inc., New York). Unlike most, he has never had to resort to outlandish money-back guarantees to attract only the finest DAX-DOERS worldwide and no such policy is expressed or implied.

His writings have been used in numerous style and content workshops and accredited courses at such institutions as California State University, UCLA, Fordham, University of Illinois and Worcester Polytechnic Institute.

smackers to find out. But I will tell you what it isn't so you'll not be off on some wild goose chase:

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David Roman, Editor, ROMAN REPORTS, Ohio

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2. Do the only sensible thing. Send me the ten bux and get started on wearing in that path to the bank.

P.S. One more thing (say, this Du Vall is a windy so and so, isn't he!). There are lots of people right now in bad financial straits. I hope you're not one of them, but if you are, having read this ad you now have absolutely no excuse for being broke, because as the saying goes, "This is it!" This could truly be the once-and-for-all solution to any money miseries you have. I guess you'll have to take my word for it until you receive these fabulous reports — but if it eases your mind any, over 1,000,000 men and women worldwide have been, over the years repeat buyers of my books, courses, reports, cassette tape programs and newsletters. There must be a reason ...

— Dean F. V. Du Vall

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OWNERS REPORT: FIERO

(Continued from page 75)

and it's true: Way back at the beginning of the 1984 Corvette's development program, GM's designers projected that car to become very nearly what the Fiero is today. So the similarity goes beyond front-end design and even beyond the plastic body—it amounts to a root kinship.

A Wisconsin mechanic became one of many respondents who mentioned the similarity, but he put it a different way: "I've followed the Fiero's development in the car magazines for about two years and had pretty much made up my mind to buy one. As a former owner of 10 Corvettes, I feel the Fiero is what the new Corvette should have been in terms of size. If it came with an aluminum V6, 200 hp and a European

name, it would cost \$35,000 and be a steal at that!"

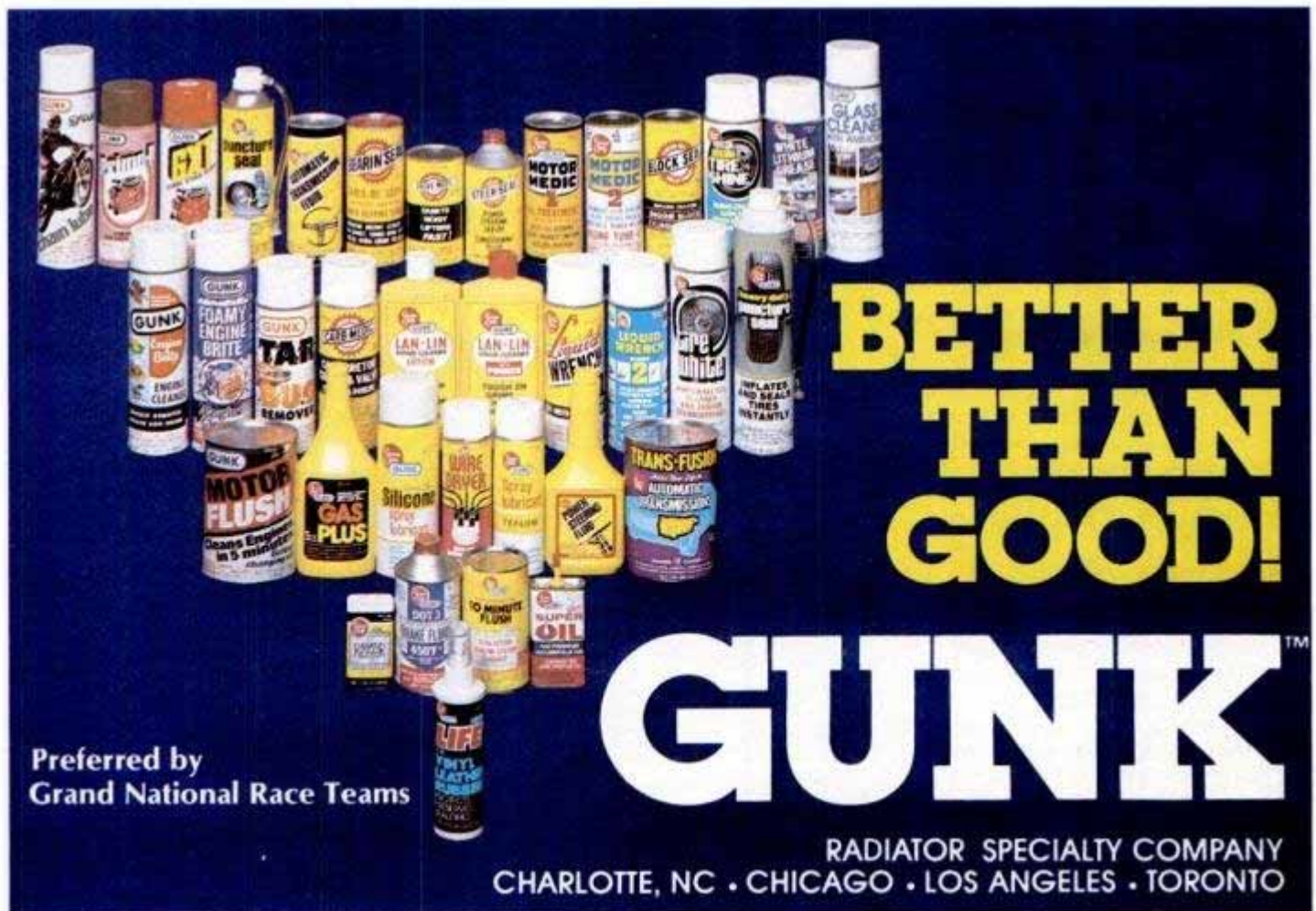
Many owners referred to their Fieros as "sports cars." Pontiac, however, views it more as an economical, sporty commuter. But just as Vette fanciers tend to be more up on cars, so are Fiero owners. No Fiero driver felt lukewarm about his or her automobile. And when things went wrong mechanically—as

(Please turn to page 204)

SUMMARY OF 1984 PONTIAC FIERO OWNERS REPORTS*

Total miles driven 863,922	Specific dislikes:	Comfort opinion:	Number of vehicles owned:
Average miles per gallon	Not enough trunk space 26.1%	Excellent 64.3%	This car only 24.1%
Four-speed manual	Hard shifting into low gear 14.1%	Good 32.3%	Two cars 34.3%
In town 24.0	Needs more horsepower 12.0%	Average 3.4	Three cars 22.6%
On the highway 31.1	Disappointing mileage 7.6	Poor 0.0	Four or more cars 19.0
Three-speed automatic	Hard to park (heavy steering) 7.2	Had any mechanical trouble?	Makes of other cars owned:
In town 23.2	What changes would you like?	Yes 54.9%	Chevrolet 43.3%
On the highway 29.7	More powerful engine 19.0%	No 45.1	Pontiac 31.3%
Transmission choices:	Five-speed transmission option 15.9	What type of trouble?	Ford 15.4
Three-speed automatic 50.0%	More luggage capacity 12.4	Electrical 27.8%	Oldsmobile 13.0
Four-speed manual 50.0	No changes 8.5	Manual shifter 17.9	Buick 12.5
Why did you choose the Fiero?	Easier shifting 8.5	Headlamp mechanism 8.6	Would you buy another Fiero?
Styling 85.5%	How much did you pay?	Brakes 7.3	Yes 69.7%
Price 27.5	Average \$11,213	Windshield wipers 7.3	No 5.5
Made in America 16.8	Range \$8,878-14,000	Dealer repairs satisfactory?	Maybe 24.8
Economy 16.4	Workmanship opinion:	Yes 65.8%	Would you buy another Pontiac?
Handling 13.4	Excellent 56.6%	No 34.2	Yes 73.4%
Specific likes:	Good 40.4	Dealer service opinion:	No 3.0
Styling 84.4%	Average 2.6	Excellent 30.7%	Maybe 23.6
Handling 63.1	Poor 0.4	Good 38.1	Age distribution of owners:
Economy 25.1		Average 19.3	15-29 years 37.5%
Comfort 24.7		Poor 11.9	30-49 years 54.0
Stereo system 23.6			50-plus 8.3

*Percentages might not equal 100% due to rounding or insufficient data.



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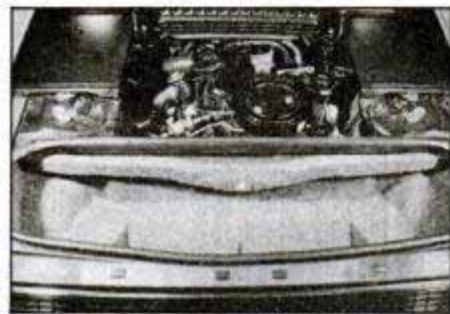
OWNERS REPORT: FIERO

(Continued from page 203)

they're bound to with any car this new—10.6 percent of the respondents to our survey fixed it themselves.

In a way, it's not fair to survey owners of the very first cars off any assembly line. But because we want to report on new models as soon as we can, we have to go to the very first buyers available. We did this with the 1984 Corvette, and we've done it again with the Fiero. However, our sampling contains the sorts of early production glitches that might have been remedied at the factory by the time you read this.

The biggest headache with early Fieros involved the electrical system. In some cases, the engine's ECM (electronic control module) for the throttle-body injector malfunctioned, causing jerky performance. A North Carolina store manager complained that his dealer had replaced the ECM three



Luggage compartment behind the engine is deep, but narrow. Soft bags are the easiest to pack into the area.

times, always under warranty, "but it's time-consuming and an annoyance to have to keep going back."

Mostly, though, electrical problems involved more minor items. "The gauge-panel fuse keeps blowing out," a Minnesota housewife told us, "and this seems to happen when I use the cruise control." The fuse for the electric decklid latch also had a tendency to blow, and a few owners had problems with their wiper motors.

A California business executive: "The voltage regulator went bad, and then I had a series of blown fuses, but service was prompt and courteous." Nearly 70 percent of our respondents rated dealer service good to excellent.

Owners with manual transmission Fieros growled that it's sometimes hard to shift into low gear, and 8.6 percent complained that the pop-up headlights tended to stick. In some cases the lamp mechanisms merely needed adjustment, but in others, the relays had burned out.

Fiero drivers were generally impressed with the way their cars handled. A mail carrier from Michigan said, "This has to be the best handling

car I've ever had the pleasure of driving."

A nuclear reactor inspector from the same state added, "I ordered the WS-6 sport suspension, which is expectedly firm, but I prefer to *drive* a car as opposed to being carried in splendid isolation. Therefore, the levels of both handling and comfort suit me fine."

A few owners mentioned that the Fiero could use power steering, especially for parking maneuvers. Power steering isn't yet a Fiero option, but it's one that Pontiac is watching. They might offer Saginaw's new electric-servo type, which is now coming out of the

experimental stage. Also, the car's turning radius seemed a bit wide to some owners, especially for a two-seater with such a short wheelbase.

But a New York electrical technician said, "This car handles great. I've owned Jags, MGs and Corvettes, but they didn't handle like this Fiero. The interior design has a way of making you feel snug, secure, in complete control, but there's still that air of roominess in the cockpit. The dashboard looks miles away, yet it's right there, and everything is very functional. Then there's the stereo—absolutely great!"

The up-option stereo won solid



praise from many owners. A Minnesota bodyman said, "The stereo system, with those speakers mounted in the headrests, totally surrounds you with sound!"

The Fiero's Lear-Siegler sport seats brought both good and bad comments. "The seats feel like they're built around you," said a California manager, "and the car handles like it's running on rails." A California network coordinator: "I'm 5-foot-2 and have to put the seat all the way forward to reach the clutch pedal. But because of the many seatback positions, I don't feel I'm sitting on top of the wheel."

A 6-foot-3 businessman figured he was about the tallest person who'd fit into a Fiero, and even at that he was having trouble getting in and out. A Nebraska nurse added, "Seats need more thigh support. A person with long legs suffers on long trips." And a few wide-bottom drivers considered the seats too narrow.

Most owners voiced satisfaction with the Fiero's performance, and a Tennessee engineer wasn't alone when he commented, "I enjoy driving my Fiero. It handles and corners well, and the four-cylinder engine delivers all the power I desire." But we also heard

from those who voted for more power. "Add a turbocharger," suggested a Maryland electrical engineer. That's another item Pontiac is considering.

"I'd be happier with the V6 engine," lamented a New York voucher clerk. She, like many Fiero owners, had heard about the forthcoming V6 and wished Pontiac had offered it earlier. Others noted the lack of a five-speed—another possible future option. So far Pontiac lists just the 92-hp Four with four-speed or automatic for the Fiero, but off-road HO parts are available from dealers, including one kit that makes the Iron Duke deliver around 250 hp. Speed shops are likewise selling hop-up and suspension goodies.

Plastic body wins praise

Overall workmanship was judged good to excellent by 97 percent of our respondents—right up there with the very best from Europe and Japan. The plastic body contributed to that fine rating and came in for quite a bit of praise. A New Hampshire steamfitter pointed out that "the body can't rust," and a Michigan housewife said, "So far as body alignments go, this is the best car we've ever owned. The pop-on body panels don't dent."

A Wyoming mining foreman wanted better visibility. "There's a blind spot at the fake rear side glass," he wrote. "Pontiac could improve this, I'm sure." An Ohio hostess felt the choice of body colors was too limited when she bought her car: "Just red and white."

Several respondents also mentioned a lack of luggage space, although this came as no surprise to anyone. The absence of a real glove compartment, no room to hang a suit, and the fact that a flat tire wouldn't fit into the Space-Savr spare compartment bothered a few. "But I'll sacrifice the space rather than see a change in the body design," added an Illinois stock clerk.

Most owners gave Pontiac great credit for a job well done. A Wisconsin foundation assistant wrote: "The Fiero has renewed my faith in the American automobile. It's my first Detroit product in 15 years, and it's excellent in every way. I look forward to driving it. Many people ask me about the car, and others look over their shoulders to grab a peek."

A Texas programmer: "The potential of this basic design is limitless. It'll be interesting to see what Pontiac does in the future. If the Fiero had 150-plus horses and a larger fuel tank, it could compete with cars costing twice as much, notably Corvette, Porsche, 300-ZX and Alfa Romeo. As it is, the Fiero is an exceptional value for the price."

And finally, from a Florida corporate general manager: "Candidly, it's a tremendous ego trip!"

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SOFTWARE DOES WINDOWS

(Continued from page 85)

data into a graph. When the desired graph is finished, it can be transferred directly into the word-processed report.

It's even possible, with Apple's Macintosh computer, to open a window into a "screen painting" program, draw a block diagram, flow chart or picture—which, perhaps, represents a manufacturing process—and then transfer the "painting" into a word-processed document so the printout contains both the text and the diagram.

The first windowing

True windowing was first applied to personal computers in Apple's Lisa, in which the screen represents a conventional desk or workspace, with various folders (or windows) on the desk that the user can open as needed. Just as with real paper folders, Lisa's electronic folders can be opened, stacked one



DESO package windows its menu, a spreadsheet and a dBASE II menu on IBM PC.

on another, even positioned so the eye can flow easily from one folder to the next. Or the material can be moved from one folder to another.

Lisa's windows and their data are manipulated via a positioning device called a "mouse" that's moved within a small area of the desk or tabletop. As the mouse is moved, it causes a pointer on the computer's screen to move in the same general direction. As a rule, window software can use a mouse or the computer's cursor-positioning keys.

Pictorial representation

Each of Lisa's functions and programs is represented by an icon, a pictorial representation. For example, the icon of a file folder represents a datafile, a quill pen represents a word processor and the icon for an internal clock is a clockface.

What appears to be a wastebasket or garbage can is "delete," an icon of a page with doodles is the graph program, while an icon of a page with columns and rows is the spreadsheet ('Calc) program.

To use a program or function, the

(Please turn to page 209)

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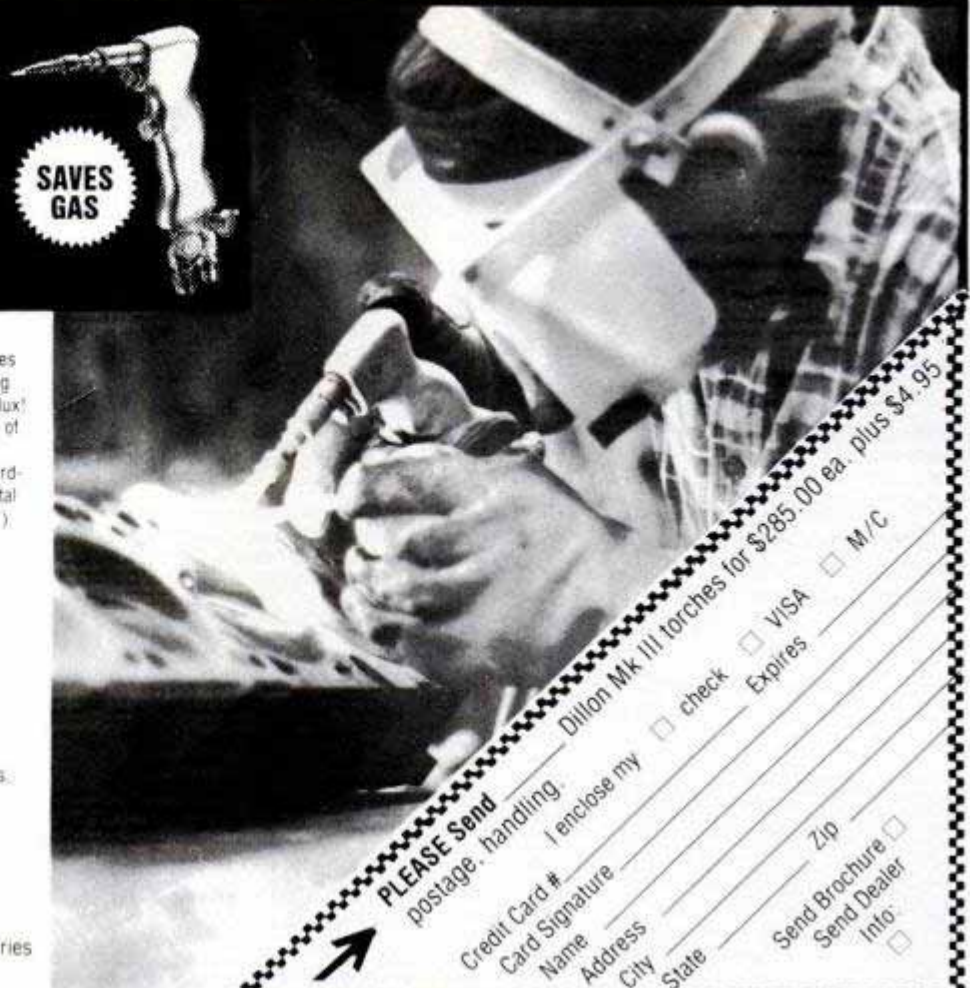
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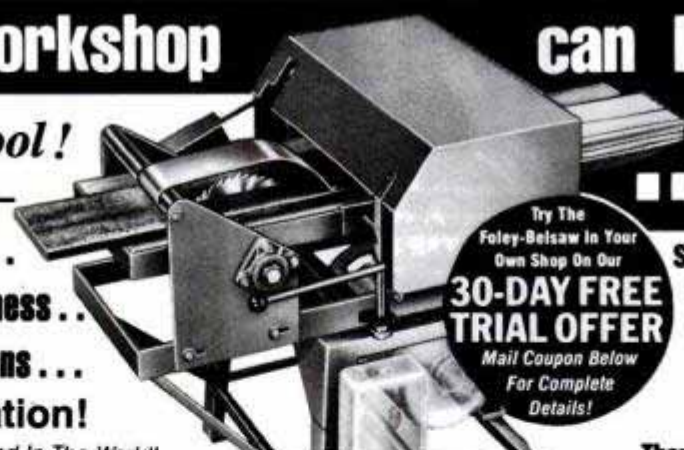
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SOFTWARE DOES WINDOWS

(Continued from page 207)

pointer is simply positioned directly on the icon. Once the software or function icon is selected, specific menus appear on the computer screen. Again, all you have to do to select a menu is position the mouse/pointer on the desired item.

Precisely how the windows are implemented is determined by the specific software and/or computer. Apple provides the window software in the Lisa as an integrated package. That is, each program is specifically intended to relate to the others. The user need not obtain all the programs at once, but any software to be run must be specifically for use with the other software in the series.

Other window software

Other kinds of window software use somewhat different concepts. Some substitute on-screen menus for the

items also integrates what was historically incompatible software without modification to the programs. For example, the package will window Lotus 1-2-3 with Wordstar and dBASE II, transferring data among programs as needed.

Bundle of programs

On the other hand, the *Visi On* window package from VisiCorp—the people who brought you *VisiCalc*—is not restricted to a particular computer. But it's bundled with four *Visi On* programs: word processing, electronic spreadsheet, graphics and a specialized

"electronic query" database. *Visi On* can integrate these four programs with other software from VisiCorp, such as *VisiCalc* and *VisiFile*.

The only substantial restriction on windowing is the required memory and disk storage, which—depending on the particular window software—varies from about 128K RAM and two floppy drives to more than a 500K RAM and a 5-megabyte hard disk.

If windowing is what you need to maximize personal computer operations, make certain it can run in your existing system, or be prepared to upgrade to a windowed computer. **PM**



Visi On shows three windows here: its menu, a bar graph and *VisiCalc* spreadsheet.

icons. Another is a complete software package which can be installed on different computers. Yet another kind of window software, such as Microsoft's program actually called *Windows*, permits the use of virtually any type of software.

Windows integrates formerly incompatible software, such as MicroPro's *Wordstar* with Microsoft's *Multiplan*. It is also transportable between computers which use similar MS-DOS conventions. That is, the software that runs on an IBM will also run without modification on a Texas Instruments (or Zenith, or other) computer, using the individual data-files and programs developed for each specific computer. In plain terms, this means that you will be able to take your IBM version *Multiplan*, run it on a Zenith computer with data prepared on the Zenith, and finally integrate the IBM *Multiplan* and Zenith data into a document that is being prepared on a Texas Instruments computer.

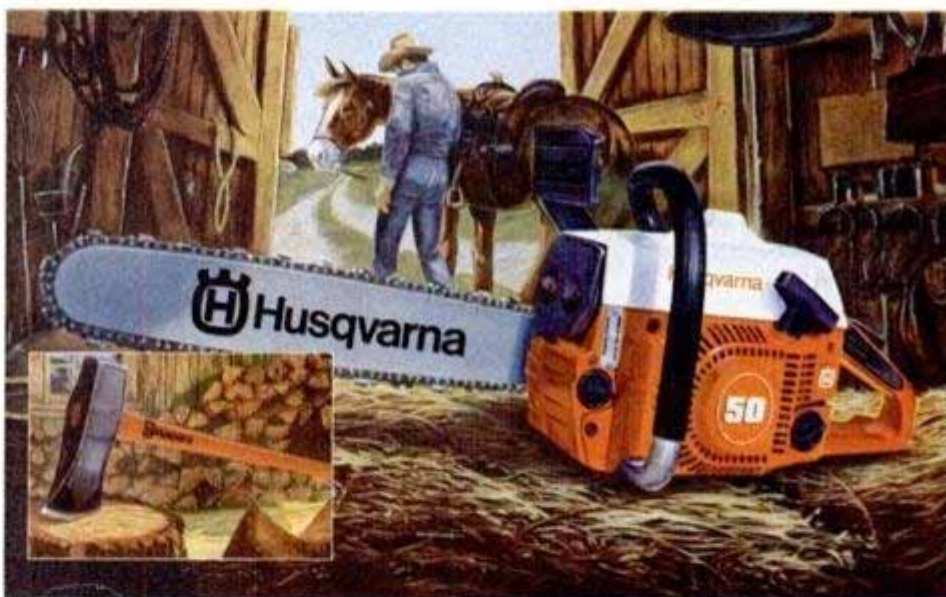
The *DESQ* multiwindow software package from Quarterdeck Office Sys-

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4 HANDSOME FENCES

(Continued from page 89)

straight, nonwarped lumber to ensure proper alignment. Test-fit the gate to make sure it is plumb before installing the hinges.

1 White picket fence

The white picket fence has become an American symbol of the comfort and warmth of home. The crisp lines of the low fence shown at the beginning of the article set off flowers and vines. This low fence with spaced pickets is a handsome way to enclose your property

without obstructing the view. Posts on this fence are of 4-in.-dia. cedar. Rails are 1x2s with 1x3 pickets topped by a corner guard. The fence is of standard post and rail construction. After carefully aligning posts and installing rails, the time-consuming job of installing pickets remains. You can speed this task and ensure equal spacing between pickets by ripping a 1½-in.-wide board and using it as a spacer for locating pickets.

2 Lattice fence with brick

The combination of white lattice and brick piers gives an impression of ele-

gance and durability. This graceful fence is built in stages. First lay brick piers. Then secure the prebuilt lattice panels to the piers with lagscrews in lead anchors.

It is particularly important that the piers be in perfect alignment. Pour concrete footings and use concrete, concrete block or brick foundation. Lay the brick piers, checking as you work to make sure that courses are plumb and level. Install a half brick or masonry fill in the center of each course. Install metal ties every sixth course. Place the top course on edge.

Construct lattice panels 1 in. less in width than the distance between piers. Cut the lattice, double inner frame parts and outer frame parts. Test-fit and assemble the outer frame and both inner frames. Install vertical lattice on one inner frame with staples and resorcinol. A 3/8-in.-wide spacing block speeds this job. Secure horizontal slats to the inner frame and to the vertical slats with resorcinol and staples. Temporarily position a 2x4 under the lattice while you are joining members.

Install the outer frame to the inner lattice frame with 6d hot-dipped, galvanized nails. Install the second inner frame. Use side spacers as required when installing the lattice panels to the brick piers.

3 Board fence with lattice top

This stately board fence with lattice top border has the grace of a bygone era. It's appealing to look at and gives privacy to those within.

Posts are 4x4s set into concrete and resting on gravel. Rails are mortised into the posts. Bottom and middle rails are grooved to receive the 1x8 slats. Lattice, available in panels, is cut to size and installed between the middle and top rails, sandwiched between crown molding.

The top arch of the fence over the gate is a double 2x12, cut to shape and laminated together with resorcinol. Vertical frame members are double 2x3s, which join the arch in corner lap joints.

The arched gate rail is made of double 1x12s, each cut to shape, then routed to accept the ½-in. plywood top panel before being laminated together. The arch and stiles are tongue and grooved together. Stiles are grooved to receive the rails and plywood panels. Heavy-duty T-hinges secure the gate to its post.

4 Cedar fence with slats

The most rustic of our fences is the vertical basket weave fence. It's made of cedar. Rails are mortised to the posts, then slats are woven and secured to the rails. Finally, the second bottom rail is nailed to the post and slats. **FM**

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A tool that inlays wood.



A tool that shapes metal.



A tool that deburrs metal.



A tool that carves wood.



A tool that removes rust.



A tool for engraving glass.



A tool for sanding wood.



A tool for grinding hardened steel.



A tool that sands plastic.



A tool that mortises wood.



A tool that shapes plastic.



A tool that shapes wood.



A tool that routes wood.



A tool that polishes metal.



A tool that polishes semi-precious stones.



A tool that grooves wood.



A tool that cuts plastic.



A tool that engraves metal.



A tool that grinds ceramic.



A tool that grinds steel.



A tool that grinds metal.



A tool that hollows plastic.



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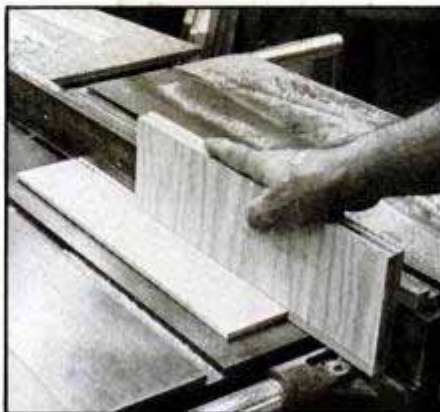
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BUILD PM'S TV BED

(Continued from page 96)

size, and do the same for the tambour groove template. Position the template on one shelf and tack-nail in place. Cut and tack in place the template appendage shown on page 96. This piece gives a straight guide for routing the door entry grooves at both shelf ends.

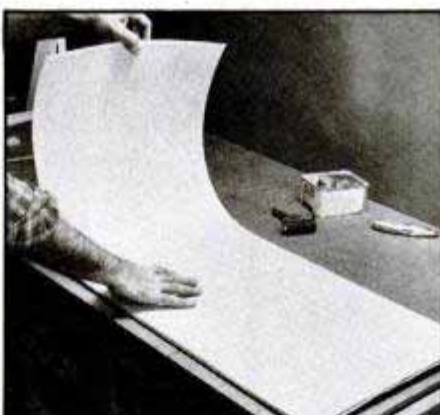


Cut tambour slats from 16-in.-long pine stock so that each rip cut yields two slats. Set table saw blade at 10° bevel and use simple push block shown for safety.

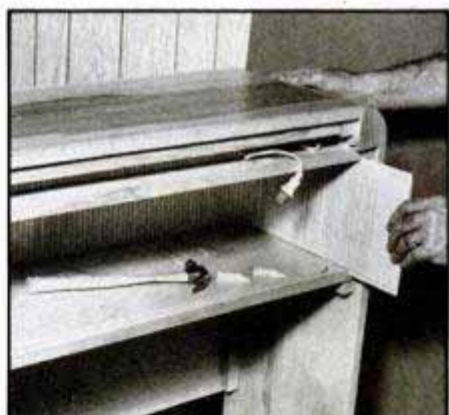
Cut the groove using a 5/16-in.-dia. straight bit and matching router template guide. Don't try to make the whole cut at once; do it in two or three passes. When the straight section of the groove is cut, remove the small template and tack it in the same position at the other end of the shelf. Continue cutting around the main template until the groove is complete. Repeat the same



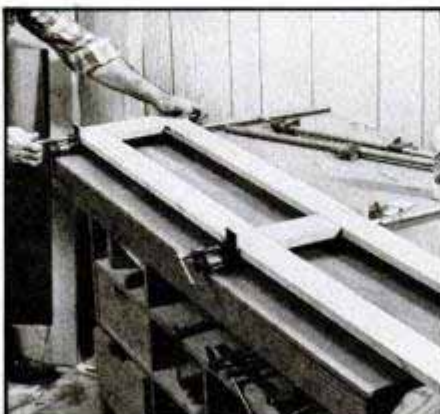
Tape canvas to bench and tack-nail two guide strips at right angle. Tape slats into groups then apply cement to slats and canvas. Butt slats to guide, lower into place.



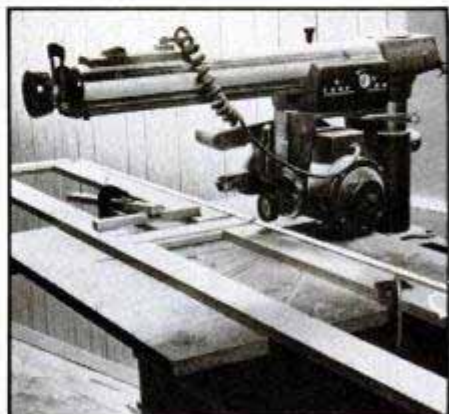
Cut flexible veneer 1 in. longer and wider than slat assembly, then apply cement to both canvas and veneer. Position veneer over slats, press down and roll smooth.



Cut tambour assembly in half to get two separate doors, then feed into headboard from back. When doors clear entry grooves, screw in small blocks to fill grooves.



Glue and clamp bed side pieces so drawer openings are identical. By cutting divider blocks and drawer fronts from one board, grain will match across entire side.



Lay out position of four plywood bed dividers on inside surface of the bed side assembly as shown in drawing. Then cut stopped dados with a radial-arm saw or router.

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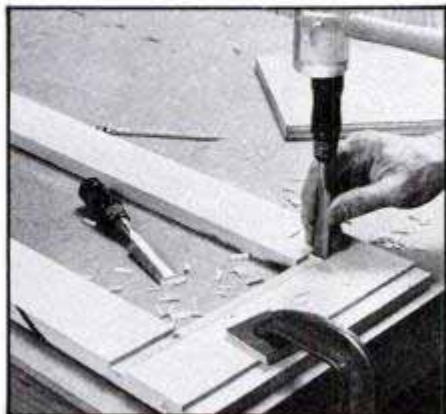
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procedure for cutting the groove on the other shelf.

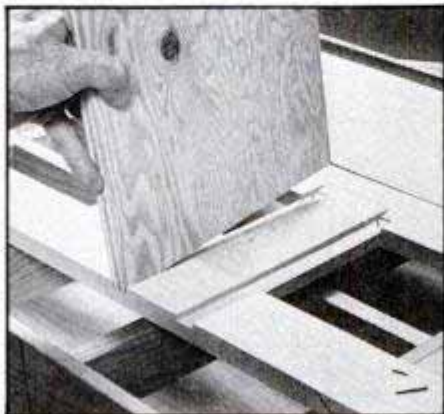
When both are done, cut four small filler blocks shaped exactly like the door access grooves, including a contour at the end to match the outside perimeter of the main groove. These will be screwed in place later to close off the access groove and prevent the doors from catching on it when pushed open.



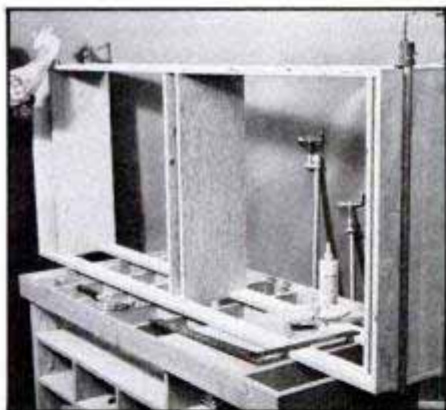
Use a chisel to square up and clean out ends of stopped dadoes. Then test-assemble all bed parts with clamps to check for proper fit. Make any necessary adjustments.

Next, cut out the two lamp openings in the upper shelf. Glue and clamp this shelf to the bottom of the corner blocks.

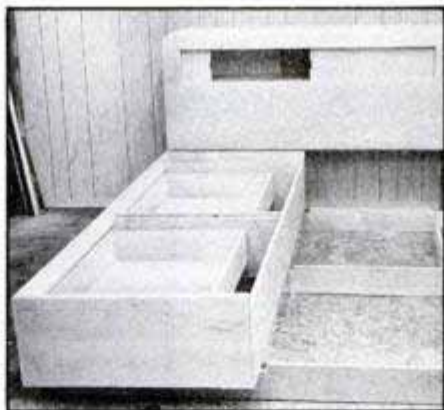
Assemble the headboard facing pieces next. The rectangular door opening is preformed by gluing in place the two short blocks (part D2) at both ends. Cut a 3/8-in. radius on the block ends that face the opening before they are



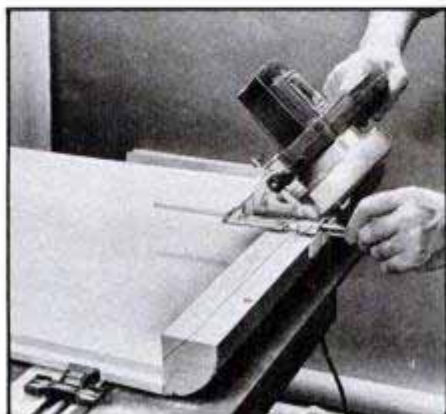
Use one 1/4-in. nail pin near top of each dado to keep parts from sliding during final glue-and-clamp assembly. Make pins by cutting heads off 4d finishing nails.



Glue and clamp bed parts as shown, then check for square. If not square, reposition clamps until parts are aligned, otherwise drawers will not close properly.



Bed section is made in three parts: platform base and two matching sides with drawers. Bed halves rest in base end notches and are joined with two bolts through center rails.



Begin chest construction by joining front panel to corner blocks with same method used on headboard. When assembly is dry, cut 45° bevel on back of blocks as shown.



Lay out position of dividers, then clamp two parallel guide boards in place. Cut stopped dadoes with router. Layout accuracy is crucial for proper movement of TV platform.

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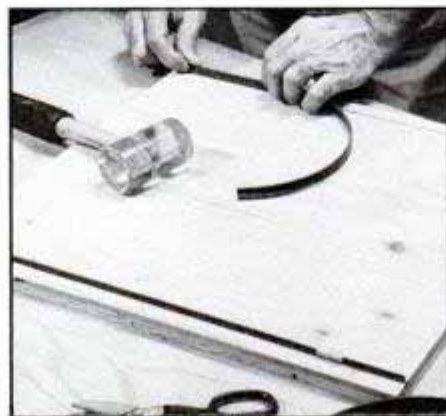
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PM 5-84

glued in place. Clamp the whole assembly for at least one hour, then let it dry overnight.

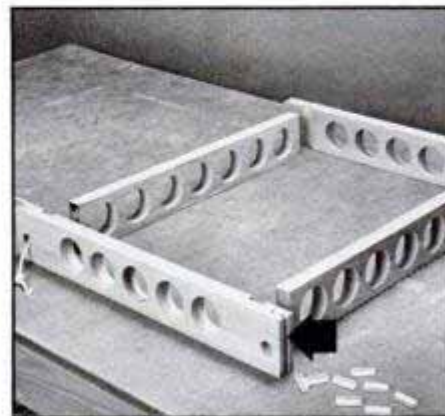
Place the facing assembly on the bench, then place the following parts on top of it: top assembly, lower shelf, sides and cleats. At this point, you should dry clamp the loose parts. This provides a chance to check for fit, squareness and the best clamp posi-



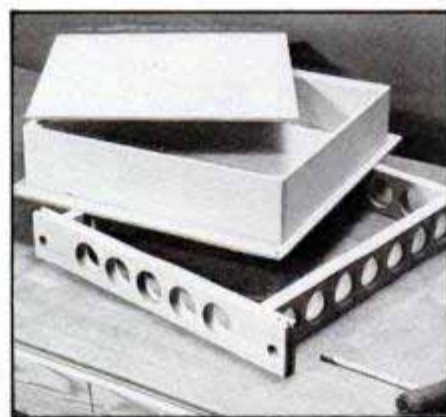
Cut chest dividers to size, then cut two 1/8-in.-wide saw kerfs on inside surface to receive plastic track. Track must fit tightly; otherwise it will loosen over time.

tioning. When satisfied, unclamp, apply glue and reclamp as before. Let the assembly dry overnight.

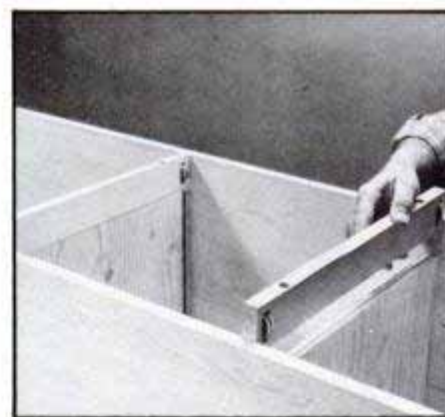
Once again, place this assembly over the back of the facing and trace onto the facing the outline of the sides and top. Cut the facing to match, then glue and clamp it to the headboard assembly as shown. Be sure to include all remaining cleats.



Make TV platform base from maple stock so that grooves [arrow] which hold plastic slides are strong. To reduce weight, bore holes through boards with hole saw.



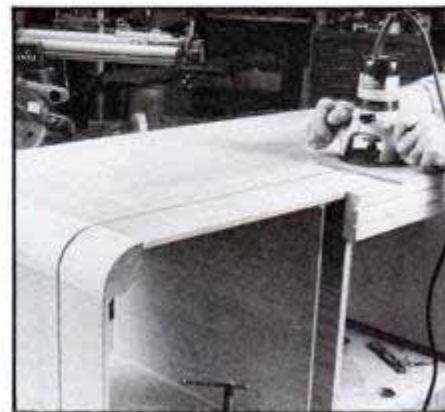
Assemble TV platform base and box, then cut top to size. Check for proper fit. When satisfied, cut electrical cord clearance holes in top and box bottom (see drawing).



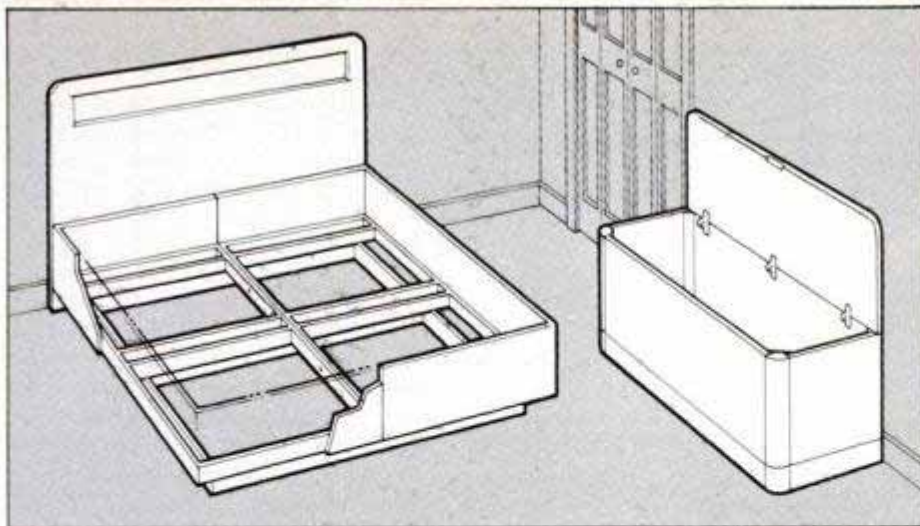
Glue and clamp chest dividers in place, then cut parts for pulley board and assemble with wheels installed. Bore screw clearance holes through board and attach to divider.



Photo shows relationship of lift mechanism parts in the TV platform. The platform slides on tracks and is counterbalanced by a weight box on each side. Cords run from boxes and over the pulleys to platform base.



Cut a shadow line groove on the chest using router that is mounted on a 1/4-in. plywood panel with a block nailed to one side. Keep the cutter perpendicular to the contour when you are rounding a corner.



Keeping the same basic shapes, you can alter this bed to suit your needs. To make the headboard shown, assemble the facing as described before, then cut a rabbet around the back of the opening and attach a 1/4-in.-thick flat maple panel. To include a box spring, and omit the drawers, build two

Next, cut the pine slats for the tambour doors using a table saw. First, rip a 10° bevel on one side of the board, then rip all the slats to width, flipping the board end-for-end after each pass so all parts will have a double bevel.

Tape the slats into groups of 10 or 12 to make assembly go faster. Then tape a piece of medium-weight canvas on the bench and tack a guide strip along one side and one end at a precise right angle.

Apply a coat of contact cement or veneer glue to both the canvas and the slats, let it set, then apply a second coat. Once the second coat is dry enough, according to the manufacturer's instructions, carefully butt the slats to the guide strips and lower into place. They will bond on contact and should be rolled smooth with a rubber-faced roller to ensure uniform adhesion.

Next, apply the flexible maple veneer to the other side of the canvas, using the same contact cement. Roll it smooth and let it dry overnight. Trim the

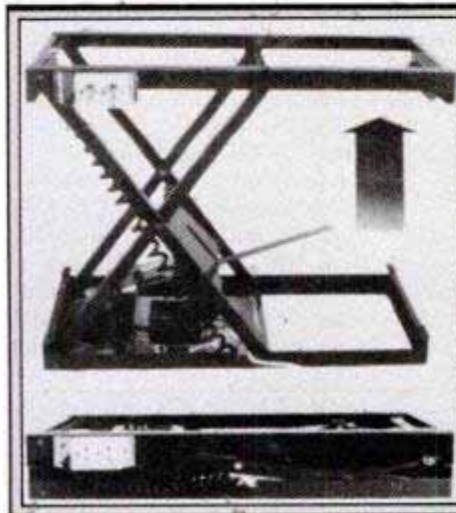
3 1/2-in.-high frames with the dividers positioned as before. The platform base remains the same, as do the overall dimensions for the bed sides and ends. And to remove the TV from the blanket chest, just build an open case, then make the lid one solid piece and hinge it from the back.

veneer to the edge of the slats, then cut the whole assembly in half lengthwise to yield the two separate doors. Finish-cut each door to size, then cut the rabbets along the top and bottom edges. Cut the back to size and set it aside. After all parts have been finished, and the doors installed, screw the back in place. Sand the whole assembly with 220-grit sandpaper.

Bed section

The bed section is made in two halves so it can be moved easily. Begin by cutting the bed side pieces to size, then glue and clamp them together. Align the middle and end blocks carefully so that both drawer openings are the same size. For professional results, cut these blocks and the drawer fronts from one piece of stock. By doing this, the finished bed side will have a continuous grain pattern.

When the side assemblies are dry, glue in place the 1/4-in.-thick maple edging pieces at both ends. These are dec-



Electric lift mechanism

If you'd rather use an electric mechanism to lift your TV, the unit shown at left—called Accu-Lift—is a good alternative. Made of cold rolled steel, it has a 110-volt motor with worm gear drive that can lift up to 175 pounds. The framework rises to 21 in., but is just 5 in. high when folded. The minimum inside dimensions for its cabinet are 18 in. wide, 34 in. long and 27 in. high. The unit weighs 48 pounds and features either a key-operated or toggle on-off switch. It's available from Armor Products, Box 290, Deer Park, N.Y. 11729, for \$495 plus shipping. With a remote control switch, it's \$590, plus shipping.

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orative and can be eliminated if you choose. However, if you do, be sure to add the extra length to the bed sides to make up the difference.

Next, cut the stopped dadoes for joining the plywood dividers to the bed side using a router or a radial-arm saw. Insert nail pins to keep dividers from sliding during gluing and clamping.

Cut the middle bed rails to size and cut the divider dadoes in them, making sure they line up exactly with the dadoes cut in the bed sides. Next, cut the ends to size and add their edging. Then cut the rabbets in the end pieces for the middle rails and the rabbets in the sides for the bed ends. Glue and clamp all parts together, including the corner glue blocks. Check the whole assembly for square.

Assemble the platform base as shown in the drawing, making sure to cut the notches in the end and middle rails. Assemble the drawers and install them with full extension slides. Keep in mind that you should base your drawer dimensions on the actual size of the opening you have. Do not cut the drawer parts to the size given in our materials list until you are certain that your opening is the same size.

The same caution applies to the drawer fronts. Make them fit your opening with a uniform 1/16-in. space

around the perimeters. Cut the finger holes to size and bevel the inside top edge to form a finger grip. Then attach them to the drawers by driving screws through the back of the false front and into the back of the maple front.

Finally, round the entire outside top edge of the bed sections to a 1/2-in. radius. Then finish-sand all parts with 220-grit sandpaper.

Chest

This chest was designed to accommodate the 12-in. TV shown. However the same basic system will work for slightly larger sets that weigh more. If your TV is wider, just make the platform and its compartment wider. If it's heavier, add weight to the boxes.

Begin construction by joining stock for the front, back and side panels, and by cutting rabbets in their bottom edges to receive the cabinet bottom. Then cut and join the corner blocks to the front using the same methods employed on the headboard. Next, carefully lay out the position of the stopped dadoes in the front and back panels. Proper functioning of the TV platform relies on alignment of the chest dividers that go into these dadoes. Use a router to make the cuts.

Cut two 1/8-in.-wide x 1/4-in.-deep grooves in each divider for the plastic

track. Install the track, then glue and clamp the dividers in place. Cut and install the bottom.

Cut the platform base parts to size and bore a series of holes through them to reduce their total weight. Then cut the end grooves on the front and back boards for the plastic slides.

Next, cut the pulley boards to size and cut the notches at each end to accommodate the wheels. Install the wheels with steel pins and cover the ends with the small maple blocks shown. These wheels were taken from ordinary hardware store pulleys.

Build the weight boxes and bore a cord clearance hole through both ends. Apply the four self-sticking plastic slides to each side of both boxes, then slide the cords through the holes and tie knots in each underneath the box.

Cut the lead weights to size and place them in the boxes. The weights we used came in 9 1/2-in.-long sections and were easy to cut with a band saw or hacksaw. If you prefer, use strips of 3/16 x 2-in. steel bar of equal weight.

Next, attach the pine strips, which form the track for the weight compartment partitions, to the chest front and back. Cut and assemble the parts for the platform box. Then cut electrical cord clearance holes through the box. Install blocks (ZZ1) to keep the platform from pinching the TV cord.

Attach the platform box to the base and slide it into the plastic tracks. Insert the pulley boards and screw in place. Then assemble the weight compartment partitions, feed the cords over the wheels and slide the partitions into place. Tie the cords to the platform.

Finishing up

Glue stock for the lids in one piece, then cut out the three separate lids so that when they are attached to the chest, the grain will line up across the entire surface. Scribe and cut each to fit and attach them with two hinges each.

Complete the job by sanding the project thoroughly with 220-grit paper. Remove dust with a tack cloth, then apply one coat of sanding sealer. Allow it to dry, sand lightly again and clean with a tack cloth. Now apply a finish of your choice. We used two coats of Deft Semi-Gloss Clear Wood Finish.

Note: A hardware kit containing many of the parts used in the chest is available from Armor Products, Box 290, Deer Park, N.Y. 11729. Included are the six hinges, 8 ft. of track and eight track slides, 29 pounds of lead weight, and a strip of self-sticking slides. The \$56 price does not include shipping charges. Excluding the weights, the kit is \$15, postpaid. The flexible maple veneer for the doors is available from Constantine's, 2050 Eastchester Rd., Bronx, N.Y. 10461. **PM**

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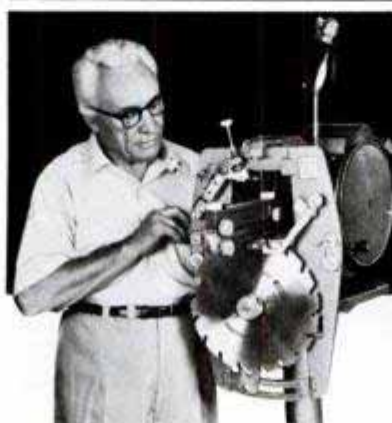


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SCIENCE GOES TO BAT

(Continued from page 74)

speed of any pitcher's throw—or any player's throw from any position—the data provided by the gun tells the manager when his pitcher is tiring. If your man throws at an average of 85 mph, a drop below 80 is a good indication that he's ready to come out, despite the usual protestations expected from a pro.

When George Bamberger was manager of the New York Mets, he used a Jugs gun to inspire confidence in pitcher Neil Allen. "Allen didn't think that he was throwing as hard at the beginning of 1983 as he had in 1982. He had hurt his arm in '82 and was worried about his fastball," Bamberger notes. So the manager had radar checks kept on Allen. "I found he was throwing 1 mph faster after the injury. You see, players have more excuses than Carter has pills, and maybe the radar speeds can give them confidence."

Senselessness works

Confidence-building has been accomplished by several clubs using a sensory deprivation chamber. It's an enclosed titanium globe that locks out sound, vibration and the whole world. The Phillies use their chamber just to relax players. But in the coffin-shaped chamber used by the Giants, there's a TV screen on the ceiling. The player can stretch out on his back and watch game tapes. The player is the star of the show. He sees himself hitting home runs, making diving catches, throwing on target—the works. The Giants' Iacini says the players "watch themselves perform perfection."

Videotape is used by some clubs outside the realm of a deprivation chamber. The New York Yankees let outfielder Dave Winfield watch himself on tape to build his confidence. And the Dodgers sit down players and coaches before a video monitor to talk out problems the player is having.

The California Angels keep an eye on videotapes to help coaches work out strategies for upcoming games. Angel players also use the tapes for confidence-building and to study themselves in search of the slightest imperfection. Among those who go to the tapes regularly are slugger Reggie Jackson and hitting star Rod Carew. At one point, the Angels used videotapes to convince pitcher Don Aase to undergo surgery. "We saw his arm was 5° higher than it should have been at the release point," says Angels assistant trainer Ned Bergert. "That caused distress to develop at the elbow."

Sports Vision Institute's Teig is working with Indianapolis engineer Mel Knopf on a revolutionary TV system. Still under development, it will

eventually project a three-dimensional holographic image on a screen. An electronic bat you can hold in your hand will be covered with a photochemical that registers a hit when you touch a laser beam projected from the screen.

With this system, a batter will be able to play standard video cassettes of opposing pitchers. A computer will translate the video image into the three-dimensional holographic figure. The pitcher will wind up and throw, and the three-dimensional baseball will come toward the batter, who's standing at an indoor home plate. If he swings and connects, the computer will register a hit and even analyze its distance and direction. The 3-D system may be available for the 1986 off-season.

In the meantime, batters are using a



Engineer Terry Bahill demonstrates glasses that measure a batter's eye movements.

twin-wheel pitcher indoors in the off-season to keep the sting in their swing. Gone are the "Iron Mike" pitchers that catapulted a baseball toward home plate. All they could hurl were fastballs. And gone are the pneumatic cannons that also hurled only fastballs right down the middle. Today, major league clubs use the twin-wheel pitcher that can spot a curve, slider, fastball, even a knuckleball, at any part of the strike zone.

The twin-wheel pitchers are set on azimuth mounts atop tripods so you can turn the housing in any direction to produce left-hand, right-hand or overhand pitching. The wheels spin in opposite directions. Put a baseball in the chute of the machine housing and it rolls down between the spinning wheels, each of which turns on an independent drive. Set the speed of one wheel higher than the other and you get a curve. Reverse the speeds on the wheels and the machine throws a

screwball. Set the wheels at equal speeds and out comes a fluttering knuckleball.

In the basement at Yankee Stadium, hitters Don Baylor, Steve Kemp and Willie Randolph work several days a week inside a batting cage facing the twin-wheel pitcher. Eleven other clubs have the pitchers in operation five days a week in the off-season.

The eyes have it

Muscles, heart, brains—they're all important ingredients in the anatomy of a great baseball player. But the eyes are the windows of a player's very soul. A batter has less than one second to look at a pitch. A fielder may have no more than one second to set himself for an oncoming grounder.

Carnegie-Mellon biomedical engineer Terry Bahill has used a set of diode-equipped eyeglasses to study the eye movement of several big-league players. His technique has already changed the way batting coaches approach the science of hitting. Hall of Famer Ted Williams said he followed the baseball all the way to the bat. But Bahill's research indicates that players who see well beyond the normal range still lose the ball 6 feet before the plate.

The tiny diodes are mounted on the glasses near the pupil, and the glasses are wired to a computer. When the eye moves, the intensity of light reflected near the pupil is reduced and the light reflected from the whites of the eyes increases.

The diodes register these changes and send the data to the computer.

Bahill put these glasses on Pirate outfielder Brian Harper and told him to keep his eyes on a whiffle ball. The ball was on a wire traveling toward him at 90 mph from 60 feet away—about the distance he'd be standing from a pitcher. Bahill found that Harper could move his eyes 110° per second, as compared to the 70° per second registered by a healthy young male. Even so, Harper lost sight of the ball within 6 feet of the plate. Other major leaguers lost it at up to 10 feet away.

Armed with that information, most batting coaches today are removing one of the big pressures from their hitters. No longer are they exhorted to watch the ball all the way in, and this technique, according to one coach, helps the hitter relax and swing more freely.

The late Casey Stengel, who had the luxury of managing Hall of Famers Mickey Mantle, Whitey Ford and Yogi Berra on the same dominant Yankee club, once said, "You can't teach these fellas anything they don't already know." Maybe, Casey, but from the looks of the rising tide of baseball technology, you can give it one heck of a try.

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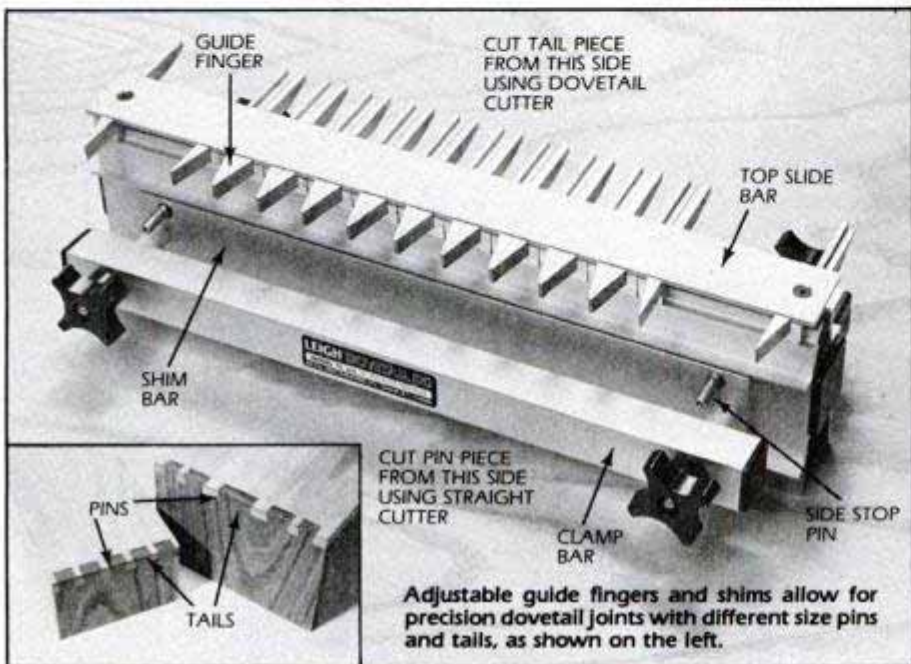
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PM LOOKS AT...

A Dovetail Jig



Here's good news for both the amateur and professional woodworker. It's now possible to make through dovetail joints using a router, thanks to the Leigh dovetail jig. Ordinarily, dovetail jigs cut only half-blind joints with pins and tails of one size and spacing. But the Leigh jig helps cut true *through* dovetails just as you would by hand, only with greater speed and precision.

To use the jig, first position the mating workpieces flush under the adjustable guide fingers. Then secure them by tightening the clamp bars. Space the fingers as desired and lock them in place. The fingers guide the router, which is fitted with a guide bushing, to

cut the joint. The pins and half-pins are formed with a straight cutter while following the angled guide fingers. Make the tails by following the square-end fingers using a dovetail cutter.

The model shown, No. TD-514 (\$155), has a width capacity of 12 in. and can accept a 1/2-in.-thick pin piece and a tailpiece up to 1 in. thick. A 24-in.-capacity model is also available: No. TD-514L (\$288). The 24-in. model comes with a 3/4-in. dovetail cutter.

Leigh dovetail jigs are available through many mail-order woodworking supply houses. For the address of a dealer near you, contact Leigh Industries Ltd., Box 4646, Quesnel, B.C., Canada V2J 3J8.—Rosario Capotosto



Remove top slide bar to position guide fingers; tighten using a hex-key wrench. Note 2x3 support bar clamped to workbench.



Use a router fitted with a guide bushing to cut the joint. Here, pins are cut using a straight cutter. Make the tails on opposite side using a dovetail cutter.

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6 Shop Ideas From PM Readers

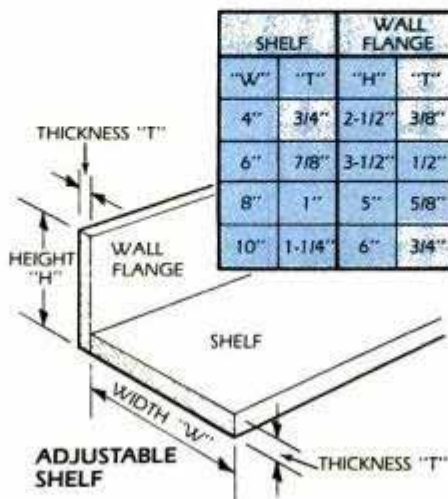
1 Low-cost shelves

Here's a simple way to add shelving to your workshop, garage, office or pantry. The shelves are designed for low cost and ease of fit. But they also have some real advantages over conventional support systems.

The suspending flange strengthens the entire length of the shelf, in the same way that an angle section is stronger than a flat. The suspending flange also protects the wall from damage when awkward loads are shelved. And heavy loading actually increases the shelf contact with the wall, instead of causing the shelf to sag away from the wall, as with most other supporting methods.

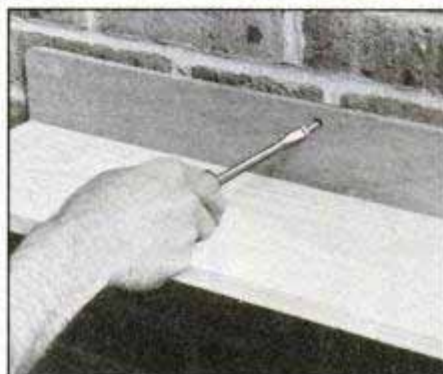
It's important to use only plywood for the wall flange. I've bought inexpensive off-cut strips from my lumberyard. The shelf must be both glued and nailed (or screwed) to the wall flange. Use wood glue and generous-sized common nails, after boring pilot holes.

The table gives suggested widths and thicknesses for the shelves and wall flanges. You can vary the dimen-



sions to suit the scrap material you have.

As with all shelving, make certain that the wall fastener is secure. For larger shelves fixed to wall studs, use two screws per stud, one above the other. For brick or concrete block walls, space the screws along the top edge of the wall flange at about 12-in. intervals. Finally, be careful not to overload the shelves.—*Kenneth Wells*



Glue and nail the plywood wall flange to the edge of the shelf (top). Space screws at 12-in. intervals when fastening the shelf flange to a brick wall (above).

2 Bag holder

Tongue-and-groove frames interlock on this garbage bag holder to grip the open bag firmly. The interlocking grip is formed by ripping oak flooring boards lengthwise in halves and mating the tongue-and-groove edges.

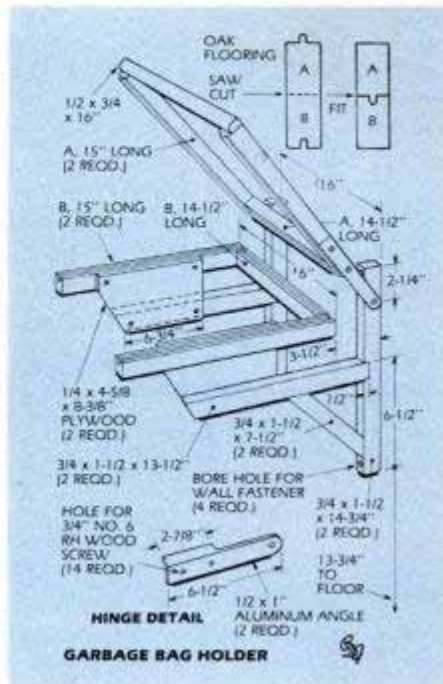
Cut the four upper frame members and join them with glue and 6d nails. Make sure the three tongued surfaces are on the same horizontal plane. Cut the three grooved lower frame members to size and assemble them with glue and 6d nails, making sure the top grooved surfaces are even.

The lower frame members are supported by plywood sides secured to braced supporting arms. Cut the vertical wall standards, plywood sides, support arms and braces. Both ends of the braces are mitered 45°. Cut 1/2-in.-deep dadoes in the wall standards and set

(Please turn to page 226)



This garbage bag holder, mounted out of the way on the side of a cupboard, holds an open bag ready to receive refuse. A plastic cup screwed to the wall holds bag ties.





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6 SHOP IDEAS FROM READERS (Continued from page 224)

them aside, then secure the plywood sides to the lower frame members and to the support arms with $\frac{3}{4}$ -in., No. 6 flathead wood screws. Fasten the sup-

port arms to the wall standards with glue and $2\frac{1}{2}$ -in., No. 10 flathead screws. Secure the support braces to the support arms and wall standards

with glue and 6d nails. When you attach the upper frame to the vertical wall standard, make sure the tongues fit the grooves. We fastened the holder to a cupboard with 3-in. carriage bolts and nuts.—*F. Douglas Parker*

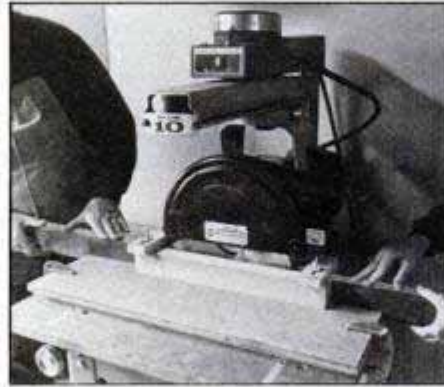
3 Resaw jig

To double the covering capacity of $\frac{3}{4} \times 3$ in.-wide cedar paneling, I developed this jig to resaw the stock. I did the work on a radial-arm saw. However, this jig works equally well on table and band saws.

The throat members are of $1\frac{1}{2}$ -in.-thick material. There is no depth limit within reason for band saws, but for radial-arm and table saws, limit depth to the blade capacity minus $\frac{1}{4}$ in. I cut the back throat member from a 2×4 . The front throat member is a 2×4 ripped to $2\frac{1}{4}$ in. wide. It has two slots bored and chiseled to receive eyebolts.

Make the jig as long as your saw table can accommodate. Size the plywood piece so it's flush with the table edge. The plywood serves as a means of fastening the jig securely to the saw table with C-clamps.

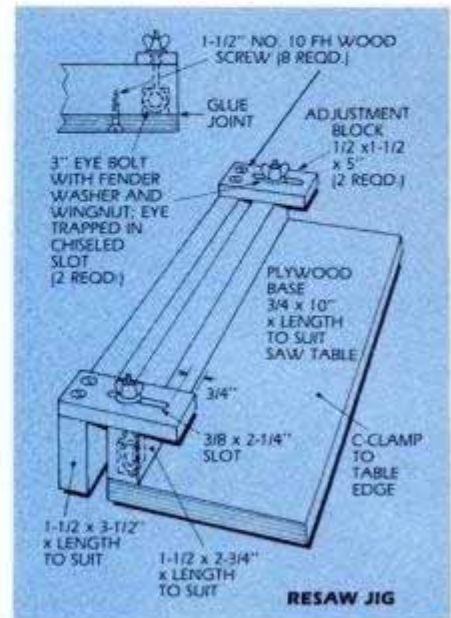
Cut two adjustment blocks. Use a drill and sabre saw to make slots for the threaded ends of the eyebolts. Position the eyebolts in their slots and assemble the front throat member to the plywood



The resaw jig helps rip pieces to a specified width on a radial saw. A helper retrieves cut pieces. Scrap plywood, not visible under the jig, is used to protect the table.

base with glue and four $1\frac{1}{2}$ -in. No. 10 flathead wood screws. Attach the back throat member to one end of the adjustment blocks with glue and screws. Run the threaded end of the eyebolts through the slots in the adjustment blocks, then add washers and wingnuts.

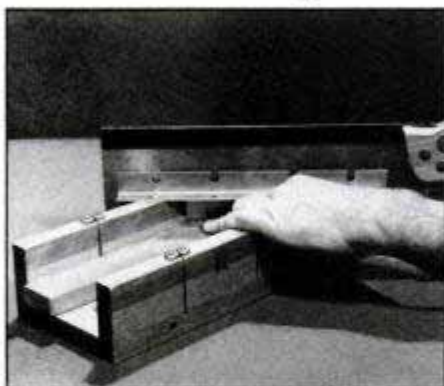
To use the jig, first adjust the throat so the stock slides through snugly but freely. Center the space between throat



members on the saw blade and secure the jig with C-clamps. Test the cut for accuracy and readjust if needed. Feed stock at a uniformly slow rate so that you achieve an attractive resaw pattern and you avoid jamming the saw.

—*Ken Brooks*

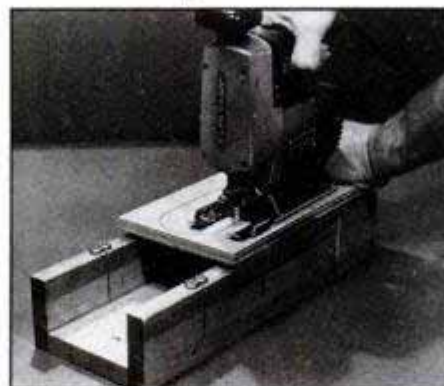
4 Miterbox guides



A pair of angle irons secured to the miter box on both sides of the saw helps guide it.

Two sections of angle iron fastened to the top of a miterbox can keep the saw at the appropriate angle to the workpiece. Fasten angle iron sections at the 45° slot spaced apart slightly more than the width of the saw blade. You can also use a pair of guides at the 90° slot.—*Ken Patterson*

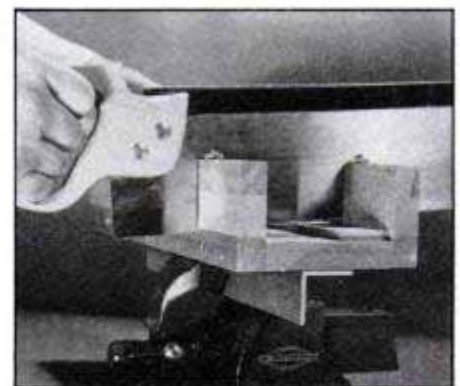
5 Saw platform



A miter box will hold small wood pieces so you can cut them with a sabre saw.

Use your miterbox as a platform to support small pieces of wood while you're cutting them with a sabre saw. The sabre saw blade won't strike the bottom of the miterbox and the sides are close enough to support even very thin wood pieces while you're cutting them.—*Ken Patterson*

6 Miterbox holder



An angle iron attached to the bottom of a miter box is held in a vise to secure the box.

A section of heavy angle iron fastened to the bottom of a miterbox can make the box much easier to use. The angle iron, cut to the length of the miterbox, should be clamped in a shop vise. The box will remain stationary, leaving both hands free to manipulate the work and to make the cut.—*Ken Patterson*

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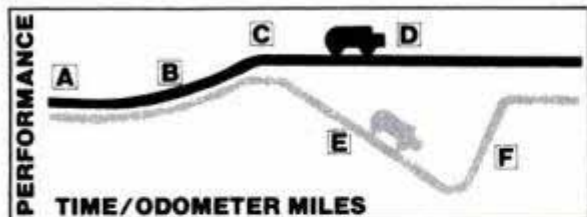
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75330	Mini External Stereo Speakers for all Walk-about radios	2.50
81120	Super light-weight headphones for Walk-about or home stereo	1.50

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82210	Sonyo DCR-100 17 watt per channel receiver with separate bass & treble	87.50
82230	Sonyo RD-7 Stereo Cassette Deck, Dolby & Metal Tape	60.00
80130	Becker PROFI01 2-way Home Stereo Speakers, 2" woofer, 3 1/2" high, 25 watts	Pair Price \$2.00
22440	Becker Pro Satellite Book-shelf type Home Speakers, 18" High, 50 watts	Pair Price \$5.00

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82020	TDK SA-80 Cassette Blank Tape	2.10
22660	Brand Name 7-120 Video Blank Tape	6.25
93700	Promotional T-120 VHS Video Blank Tapes	4.00

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How To Break A File ...Safely



Sometimes it's helpful to break a file and use a smaller section for some special application in your workshop. You can save old files to use in a jigsaw for power filing or to do heavy metal cutting.

Since files are brittle, they may break erratically if simply struck sharply with a hammer. There is also the chance that

bits of shattered metal could fly about and cause injury.

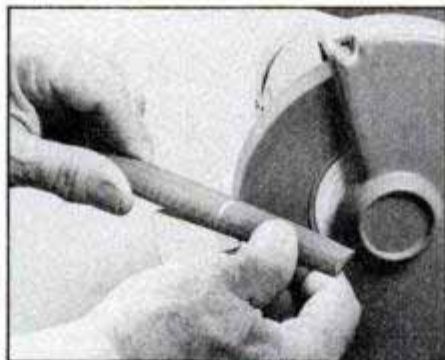
PM reader S.A. DeBonny suggested this three-step technique for breaking a file safely—and precisely on the mark:

1. Use the corner of a grinding wheel to form a shallow notch where you want the file to sever. This creates an area of weakness in the metal, thus facilitating a cleaner break.

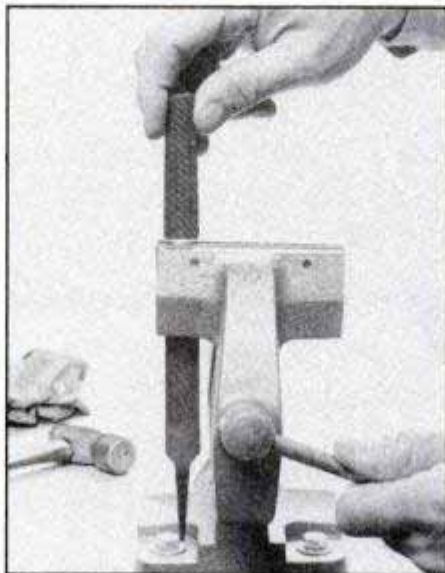
2. Grip the file firmly in a vise, making sure that the groove is aligned with the top of the vise jaws.

3. Wrap and tape a piece of cloth over the exposed section of the file to catch all metal particles. Strike sharply with a hammer on the protruding portion of the file as shown. This will create the maximum pressure at the desired breaking point and the file will break cleanly.

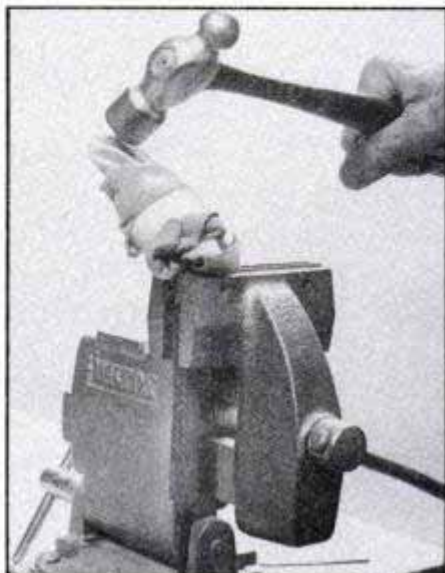
Although this method is the safest that we have used, you should still wear goggles.—Rosario Capotosto



Use a grinding wheel to cut a notch into the file where you want to sever it.



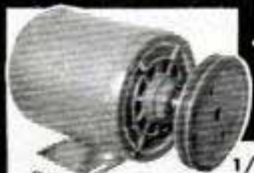
Grip the file firmly in a vise with the groove aligned with the top surface of the jaws.



Place a cloth over the part to be struck to catch the fragments and prevent injury.

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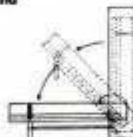
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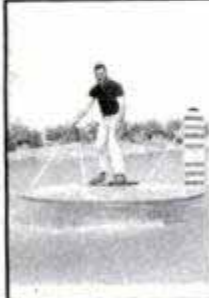


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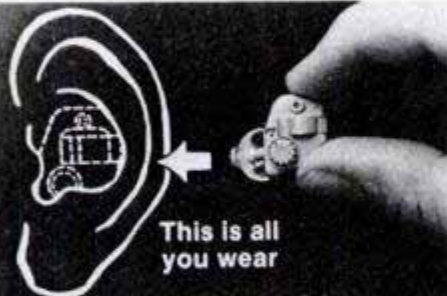
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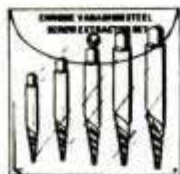
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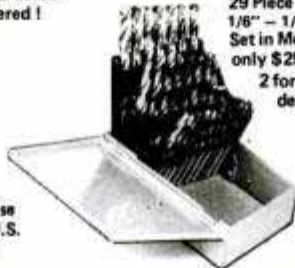
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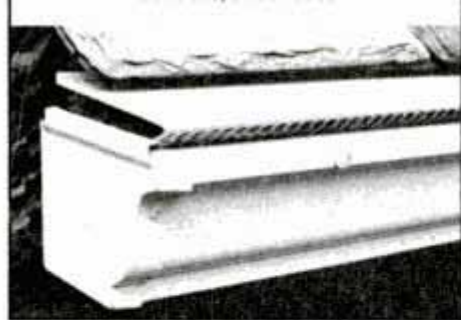
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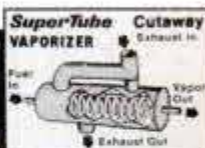
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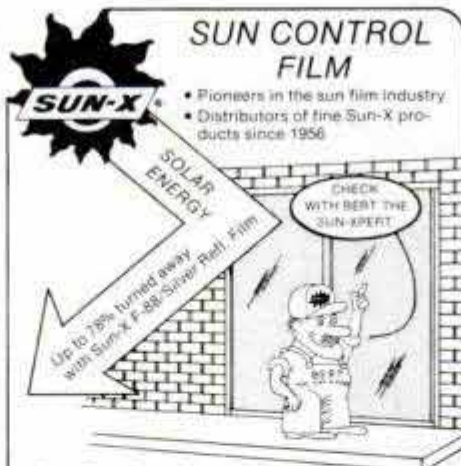
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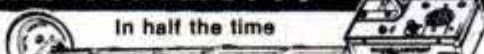
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4 x 24 x 2" Cylinder (Can go UPS) #902424 **\$115**

5 x 24 x 2" Tie Rod Ship wt. 100 lbs. #909524 **\$210**



4

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6

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4. Trailer Parts

We have the largest stock of trailer parts to repair or build your own at discount prices including Hubs, fenders, wheels and tires, Axles, Brakes, Hitches, Winches etc. 4 hole Hubs + Spindles **\$37.50/Set**
\$24/PR
 Item #1251 Trailer springs 2000 LB capacity

5. Item	Wheel and Tire Sets	Wheel and Tire	Tire Only
1211	480x8 (4 Hole)	\$22.00 ea.	\$15.50
1216	480x12 (4 Hole)	\$34.00	\$22.00
12131	570x8 (5 hole)	\$31.00	\$26.00

6. Wagner Airless Sprayer

Ideal for exterior and interior use. Can convert to feed paint directly from can. Factory reconditioned 120 volts. 1 Year Warranty
 Item # 15924 Model 200 Gen purpose Sale **\$65.95**
 Item # 15925 Model 300 Hvy Duty Sale **\$95.50**

7. Honda Generators

500 watt, 115 volt AC or 100 watt, 12 volt DC wt.40 lbs.
 Item # 1660.....**\$299** EX-800, 800 watts
 EM-600, 600 watts Item # 1663.....**\$383**
 Item # 1662.....**\$327** EG-1400, 1400 watts
 Item # 1667.....**\$433**

Larger Generators Available Will ship these generators to 48 states for \$12.

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Horiz. 5 Hp. Briggs 3/4" Shaft #6052 **\$137**
 5 Hp. Tecumseh 3/4" Shaft #6051 **\$134**
 8 Hp. Tecumseh cast iron sleeve #6081 **\$186**
 10 Hp. Tecumseh cast iron sleeve #6010 **\$224**
 Vert. 8 Hp. Tecumseh 1" shaft #7082 **\$199**
 8 Hp. Briggs 1" shaft #7080 **\$208**
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 Other 3-20 Hp. models at savings up to 50%

2. Homelite Water Pump

Corrosion resistant construction, ideal for water and chemical transfer. EPDM seal 2" suction, 28' lift 120' head. Will pump 8400 GPH - 3 hp Briggs. Will ship 48 states for \$6.00
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3. 5 hp Air Compressor

5hp 60 gal. vert. - Campbell-Hausfeld Model #VT5587 two cylinder, pressure gauge with safety relief valve. 230 volts 11.8 CFM at 40 PSI and 9.4 CFM at 90 PSI. 25"x22"x65" Item #15954 List \$1160 Sale **\$598.00**
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4. Homelite String Trimmers

Rugged 26.2 cc 2 cycle engine with trigger controlled throttle. 15" cut. Solid state ignition.
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Buckle up—for life.

The people in Iliamna, Alaska, are replacing their dog sleds with Isuzu P'UPS.

Iliamna.

An Aleutian Village about 250 miles from Anchorage.

It's got a population of 100 that swells close to 400 during the "tourist" season—if you can call it a season. You see, summer in Iliamna officially checks in at 12:01 on June 21st and unofficially beats a hasty retreat about a week later. Because, mama, it gets cold in Iliamna.

Not only that, there are no paved streets in Iliamna. Truth is, there are barely any roads at all. In fact, up until now the basic form of transportation has been dog sleds and three wheelers. But not anymore. Because now Iliamnians have discovered that Isuzu 4X4 P'ups are tougher than tundra.

Seems the first folks to buy an Isuzu 4X4

truck happened to be the owners of the local bait and tackle shop. And good news, like Isuzu trucks, travels darn fast. Because now there is a total of six Isuzu 4X4's clogging downtown Iliamna.

And the reasons for our success are simple. Isuzu trucks are built with an all-steel welded body and steel ladder frame. Paint is applied with a special, six stage, anti-corrosion painting process. What's more, our guts consist of a 1.9 liter, overhead cam engine that's extremely strong, reliable and fuel efficient. Not only that, Isuzu trucks are priced from only \$5,775* Enough to warm the cockles of any Iliamnian's heart.

What it all comes down to is that in the truck business, Isuzu P'ups are emerging as top dog.



Isuzu. Our wheels are always turning.



*ISUZU standard bed truck \$5,775 manufacturer's suggested retail price P.O.E. excluding tax, license, transportation.

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