

JUNE 1985 \$1.50

Popular Mechanics

ARBOR PLANS
Build This Shady Retreat In A Weekend

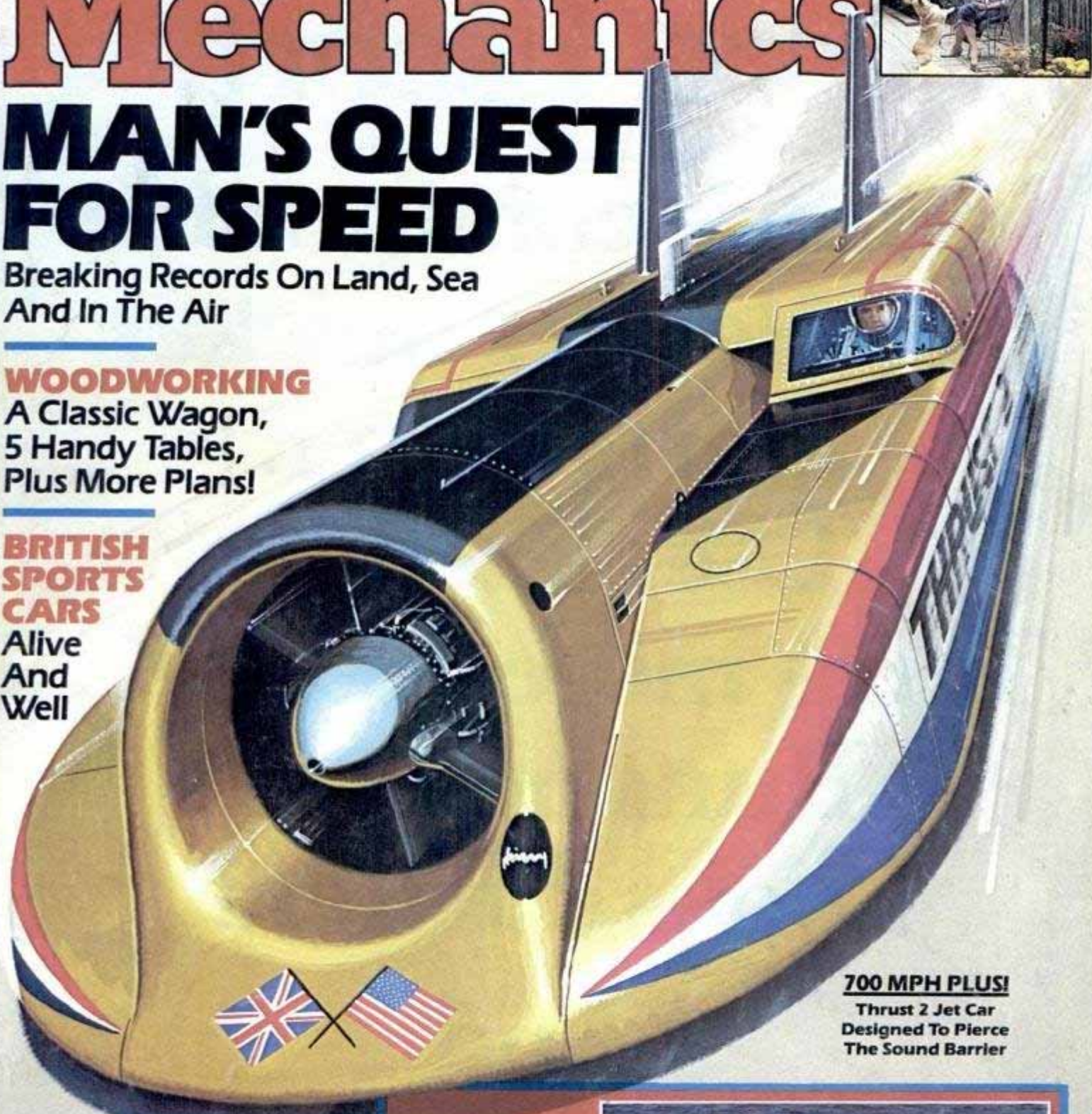


MAN'S QUEST FOR SPEED

Breaking Records On Land, Sea And In The Air

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5 Handy Tables,
Plus More Plans!

BRITISH SPORTS CARS
Alive
And
Well



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Thrust 2 Jet Car
Designed To Pierce
The Sound Barrier



Contest



The New Ford Escort.

It's more comfortable.

Accelerates quicker.

Starts better.

Uses less gas.

Turns more precisely.

Runs quieter.

Looks different.

And
remains, dependably,
an Escort.

Ford Escort has been the best-selling car in the world for the last three years.* But instead of resting on our laurels, we've made the new Ford Escort 30 ways better.

Its sleek new front design speaks for itself. But you'll have to drive the new Ford Escort to experience the preciseness of its steering and the quicker acceleration provided by a new 1.9 liter engine. A quieter, better-starting, more powerful engine that delivers even better fuel economy than last year: 36 estimated highway and 27 estimated MPG.**

New lumbar support seats and new trim fabrics make the new Escort's interior more comfortable and inviting.

We'd also like to assure you that, in many ways, Ford Escort remains unchanged. It still has front-wheel drive, four-wheel independent suspension and the same devotion to duty that helped make it world famous.

Best-built American cars.

"Quality is Job 1." A 1984 survey established that Ford makes the best-built American cars. This is based on an average of problems reported by owners in the prior 6 months on 1981-1983 models designed and built in the U.S.

Lifetime Service Guarantee.

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. See your participating Ford Dealer for details.

*Based on worldwide sales and export data for 1981-83 calendar years.

**Ford 1985½ Escort 5-speed MTX. These are projected Ford ratings based on Ford engineering data, and are expected to be very close to official EPA ratings. Actual mileage will vary with maintenance, options, driving conditions and driving habits. Ratings for the 4-speed MTX FS are not expected to increase.



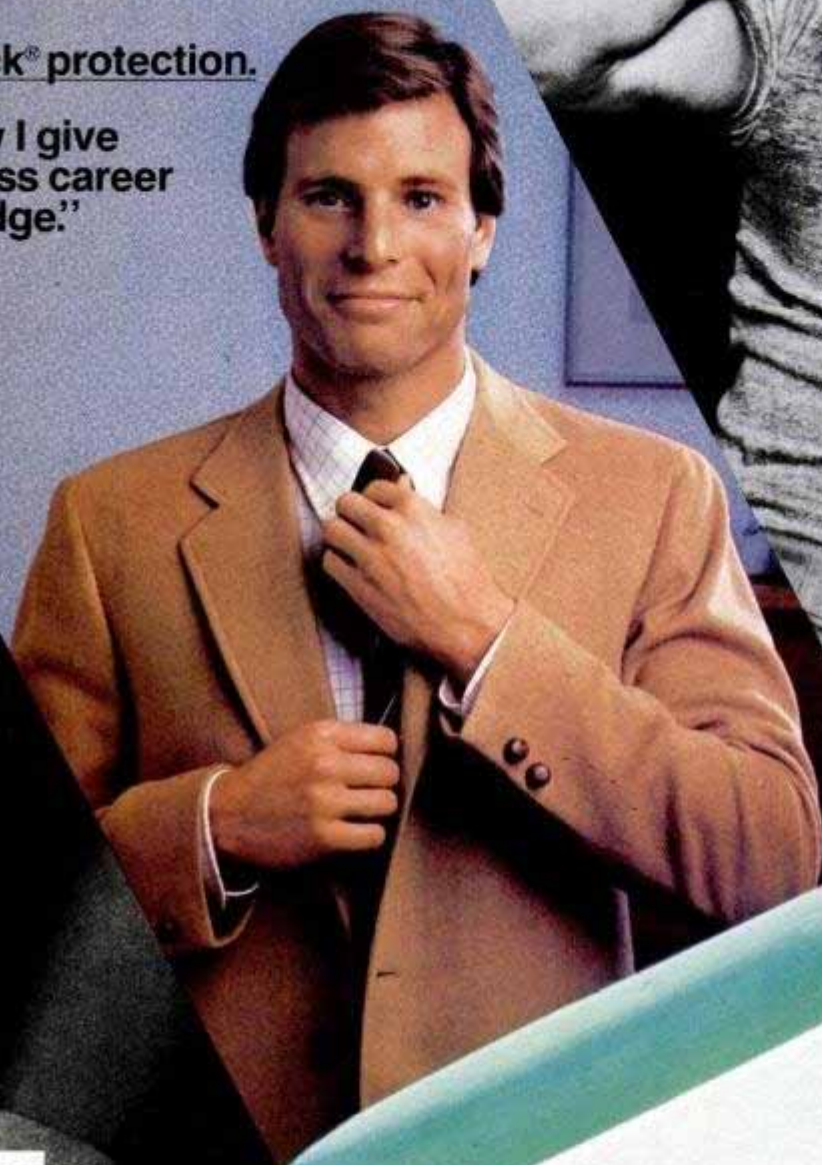
Have you driven a Ford... lately?

Get it together — Buckle up.



"Fifty situps.
Twenty pushups.
Ten laps.
Shave.
Shower.
Speed Stick® protection.

That's how I give
my business career
an extra edge."



**THE
WIDE
STICK™
GIVES
YOU THE
EDGE.**

by **MENNEN**

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ON THE COVER

Will man ever drive a car at Mach 1—more than 700 mph? He's about to try in an exotic, jet-powered vehicle called *Thrust 2*. Read the exciting account of how this and other high-tech speed merchants plan to set new records on land, water and in the air. Story on page 71.

—PM painting by Ed Valligursky

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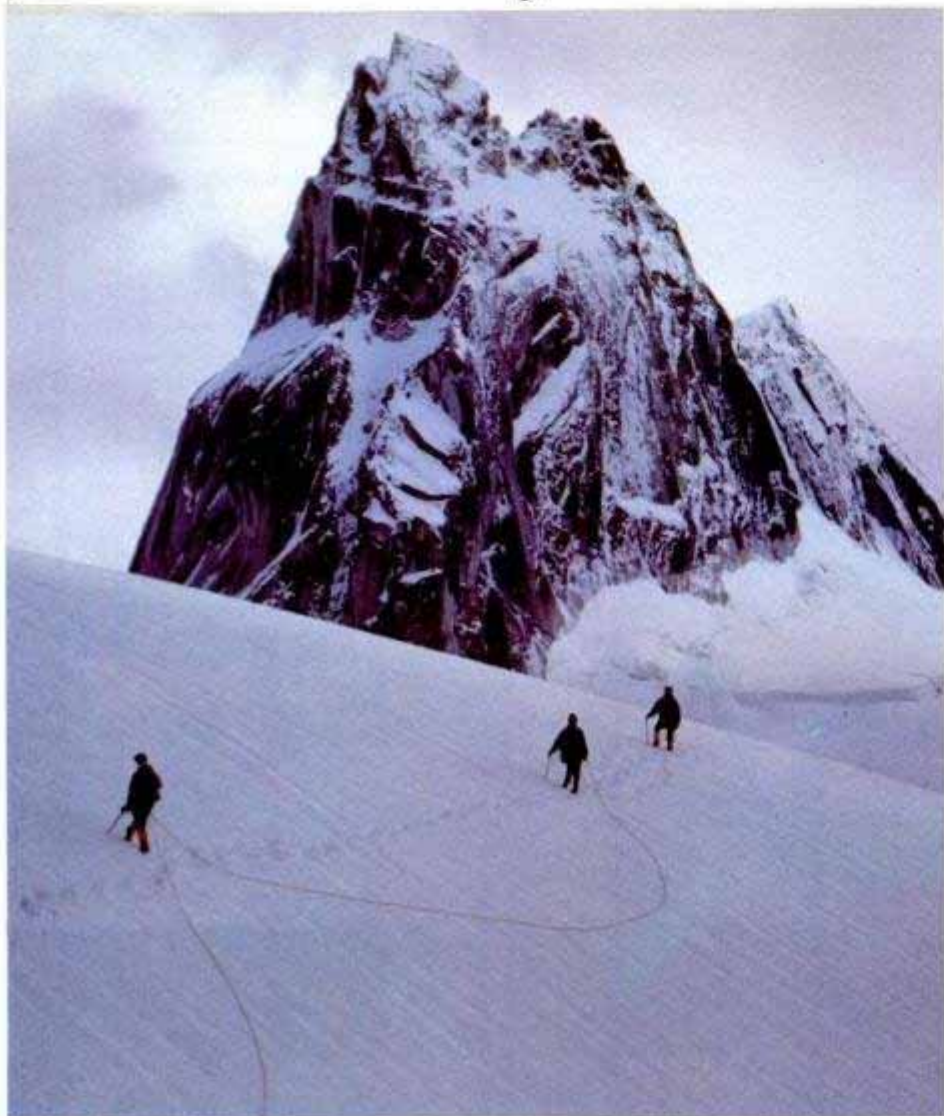
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Purcell Mountains. A rugged place for a smooth whisky to start.



WESTERN CANADA—The hardest part of the climbing is just getting enough air. I gulped it in. Icy. Thin. And then we stopped, and looking around took my breath away all over again.

Later, thawing out by the fire, we knew we'd been someplace we could never forget.

Over Windsor Canadian, we talked about it all night long. That's some smooth whisky.

It's made from water that runs down from the glaciers. They use the local rye. And that high, clean air must have something to do with the way Windsor Canadian ages.

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WINDSOR

CANADA'S SMOOTHEST WHISKY.



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EDITOR'S NOTES

In 1980, we reported on an attempt to take a souped-up hydroplane to half the speed of sound (Mach .5) on the waters of Lake Tahoe. The attempt ended tragically and seemingly ended the race for Mach .5 on water—about 380 mph. But now a new attempt is in the works.

Plans are being made to drive a jet-engined car faster than the speed of sound on land. And the aerospace industry is working on a plane with an advertised top speed of Mach 7. At a more pedestrian level, several efforts are being mounted to ride a bicycle more than 65 mph. Yes, there are still many exciting speed barriers challenging man and they're all documented in this month's cover story (*Breaking The Speed Barriers*, page 71). . . . There's a first in this month's PM. You're probably familiar with our car, audio and video component, photography and even tool comparison tests. This is the first time we've compared boats in actual head-to-head, in-the-water tests (*Small Boat Shootout*, page 80). To perform the testing, Executive Editor Joe Oldham enlisted the aid of veteran boating writer John Wooldridge, the entire Mercury Marine test facility in Placida, Fla., four boats, four boat engines, five boat handlers, two models, two photographers and one art director. We think you'll find the results interesting . . . According to science editor and confirmed speed freak Dennis Eskow, nothing is more exciting than Daytona during Speed Week. Especially when the top brains in auto racing assemble around a high-tech race car. This year, one of the top brains was a computer called OSCAR. Built by Buick Engineering, this mobile computer system measures 100 inputs a minute via a battery of sensors installed on any car. George Claypole, Buick engineer and OSCAR's father, took Eskow for a tour of the rig and for a ride in a car loaded with OSCAR's sensors and memory. The results are in *Technology Update* beginning on page 133. . . . Straight from the horse's mouth, James Beggs, NASA's chief administrator, gives you an in-depth look at two new spaceships on the drawing boards and several missions planned for the next few years (*NASA's Next Spaceships*, page 84). You can't get much more authoritative than that.



Graphics Director Bryan Canniff, Oldham and Wooldridge getting ready to hit the water in Placida, Florida.



Eskow and Claypole check out OSCAR's nerve endings before tackling Daytona.

John A. Littleton

True Value
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TOOL VALUE OF THE MONTH



2⁹⁹

SerVess T.M.

8-in. Adjustable Wrench

Drop-forged, triple chrome plated steel tool features smooth-rolling adjusting nut and vinyl grip. Act fast! Offer good from May 10 while supplies last only, at participating True Value Hardware Stores. 608S



GREEN THUMB 1/2-gal. Sprayer

Non-corroding polyethylene tank is tough enough for insecticides, detergents, chemicals, more! Hurry! Offer good from May 20 only while supplies last, at participating True Value Hardware Stores. 235002

CHARGE IT at participating True Value Hardware Stores. For store nearest you, see "Hardware" in the Yellow Pages.



No. 1 power in V-8's. Ford Pickups

For '85 Ford offers not only a wide choice of V-8's but the most powerful V-8's of any pickup truck maker!

And, what a great selection of four high torque engines to choose from:

- The 5.0L V-8, most powerful in its class, with new electronic fuel injection.
- 5.8L High Output V-8* with 4-barrel carb that gives you more horsepower than Chevy's midsize V-8.
- 7.5L engine, with 245 horsepower,** the biggest, most powerful V-8 in any pickup.



- And, the 6.9L diesel V-8, the most powerful diesel in any pickup.

It adds up to more V-8 power for you, more muscle on and off the highway, more get-up-and-go wherever you drive. For '85, America's best-selling full-size

pickup,† powers its way to the top with V-8 power to spare—and you're in the driver's seat!

Peak payloads, too!

Ford packs the payload you need for today's

bigger, harder hauls; up to 5,740 lbs. worth! Plus the ability to tow trailer loads as big as 12,500 lb. when properly equipped.

Great choice of comfort!

And, no one tops Ford in offering you so many pickups to pick



from: from roomy Regular Cab models to the exclusive SuperCab with folding rear seat option; or 4-door Crew Cab, now with single or dual rear wheels.

Built Ford Tough.

These big Fords all come with 2-wheel drive, as 4x4's with unique independent front suspension, or Mono-Beam front suspension for those extra heavy duty jobs. And these tough Fords come with galvanized double-wall box in back.

Best-Built American Trucks.

At Ford, Quality is Job 1. A 1984 survey established that Ford makes the best-built American trucks. This is based on an average of problems reported by owners in the prior six months on 1981-1983 models designed and built in the U.S.

Lifetime Service Guarantee.

As part of Ford Motor Company's commitment to your total satisfaction, participating Ford Dealers stand behind their work, in writing, with a Lifetime Service Guarantee. No other car companies' dealers, foreign or domestic, offer this kind of security. Nobody. See your participating Ford Dealer for details.

*Not available in California or with manual transmission.

**Horsepower based on SAE Standard J1349. Rated horsepower lower in California.

†Based on final 1984 calendar year manufacturers' reported retail deliveries.



"My Ford Pickup & Me."

FORD PICKUP
AMERICA'S TRUCK **BUILT FORD TOUGH**



This One



31SQ-W6F-GRU9

Get it together - Buckle up!

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LETTERS TO THE EDITOR



Tale of two-wheelers

In your *Editor's Notes* column for December '84 (page 8), you said that Daimler made the first power-driven motorcycle in 1885. This overlooks the steam-powered motorcycle that was built around 1869 by Silvester H. Roper of Roxbury, Mass. It was called the Roper Steam Velocipede and is now in

the Smithsonian Institution in Washington, D.C. (photo, below). Roper used to exhibit it at fairs, advertising that it was "faster than a horse."

In any case, the Daimler creation, with its outrigger "training wheels" for stability, was really a four-wheeler and could not be called a true motorcycle. It was actually a test bed for Daimler's experiments with internal combustion engines for cars.

The first gasoline-powered two-wheeler to be made in quantity and sold to the public was the Hildebrand & Wolfmuller, produced in France and Germany from 1894 to 1896.

ALLAN F. JOHNSON
GEORGETOWN, ONT.

Thank you for taking the trouble to set the record straight.

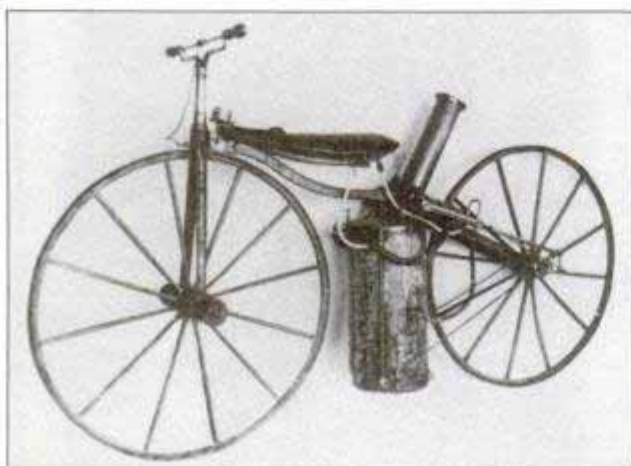


PHOTO COURTESY SMITHSONIAN INSTITUTION

Roper's Steam Velocipede circa 1869: "Faster than a horse."

Four centuries later . . .

Your article *Great Moves Of History* (page 100, Mar. '85) was very interesting, especially the illustration showing the raising of a 400-ton obelisk in 16th-century Rome. Something didn't look quite right, then it hit me. The hoisting ropes are wrapped around the capstans the wrong way. Clockwise as shown, the capstans would let the obelisk down, not pull it up. PETER GERTONSON
LEWISTON, IDAHO

Good catch. Ironically, our illustration was based directly on Domenico Fontana's original 16th-century drawings showing how the hoisting job would be done. Apparently, it's taken four centuries for someone to notice the error. We should have spotted it.

Wrong-way tenon

Your article *10 Ways To Join Legs To Rails* (page 114, Mar. '85) was excellent, but you goofed in one place. You showed a wedge-locked tenon with the wedge parallel to the grain in the surrounding wood. This way, the wedge

could split the wood. It should be cross-wise to the grain. Right? D. R. SMITH
MIAMI, FLA.

Right. The tenon was inadvertently turned the wrong way just before the picture was taken. Our apologies.

Those were the days

Many years ago, about 50, I can remember buying used copies of PM for a nickel. I devoured them just as I do your current issues now. One of the features I like best is *PM's Time Machine*. It takes me back to the great old issues I used to read as a boy. RALPH D. ROSS
OSWEGO, ILL.

Oil burner update

In your article *Tune Up Your Oil Burner For Winter* (page 56, Oct. '84), you said: "The procedures outlined here should be performed once every two years." Would you drive for two years without lubrication, oil change, new oil filter?

This is one of many inaccuracies.

Warm-air furnaces for the past couple of years have had cerafelt chambers. Scraping or vacuuming would destroy them. Replacing the oil pump without testing because it is 15 years old is ludicrous. Blowing out oil lines without knowledge of check valves, foot valves and filters could be dangerous.

We feel *Popular Mechanics* has done a great disservice to burner and furnace manufacturers, the members of NAOHSM and your readers. I'm sure you received other correspondence.

CHARLES E. BARTRAM, PRESIDENT
NATIONAL ASSOCIATION OF
OIL HEAT SERVICE MANAGERS
ELMWOOD PARK, N.J.

Yes, we did receive a lot of mail regarding this story. The questions raised were the result of our failing to make it clear that some of the suggested maintenance work pertained to a specific type of GE furnace. The bulk of the article, however, dealt with routine procedures, such as removing rust and corrosion, that apply to any furnace. Discarding a 15-year-old oil pump, while perhaps not necessary, is good insurance against having it go bad just when you need it most.

New jointer tricks

I've been using a jointer for half a century and thought I knew everything there was to know about it. That was before I read your article *PM's Guide To Using The Jointer* (page 100, Feb. '85). I learned some useful tricks. My compliments to you. HOUGHTON SAWYER JR.
HONOLULU, HAWAII

Frostbite vs. hypothermia

Your article *New Gear For Cold Weather Camping* (page 96, Feb. '85) was very interesting, but there was one error. You said hypothermia is "a condition where exposed body parts actually begin to freeze as a result of subnormal body temperatures."

What this describes is frostbite, the freezing of unprotected extremities. Hypothermia is the lowering of body core temperature to the point of causing shock and, if untreated, death.

SIMON PEACOCK
OAKVILLE, ONT.



NEW MONROE[®] LOAD-HANDLER.[™] IT WON'T LET YOU DOWN, WHEN YOU LOAD UP.

Now you can carry extra loads* with a feeling of safety and comfort. New Monroe Load-Handler variable rate coil springs are designed to reduce body sag, bottoming out and side sway caused by loads.

Monroe Load-Handler coil springs are great if you pull a trailer, boat, or camper. Or just carry extra loads* in your car. They're also ideal for pickups and vans.

They feature an advanced design with increased distance between the convolutions of the spring. So, as the load pushes down, Monroe Load-Handler automatically pushes back, increasing the rate of support. This

helps prevent loss of alignment, improper handling and poor steering response when carrying loads.

And whether your vehicle is loaded or unloaded, you'll get the same comfortable, stable ride you've come to expect from Monroe.

So install a set of Monroe Load-Handler variable rate coil springs on your vehicle. They won't let you down when you load up.

*Load carrying ability is limited by the vehicle suspension and tires. See owners manual.

MONROE
Monroe Auto Equipment 
Division of Tenneco Automotive



IMPORTS & MOTORSPORTS



Saab's new spark

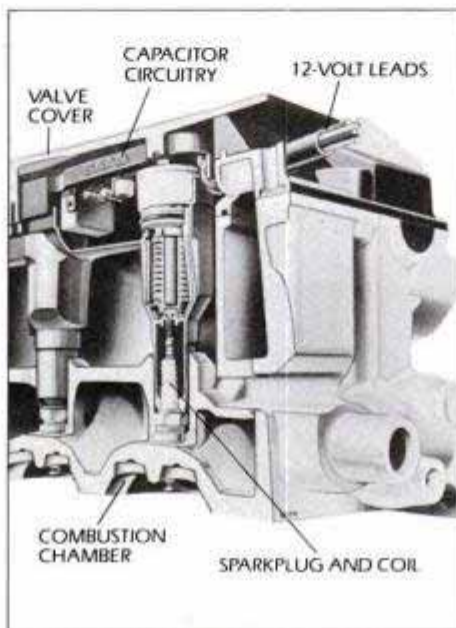
The model lineup at Saab moved up a notch—a two-door notch. The 900S notchback joins the four-door sedan and three-door hatchback.

The two-door gets the same equipment as the other models, except for seats, which are the sport type used in Saab Turbo models.

The intriguing development at Saab, however, is a new ignition system that does away with distributor and high-voltage leads. In the Saab Direct Ignition system (SDI), each sparkplug has its own integral coil which is connected to a capacitor housed in the valve cover (see illustration at right). SDI is a capacitive system (as opposed to the inductive systems used for the last 100 years) that's ingeniously simple: 12 volts from the battery is stepped up to 400 by the capacitor and boosted to 40,000 volts by the small, high-power coil at each plug. Spark duration is short, but precise timing makes the system work. Saab will test the system before considering it for production cars. One test bed will be a new Formula III engine for racing this season.



Two-door notchback is new to the Saab line.



Gimme four!

Throttle-happy time is here again. No more ice and snow or—what can be even worse—sand put down by winter highway crews. But, careful, there are always road hazards of one type or another out there: wet blacktop, oil slicks, loose gravel—traction challengers all. These conditions are nasty with rear-wheel drive, tricky with fwd, but can almost be taken in stride with all-



Ford Sierra XR now has four-wheel drive, and U.S. version, the Merkur, gets it soon.

wheel drive. Four-wheel drive for passenger cars is catching on fast, and it's the hottest thing since four on the floor. Ford's European Sierra now has a 4x4 system, which means that its sister ship, our Merkur, will soon have it, too. And, there's no outrunning the local authorities in South Hampton, N.H.: Their police car is a 4wd Audi 4000S



Audi Quattro is used for high-traction pursuit by the South Hampton, N.H. police.

Quattro. With most four-wheel-drive cars, including the Quattro, the power split is 50 percent to the front axle and 50 percent to the rear. But it doesn't have to be divided that way.

The Sierra split is 34 percent to the front and 66 to the rear—a rear-drive-car bias that's the choice of most competition rally drivers. Audi, however, sticks with the 50/50 split as best for everyday drivers.

This summer we'll have an in-depth look at 4wd systems in a special feature, *Four-Wheeling Into The Future*. **PM**

Toyota turbo truck



Toyota 4x2 Xtracab SR5 is turbocharged.

Toyota's first turbocharged gas engine to be sold here is mounted in its 4x2 Xtracab SR5 pickup. The turbo boosts hp of the 2.4-liter, fuel-injected engine to 135 at 4,800 rpm. That's a 16.4 percent increase in hp and a 23.5 percent increase in torque. Xtracab models, we've found, give that little extra space that can make a big difference in mini pickup utility.

For some drivers it's not enough space. If you're one of them, you'd better go to Custom Fab Mfg. Inc.

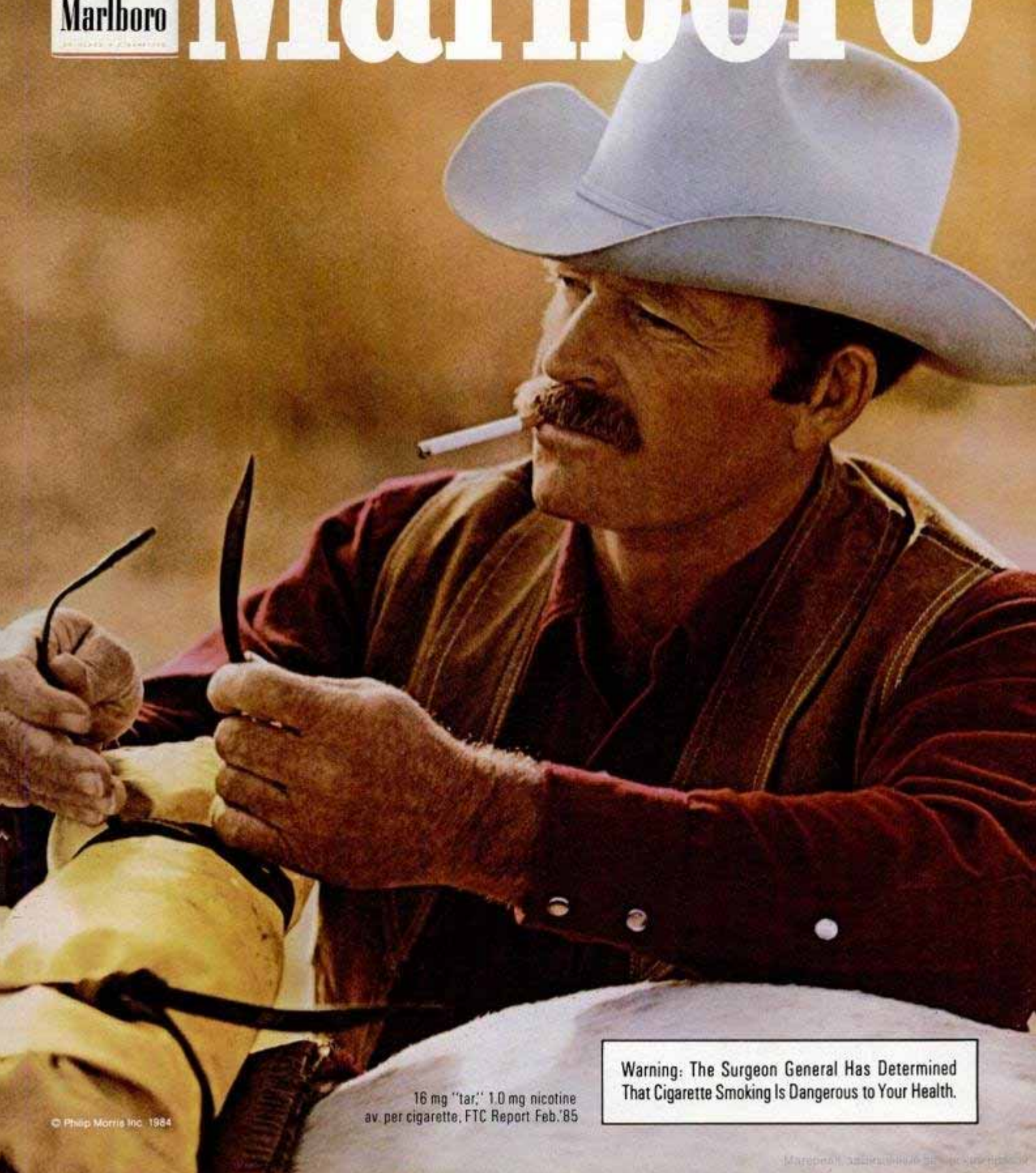
(Hemet, Calif.) where stretch pickups are the brainchild of Bill Rohrbacher. He takes minis—Toyotas, Fords, Chevys, Mitsubishi's, Dodges, Plymouths—cuts them in half and splices in a new section. A bench seat or buckets and roll cage go in the added 32 inches. Turning radius is somewhat wider with the addition, but that's alright, 'cause Rohrbacher's Custom Cabs are something else!



Stretch pickups are from Custom Fab Mfg.



Marlboro



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

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

IS THE STEERING RESPONSE
OF YOUR CAR AS
PREDICTABLE AS IT SHOULD BE?



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BF GOODRICH **T/A** RADIALS

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Steering that responds quickly and reliably to driver input is one of the most important tasks a tire can perform for your car. While no tire can claim the ultimate in any performance characteristic, the BFGoodrich Euro Radial T/A[®] was designed for a remarkable balance of both transient and steady state steering response. The result is steering that is quick—but not too quick—and that responds as expected to steering wheel inputs.

The same basic computer-aided technology used in building the Euro Radial T/A (in 60 and 70 aspect ratios) was applied to the entire family of BFGoodrich T/A[®] Radials. The result is a complete line of high-performance car and truck tires in many sizes, designed for a wide variety of performance needs and driving styles.

THE BFGOODRICH EURO RADIAL T/A[®]

- A. Quick and predictable steering response plus high-speed handling result from special belt configuration. Tire is also reversible for your choice of raised white letter or black sidewall styling.
- B. Excellent cornering, handling, and dry traction derive from a race-proven tread design.
- C. Remarkable tread life in an H speed-rated tire (up to 130 mph) is due to special dual compound tread.
- D. Reduced hydroplaning and excellent wet traction are assisted by open tread design with transverse lateral grooves and notched blocks.

The BFGoodrich Euro Radial T/A[®] was designed to optimize the speed and predictability of your car's steering response. Sidewall and belt stiffness plus large tread block elements that resist squirming enhance the direct road feel of modern steering systems.



WE MAKE CARS PERFORM[™]

ALL OUTDOORS



Mopeds come back

If you haven't seen a moped for a while, you might be in for a surprise when you stop in at a dealer. The new breed of moped looks almost like a small motorcycle. No more wimp look that was common in the '70s. The new look is called the crosstank design and it definitely beefs up the moped image.

Unfortunately, finding a dealer won't be that easy. The hundreds of moped importers who prospered in the '70s and early '80s have shrunken in number to less than a dozen. Dealers survive by selling bicycles and motor scooters as well as mopeds. Many of the famous company names have disappeared from the market—Benelli, Peugeot, Motobecane. But several companies remain—Puch, Garelli, General, Trac and Derbi. Among them, Puch and



New breed of mopeds looks like small motorcycles. Speed is limited by small size of engines and state laws.

for a longer range.

Garelli has upgraded its line with sleek crosstank models boasting larger breaks with expanding drums. The Monza GT has 2.50 x 16 low-profile tires plus a new, lightweight

Garelli are at the top of the list, both in quality and in service.

Puch's crosstank entry, the Cobra, succeeds the earlier Magnum series and features a high-torque engine with a new triple-clutch design. Performance backs up the new brawnier image. The Cobra rides on slightly skinnier tires (2.25 in.) but on larger diameter wheels (17 in.) than the Garelli. In addition to making the Cobra look hairy, the crosstank design also increases fuel capacity to two gallons

engine with a aluminum cylinder and head for improved cooling. The Super Sport XL comes with mag wheels and either a single or two-speed automatic. Swing arms and dual shocks are standard in the rear with telescopic coil springs up front.

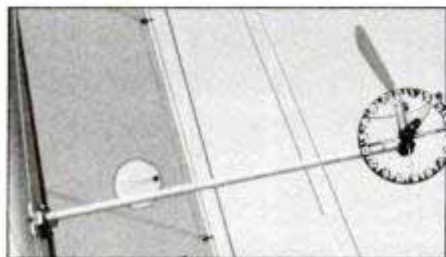
Both Puch and Garelli mopeds are backed by a good, if not large, dealer network for servicing and maintenance, something that can't be said for other brands of mopeds still being sold.

—Frank Coggins

Wind compass

Sail closer to the wind and get more sail efficiency and boat speed with the Wind Compass, a wind-angle readout unit that works in the lightest air. It mounts on the mast 6½ feet from the base, close to the center of effort of the sails. One 6½-inch dial mounts to port and another to starboard.

Wind Compass is available for about \$450 from Ahmer Marine, 3330 Commerical Ave., Northbrook, Ill. 60062; call (312) 564-1730.



Wind Compass mounts 6½ feet up on the mast.



The Voyager can accommodate 18 to 20 people plus gear, but 10 fit more comfortably.

Up the creek with 10 paddles

Have a large family? Maybe you're the scoutmaster of a small troop. There's enough room for everyone in the Voyager, a reproduction of an 18th century, 36-foot Montreal canoe. It'll hold 18 to 20 persons plus gear, and carry up to three tons.

In place of the traditional birch bark construction, the Voyager relies on a hull made of fiberglass reinforced

plastic and a high-density foam core. Other features include rockered stems and a keelless, fully rockered bottom with good tumblehome.

The canoe tips the scales at 500 pounds and will tip your wallet to the tune of \$9,450. For more information, you should contact the manufacturer, Voyager Canoe Co., by writing to 3 King St., Millbrook, Ontario LOA 1G0 or calling (705) 932-2131. **FM**

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**It's a new Black & Decker Sweepstakes.
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The perfect tool for restoring the things you cherish. The Deluxe Radial Arm Saw built by Black & Decker, complete with shaping, routing, sanding, and planing accessories. A \$1,000 value.

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*Or anytime between Oct. 1, 1985 and July 4, 1986, without the celebration. Or if you can't go anytime, we'll give you the cash equivalent.

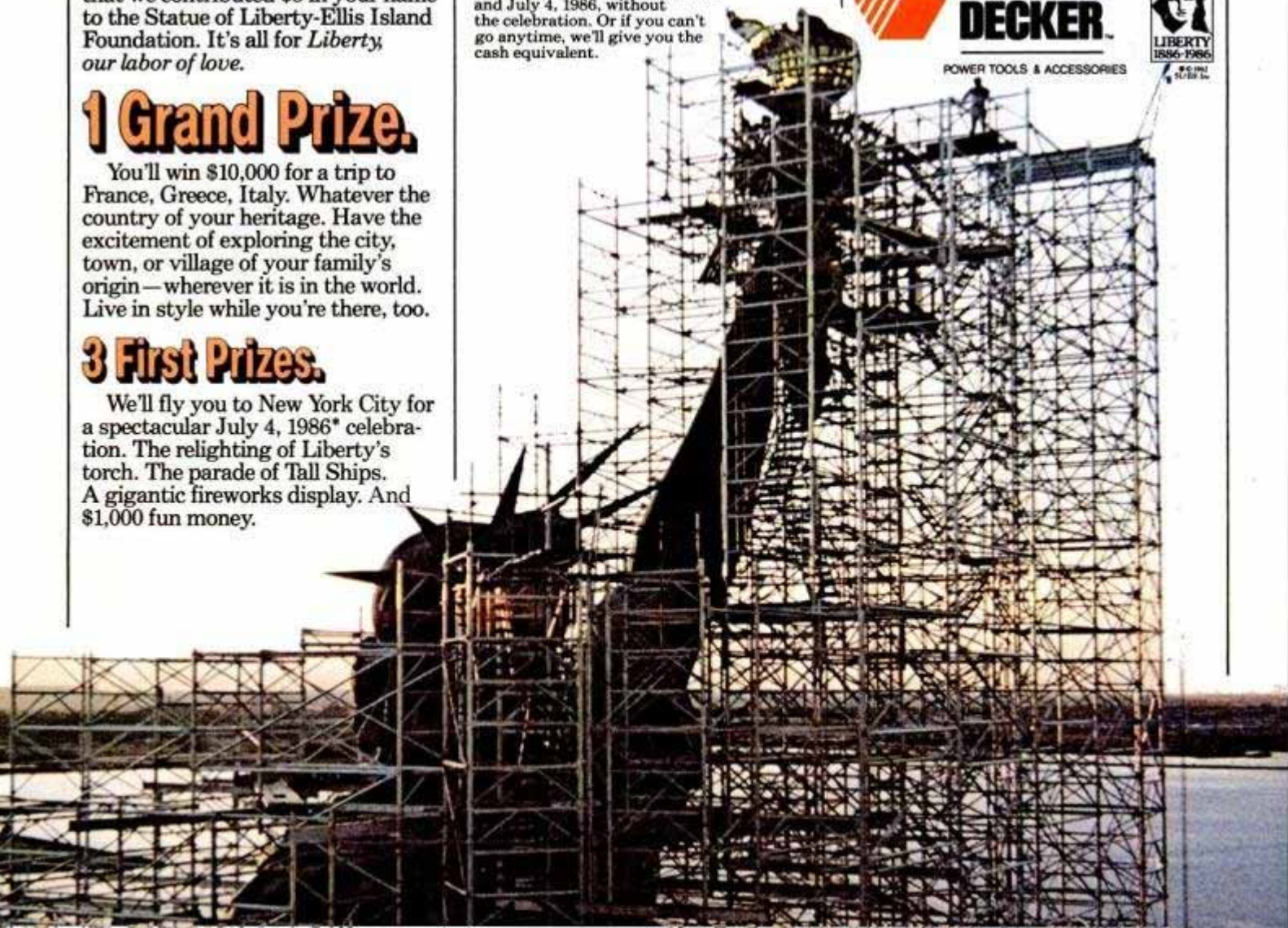
*Don't wait. Enter now. Enter often to win your once-in-a-lifetime chance to explore the land of your heritage. Just pick up your entry at any participating Black & Decker outlet.** No purchase necessary. Void where prohibited by law. All entries must be received no later than July 31, 1985. Buy the Black & Decker tools and accessories you want, too, and help restore Liberty.*

**Or send a self-addressed stamped envelope to Black & Decker *IT'S A FREE COUNTRY* Sweepstakes, P.O. Box 676-L, Ridgely, MD 21660. State of Washington residents not required to include envelope postage. Limit one entry per request. Request for entry blank must be received by July 4, 1985.



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APPLIANCE CLINIC



Waterlogged refrigerator

My Coldspot refrigerator, model No. 106.7667442, keeps filling with water under the crisper drawer. The water dribbles down the rear wall of the refrigerator and collects on the bottom, or leaks out onto the kitchen floor. What can I do to correct this?—D.R. DeRoven, New Iberia, La.

Very likely the drain plug fitting or the mouth of the drain tube is clogged with food particles or algae. This blocks defrost water from passing freely through the drain tube to the evaporator pan at the bottom of the refrigerator. It is a recurring problem, not only with Coldspot, but other brands of refrigerators as well. Fortunately, there's an easy solution.

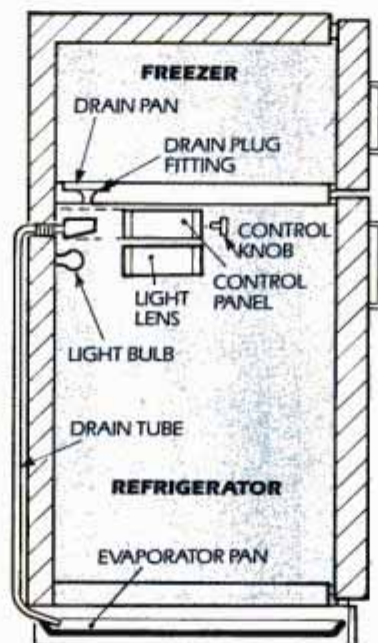
First unplug the refrigerator. Open the refrigerator door and remove the two control knobs from the control panel at the top rear of the compartment. Next, remove the plastic light lens by pushing in on the upper center of the lens until the center tab clears the lower edge of the control panel; then pull the lens downward and out.

Remove the two 1/4-in. Phillips-head screws on the control panel that hold the panel to the rear wall. Then remove the control panel. Locate the white plastic drain cup in the center of the rear wall, and pull it forward and out of the refrigerator. Clear any debris in the cup and rinse it with hot tap water.

Mix a solution of one cup hot water with one tablespoon of baking soda. Then, use a basting syringe to squirt

this solution into the drain plug fitting and into the opening that leads to the drain tube. This should clean out any residue that has built up in the drain tube or openings.

Replace the drain cup and reassemble the control console and light lens. Plug the refrigerator back into its power source. The procedure should correct the problem, but you may have to repeat the routine every few years.



Defrost water passes through drain tube to evaporator pan. Occasional cleaning prevents water leaking into refrigerator.

Faulty oven timer motor

I have a General Electric range, model No. JD12Y1GR with a faulty oven timer motor, and my General Electric dealer can't sell me a replacement motor. I contacted the International Service Center in Dayton, Ohio, which you suggested to a reader in your July '84 Appliance Clinic, but they deal mostly in Frigidaire timers. Do you know where I might be able to get help?—Harold F. Leister, Chambersburg, Pa.

The timer motor for your clock assembly is no longer available as a separate part. However, you can obtain a rebuilt clock and timer assembly.

Unplug the range and remove the clock and timer assembly. Label all the wires as you disconnect them, using a

small piece of masking tape folded around each wire to leave a tab. On the tabs, write the contact numbers of the timer assembly from which each wire was removed. The tabs will aid you when reconnecting the wires.

Once the assembly is removed, send it to General Electric Service Co., Morrison, Ill. 61270. Attention: Exchange Dept. In the package, be sure to enclose a note stating that you wish to purchase an exchange timer assembly, part No. WB19X108.

The cost of the exchange timer will be approximately \$35, and it is guaranteed for two years. The company will send back an exchange timer within 24 hours of receiving your package, along with a bill for the exchange.

Easy Spin parts

Since you often are able to list sources of repair parts for appliances, perhaps you can tell me where I can find parts for an Easy Spin washer and dryer.—Frank E. Devery, Sacramento, Calif.

After checking several sources, I located an appliance parts company in Pennsylvania which has a large inventory of replacement parts for Easy Spin washers and dryers.

Write to Koss Appliance Service Co., Inc., Route 309, Montgomeryville, Pa. 18936. In your letter give the model number of your appliance, and the name and number of part or parts you need.

If you have difficulty identifying the part, send them your model number of your appliance and explain your problem. They will send you a copy of the pages in the repair parts manual that show pictures and part numbers. You can then pick out the parts you need and send this information back to the company.

Garage light out

I have a Sears automatic garage door opener, model 139.655000, serial No. E-315060. About two months ago the automatic light stopped turning itself on when I activate the opener. Both light bulbs are OK. How can I repair this?—Y.T. Hsi, Napa, Calif.

The light delay assembly is probably causing your problem. The electrical contact may be burned or the bimetal heater may be inoperative. The part number for the light delay assembly is 1A35; it costs about \$8, and can be purchased at any Sears store repair parts center.

To replace the light delay assembly, unplug the opener's power cord. Then, remove the four screws holding the cover to the opener chassis. The light delay assembly is located on a terminal board just above the large drive pulley. It's held to the board with three screws. Loosen the screws and slip the old assembly out. Install the new part, replace the cover and plug the line cord back into its power source. This should correct the problem. **PM**

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

DETROIT LISTENING POST



'86 Olds Toronado



Toronado will switch to a transverse engine for the first time in its history in '86.

Here is the final installment of the GM-30 trio—the 1986 Oldsmobile Toronado. As previously shown here (*DLP*, page 50, Jan. '85), the GM-30 family of cars consists of the Olds Toronado, Cadillac Eldorado and Buick Riviera. All

use MacPherson struts up front with coil springs. The key rear suspension component is a transverse fiberglass leaf spring, first introduced on the Chevrolet Corvette. Oldsmobile sources say a patented camber adjust-

ment feature will improve the accuracy of wheel alignment.

The GM-30s may share a similar body profile, but the '86 Toronado has the most distinctive look of the three stablemates.

Exterior styling is a significant departure from the heavy, angular model left behind. Hundreds of pounds lighter and inches shorter than the '85 car, it once again features hidden headlights and a horizontal bar grille reminiscent of the original '66 Toronado. In the rear, a full-width horizontal taillamp runs beneath the decklid.

Inside, a split bench seat in front will be standard. Buckets will be optional. Expect a silver-gray 20th Anniversary model early in the year.

Power for the Olds Toronado will come from a transverse-mounted Buick 3.8-liter V6 with sequential fuel injection (SFI), but no turbocharger. A four-speed automatic transmission will be standard.

Chrysler hardware

Turbocharging may be a performance solution falling from favor.

Witness the Chrysler 16-valve, 2.2-liter Four, shown here at the Chrysler Shelby Performance Center. Chrysler performance maven Carroll Shelby recently addressed the Detroit Auto Writers Group and spoke in glowing tones

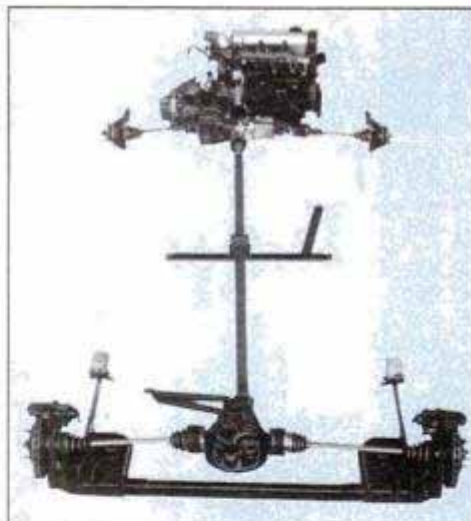
about the efficiency of multiple-valve heads over turbocharging.

In addition to extra-valve heads, Shelby's West Coast horsepower guys have done a lot of serious testing on four-wheel-drive systems for vehicles ranging from the T-wagon mini-van to the Dodge 600ES sedan. The group has assembled a test Dodge Daytona featuring 4wd, advanced suspension and the dual overhead cam, 16-valve Four. Most of the work is a product of parts-bin technology—i.e. adapting existing components to new uses.

Most Chrysler performance developments find their way to the public through Direct Connection, Chrysler's aftermarket performance parts marketing program. A new intercooler kit for Chrysler turbos is such an example. Though it might be pretty hard to offer the 4wd system to the weekend mechanic over the counter, we expect the 16-valve head to go public through Direct Connection very soon. Later, it may show up on 2.5-liter production engines, with or without a turbocharger, depending on the state of Detroit's latest horsepower race.

Good 'n sticky

A special S version of Goodyear's Eagle high-performance street tire will be built in the Akron Technical Center,

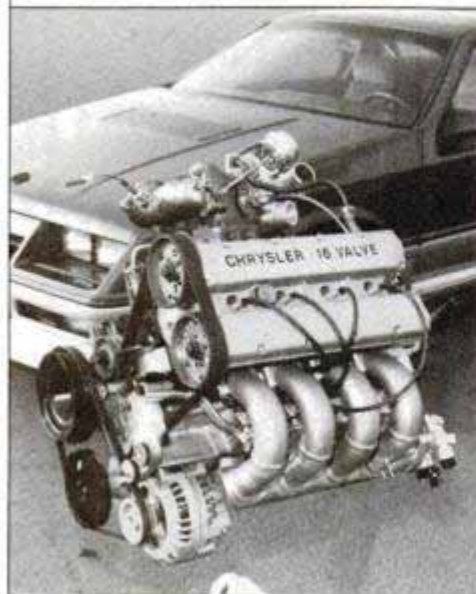


Shelby 4wd system is designed to get all that Chrysler power to the road. It has a Dana rear end and 11 cv and U-joints.

alongside Goodyear's racing tires. The new Eagle VR-S and GT-S will aim for maximum grip and responsiveness on the road. Previous versions were compromised more for tread life and lower rolling resistance.

A set of these sticky S tires contributed to the phenomenal handling of an Olds Ciera GT in a recent *Popular Mechanics* test (*American Sports Sedans*, page 80, Apr. '85).

(Please turn to page 20)



Chrysler's do-it-yourself 16-valve cylinder head will provide turbo-like power without the reliability problems of a turbocharger.

Why Rust-Oleum is now in the auto care business.

We're in it for the money, guys. But we've got something worth buying. We've found a way to make a car wax

The shine, incidentally, is fabulous.

Our new body fillers will outlast and outperform whatever you're

that prevents rust.

A body filler that prevents rust.

A whole line of auto care products (including touch-up paints)

that prevent rust.

Without taking you through chemistry 101, let us just say that these new Rust-Oleum products create an electro-chemical barrier on the surface of a car that prevents rust like no other products in the world.

Our car wax will, indeed, prevent rust.

What's more the stuff that makes Rust-Oleum car wax prevent rust also makes it last longer through washings and lousy weather—so you don't have to wax as often.

using now.

As for the touch-up paints—remember who they're from.

The same guys who make the rust fighting paint for your iron fence, your lawn furniture, your locomotive and,

yes, even your space shuttle.

These new products aren't in every store in the country yet. So fire up the old rust-mobile.

And start looking.

For the nearest store, call our toll free number:

1(800)323-0851.

In Illinois, 1(800)942-0876.



RUST-OLEUM

Nobody fights rust like Rust-Oleum.

DETROIT LISTENING POST

(Continued from page 18)

Seat belts work!

After a long and sometimes acrimonious debate in the Michigan legislature, Michigan finally passed a mandatory seat belt law to take effect July 1, 1985. The bill had been gestating in various forms for three years. "I feel like I've birthed an elephant," remarked a victorious Michigan lawmaker.

Under the new law, a \$10 fine will be imposed on drivers and front-seat passengers who are caught without seat belts fastened. The law will only be

enforced on occupants of vehicles stopped for other reasons and no points may be assessed against a violator's license. After Jan. 1, 1986, the fine rises to \$25. Cars built before Jan. 1, 1965, are exempt.

It's believed Michigan's passage of mandatory seat belt legislation will generate a domino effect of similar actions in other states. At this writing, Michigan joins only three states—New Jersey, New York and Illinois—with seat belt laws. According to the American Seat Belt Council, however, 32 states introduced seat belt legislation in January alone.

Ear to the ground

Skylark 4-porte: Buick says its Skylark nameplate will live on next year as an '86 four-door GM-20. The '85 Skylark is an X-body car. The two-door version of the car will continue to be called a Somerset Regal. The Olds Calais and Pontiac Grand Am may get the four-door models as well.

Same car next year? Chevy General Manager Bob Burger told me at the Chicago Auto Show that the Chevette, now crowded by Japanese imports Spectrum and Sprint, will "stay around from year to year." He says the car is popular in the eastern U.S. and Canada, but "West Coast dealers probably don't care if they see another one."

Chrysler bits: A Maserati source says anticipated revenues in sales to Chrysler over a six-year period could reach \$500 million. In related news, DeTomaso Industries Inc. of Red Bank, N.J., said it reached agreement with Highland Park to design and build a two-seat sports coupe.

With the cancellation of the Voluntary Restraint Agreement (VRA) limiting Japanese imports, Chrysler says it will ask for 200,000 more imported cars from its Japanese partner Mitsubishi. Chrysler imported 87,500 Mitsues under the VRA. Part of the added import lineup at Chrysler will be a 4wd *Colt Vista station wagon*, and an intercooler to boost the turbo Conquest (Mitsu Starion) from 145 hp to 170 hp. Both are available now.

Auto theft up: With a recent assault on my new Jeep CJ-7 fresh in mind, a U.S. Justice Dept. study attributes the tenfold increase in auto theft in the past 10 years to professional thieves—not to amateurs out for a joyride.

Chinese Cherokees: The China/AMC joint venture, Beijing Jeep Corp., will build *Jeep Cherokees in China* beginning this year. Assembled almost entirely from CKD (complete knocked down) kits, the vehicles will be sold in China and later offered for export.

Short drives: Chrysler's *Dodge/Plymouth Conquest* is a Mitsubishi import worth a good look by serious performance-car buffs. It's fast, comfortable and capable, if sometimes a bit dicey in hard turns.

The *Chevrolet Camaro IROC Z* will impress you. It's 90 percent of everything the Corvette is at about 50 percent of the price. Incredible handling and drag racer acceleration, in colors so hot they'll make you squint, the IROC Z is a terrific sports car bargain.

The *Mercury Cougar XR-7* combines aerodynamic styling with Mercury luxury in a turbocharged package. An automatic four-gear transmission helps greatly in traffic, and is a fun handful when the turbocharged Four is unleashed. **PM**

POPULAR MECHANICS • JUNE 1985

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You've read in *Time*, *Omni*, *Psychology Today*, *the Wall Street Journal* and elsewhere about the exciting success of subliminal techniques. Now, thanks to recent breakthroughs by leading psychologists, you can use these same innovative techniques to *turn your life around*.

SUBLIMINAL TECHNIQUES ARE THE PROBLEM SOLVERS FOR THE 1980s AND BEYOND.

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The subconscious mind is a mysterious thing. We're finding out more about it every year. It's not like your conscious mind. Instead it soaks up impressions. You'll be amazed how fast the "success-mechanism" within you makes big changes in your life.

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On one side, subliminal stimulation. You hear waves breaking on the shoreline. But your subconscious hears more. There are subliminally embedded messages at work—literally hundreds. Chances are, you won't be able to hear them consciously. But your subconscious will. And, it will obey. Listen while you work, read, play, relax, watch TV, or even while jogging or driving your car. The sounds of the waves create a pleasant background while alone or with others. A brief introduction on each tape lets you know the exact wording of the subliminal messages coming up.

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You'll get all the benefits of subliminal stimulation—and more. On the other side of each tape is an audible hypnotic

session. You'll hear suggestions, affirmations, in a very real sense "orders to your subconscious." Yet all you do is relax. Put forth no effort whatsoever. You're in full control. Both sides provide you with an experience like you've never had before. And the results are *sensational*. In fact, these techniques are widely used by professional therapists and hospitals.

Each side inspires you and revitalizes you. So listen again and again. Very soon you'll see an exciting change in your life. That is why more and more aware people—people who want more out of life—are finding new happiness today. These Subliminal Stimulation™ Cassettes are the long-sought answer.

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But here's still more good news. You get one FREE for every three you order! Just fill out the No-Risk Express Order Form and rush it back today, along with your check or money order. Or use your Visa or MasterCard. You're protected by our **FULL MONEY-BACK GUARANTEE**: We call it our "double-length" guarantee because it's good for 60 days, not 30. If you're not elated with the results the tapes bring, return them for a full, prompt refund—including the \$2 shipping and handling. *1985 Advanced Learning Systems, Inc.

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| | <input type="checkbox"/> A9002 Sanyo Sportster Mini-Stereo
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CAR CLINIC



Ford/Chrysler and SAE 5W-30

GM's policy regarding the use of SAE 5W-30 motor oil was summarized in the *Car Clinic* column in September 1984, January '85 and March '85. I said then that if Ford and Chrysler begin recommending SAE 5W-30, I would let you know. This has happened.

Regarding Ford, if you own an Escort, EXP, Tempo, Lynx or Topaz with 1.6- or 2.3-liter (HSC) engine, Ford now recommends that you use SAE 5W-30 motor oil when the ambient temperature is from -20° to 100° F. Ford claims the benefits are improved cold weather

starting, reduced internal engine friction and improved fuel economy.

If you choose to use SAE 10W-30 or SAE 10W-40 in these engines instead of SAE 5W-30, your warranty will not be affected. However, using SAE 10W-40 in a 1984 or 1985 GM engine could lead to your having to pay for certain engine repairs if the dealer determines that the damage was caused by use of the incorrect oil.

If you have a problem finding SAE 5W-30 meeting Ford specification ESE-M2C153-C and API (American Petro-

leum Institute) category SF, SF/CC or SF/CD, order it from a Ford dealer. Ford packages SAE 5W-30 motor oil under the Motorcraft label.

Chrysler recommends using SAE 5W-30 or SAE 5W-40 meeting API requirements for SF, SF/CC or SF/CD in the 1985 318-2V V8 engine. Failure to follow this recommendation will not affect your warranty. Chrysler also suggests putting SAE 5W-30 or SAE 5W-40 in any engine that's used where the ambient temperature is below 0° F. over time. Chrysler distributes SAE 5W-30 and SAE 5W-40 through its dealers under the Mopar label.

The light dawns

I had a close call recently, and I would like to warn others. My car is a 1983 Chrysler New Yorker Fifth Avenue. Recently, I noticed the interior lights (overhead map light, entry lights on doors and lights under the dash) were out. I didn't think much about it. I drive mainly during daylight hours, so I didn't replace the fuse right away. When I finally checked the manual to see which fuse was involved, I felt weak in the knees. Did you know that the brake and interior lights in this car are on the same circuit? It became abundantly clear why on several occasions during those few days, cars had come to skidding stops to avoid rear-ending me. I think safety demands that brake-lights be on a circuit that would make it apparent to the driver at once when they aren't working.—Albert Masetti, Staten Island, N.Y.

Chrysler claims that making brake-light failure apparent to the driver is exactly why brake and interior lights have been linked together for many years in Chrysler vehicles. The warning is given vaguely in owner's manuals that if interior lights don't glow, owners should check brakelights. Listed under "Specifications-Fuses" is the information that brakelights are combined with several other electrical components on the same circuit.

Since few car owners ever look at fuse specs in the owner's manual until they're needed, a warning device, such as a buzzer, might be a good idea.

Panty raid

There's been a fluid leak from the automatic transmission pan of my 1982

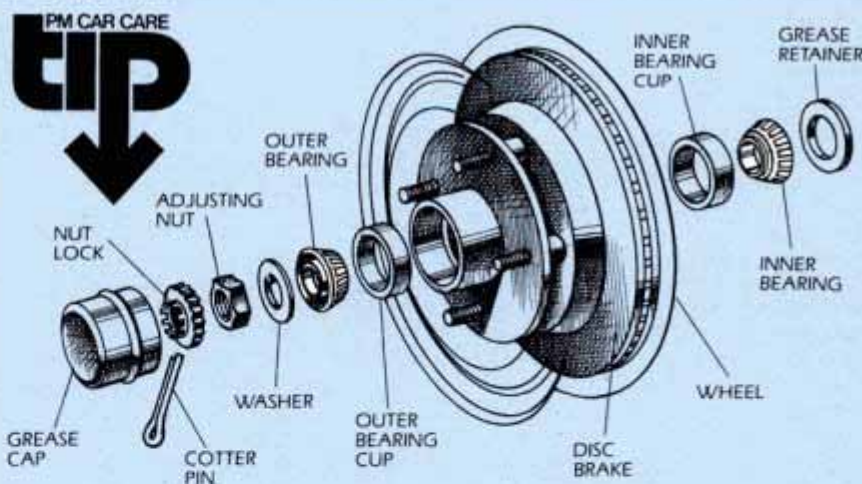
Chevrolet Citation since the day I bought the car. The only thing dealers do to the car is replace the pan gasket. This has been done five times. Is there no solution to this problem?—J.B. Bowers, Linwood, Pa.

As you and other GM X-car owners have discovered, you can replace gaskets of the THM 125 transmission from

today until tomorrow and fluid will still leak. That's because the pan flanges don't hold the pan securely enough to prevent leakage.

A solution has recently been found. It's to replace the assembly with new parts carrying the following part numbers: oil pan (No. 8643574), valvebody

(Please turn to page 24)



Follow the leader

Is wheel bearing service a thing of the past? Not according to Ed Richter of Columbus, Ohio. He and his wife had just started on a trip in their 1977 Buick LeSabre when he heard a clunk from the right front wheel. He didn't think much about it until 10 miles later when a grinding noise started. He stopped at a service station and had the wheel removed. That's when he received the bad news.

The washer had welded itself to the retaining nut, and the outer bearing had

welded itself to the wheel spindle, causing the spindle to twist. That shot a day of Ed's vacation.

"Two dollars worth of grease applied to the bearing every so often would have saved me \$200," he says. "Never again will I forget those bearings, and I think your readers would be wise to follow my lead."

If you do follow the leader, service front-wheel bearings of a rear-wheel-drive car every 30,000 miles. Do the same for rear wheel bearings of a front-wheel drive car.



Wild breed.

You heard it from the old-timer: "Day's hike from civilization... that's where them wild brookies live all right." You say goodbye to civilization, shifting S-10 Blazer 4x4's Insta-Trac system into 4WD High without slowing down.

It's no day's hike for Blazer. In just over an hour, Blazer powers its way over miles of wild, rugged terrain so easily you swear it knows where it's going. One more mountain ridge, then down into the cool towering pines and you're there. Deep, crystal-clear pools. And then you see them.

Go ahead. You were made for this. And so was S-10 Blazer.

LET'S GET IT TOGETHER...BUCKLE UP. Tires supplied by various manufacturers.

NOTHING WORKS LIKE A
CHEVY TRUCK



CAR CLINIC

(Continued from page 22)

cover (8643575), oil pan gasket (8643572), valvebody cover gasket (8631340) and hexhead bolts with conical washers (8643879). Chevrolet service bulletin 84-8, issued in October 1983, outlines this fix.

Since it's on record that the leak has been a problem with your car during the time it was covered by warranty, repairs should be done free of charge.

Double play

I was driving my 1985 Plymouth Caravelle down Interstate 80 on speed control when the speedometer dropped to zero and the speed control disengaged. How come both problems occurred at the same time?—Fred Wolff, Allamuchy, N.J.

Because the speedometer cable broke. The brain (servo) of the speed control is in series with the speedometer, that is, it's between the transmission and speedometer with the speed-

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.

PM CAR CARE TIP

Save spikes for TDs
Many people who have computers use surge protectors to guard equipment from *spikes* (surges) of voltage. Electronic control units in cars (microprocessors, computers, call them what you will) must also be protected. Methods used to protect these expensive boxes from damage are simple:

- When you charge the battery, disconnect the negative (ground) cable and attach the battery charger clamp right to the battery terminal.
- If your car ever requires that someone use an electric welder, remind him to disconnect the ground cable before he does.
- If you have to remove or install a component that's part of an electronic system in the car, first make sure the ignition key is on off and the ground cable removed.
- Be very careful not to reverse polarity when installing a battery. This can knock a computer out of the game.
- A basic safety precaution: Be sure the engine is off before disconnecting battery cables.
- When you have to get a boost, make sure the booster isn't putting out more than 12 volts. The excess can make spaghetti of microprocessor circuitry.

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Use Elmer's® Carpenter's Wood Glue or Wood Filler and get easy to follow plans for any one of these original heirloom designs for just \$3.00.

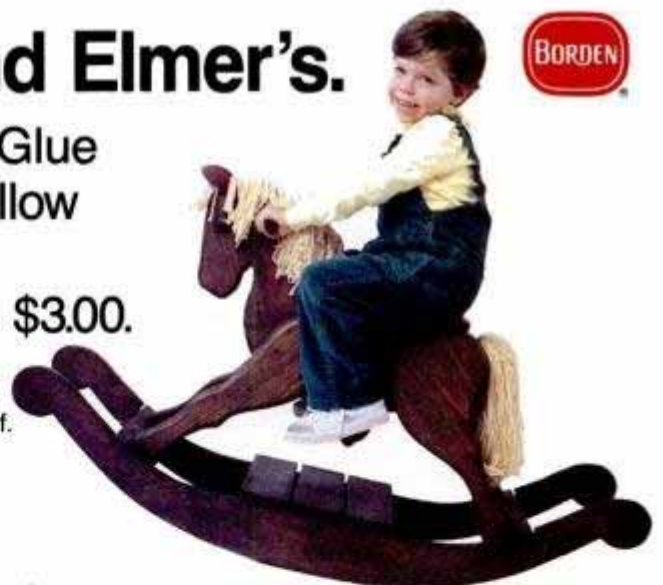
Elmer's Carpenter's Wood Glue grabs instantly, realigns easily, then forms a bond stronger than the wood itself. Elmer's Wood Filler spreads easily; then you can sand it, varnish it and stain it. Both Elmer's products help give you professional results every time. Buy one or both, then send for the plans at just \$3.00 each. Your child will love the results!

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Functional plans for airplane, truck and steamboat. Each a classic design.

Favorite for young or old, Victorian style measures 36" high.

A child-size collector's item.

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SECURITY BLANKET.

SL-2™ Rechargeable Light. Sleep easy. Because you're never in the dark when the Black & Decker SL-2™ Rechargeable Light is at your bedside. And now, our \$3 rebate makes it even easier for you to get a good night's sleep. 

Offer expires June 30, 1985.

ometer cable connecting the three units. This is done to provide the regulator with an indication of vehicle speed. One function of the regulator is to disengage the speed control when road speed, as measured by the speedometer-cable gear in the transmission, falls to a speed that would register just below 30 mph on the speedometer.

In other words, the speedometer cable between the transmission and speed control regulator broke or came loose. The regulator "sensed" a drop in road speed to less than 30 mph, and it disengaged. Obviously, the speedometer gauge won't work if it doesn't get a speed indication from the cable, which it can't if the cable is busted.

Feisty Fiero

My 1984 Pontiac Fiero with manual transmission ran nicely for the first 8,000 miles, but then the engine began pinging lightly while cruising at a steady speed. Now, at 15,000 miles it is pinging to beat the band. My dealer put in GM Top Engine Cleaner and told me to use premium fuel which I do. He claims there's nothing else to do—that pinging is normal. Help.—James Holbrook, Saltsburg, Pa.

Bet him on it. Then, ask him to test all of the components that can cause spark knock. These include EGR, EFE and hot air systems. He should also check for incorrect ignition timing, incorrect sparkplug heat range, overheating or engine control (computer system) problems.

If none of the standard repairs work, tell him to replace the computer PROM with one carrying part No. 1227134. A revised PROM is also available for automatic transmission cars. It carries No. 1226912. Either of the new PROMs will correct the calibration problem by cutting back part-throttle (cruise condition) spark advance. The excess advance results in a type of pinging that fuel engineers call post-ignition, which we used to call detonation.

In search of Biobor, part 3

In the January 1985 *Car Clinic* (page 40) I discussed an additive called Biobor Diesel Doctor made by U.S. Borax Co. It's poured into fuel tanks of vehicles with diesel engines to keep bacteria and fungi from clogging the fuel system.

If you have difficulty finding a dealer who carries Biobor Diesel Doctor, call Krex Inc., which distributes the product, for assistance at 1-800-323-9038. **FM**

SERVICE TIPS

- Overheating or coolant loss in a 1984 Jeep with a 2.5-liter four-cylinder or 4.2-liter six-cylinder engine may be caused by broken cylinder head bolts. Using MR 252 IS Note 2E as a reference, ask your dealer to replace the short head bolts on your Jeep with a set having part No. 4006593.
- The fuel pressure regulator in a 1984 Chrysler Corp. model with a turbocharger can be the cause of that clicking, tapping or rattling you're hearing at idle or slow speed. Chrysler is distributing a damper package (part No. 4203640) to quiet things down. TSB 14-47-84 gives the details.
- A vibration and drone coming from the 3.8-liter engine of a 1984 Thunderbird, Cougar, LTD, Marquis, Mustang or Capri may be from an alternator that's out of balance. The alternator may have to be replaced and a different bracket arrangement installed. Ask a dealer to see TSB 85-1-18.
- Engine oil and filter change interval charts in your 1985 Chevrolet owners manual may not be correct. In some manuals the chart that should have been on p. 5-6 was printed on p. 5-9, and the chart that should have been on p. 5-9 was printed on p. 5-6. This reversed recommendations for gasoline and diesel engines. Guide yourself by the fact that normal change interval for 1985 Chevy gasoline engines is 7,500 miles or 12 months, while that for the diesel engine is 5,000 miles or 12 months. For severe use, change gasoline engine oil and filter at 3,000-mile intervals and diesel engine oil and filter at 2,500-mile intervals.

FOR OUT-OF-THE-WAY PLACES ELECTRICITY HASN'T REACHED.



Space Light™ Closet Light. Now you don't have to tangle with wires for light. Black & Decker's Space Light™ Closet Light is cordless and rechargeable. A bright way to light closets, tool sheds, and the dark reaches of your home.

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THE PM GARAGE



Ramp that's a champ



Sturdy Versa Ramp supports 790-pound loads and folds easily for stowing.

Here's a handy gadget that I've often wished for. It's a collapsible scissor-action ramp that hooks to the tailgate of a pickup truck or station wagon and lets things like ATVs, dirt bikes and lawn equipment roll up and down nearly as easily as on solid ground.

Versa Ramp is constructed totally of steel. It measures 48 inches wide, extends to 73 inches and has a load capacity of 790 pounds. Folded, the

ramp takes up just 9 inches of bed space and weighs in at 100 pounds. All of the hardware needed to mount the ramp is included, and the ramp locks into place with two simple pins.

The Vera Ramp sells for approximately \$369. For the address of your nearest dealer, write to Northstar Marketing Inc., 2600 Cross Country Drive, Suite 77, Columbus, Ga. 31906; or call (800) 438-6934.—*M.L.*

Fuel or fire?

When my car misses, won't start or is generally feeling bad, I'm enough of an engine doctor to suspect either a fuel or ignition ailment. My troubleshooting technique usually involves lots of trial



Troubleshooter can detect ignition failures.

and error just to decide whether it's fuel or fire causing the problem.

The Thexton Fuel/Ignition Troubleshooter makes diagnosis easier. It has an adapter that fits between the spark-

plug and plug wire. Connected to the adapter is a neon test light on a 5-foot lead, fitted with a suction cup to stick to the windshield.

If, during a test drive, the light flashes continuously, you'll know it must be the fuel system at fault, not the ignition. The troubleshooter costs about \$12 at auto parts stores, or order it directly from Thexton Manufacturing, 7685 Parklawn Ave., Minneapolis, Minn. 55435.—*Bob Berger*

Welcome delay

If your car is a foreign make or more than a few years old, it may be missing one of the handiest new accessories—a variable intermittent windshield wiper. The ZT-101 delay control can be added to most domestic and foreign cars having 12-volt electric wipers (excluding some Chrysler models) and gives just the right wiping frequency for misty and drizzly days. Intermittent wiper

strokes can be adjusted between two and 20 seconds. The illustrated instructions cover most makes, and normal wiper operations are not affected. Priced at \$14.99, it's a product of Cal Custom/Hawk, 23011 South Wilmington Ave., Carson, Calif. 90747.

—*Don Green*



Control adds intermittent wiper action.

Versatile pliers

In my garage, there are a lot of jobs but not too many tools. So I'm grateful when one tool can perform several functions.

All Grip's locking plier kit fills the bill perfectly with five sets of interchangeable jaws that can lock onto the basic plier with a spring-loaded detent ball arrangement. Straight jaws make a handy portable clamp vise. Curved jaws lock onto rod or pipe. Two sizes of long-nose jaws can get at those hard-to-



Locking pliers accept five jaw styles.

reach spots and add leverage for bending. Flat sheet-metal jaws make for accurate crimping and bending.

The complete locking plier kit sells for \$19.95 and comes with a handy case. It's available at retail chains and hardware stores, and is distributed by ALLTRADE Inc., 2140 Davie Ave., Commerce, Calif., 90040.—*W.H.*

HOMEOWNERS' CLINIC



Beating below-grade mildew

I have a second home which we use mostly on weekends. The house is four years old and is built into the side of a hill. My problem is mildew in the closet, bathroom and laundry room on the lower floor. Last summer everything in the closet mildewed—clothes, shoes, walls. The bathroom and laundry also mildewed around the baseboards, and on some of the walls.

We washed the walls and ceilings with a Clorox solution, which seems to retard growth of mildew but doesn't stop it. I've been told to vent the area by putting in small fans, or to run a dehumidifier. But since it's only a weekend house I don't want to leave anything electrical on when it's empty.

I have found this to be a common problem with weekenders all over our area, but no one seems to know what to do.—Frank Stearns, New York, N.Y.

Mildew thrives in a damp environment, and in order to prevent it, it's necessary to control the dampness.

When the dampness is the result of condensation of the warm, moist summer air, it can be controlled by a dehumidifier and ventilation as was suggested to you.

However, it sounds as though your problem is caused mainly by moisture buildup on the foundation walls and floor slab because of the hydraulic pressure of wet soil adjacent to the house. In this case, additional measures must be taken.

Since your house is built into the side of a hill, it's likely that the ground on the uphill side is not graded properly. The ground, for at least several feet, should slope away from the house so surface water will not accumulate against the foundation. Also, gutters and drain pipes should channel roof rain runoff away from the house, and toward the downhill slope of the land, rather than letting it saturate the soil adjacent to the foundation.

It is also possible that when the

house was built, the builder failed to properly waterproof the foundation wall below grade. If this is so, you should consider excavating that section of wall and coating it with a cement-based sealant such as Thoroseal Foundation Coating.

Thoroseal also is available for waterproofing concrete and masonry walls from the inside, provided these walls are exposed. Both varieties of waterproof coating can be applied by brush, and they are sold at home centers and building supply stores.

Since you don't want to run a dehumidifier and fan during the week when the house is empty, you might try getting rid of the dampness using chemicals that absorb moisture, such as silica gel and activated alumina. These chemicals can be placed in open containers or cloth bags in the problem areas. The chemicals have the capacity to absorb half their weight in water. After they have become saturated they can be heated to draw off the water, and then reused.

Faulty shower diverter

I have a problem with the shower diverter on my bathtub faucet. When the knob is pulled up to divert water to the shower, a lot of water continues to flow into the tub. Is there any way to either replace or repair this unit without going into the wall?—Clarence D. Bement, Pine Bush, N.Y.

Yes, there is. The diverter valve mechanism that you refer to is inside the tub faucet spout, not inside the wall. The spout is screwed onto the water pipe and can be unscrewed easily. Once the spout is removed you can see the diverter mechanism. The diverter is

a small gate valve attached to the base of the plunger shaft. It is held up (closed position) by water pressure. When the water is turned off, the gate valve drops and opens the tub spout.

If the diverter can't be repaired, it's cheap enough to replace the entire spout, including the diverter mechanism. These spouts are available at plumbing supply stores and cost between \$10 and \$15.

There are different types and sizes of diverter spouts available, so take your old spout along to the plumbing supply store to make sure you get the right one. Check especially that the set-back

distance of the threads within the spout matches the length of your protruding water pipe, so you get a tight fit between the spout shoulder and the wall.

When replacing the spout, use pipe-joint compound on the pipe threads. Completely fill the hollowed-out back end of the spout with plumbers' putty to prevent water from penetrating the wall.

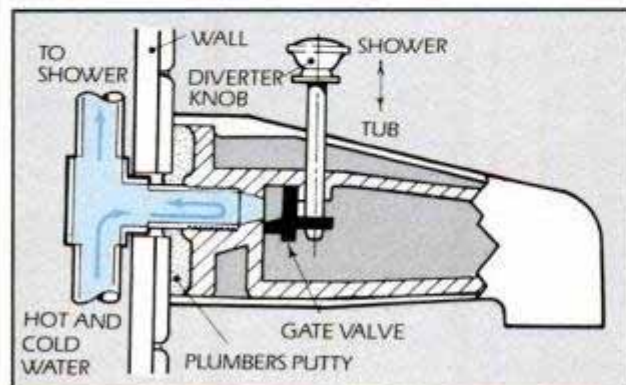
Bleeding knots

I have built-in corner cabinets in my dining room that I painted to match the room trim. The cabinet doors are pine, and after two years the knots are bleeding through and looking really bad. They doors now have four coats of paint but it doesn't stop the bleeding.—D. L. Copeland, Huntersville, N.C.

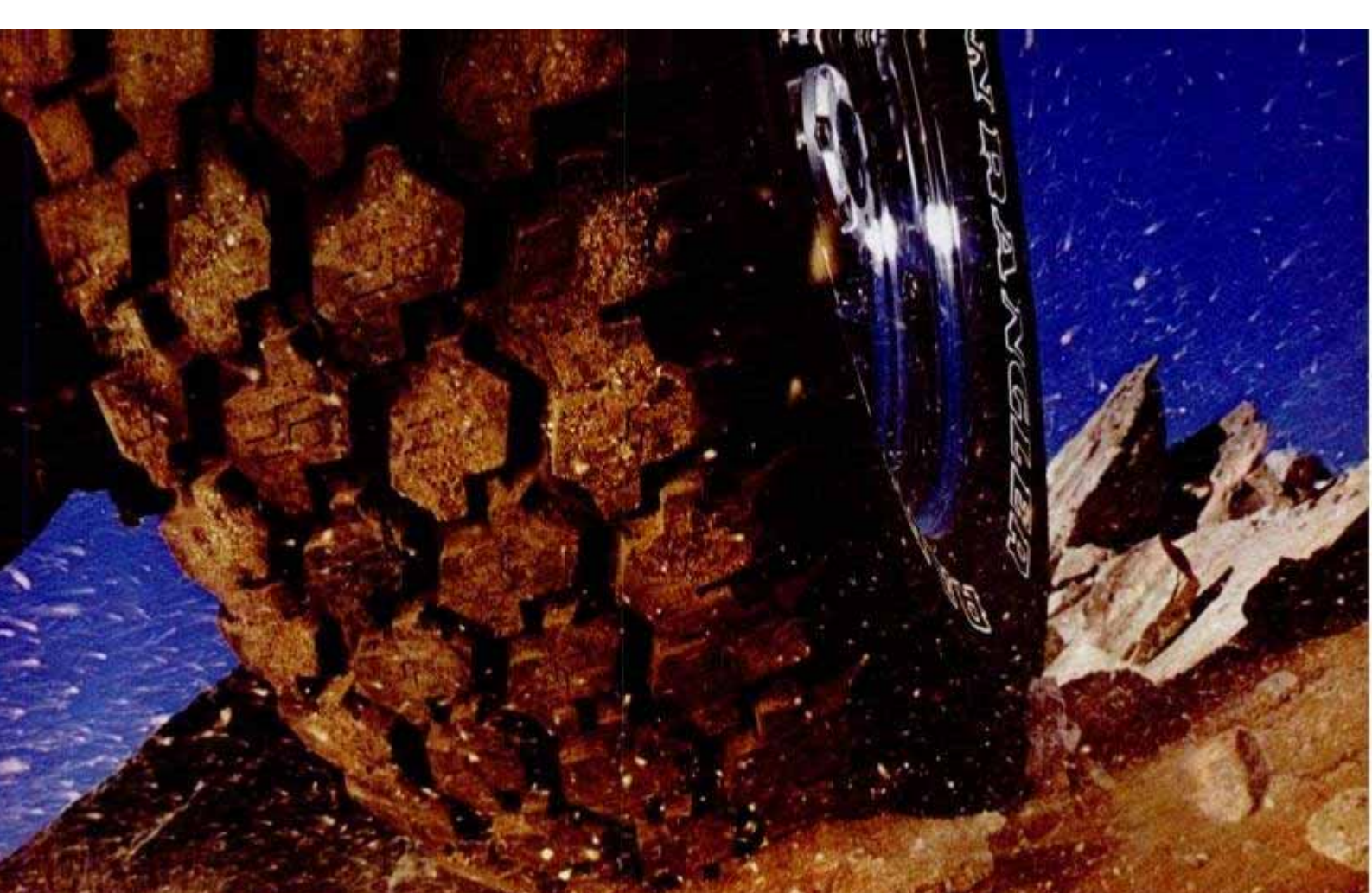
Probably your cabinet doors were not primed and sealed prior to the original painting. The Parks Corp. of Somerset, Mass., has a product called UnderCover which they claim will keep wood knot and sap stains sealed beneath its prime undercoat. UnderCover is available in paint stores and costs about \$17 per gallon.

Don't add a fifth coat of paint to the cabinet doors. Your best bet is to strip off the four coats of paint. Sand all the rough areas and make sure the surface is smooth and clean. Apply the UnderCover primer coat, then paint. **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.



Shower diverter spout unscrews for repair or replacement.



MOUNTAIN CLIMBER.

WRANGLER

E N G I N E E R E D F O R S U R V I V A L

Goodyear is well aware that the shortest distance up any mountain is rarely a straight line. One very good reason why Goodyear developed the Wrangler All-Season Radial. The all-terrain tire engineered with a unique

block-tread to claw through sliding rock and debris. Plus strong sidewalls to help withstand the beating off-road driving inflicts. After all, if a driver is to survive off-road, it's essential that he drive on a tire equipped to survive.

GOODYEAR

COME ALIVE, COME AND DRIVE

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**NEW
LONGER
LONG BED**



1985 NISSAN LONG BED.

Meet strength in a new length:
Nissan's longest Long Bed ever.

Not only is the bed longer, it's stronger.

- Nearly 7½ feet of new, smooth-side strongbox, built tough for the longer haul.

- Re-engineered, seamless strongbox fights corrosion; welded double walls resist dents.

- 1,460-pound payload, standard... nearly ¾ ton... a truck payload.

More than Toyota, Chevy S-10 or Ford Ranger standard models.

- More combined horsepower and torque than any other leading standard compact truck.

- Extra-large strongbox and roomy cab ride on the rugged backbone of a semi: full-box girders welded into ladder-type frame.

- 5-speed transmission, standard.

- Steel-belted radials; full-size spare.

- Choose from 4x4 or 4x2 Long Beds, including a new low-price model that offers such extras as halogen

headlights, electronic ignition, 3-across seating and lots more at no extra cost.

Now you know what Major Motion means. No wonder more truckers drive more Nissan-built compacts than any other.

The best extended-service plan available: up to 5 years/100,000 miles. Ask about Nissan's Security Plus at participating Datsun dealers.



BELT YOURSELF



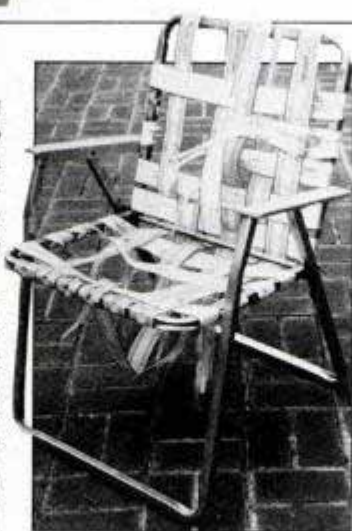
AT YOUR DATSUN DEALER

Датсун — защищенный вариант из профлиста

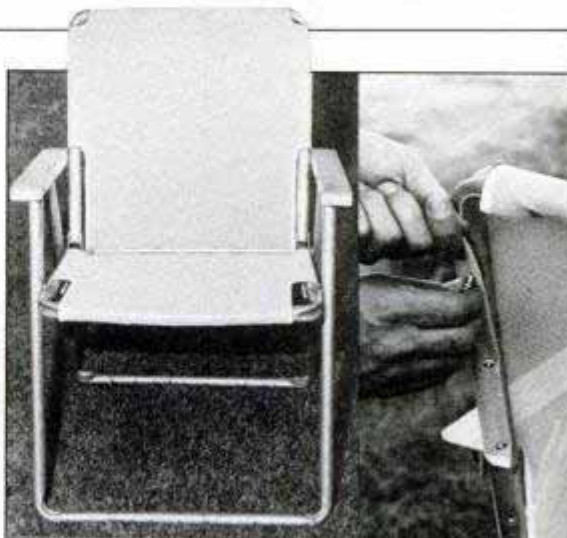
Better than new

Replace the old, frayed plastic webbing on your aluminum lawn and patio chairs with the new Better Bottom replacement cover. The durable one-piece cover is made of superstrong vinyl-coated polyester and will last five years, according to the maker.

To install a Better Bottom cover, simply remove the old webbing from the chair, position the new cover on the frame and attach it using the original fasteners. Better Bottom covers are available at hardware stores, home centers and mass merchandisers in four colors—yellow, blue, green and sand—and in a plaid or stripe pattern. Covers are available for chairs (\$6) and chaise lounges (\$10). For details, contact Phifer Wire Products, Box 1700-PM, Tuscaloosa, Ala. 35403.



Most aluminum lawn chairs have plastic polypropylene webbing which can dry out, become brittle and break.

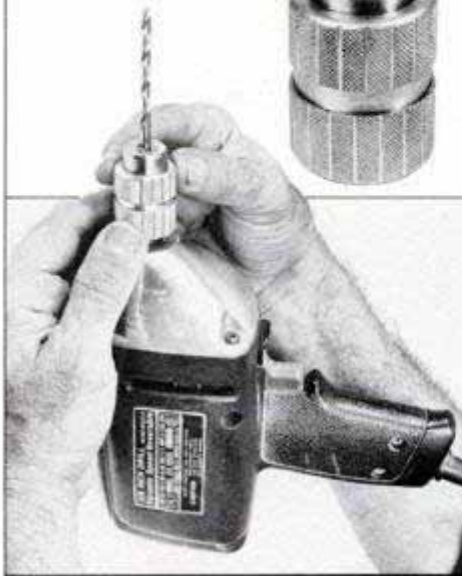


Replace old chair webbing with a one-piece vinyl-coated polyester cover (left). The easy-to-install cover is durable, comfortable and mildew-resistant. Attach the new cover using the chair's original fasteners (right).

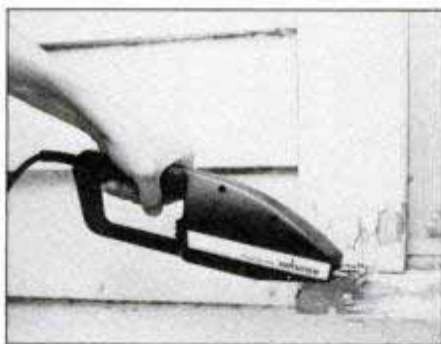
Convert to keyless

Add keyless convenience to all your hole-drilling tools with a Kawasaki keyless replacement chuck. The easy-to-install chucks are available for use on nearly all portable drills, drill presses and lathes in capacities from 1/4 to 3/4 in. The chucks will accept tapered, straight and threaded arbors. A locking ring allows you to hand tighten and loosen the tool without using a chuck key.

The model MU-65 for use on a 1/4-in. portable drill is available for \$27 postpaid. For more information, contact Nicholson Tool Co., 1324 Kingston Dr., Ogden, Utah 84403.



The right tool for scraping



Wagner has simplified the tedious task of paint scraping with the introduction of the Power Scraper—an electric paint scraper. The Power Scraper features a reciprocating alloy steel blade that vibrates 3,600 times per minute to remove peeling, flaking paint quickly and easily. The blade is powered by a heavy-duty linear motor which eliminates the typical pushing and pulling associated with hand scrapers.

Use the Power Scraper for removing old paint from siding, fences, outdoor furniture, floors and concrete and steel surfaces. The blade is angled to minimize "digging in," which damages the surface.

The Power Scraper is available at hardware stores and home centers for about \$70. For more information, contact Wagner, 1770 Fernbrook La., Minneapolis, Minn. 55441.

Oil-free rust protection

A new nongreasy rust preventative is offered by Schwab Industries, Box 1269, Sequim, Wash. 98382. Rust-Guardit is a wax-like spray that has good adhesion, dries in 30 seconds and won't crack, peel or evaporate, according to the manufacturer. Rust-Guardit contains no grease, oil, silicone or Tef-



lon and it can be removed with any petroleum solvent.

Use Rust-Guardit to protect tools, hardware, shop equipment, firearms, fishing tackle and auto trim from rust and corrosion. The 10-ounce can is at hardware and sporting goods stores for about \$4, and from the maker for \$4.95 postpaid.



PM

PM ELECTRONICS MONITOR



Flat-panel TV closer to reality

A flat-screen TV that would hang from a wall like a picture frame seems attainable now that Japan's Matsushita has unveiled a 10-inch diagonal color prototype only 4 inches deep.

The revolutionary design made its debut in Matsushita's exhibit during the Science World's Fair now in progress in Tsukuba, Japan. Matsushita is the corporate parent of the Panasonic, Quasar and Technics brands sold here.



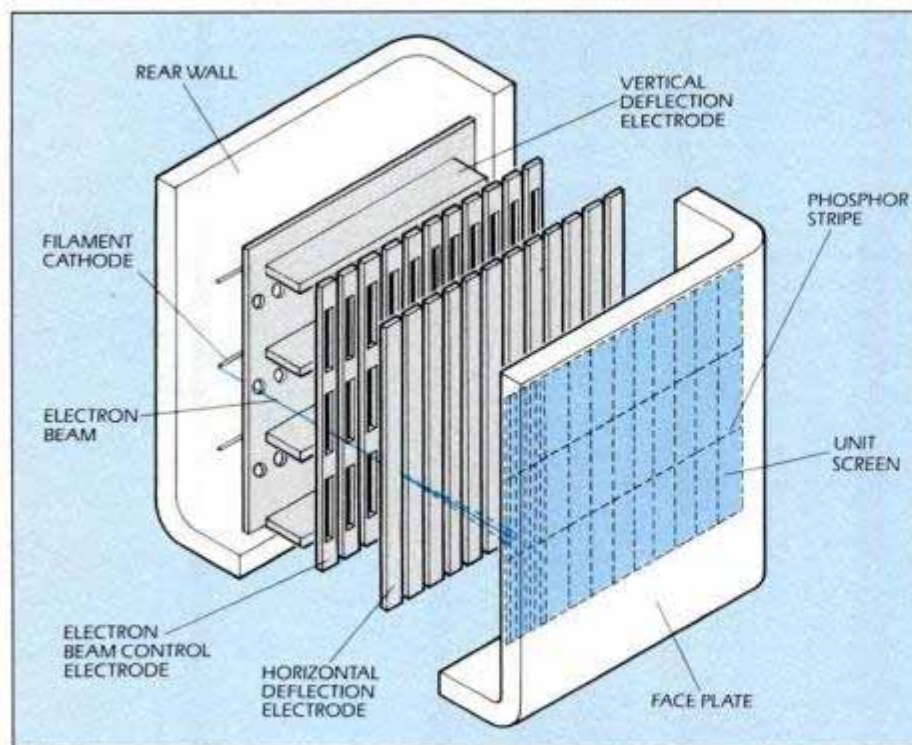
TV is 4 in. deep with 10-in. diagonal screen.

Although the company announced no timetable for actual sale, officials told PM all that's needed is to develop techniques for mass production. They claim there's no limit to picture size for the flat-panel technology.

The screen PM viewed at Tsukuba measures 10 inches diagonally by 6 inches high and 8 wide. The picture tube itself is 2½ inches deep. The entire set measures only 4 inches deep, 9 inches high and 11 inches wide.

Despite the compact size, the set weighs a hefty 31 pounds. That's because it uses a cathode ray tube (CRT)—unlike the lighter, liquid crystal displays (LCD) employed by other companies announcing flat-panel TVs.

CRT displays offer inherently better brightness and resolution than their LCD cousins can provide at this date. The Matsushita prototype we saw produced images as well as any current TV. The company achieves unusual thinness by eliminating the conventional shadow mask, and using a combination of digital signal processing and beam indexing to guide a scanning electron beam to picture cells embedded in the tube's glass screen.



Flat TV has no yoke or shadow mask. Instead, index stripes in screen guide electron beams.

Eliminate interference

Tired of static and other interference disrupting your telephone conversations? AT&T has the answer. It's a line filter claimed to eliminate intrusions from ham, CB and AM radio on your conversations. The modular jack plugs into any telephone so equipped. Price is \$8.95. The \$64,000 question: Where was it before the divestiture?



AT&T's filter cleans up phone interference.

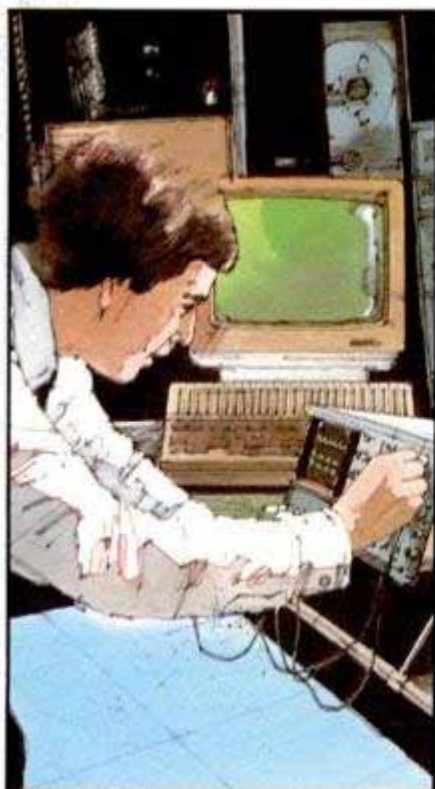
Currents

■ In case no one told you, the Federal Aviation Administration has decreed that the use of portable computers, calculators and electronic games doesn't interfere with aircraft navigation and communications gear. For safety, airlines will continue to prohibit use of such equipment during critical times such as takeoff and landing.

■ There'll be more radio stations using the Motorola system of AM stereo radio soon. Harris Corp., a competitor to Motorola, recently threw in the towel and swore allegiance to the C-QUAM standard. This means nearly 200 stations formerly broadcasting according to the Harris gospel will begin preaching Motorola's. Most auto companies and car stereo manufacturers are producing Motorola-type receivers.

■ By the time you read this, NBC will be transmitting stereo sound to all its affiliated TV stations equipped to transmit it to you. Readers in Los Angeles, New York and Washington, D.C., with stereo TV sets will be the first to get *The Tonight Show* and *Friday Night Videos* in two-channel sound.

■ Reader Advisory: The Videocaster TV/VCR accessory shown in April's market for failure to comply with Federal Communications Commission regulations. No word yet from Quantec International, the maker, as to when the device will be available again. **PM**



What can you do with electronics? Ask CIE.

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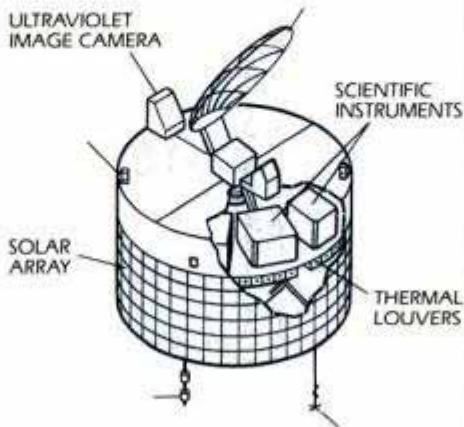
PM-09

SCIENCE WORLDWIDE



Launched in Japan, heading for Halley

Japan will launch its first planetary spacecraft on its own rocket from a northern Japanese base late next year. The craft, dubbed Planet-A, will approach Halley's comet as the comet completes its turn around the sun and heads back to the depths of the solar system. Reaction-control thrusters will position Planet-A at any angle desired as it closes to within 50,000 miles of Halley. An ultra-violet camera and scientific instrument packages will photograph the comet and measure its temperature, density and constituents. A group of antennas will beam back to Earth pictures of the comet and data on its makeup. Mission control for the Japanese spacecraft will be located in Tokyo and nearby Tsukuba.



Japan's Planet-A spacecraft is rigged to send pictures of Halley's Comet to Earth.

Halley helps

At a recent conference, I spoke to several astronomers about Halley's comet. The consensus? If you didn't see Kahoutek's Comet in 1974, you won't see Halley's comet in late 1985 and early 1986. Remember the disappointment when Kahoutek didn't light up the night skies? Halley, the astronomers predict, will be just as disappointing. Unless you're prepared.

If you get ready for Halley, you'll find it by next spring, and you'll be glad you did. There's an excellent free pamphlet to help get you started looking. To get "Halley's Comet is Coming," send a self-addressed stamped envelope to: Halley Center, Bushnell, 2828 E. Foothill Blvd., Pasadena, Calif. 91107.

Swell treatment for arthritis

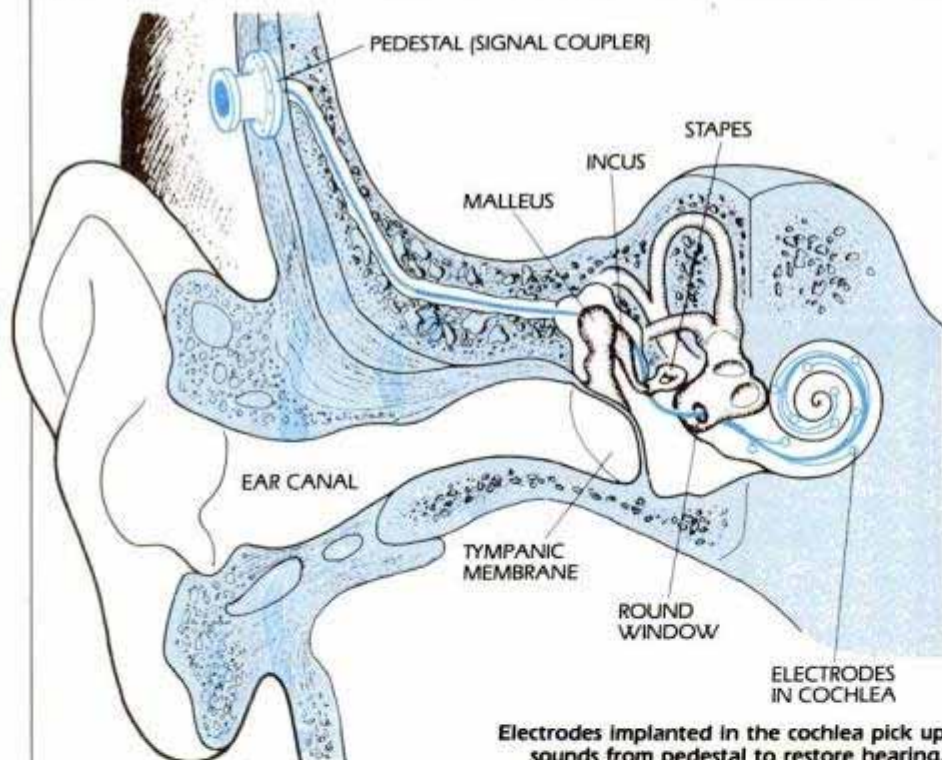
A Harvard Medical School team has come up with a new method for reducing or eliminating the very worst symptoms that come with the most advanced cases of arthritis. It's called radiation synovectomy and it both reduces arthritic swelling in joints and prevents joint destruction associated with advanced arthritis. The treatment takes 24 hours to perform. A very short-lived radio-active chemical is injected into the joint where it destroys the synovium, or the joint lining. That immediately reduces swelling. A few months later, a new lining grows in with far less swelling than the original lining. The treatment, tried on over 100 patients, will be available in two years.

Stop that atom!

Atoms move about at thousands of feet per second which makes it very difficult to take readings of individual atoms. Scientists studying atomic structure want to see the wavelengths of light reflected by individual atoms to help figure out the shape, size and energy of each one. Until recently, they had to do a lot of guesswork.

But now two research teams at the National Bureau of Standards—working independently—have brought streams of atoms to rest inside observation chambers cooled to within one-tenth of a degree of absolute zero. That brings the atoms to an almost complete halt. The atoms are then zapped with laser light which stops them dead for a few millionths of a second, long enough to take readings.

PM



Electrodes implanted in the cochlea pick up sounds from pedestal to restore hearing.

Electronics bring hope to the deaf

It isn't a cure-all, but a new implant operation promises to give profoundly deaf people their first chance of taking part in close to normal conversation. Several institutions across the nation are experimenting with the cochlea implant surgery that allows the patient to hear, sometimes with a boost from lip reading, but often without that boost. The cochlea is a snail-shaped

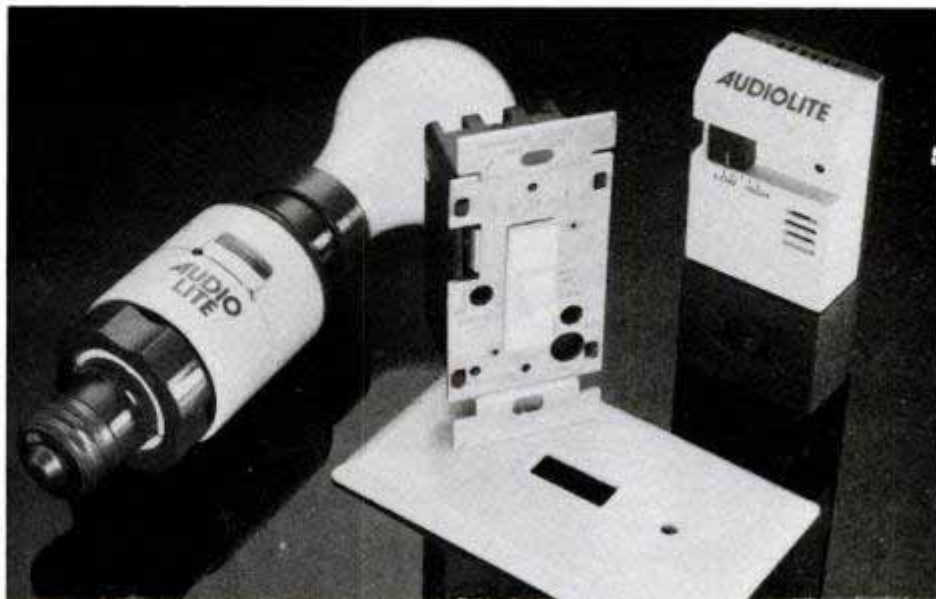
bone in the inner ear. In the surgery, a series of electrodes the size of a pin-head are implanted in the cochlea. A thin wire is run through the stapes, incus and malleus sections of the inner ear to a pedestal sewn into the skin just behind the ear. Sounds processed through the pedestal are routed to the cochlea and then to the auditory nerve leading to the brain.

New Home Security Device Stops Burglars

The following introduces one of the best bargains in low cost home security ever to reach the market! Now you can protect your home and family for as little as \$24.95.

Imagine it's midnight. A burglar is watching your home. His mission — to rip you off! In the dark, he approaches your door. Suddenly, your yard is flooded with light. He wonders if you're armed and waiting. Shocked, the thief runs. Your home and family remain untouched. And you weren't even home.

The professional burglar was fooled by a new idea in home protection — the AudioLite. This ingenious security device reacted to the sound of a burglar and turned on lights, preventing an attempted break-in.



AudioLite stops burglars by turning on lights at the sound of an attempted break-in. Three models for your total security. AudioLite Socket, AudioLite Switch and AudioLite Plug.

Safety and Convenience

Now, with the AudioLite as your "thief stopper," as you drive up, the sound of your car turns on the yard lights. Your footsteps turn on the porch light. Your key in the door turns on lights in the hallway. And, after you're safely inside, the AudioLite turns the lights off automatically.

Simple to Use

Never touch a light switch again with AudioLite. Your voice is the remote control for instant lighting. You set the exact amount of sound needed to activate the AudioLite. Anything from a whisper to a loud shout (what a lifesaver for senior citizens or the handicapped).

When you're away, inside lights will turn on at the sound of common house noises, such as the doorbell or telephone, making it appear that you're home.

Lights are timed to stay on up to two minutes. Each new sound triggers the internal timer, and it begins a new countdown, so lights stay on while you're in a room and go off automatically when you leave. However, for quiet activities, such as reading, the AudioLite has a manual on-off switch.

Combine 3 Models for Total Security

- **AudioLite Plug** just plugs into any standard outlet. Plug a lamp into the AudioLite, it's that simple. Any room with a lamp can be sound activated. The plug is portable so you can use it anywhere.
- **AudioLite Socket** For outdoor light

sockets, it can stop a burglar in your yard, before he gets near your home. Frightening to burglars, but welcoming to friends. So easy to use, just screws into your outside light socket.

- **AudioLite Switch** turns on ceiling lights. It's terrific for dark stairways, hallways, entry ways, basements and garages. Installs quickly and easily in place of your present light switch. Using just a screwdriver, it takes only a few minutes, even for a novice.

Saves You Money

Since your lights automatically go on when you enter a room and go off when you leave, you don't pay for lights you're not using — slashing your electric bills. For additional savings, AudioLites can operate lights at reduced energy.

Solid state construction and quality craftsmanship means no wear and tear on parts. The **Switch** and **Socket** work with up to 150 watts, the **Plug** up to 300 watts. They are UL approved and have a one year replacement warranty.

Order Four — Save over \$20

Order one AudioLite for your home at the new low price of \$24.95 or for total home security, order a set of 4 for only \$79.80 (that's \$19.95 each — **SAVE \$20**) and get **FREE SHIPPING!** Try AudioLite for 30 days, risk free, you'll wonder how you ever lived without them. Discover the

security of a home that scares the daylight out of burglars.

Order Today — Free Gift

Eight **FREE** Burglar Alarm Warning Stickers (for windows and doors) with orders of 4 or more (\$3.95 value). Call **TOLL FREE 1-800-525-8624** (in Colorado 303-762-1385) or send to: Progressive Energy Corp., 3148 South York, Englewood, CO 80110.

Yes, I want the best bargain in home security. If in 30 days, I am not fully satisfied, I can return AudioLite for a prompt refund.

Please send me ___ AudioLite(s) at \$24.95 each and \$2.50 shipping and handling (shipping is \$3.50 for 2 or 3).

I want to save \$20 and have total security. Send me 4 AudioLites at \$79.80 (shipping is FREE).

3 models: ___ Plug(s) ___ Socket(s)
___ Switch(s)

Check MasterCard/VISA C.O.D.

Card # _____

Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

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THE PM WORKBENCH

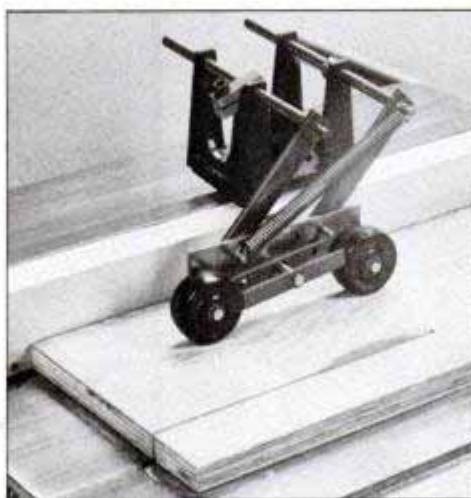


A finger-saving ripping guide

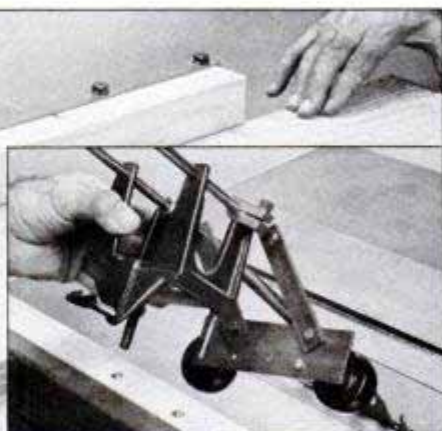
Reduce the risk of injury and dangerous kickback with the Ripstrate table saw ripping guide. This unique safety device allows you to cut while keeping *both* hands away from the saw blade.

Mount the Ripstrate to an auxiliary wood rip fence. The two rubber rollers on spring-loaded arms hold down the workpiece firmly on the saw table and tight against the saw fence. Kickback protection is provided by the steel pawl that is positioned between the two rollers. If the workpiece attempts to move back toward the operator, the pawl will become jammed, locking the rollers and workpiece in place. The Ripstrate can also be used on a radial-arm saw.

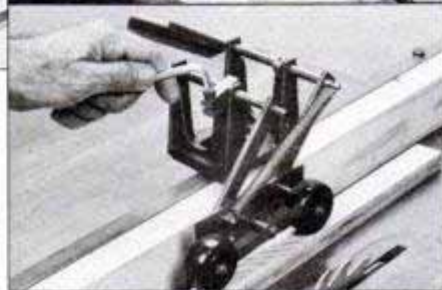
It's from Fisher Hill Studios, Fisher Hill, Fitzwilliams, N.H. 03447, for \$63 postpaid.—Rosario Capotosto



Ripping guide allows you to keep both hands away from blade (above). Rollers hold work down and against the fence.



Mount the guide in two holes bored in an auxiliary wood fence (upper right). Then, adjust the rollers to accommodate the stock thickness by tightening the locking collar with a hex key wrench (right).



Supergrip sockets

If you've ever struggled with a stripped nut, you'll appreciate the revolutionary Cam Action Grip socket. The socket's six-roller-pin cam mechanism grips a nut firmly regardless of how badly it is stripped. In fact, the cam action will even engage on a round bar. The sockets fit any $\frac{3}{8}$ -in. drive ratchet wrench.

The sockets come in sets of three, $\frac{1}{2}$, $\frac{9}{16}$ and $\frac{5}{8}$ in., for \$33.45 postpaid from Metek Tool, 212 Andover Rd., Billerica, Mass. 01821. Replacement pins and inserts are also available for \$3.10 postpaid.—Rosario Capotosto



Supergrip sockets are available in sets of three for use with a $\frac{3}{8}$ -in. drive ratchet.



The six roller pins become wedged against the nut when wrench pressure is applied.



Gripping a totally stripped bolt head is no problem for the cam-action grip socket.



The unique socket even grasps round stock firmly. Sockets grip in both directions.

Home improvement booklets

Eight do-it-yourself home remodeling and decorating booklets are being offered by Georgia-Pacific. The topics that are covered in the new booklets include paneling, deck building, working with gypsum wallboard, reroofing, easy-to-make projects, making children's toys, home storage ideas and gifts you can make.

Each home improvement booklet is



Eight colorful, informative booklets offer a variety of home remodeling and decorating ideas for the active homeowner.

\$2. As a special offer to *PM* readers, order all eight booklets for \$7. For more information, write to Georgia-Pacific, Great Possibilities, Dept. NR, Box 48408, Atlanta, Ga. 30362.—J.T.

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



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

Lights: 8 mg. "tar", 0.7 mg. nicotine av. per cigarette by FTC method.

15 Most Common HOUSE PROBLEMS

If you're buying a house, or doing an annual inspection on your present home, here's what to look for.

BY NORMAN BECKER, P.E.

During the last 14 years, I've inspected thousands of houses for owners and prospective buyers in the New York area. When discussing inspections, my clients usually ask, "Is the house structurally sound?" "Will the house stand for another 30 years?" They're primarily concerned with structural problems. Although some houses do have structural problems, most problems are *not* of a structural nature. Being aware of the most common problems can be helpful to you as a prospective buyer, a seller, or if you simply want to upgrade your home for greater comfort and safety.

1 Damaged exterior paths and steps—90 percent of all homes that were inspected.

Exterior paths and steps in need of repair are a very common problem. Cracked sections often need resealing. However, in many homes paths are not only cracked, they have broken, loose, settled and uneven sections that need replacement.

When a path or sidewalk is near a

tree, the growing roots push up and cause heaving on the walkway. This is a dangerous condition that should quickly be corrected.

2 Inadequate attic insulation and ventilation—60 percent of all homes inspected.

Attics are often inadequately insulated and inadequately ventilated. The attic should be insulated to reduce heat loss in winter and heat gain in summer, the latter to minimize air-conditioning costs. In an unfinished attic, the insulation should be located between the floor joists and not between the roof rafters. Quite often, in finished or partly finished attics, there is no insulation on the unfinished side of the partition walls.

Attic ventilation helps prevent moisture accumulation. The attic can be

ventilated by gable vents, soffit vents, roof vents and/or a ridge vent. The effective ventilation opening in an attic
(Please turn to page 44)

Norman Becker, a licensed professional engineer, is president of Universal Home Inspection Inc. in Suffern, N.Y. Becker also writes PM's Homeowners' Clinic.



Steps with two or more risers should have a handrail. These steps could prove especially difficult to use without a rail in the winter months. Steps—both interior and exterior—without rails or with uneven risers are the 12th most common house problem (see page 48). The joints between bricks and the cracked sidewalk here also are in need of repair.



Problem 1: Most homes have damaged exterior sidewalks or damaged exterior steps. This heaving sidewalk caused by roots of an adjacent tree is a tripping hazard. In most communities, repair is the responsibility of the homeowner.

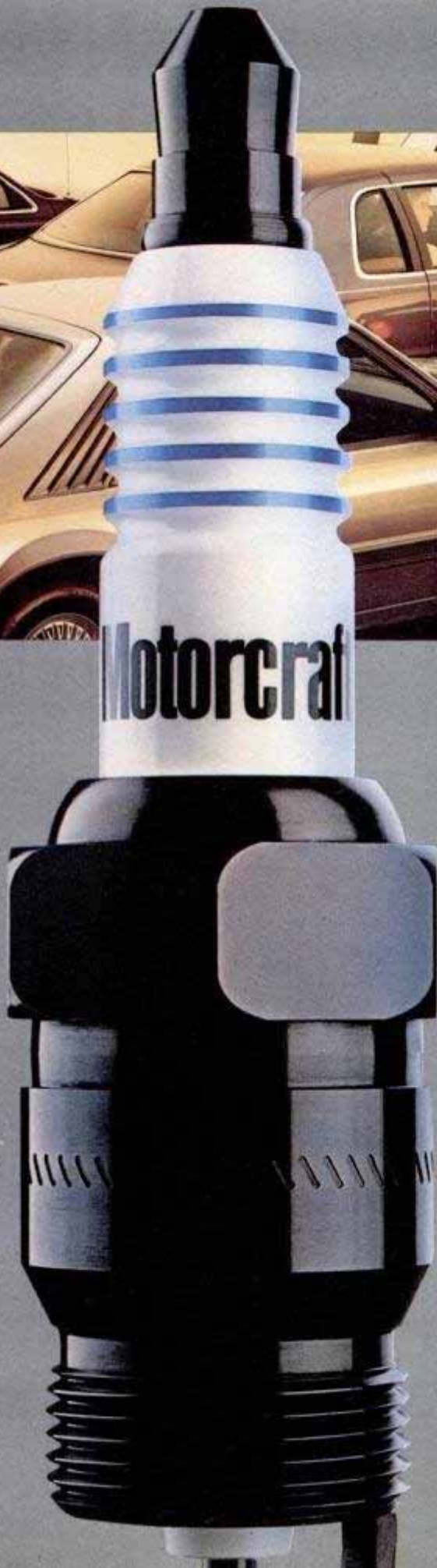


Problem 2: This attic has adequate insulation for the region, but many attics don't. Here, insulation is located both between the floor joists and over them. The insulation over the floor joists reduces heat loss through the joists.



Problem 3: Inadequate crawl-space insulation is widespread. To correct this situation, the area between the floor joists over the crawl space is covered with rigid foam insulation boards, which reduces heat loss and conserves fuel.

How Motorcraft Extended Tip Spark Plugs handle idle threats.



Stop and go traffic can be murder with fouled plugs.

That's when sooty carbon buildup, caused by repeated cold starts, can lead to rough idle and misfire. A threat we never took lightly at Motorcraft.

Hence, our extended tip design. An engineering masterpiece that can handle power surges up to 38,000 volts without missing a beat.

A design that burns away sooty carbon as you drive.

The result: a sure, clean burn for better engine performance and better gas mileage (provided your engine is properly tuned and normally driven).

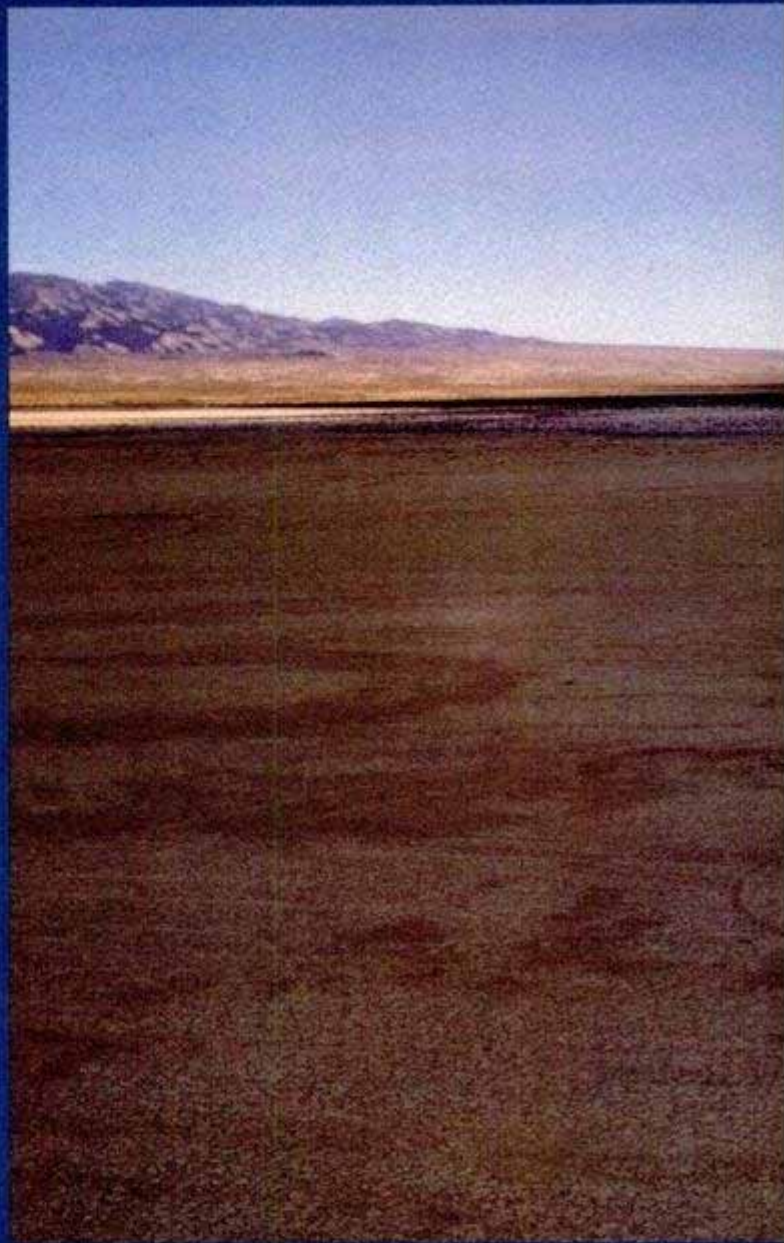
The extended tip spark plug from Motorcraft. Quality parts for all makes of cars and trucks.

Get it together — buckle up.

Motorcraft
EXCEEDS THE NEED



ISUZU



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WHERE NO LIFE EXISTS EXCEPT
SMALL COLONIES OF ISUZUS.

Buckle up — for life!



In some of the farthest corners of the earth, you'll find the only form of transportation is an Isuzu. Or a donkey.

Take the small colony of Isuzus you see here. Clockwise, you'll see our new Space Cab,* standard bed pick-up, Trooper II, longbed pick-up and another Trooper II. Five versions of high adventure powered this year by an all new 2.3 liter gas engine. (An optional turbo-diesel engine is available for the pick-ups and the Trooper II.**)

The Trooper II is a go anywhere, do anything, four-wheel drive that thinks it's a utility truck. With its huge 21.9 gallon fuel tank, you can leave civilization and go up to 613 miles without refueling.*** The

versatile Trooper II was voted "4x4 of the Year" by *4 Wheel & Off-Road* magazine. And still, it's the least expensive 4x4 in its class!

Then there's our Space Cab. In its cab, there's room for up to four people, with the optional jumpseats. Plus, there's extra storage space for your equipment, with a built-in tonneau cover for security. There's even a sunroof standard on the LS model.

And now our most popular Isuzus. Our longbed and standard bed. No other truck in its class has a larger bed than our longbed; it also has the largest standard fuel tank in the field. And our standard bed just won the toughest off-road race in the world — the Baja 1000.

Isuzu trucks. You'll find a small colony right at your Isuzu dealer. Ready to go. Anyplace.



THE FIRST CAR BUILDERS OF JAPAN.

*Space Cab available summer of 1985. **Turbo-diesel not available in California. Turbo-diesel trucks available summer of 1985. ***Turbo-diesel Trooper II, 28 estimated MPG. Use estimated MPG for comparison. Actual mileage may vary.

15 COMMON HOUSE PROBLEMS

(Continued from page 40)

where there is a vapor barrier on, or next to, the insulation is 1/300 of the attic floor area.

To determine the approximate insulation R-values for your geographical location, consult the map in *How To Spot Home Energy Wasters*, page 131, Sept. '84, or call your local utility.

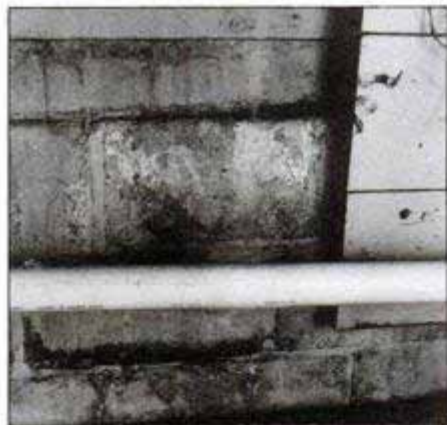
3 Inadequate crawl space insulation and ventilation—55 percent of all homes with crawl spaces inspected.

The problems in a crawl space are similar to those in attics—inadequate insulation and ventilation. Water seepage can also be a problem. Many crawl spaces have dirt floors, which should be covered with polyethylene plastic sheet to control the moisture buildup.

Adequate ventilation minimizes moisture buildup that promotes rot. For most homes, 1 sq. ft. of unobstructed opening for each 25 linear ft. of wall is adequate to properly ventilate.

4 Wet basement—50 percent of all homes with basements inspected.

Due to its below-grade location, a



Problem 4: Some signs of a wet basement are water stains, discolorations and scaling paint on the foundation wall. These indicate that water or moisture has seeped through from the exterior to the interior.

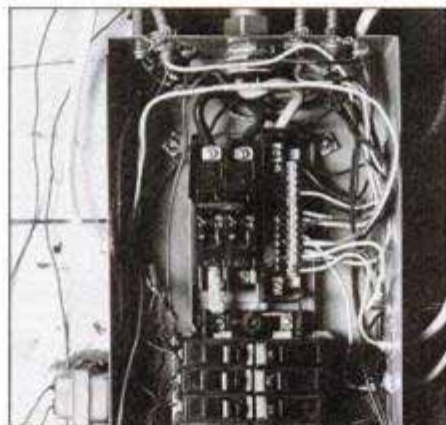


Problem 7: Cracked and deteriorating asphalt shingles are a widespread problem. These shingles on the roof ridge should be replaced even though there is no indication that water has leaked into the house.

basement is vulnerable to water penetration. Water seepage into a basement can be caused by a number of factors: faulty gutters and downspouts, poor grading of the ground immediately adjacent to the structure, leaking basement walls due to high hydrostatic pressure, and/or a high ground water condition. Depending on which item or items are causing the wet basement, the solution would be either the use of drainage pipes, regrading, installing a sump pump, waterproofing the foundation or possibly using a combination of the above.

5 Electrical problems—48 percent of all homes inspected.

To adequately inspect the electrical system, it's necessary to remove the cover to the electrical panel box. This should be done only by a person experienced in electrical work. Once the cover is removed, you can determine whether the individual branch circuits are protected properly. Quite often, branch circuits rated at 15 and 20 amps are protected by 20- and 30-amp circuit breakers or fuses. If those branch circuits are overloaded, instead of the circuit breaker tripping or the fuse



Problem 5: To evaluate electrical service, remove the panel box cover. Check compatibility of circuit breaker amperage and gauge of respective branch circuit wires. Also check for aluminum wiring.



Problem 8: The base of this downspout should be extended, or a splash plate should be installed, so that water flows away from the house. Water from this spout had entered the basement.

blowing, the circuits will become very hot and could cause a fire.

In a number of houses built between 1965 and 1973, aluminum wiring was used in the electrical system. According to the Consumer Product Safety Commission, aluminum wiring is a definite fire hazard.

In order to correct aluminum wiring problems, it's necessary to pigtail short copper strips at the ends of the aluminum wires and to secure them with a special safety connector made for this purpose. The connectors are available at electrical supply houses. The free ends of the copper strips should then be fastened to the outlet receptacles and switches (see *Homeowners' Clinic*, page 30, May '85).

6 Heating system problems—42 percent of all homes inspected.

Most homes are heated by warm air, hot water or steam through oil- or gas-fired furnaces or boilers. On my inspections, I often see an aging or obsolete boiler or furnace, as well as malfunctioning or missing controls such as low-water cutoff, high pressure or temperature limit switch, fan control, relief

(Please turn to page 46)



Problem 6: Antiquated heat systems are commonly in use. This old coal-burning boiler was made more efficient with a new oil burner (foreground). But there is no low water cutoff added.



Problem 9: A fire hazard such as lack of smoke detectors is an easy and inexpensive problem to correct. A smoke detector should be located on the ceiling in the hall that is next to the bedrooms.

THE LEADING EDGE.

Black & Decker

3/8" DRILL

Introducing a revolution in power tool technology, the M47 Series™ Drill. From Black & Decker.

It's a drill that has been redesigned from top to bottom. The sides are straight, parallel with the drill bit and square to the work surface, for easier, more accurate drilling. The back of the drill is flat, so hand pressure can be applied directly in line with the bit. It's got a center pistol grip for better balance. And an optional rotating side handle for better control,

with a compartment for storing bits.* And it comes with a Full 2-Year Home Use Warranty.

This superior shaped tool has been made possible through a remarkable innovation in small motor technology. A high efficiency, high density, copper wound motor, with more power and more torque than our comparable traditional motors, yet is 25% smaller and uses less electricity.

The M47 Series Drill. One of the revolutionary, new M47 Series power tools. From Black & Decker.

Truly the leading edge in power tool technology and design.

*Side handle will be included FREE with purchase of the M47 Series 3/8" Variable Speed Reversing Drill (model #7144) thru 6/30/85.

M47 Series™

Your Ultimate Weapon Against Athlete's Foot.



New
FootWork™
TOLNAFTATE 1% ATHLETE'S FOOT REMEDY

There's no stronger, more effective way to prevent and cure athlete's foot without a prescription.

Also available in cream, powder & solution.

15 COMMON HOUSE PROBLEMS

(Continued from page 44)

valve, oil burner, gas valve, zone valves or circulating pumps.

7 Deteriorated roof shingles—40 percent of all homes inspected.

Most of the pitched roofs in the United States are covered with asphalt shingles which have a projected life of 17 to 22 years. As shingles age and weather, they begin to curl, lift, lose the granular coating, develop hairline cracks in the surface and erode in the slots between the shingle tabs. As they dry, they also become vulnerable to wind damage and can be torn off their mounting.

In the house shown, the ridge shingles over the front entry area had developed large cracks and were in need of replacement. As a roof covering ages, replacement of some of the shin-

gles may become necessary to extend the life of the roof. It is usually not necessary to reroof a structure because of missing or defective shingles.

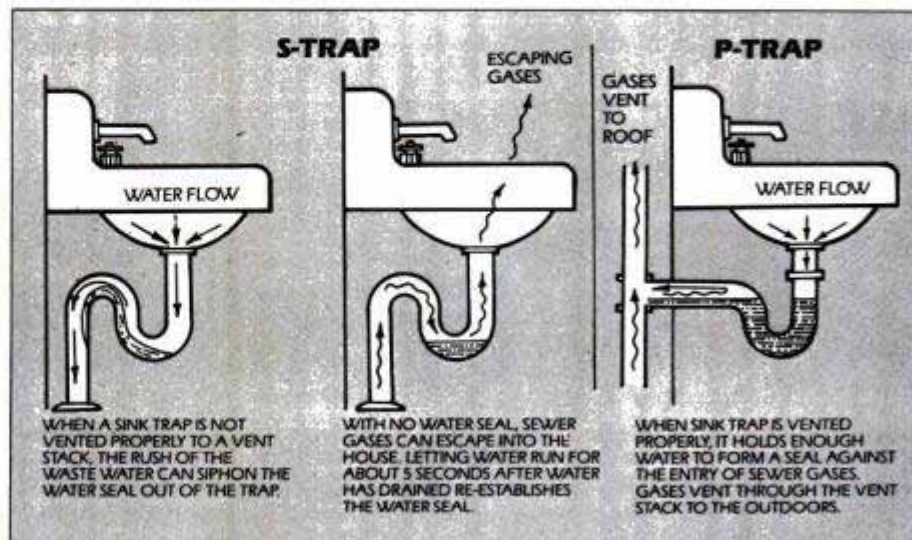
8 Missing or damaged gutters and downspouts—34 percent of all homes inspected.

Most houses could benefit from gutters and downspouts controlling the rain runoff from the roof. Yet, sagging, loose, missing and leaking sections of gutters and downspouts occur in about one out of every three homes. Occasionally, downspouts are set improperly. The lower section of the downspout must be set outside of the upper section. Otherwise, water will leak through the joint. Bases of the downspouts must always be extended so that water flows away from the structure.

9 Fire safety hazards—30 percent of all homes inspected.



Problem 10: Deteriorating plumbing piping is common. Mineral deposits and rust buildup at the joint between an iron pipe and brass fitting (left, arrow) indicate leakage. The combination of iron with copper and brass results in galvanic action that accelerates corrosion of the iron pipe. Mineral deposits along the sides of a brass pipe (right, arrow) indicate leakage resulting from zinc in the brass dissolving into the water. Deposits temporarily self-seal the leak. But the pipe needs replacement.



S-type sink traps (left and center) are usually improperly vented and aren't allowed in some communities. P-type sink traps (right) usually vent sewer gases in the proper manner.

All houses should have a smoke detector mounted on the ceiling in the hallway by the bedrooms. The lack of a smoke detector is a fire safety hazard.

In many homes, there are exposed wood framing members in close proximity to the heating system boiler or furnace. The exposed wood should be covered with fire-rated gypsum board, such as Type X Sheetrock, as a fire



Problem 11: Subterranean termites, the type which causes the most harm to houses in the United States, are found in every state except Alaska. Small, patched holes, evenly spaced in a concrete block foundation wall, indicate that the house has been treated against termite infestation.



Problem 13: Incorrect installation of a water heater is a common occurrence. In this case the exhaust stack (white arrow) slopes improperly downward from the water heater to the chimney, and the gas pipe has a flexible connection (black arrow) rather than a rigid black iron pipe.

safety precaution. This material has a one-hour fire rating. Although it will not stop a fire, it will prolong the amount of time it takes before the fire makes contact with the wood. This hopefully will provide sufficient time for the occupants to make their way safely out of the house.

10 Deteriorated or improperly vented plumbing—28 percent of all homes inspected.

The plumbing system in a house includes the distribution piping, the wastelines and the fixtures. Deteriorated distribution piping is a very common

problem in older homes. Normally, pipes are iron, brass and/or copper.

Iron pipes have a projected life of about 45 years. When they are replaced, they generally are replaced on an as-needed basis with copper pipes. Unless an electrolytic coupling is used at the joint between the iron and copper section, galvanic action at that joint will cause deterioration of the iron pipe. This is noted by a buildup of rust and mineral deposits at the joints.

Another problem with brass pipes is that the zinc in the brass begins to dissolve into the water, leaving pin-

(Please turn to page 48)

Got some major league weed and grass trimming ahead? The Husqvarna 16R is in a league by itself.

Forget those under-priced electric trimmers with their limiting cords. The 16R's gutsy 16cc engine, 11 pound overall weight and large capacity fuel tank add up to an unbeatable combination of strength, lightness and convenience. And since it's part of the Husqvarna team, you know it's built to stay that way.

So don't trust your brush cutting to a bush league tool. Check out the trimmer that's with the winning team: the new 16R, from Husqvarna. And check out its bigger, even more powerful teammate, too, the 24cc model 24R.



FIRST STRING

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SWEDEN

The Chain Saw Professionals.

For the dealer nearest you consult your Yellow Pages.
Or write Husqvarna, 224 Thorndale Avenue, Bensenville, Illinois 60106.

15 COMMON HOUSE PROBLEMS

(Continued from page 47)

holes in the pipe. Water oozing out at those pinholes evaporates. The minerals contained within the water are deposited on the pipe. Eventually, these minerals self-seal that leak. A pipe in this condition should be replaced.

Another common plumbing problem concerns sink drains that have S-type drain traps. These traps are no longer allowed in many communities because they often are not vented properly. Under certain conditions, the sink trap can lose its seal and you have, in effect,

an open pipe between the sewer and the sink. Noxious sewer gases can then seep into the room. S-traps are found in older homes, and in newer renovations that were not approved by the municipal building inspector.

11 Termites—23 percent of all homes inspected.

A termite condition can be controlled by applying chemical insecticides to the building and surrounding soil.

You can often tell if the house has been treated chemically by the patched holes in the foundation wall. In the house shown, the foundation wall is

concrete block with an outside cement coating. The blocks were drilled and the voids in the blocks were filled with chemicals and then patched.

12 Hazardous steps and stairs—21 percent of all homes inspected.

When there are more than two risers in a set of steps, a handrail is recommended. This is especially true for exterior steps subjected to freezing rain in winter. Indoors, stairs leading to a full attic quite often are missing a handrail, as are steps going to a basement. Frequently, stairs have uneven risers (vertical distance between steps). This is a tripping hazard.

(Please turn to page 126)

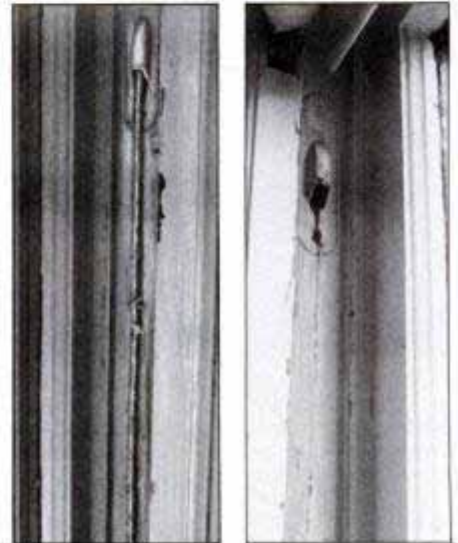
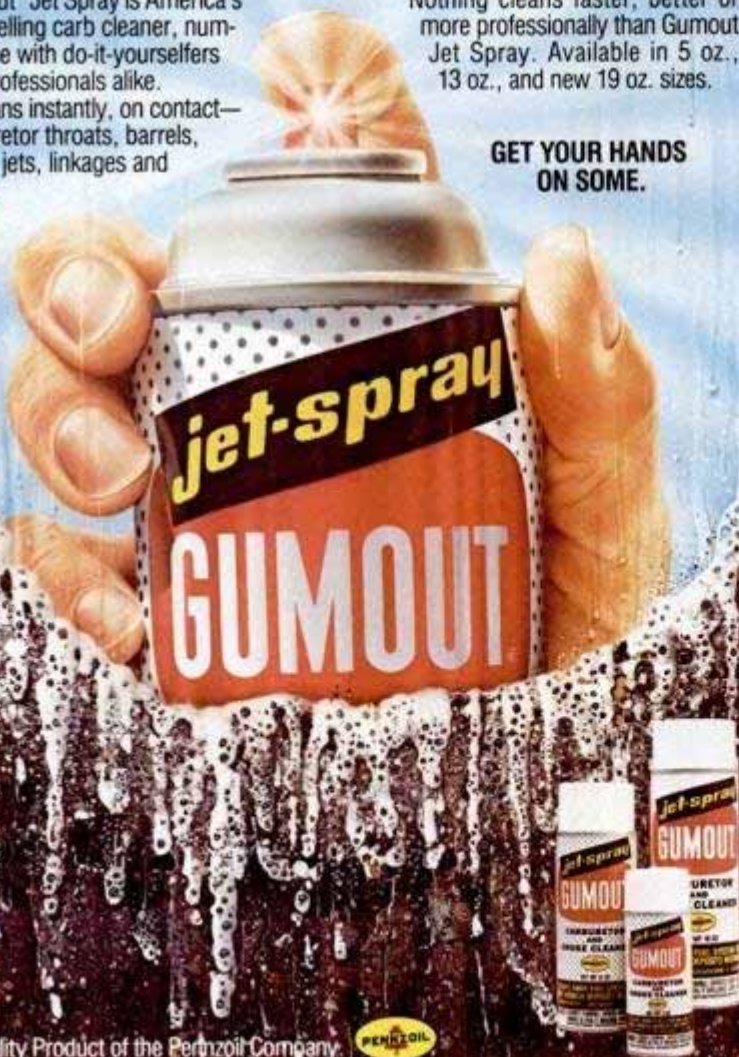
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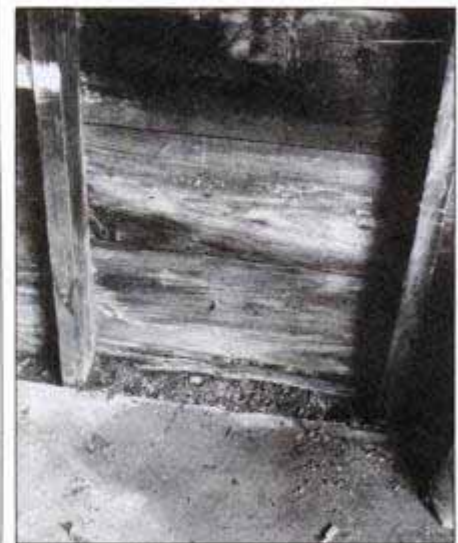
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Problem 14: A frayed sash cord (left) or one that's broken and missing (right) occur in older double hung windows. Cords can be replaced by a new cord or chain, or the counterweight system can be replaced by a pressure-balance system of channels (see *Homeowners' Clinic*, page 25, March '85).



Problem 15: Common problems in a detached garage include rotted sill plate and termite damage. Both problems are present here. In addition, the back wall is bowed outward due to the impact of parking cars. The problems with attached garages involve exhaust fumes and fire hazards.



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REPAIRING POWER STEERING SYSTEMS



BY MORT SCHULTZ

There are some Saturday mechanics who want nothing to do with troubleshooting and repairing power steering systems. If you're one of them, consider two factors before deciding to wash your hands of the matter.

1. You can do a lot of troubleshooting using only your eyes. If you decide to buy a test gauge that reveals whether the system is developing and holding ample pressure, there isn't a power steering problem that you can't track down for yourself. The test gauge, described later, costs about \$75.

2. Replacing two of the three key elements of a power steering system is not difficult. Changing the high-pressure (delivery) and low-pressure (return) hoses can be done in less than 30 minutes. Installing a power steering pump takes less than two hours. However, replacing the power steering gear should probably be left to a professional. Fortunately, it fails much less frequently than a hose or pump.

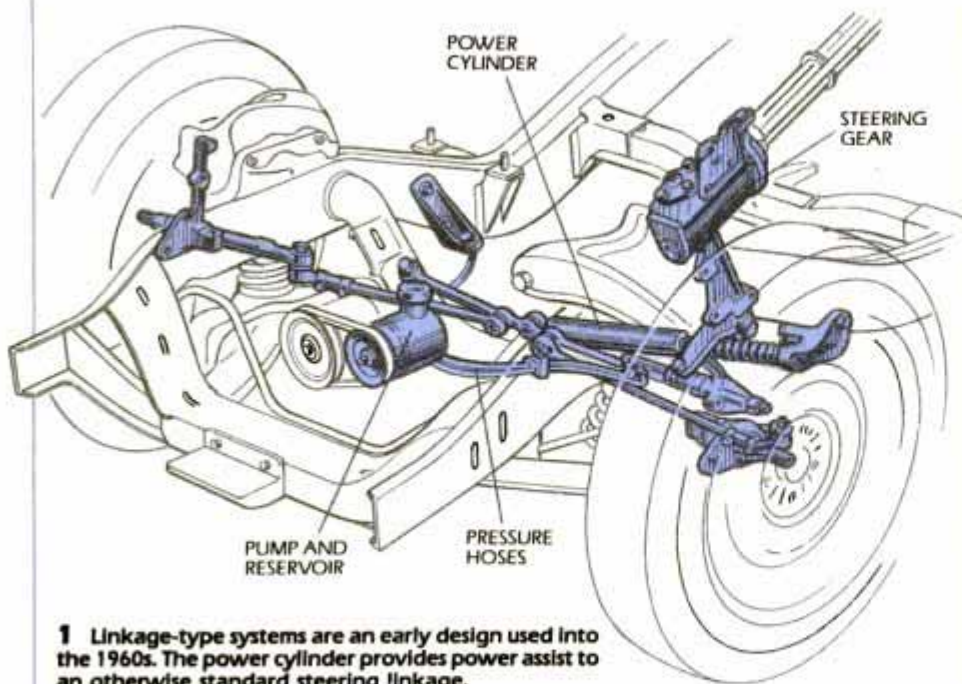
Replacement vs. overhaul

Replacing a pump with a used or

Integral power steering system uses an engine-driven pressure pump to operate a built-in power cylinder.

reconditioned unit is less expensive than overhauling it. To give you an idea of costs, compare the following price quotes for a 1982 Grand Prix:

■ The service department of a Pontiac dealership quoted \$200 to overhaul it.



1 Linkage-type systems are an early design used into the 1960s. The power cylinder provides power assist to an otherwise standard steering linkage.

(A new pump is \$450, installed.)

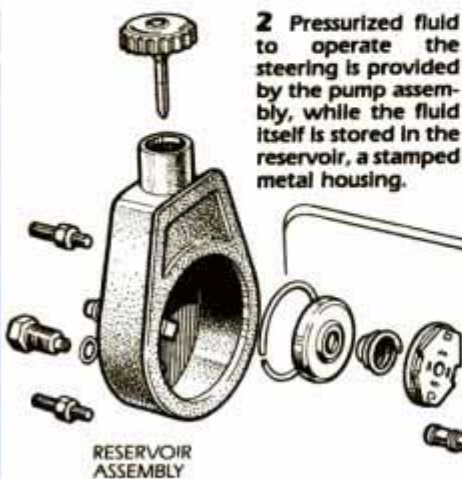
■ An independent mechanic wanted \$150 to replace the defective pump with a junkyard unit.

■ By comparison, it would cost only \$50 if you went to a junkyard to buy the pump, then installed it yourself. Even if you purchased a remanufactured pump for an '82 Grand Prix and installed it yourself, it would cost \$95.

As for do-it-yourself overhaul of a power steering pump, you may need special tools. The repair kit costs about \$20 and it takes longer to do than simply replacing the pump. Do-it-yourself overhauling doesn't seem like a practical approach.

Finding trouble

The first step is to isolate the cause of a problem if, indeed, the cause is confined to the power steering system. A



2 Pressurized fluid to operate the steering is provided by the pump assembly, while the fluid itself is stored in the reservoir, a stamped metal housing.

steering problem could also be the result of faulty wheel alignment, a defective steering linkage or faulty suspension component.

Problems normally associated with a malfunction in the power steering system are a jerky feeling in the steering wheel while moving at a slow speed or when turning the wheel with the car standing still; noise (groan, grind, squeal); a momentary loss of steering assist; and hard steering.

There are two kinds of power steering systems: integral and linkage. The integral system (see lead illustration) has the power cylinder built into the steering gear. The linkage system (Fig. 1) has the power cylinder mounted externally on the steering linkage.

The integral system, now in widest use, is the one we concentrate on here. For a linkage system, troubleshooting is done the same way, except you also must inspect the power cylinder.

Drive belt

If the problem you're having is a jerky feeling in the steering wheel or hard steering, first check tires for proper inflation. Then, inspect the belt that

drives the power steering pump. If the drive belt is frayed or split, it must be replaced.

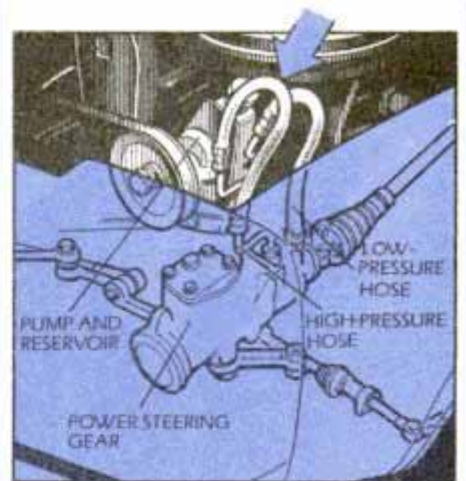
To determine if a power steering pump drive belt is too loose, check it with a belt tension gauge or press down on the belt with your finger. A properly adjusted belt should deflect $1/4$ to $1/2$ inch—no greater.

Tighten a belt by loosening the adjustment bolts and pulling the pump toward you. Use a pry bar, if necessary, but don't press against the reservoir. You may bend or distort it. Place the bar against the pump housing, which is solid. The pump and reservoir actually are separate components (Fig. 2).

Tracing a fluid leak

Next, check the fluid level. Power steering fluid doesn't evaporate, so a low level indicates a leak. Often, a low oil level will cause the steering pump to make a groaning noise.

However, there is the possibility that in checking fluid level on a previous occasion someone left the cap loose and fluid was lost out the neck of the



3 High-pressure hose is the weak link in the system, and most likely to leak.

reservoir. Therefore, refill the reservoir, tighten the cap and keep an eye on the level for a few days.

If the level drops again, check for leaks by wiping high and low pressure hoses clean. These hoses extend from the power steering pump to the steering gear. Examine them for cracks and splits and for fluid seeping from around fittings (Fig. 3).

A leak may not show up then and there, especially a small leak. If there's doubt, spread chalk dust or talcum powder on the hoses. Start the engine

and move the steering wheel from stop to stop three or four times. Shut off the engine and check to see if the chalk dust or talcum powder reveals a leak.

Replacing hoses

If the leak seems to be coming from a metal fitting where the hose connects to the power steering pump or gear, tighten the fitting and test again. Notice that in order to replace a hose you often have to disconnect it at these fittings and not where the rubber part of the hose connects to the pipe. On many pumps, the hoses and pipes are one-piece units at both ends. On some pumps, low-pressure hoses and pipes can be separated where they are joined together with clamps.

The new hose you buy must be one designed for power steering systems. Make certain that the metal parts of the new hose are the same as the old hose. If they aren't, make sure they can't make contact with any electrical connections. After installing the hose bleed the system to expel air.

Bleeding the system

Fill the reservoir, start the engine and turn the steering wheel all the way from one stop to the other. Do this five times in each direction, pausing a second or two at each stop—but *no longer*. Keeping the steering jammed against a stop can damage the pump.

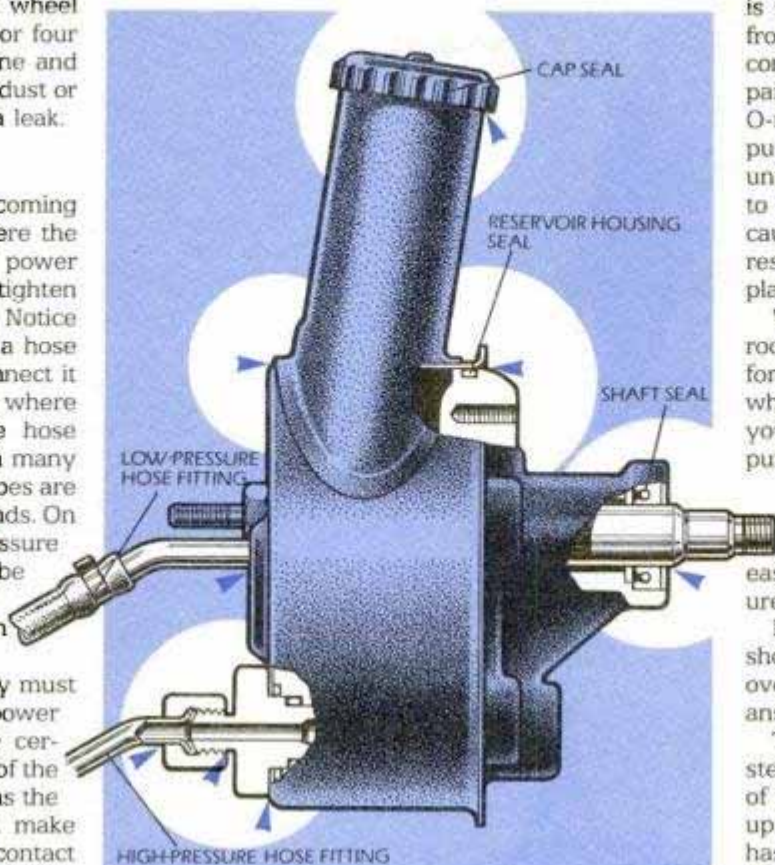
Now, with the steering wheel in a straight ahead position, run the engine at idle for three minutes. At the end of this time, siphon some power steering fluid from the reservoir into a glass container and examine it.

If fluid is light tan or a milky color, there may still be air in the system or the fluid may have been contaminated with water. Repeat bleeding. If the color doesn't clear up, siphon fluid from the reservoir, add new fluid and repeat the bleeding procedure.

Inspecting pump and gear

If hoses aren't leaking, inspect the power steering pump and steering gear for leaks. Start with the pump. Clean it with a rag, using a cleaning solvent if necessary. Then, spread chalk dust or talcum powder, concentrating it in areas pointed out in Fig. 4.

Start the engine and turn the steering wheel slowly from stop to stop two



4 Power steering pumps are most likely to leak at pressure hose fittings, cap seal, shaft seal and housing flanges.

or three times. Remember—don't put force or hold the wheel against the stop.

Turn off the engine and examine the pump. If there's a leak, fluid will show up on the chalk dust or talcum powder.

Some leaks are easy to repair. A leak from the reservoir cap usually can be fixed by replacing the cap. On GM power steering pumps, a leaking shaft seal can be replaced without disassembling the pump; even the reservoir seal.

is fairly easy to replace. Leaks from the area where a hose connects can frequently be repaired by simply replacing an O-ring seal. Before replacing a pump with a junkyard or rebuilt unit, check your service manual to see what's involved. Leaks caused by damage to the pump reservoir are grounds for replacement.

While checking the pump, try rocking the pulley back and forth. This test establishes whether the shaft is worn. If you find that it is, replace the pump and bleed the system.

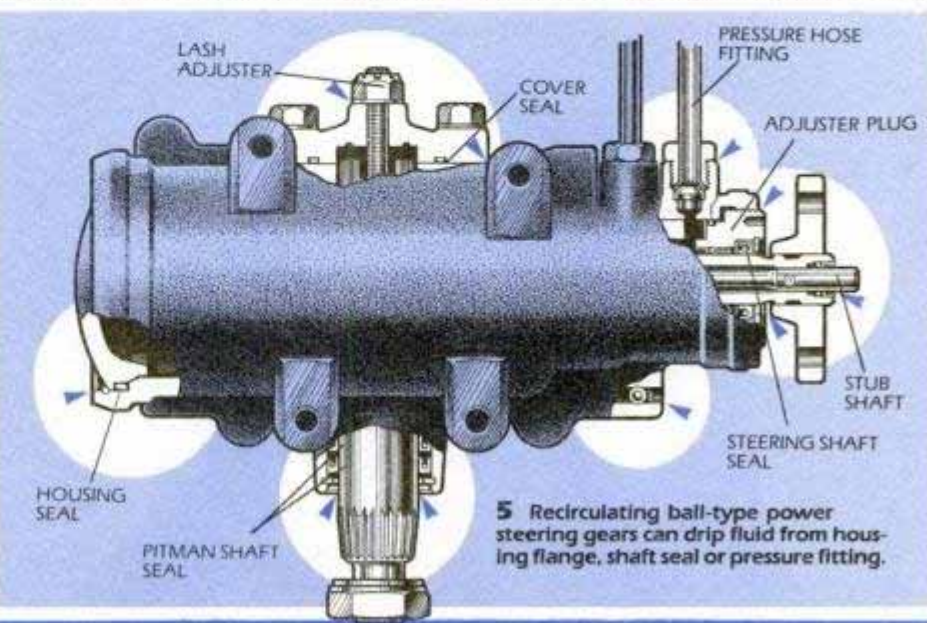
Check the steering gear for leaks the same way, concentrating on those areas that are pointed out in Figures 5 and 6.

If the steering gear leaks, should you have it replaced or overhauled? There is no simple answer.

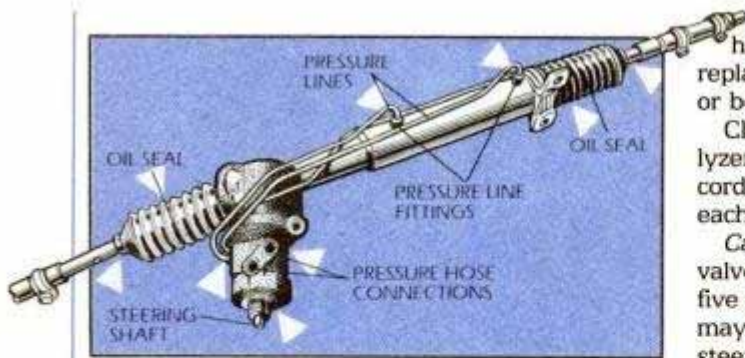
There's a good chance that a steering gear leak is the result of seals having been chewed up, because the steering shaft has corroded or pitted. New seals will only suffer the same fate. If that's the case, overhauling the unit would be a waste of time and money.

Make the decision whether to repair the leak or replace the unit after consulting with a mechanic and/or your service manual.

One potential problem with junkyard parts is that they may be in no better condition than the parts you're replacing. The junkyard will probably permit you to return defective parts, but you lose out on the labor involved. Don't



5 Recirculating ball-type power steering gears can drip fluid from housing flange, shaft seal or pressure fitting.



6 Rack-and-pinion power steering gears carry additional pressure lines and oil seals prone to leakage.

attempt to replace a steering box or rack without a service manual.

Pressure testing

After checking the drive belt and looking for leaks, the final step in troubleshooting a power steering system is a pressure test. A power steering system analyzer is needed for this.

A pressure test can determine if a problem is caused by a pump or steering gear failure. The test should be performed when any of these symptoms are noted: an increase in effort required when turning the wheel fast, jerking action in the wheel when turning that is not cured by V-belt replacement, or generally hard steering and lack of assist.

Disconnect the high-pressure hose at the steering gear and pump. Attach the analyzer between the two (Fig. 7). Identify the high-pressure hose by starting the engine and holding your finger on each hose as someone moves the steering wheel from stop to stop. The hose that you feel a surge from is the high-pressure hose.

Another way to identify high and low pressure hoses is by the fittings that secure hoses to pipes. Generally, crimped fittings are used on a high pressure hose while a clamp is used on a low pressure hose.

Warm the fluid

With the analyzer connected and its control valve open, start the engine and let it run until the power steering fluid gets warm. For accurate test results, fluid temperature should be between 150 and 170° F. Help raise the temperature quickly by turning the steering wheel from stop to stop a few times.

Now, with the steering wheel in the straight-ahead position, make a note of the reading on the analyzer gauge. Check this reading against the *at standstill* specification given by the car manufacturer in the service manual.

If the reading is higher than this and

hoses are not kinked, replace both of them. One or both have restrictions.

Close and open the analyzer valve three times. Record the pressure reading each time it is closed.

Caution: Don't keep the valve closed longer than five seconds at a time. You may damage the power steering pump.

Again, check readings against the specifications. Notice the difference in

pressure between the three readings. It should vary no more than 50 psi.

Interpreting readings

A lower-than-specified pressure reading or pressure readings not within 50 psi of each other could indicate a malfunctioning flow control valve or pressure relief valve, which is in the power steering pump of most non-GM cars. In a GM car, the pressure relief valve is in the power steering gear. It may be possible to restore these parts by removing and cleaning them. If the pressures are constant but below specs, the rotor and vanes are damaged and the pump must be replaced.

To test the steering gear, open the analyzer valve. Turn the steering wheel all the way to the left. Record the reading. Then, turn the steering wheel all the way to the right and record.

Compare both readings to the *maximum* reading you got when you closed the analyzer valve during the last test. If the two readings are lower, there is an internal leak in the power steering gear. Overhaul or replace the unit.

Tips on replacing a pump

1. Replace a power steering pump when the engine is cold to avoid burning yourself.

2. Remove battery negative cable.

3. If possible, remove hoses from the pump after removing the pump from the engine to keep from spilling power steering fluid.

4. When you've disconnected hoses, place caps or tape over their ends to keep dirt out of them.

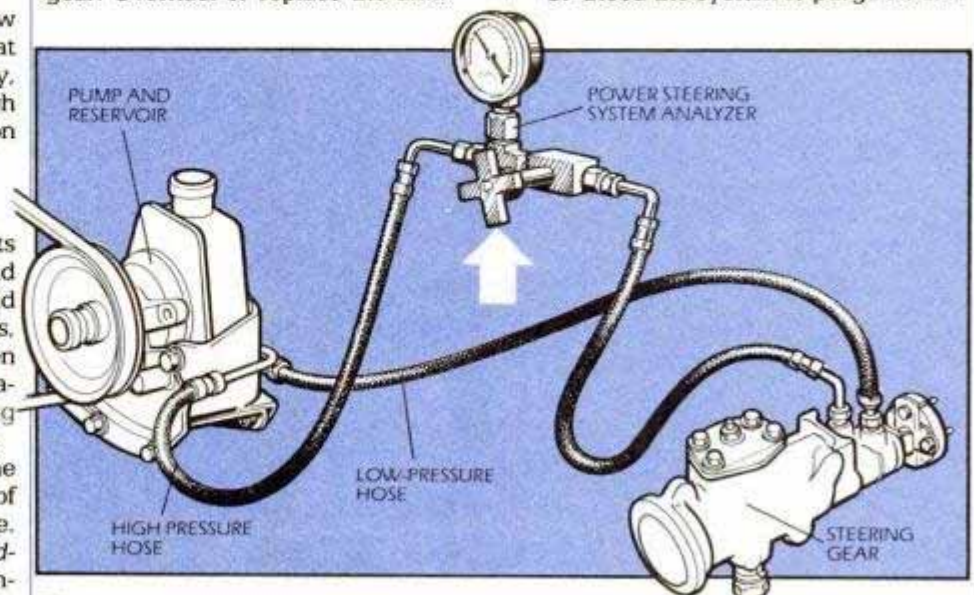
5. If the drive belt pulley is in front of the bracket holding the pump to the engine, you may have to remove the pulley before you can detach the pump. If the pulley is pressed on the shaft, you'll need a puller. You may also need a puller to remove the pulley from a pump after taking it off the engine, so you can transfer the pulley to the replacement pump.

6. In some cars, the power steering pump and bracket are two separate parts. Remove the pump by unbolting it from the bracket. In other cars, the pump and bracket are removed from the engine as an assembly.

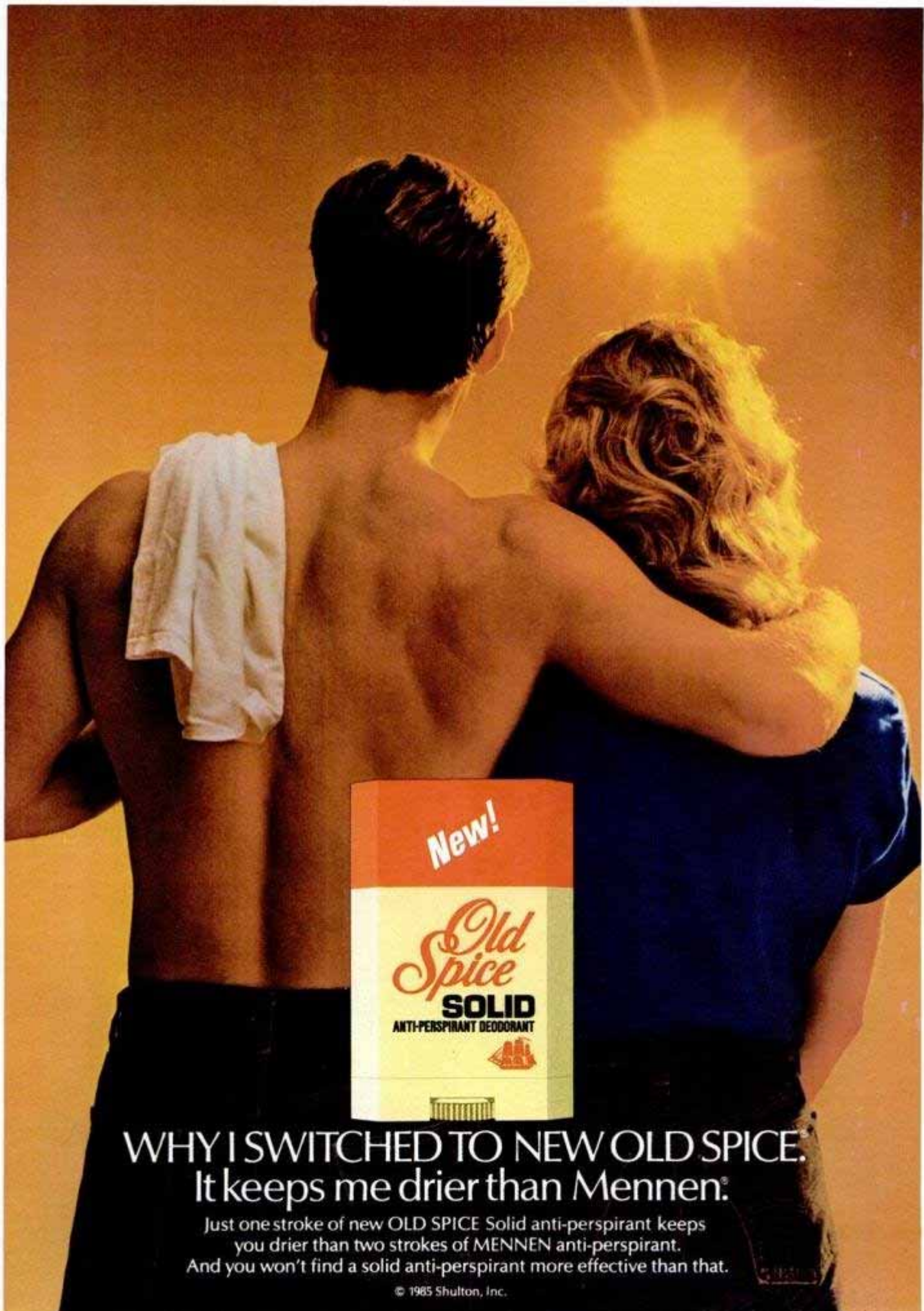
7. After installing the new pump, tighten the drive belt until it deflects 1/4 to 1/2 inch—no more, no less. If you make the drive belt too tight, the pump bushing may wear.

8. Fill the reservoir with power steering fluid—not automatic transmission fluid. The two are not the same. **Note:** This precaution does not apply to cars made by Ford Motor Co. According to Ford, you may use Type F automatic transmission fluid (but not Dexron or any other type) in a Ford, Lincoln or Mercury power steering system.

9. Bleed the system to purge air. **PM**



7 Power steering system analyzer is tapped into the high-pressure hose to troubleshoot pump failures. Use control valve (arrow) in order to take pressure readings.



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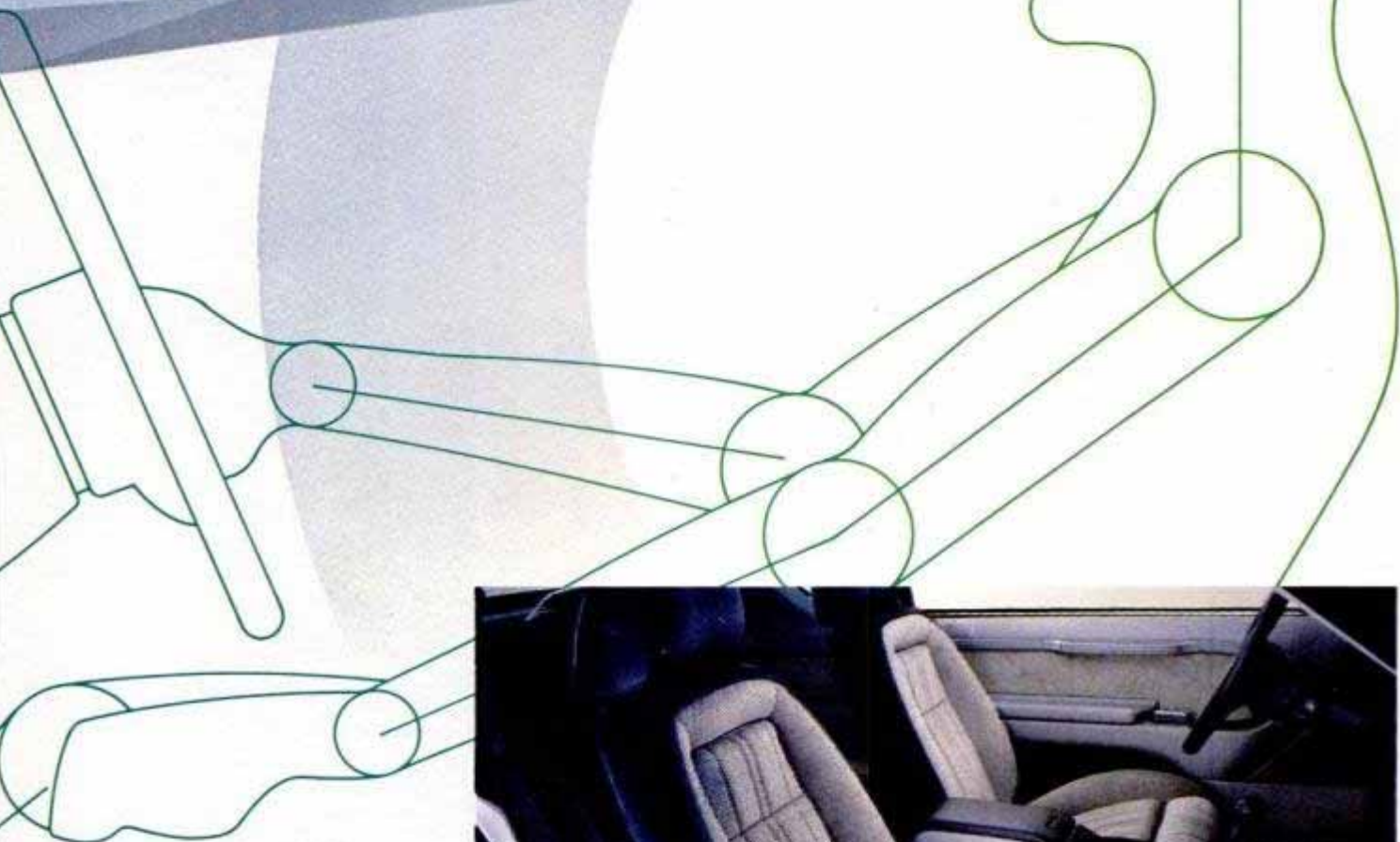


In this CL 9000, Ford clusters 45 gauges and controls within easy to read, easy to reach range. All gauges, switches and bulbs are plug-in type for easy service.

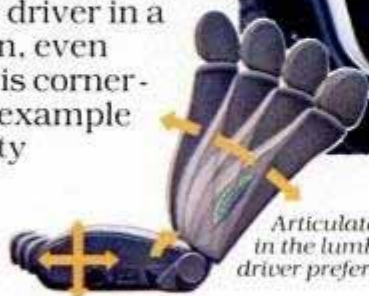
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MICS



The seats in the Mercury Cougar XR-7 are designed to be comfortable for more than just your bottom. Moveable seat bolsters and adjustable thigh supports help keep the driver in a stable position, even while the car is cornering. Another example of Ford Quality you can feel.

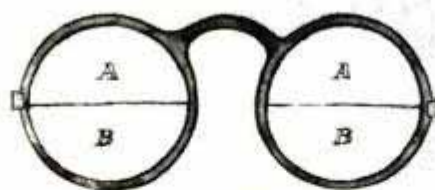


Articulated seats on the Cougar XR-7 include an air chamber in the lumbar area that may be inflated or deflated according to driver preference by a power actuated pump.



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**Quality
is Job 1.**



Ben Franklin's bifocals consisted of two pairs of lenses, each ground for a different focus.



BIFOCALS:

LOOKING BETTER AT 200

We've advanced from Ben Franklin's bifocals to bifocal contact lenses.

BY JACK GRAZIER

Ben Franklin patented the world's first bifocals 200 years ago this month. In a letter to his friend, George Whately, Franklin wrote: "I formerly had two pairs of spectacles, which I shifted occasionally. Finding this change troublesome . . . I had the glasses cut and half of each kind associated in the same circle."

Using cast-iron hand tools and abrasives, Franklin's optician ground the lenses, starting with pieces of flat glass. The line in the center of each frame appeared where the two half-lenses joined—the bottom half for reading, the top half for distance. Today's "executive" bifocals, made with only one piece of glass in each frame, bear a similar straight bisecting line where the two differently ground refractive surfaces of the same lens meet.

Bifocals in the past decade have undergone major technical leaps. One

method is the shaping of progressive addition lenses—bifocals without the lines—called sagging. A piece of glass is heated to the point where it slumps, or sags, over a ceramic mold, producing a curve graduating from ellipses to parabolas to hyperbolas so gradually that no line between varying refractive surfaces exists. Some companies make the no-line lenses by machining them, using computer-controlled tools to shape the progressive curve.

The ultimate no-line bifocal is called the soft-contact progressive addition, or varifocal. It's a contact lens. The distant-vision area in the center of the contact changes gradually to the near-vision zone surrounding it. These lenses are made of hydrogels, "water-loving" plastics which allow oxygen transfer to the cornea. The water contained in soft contact bifocals can vary from 38.6 to 79 percent, depending on

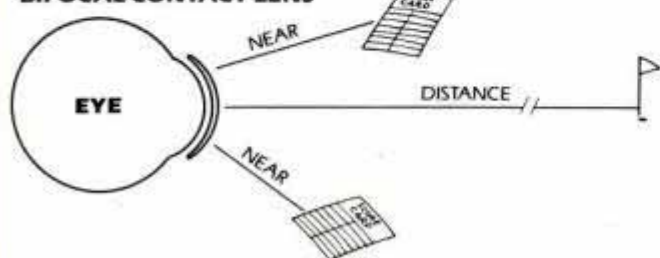
the quality of the hydrogel.

New lenses recently developed by Corning Medical Optics Dept. filter specific blue light wavelengths believed to accelerate the degeneration of the eye found in *retinitis pigmentosa*, a disease causing tunnel vision and night blindness. The lenses are made from photochromic glass subjected at high temperature to gases developed by Corning that alter the surface composition of the glass, causing the filtering effect. Corning has also developed lenses to help patients with other light-sensitive eye diseases to see better.

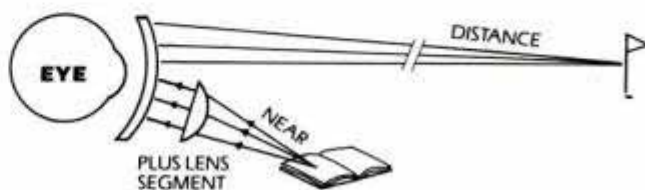
An infamous statement made by a Patent Office official in 1812 suggested the office be closed permanently since "future invention is likely to be slow or nonexistent." In 1984, however, over 160 patents were issued for eyeglass variations alone, and the future still looks bright. **PM**

NEWEST IN BIFOCALS: CONTACTS

BIFOCAL CONTACT LENS



BIFOCAL EYEGLASS LENS



With new "progressive addition" contact lenses (left) the user can see near objects above and below, viewing distant objects straight ahead as he would in normal vision. Traditional bifocals make you look up for distance and down for near objects.

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PM

8 mg "tar," 0.5 mg nicotine av. per cigarette, FTC Report Feb. '85

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TIRES

A CENTURY OF PROGRESS

From solid-rubber boneshakers to 50-series radials, tire advances made auto progress possible.

BY MORT SCHULTZ

Illustrations by Pat Ruggero

First came the wheel. According to estimates, that was about 3500 B.C. Then came the tire. The first patent granted for a pneumatic rubber tire was in 1845—to Robert William Thomson, an English clergyman turned blacksmith. He made hollow tubes from pieces of rubber-coated canvas, covered them with leather to provide protection from the roughness of roads and filled them with air.

Thomson's pneumatics were a complete bust in more ways than one. Word soon made the rounds among coach and wagon makers that they blew out after only brief mileage, scaring the oats out of the horses, which were likely to bolt

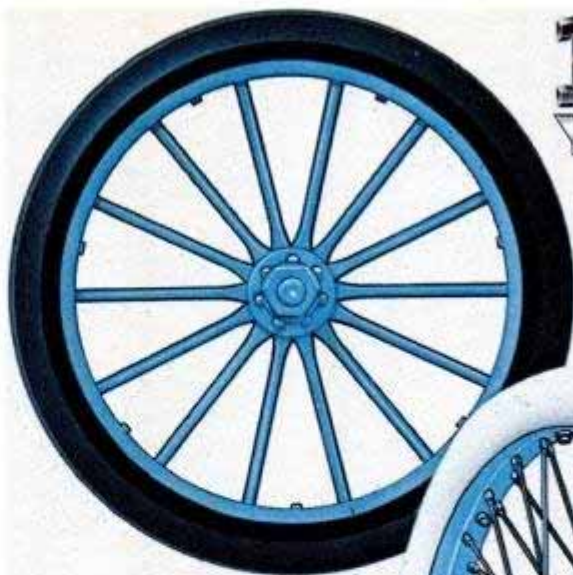
and run. Despite Thomson's contention that riding on air was more comfortable than riding on old-fashioned metal tires and those new-fangled solid rubber tires, manufacturers stayed pat, and Thomson's patent for the pneumatic tire was retired to the archives.

Between 1845 and the 1890s, metal tires were used on horse-drawn and motorized vehicles. Thereafter, solid rubber tires became popular.

The history of the tire for cars—indeed the history of the automobile itself—is so closely entwined with the

PM thanks the research library of the Motor Vehicle Manufacturers Assn. (MVMA) for its help in preparing this series of articles.

100
YEARS



1890s
Solid rubber tire on a wooden carriage wheel.



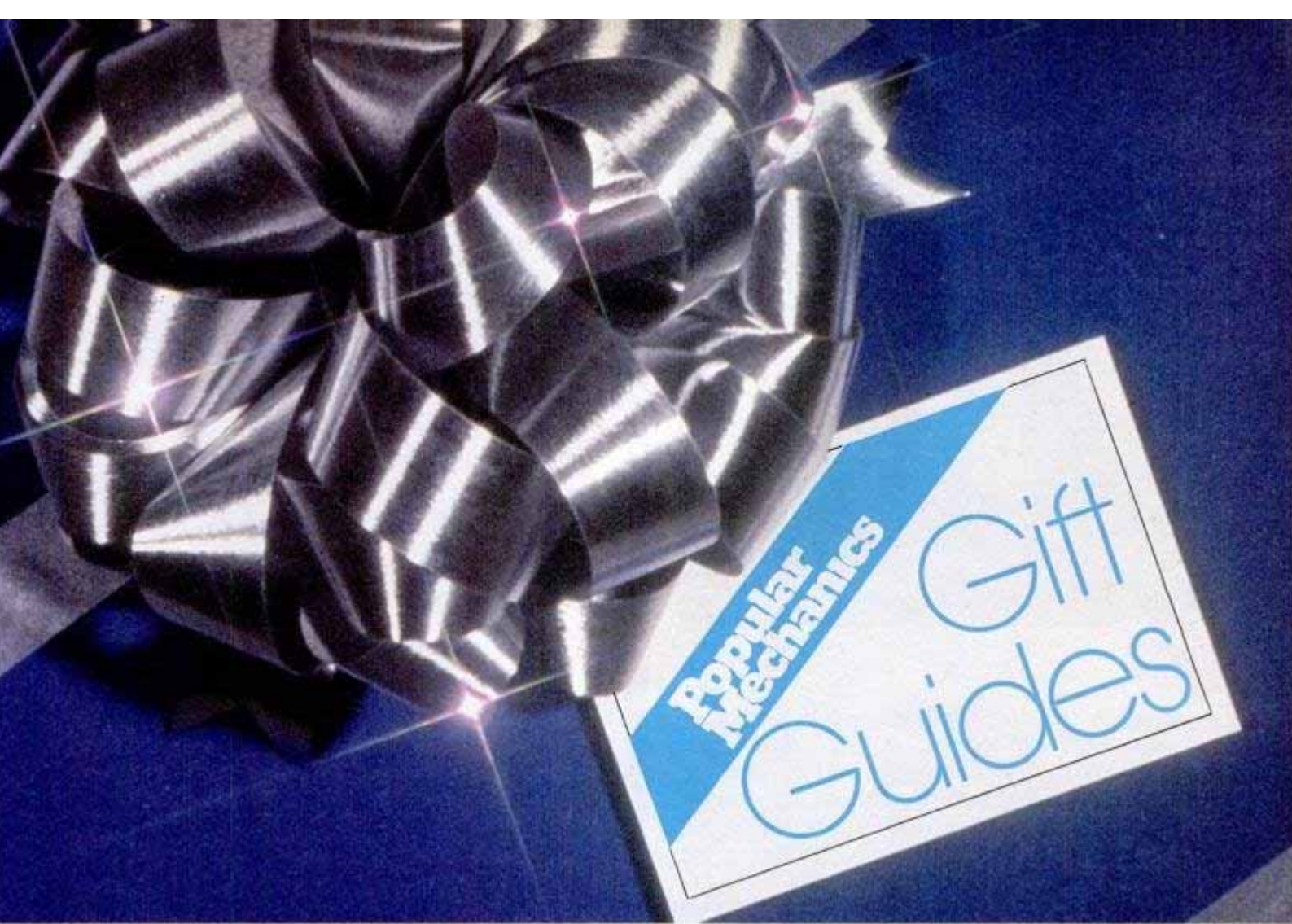
1900s
White rubber pneumatic tire on a light spoke wheel.



1910s
Firestone tire with "NON-SKID" tread on a wooden artillery wheel.

1930s
Low-pressure "balloon" tire on a heavy Ford wire wheel.

1980s
Low-profile 50-series radial tire on a cast-aluminum wheel.



development of rubber that the two are inseparable. The man usually associated with both is Charles Goodyear, who is often called the Father of the Rubber Industry. Many also regard him as the Father of the Automobile Industry.

They have good reason. It was Goodyear who made it possible for people to ride in comfort—first on solid and then on air-filled rubber tires.

Before the development of the rubber tire industry, not many were willing to trade in their horses for a motorized vehicle that couldn't be driven faster than a coach because of vibrations created by metal tires.

How rough was it riding in a car that was equipped with metal tires? Here's how Lt. Cmdr. Montague Grahame-White described those early days of travel in his memoirs on the auto industry, written in 1945:

"As a first experience of road transport without a horse, I have vivid recollection of a drive along Farringdon Road. The car was an iron-tyred Daimler . . . in 1896. The road surface was unevenly laid granite sets. The jolting over these cobbles reminded me of the medicine-bottle directions: 'Shake well before taking.'

"A drive some months later on a car shod with rubber tires was like reaching harbour after a rough Channel

crossing. Noise and vibration seemed to have vanished."

Raw rubber is an unstable substance of the tropics that turns gummy in warm weather. Finding a way to overcome this characteristic and make rubber a usable material became an obsession for Goodyear.

The events leading to the discovery of the vulcanization process began in 1830 when Goodyear purchased some gum rubber from a Boston shoe factory. He bought the rubber on credit. When he couldn't pay the bill, he landed in debtors' prison.

While serving his sentence, Goodyear had ample time to conduct a series of experiments to try and turn the soft, gummy material into a solid form that would hold its shape in hot as well as cold weather.

The experiments continued without success until a wintry night in 1839. Goodyear had gathered some acquaintances in a New England cottage to ask for funds so he could continue his work. In his hand he held a ball of gum rubber that had been mixed with sulphur and treated in an acid-gas process, which demonstrated that he could at least harden the surface of the material.

Arguing his case, Goodyear waved his arms and accidentally struck the surface of a wood stove with the rubber.

A band stuck to the hot metal.

Scraping the mass off the stove with a knife, Goodyear was startled to find that the rubber was as solid in the center as it was on the surface. Thus was the vulcanization process born, and with it the rubber tire industry.

Most of the earliest cars were equipped with metal tires—not rubber, which was obviously not as sturdy. Comfort soon won out, however, and by 1900 few automobiles sported anything but solid rubber tires.

Many early tire manufacturers filled thick rubber tubes with cushioning materials such as cork, glue, syrup, glycerine, rawhide, arsenic, sawdust, sand, rags or even tennis balls!

In 1888, a Belfast veterinarian named John Boyd Dunlop reinvented the pneumatic tire for use on his son's bicycle. Dunlop, unaware of Thomson's invention of 43 years earlier, fashioned a tube from sheet rubber and covered it with linen. He received a patent for "an improvement in tyres . . . for bicycles and tricycles." In 1889 he sold the rights to Harvey du Cros Sr., who founded the Dunlop Rubber Co. Ltd. Dunlop himself had no further connection with the firm.

Du Cros did not initially try selling pneumatic tires to the fledgling auto-

(Please turn to page 62)



The Ready-Lite rechargeable light is better than a flashlight because it's always fully charged and ready to use. Only Ready-Lite has a swivel head to shine the light where you want it. And, Ready-Lite shines 50% longer on a single charge than the other leading brand. Ready-Lite by First Alert.



The power tool you'll have to share with your family.

The Hoover® Help-Mate II™ hand vac is more powerful than battery-operated vacs. Great for keeping your workshop neat. It's so versatile, you're apt to find people using it for cleaning upholstery, drapes, stairs, even the car. But go ahead and share.

Because it's a plug-in, your Hoover Help-Mate II never runs out of power.

100 YEARS

(Continued from page 61)

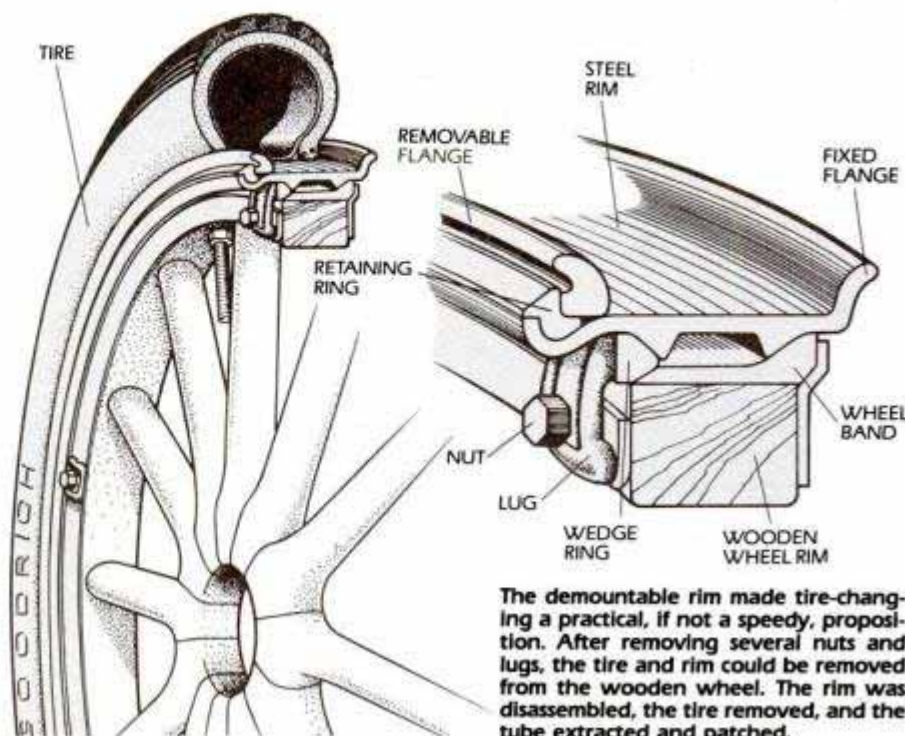
mobile industry. That distinction goes to a Frenchman, Andre Michelin. In 1895, Michelin outfitted a car with pneumatic tires and entered it in the Paris to Bordeaux race. The result, summed up by auto raconteur H.O. Duncan, was: "No fewer than 22 of the air tubes left strewn along the road between Paris and Bordeaux"—a distance of about 350 miles. Air-filled hard rubber tubes had no "give" to them and were penetrated by objects in the road and by the road surface (mainly cobblestones) itself.

Said M. Levassor of the auto firm Panhard & Levassor, whose car won the race on solid rubber tires: "Tyres filled with hay or straw might be successful, but never if filled with air." The prediction held true for another 16 years.

The success of pneumatic tires can be laid to a New York businessman and scientist named Alexander Straus. In 1894, Straus developed a process that allowed fabrics to stretch in one direction while not yielding in the other. The patent laid in limbo until 1911 when Straus' son, Philip, found it among his father's papers. Philip was treasurer of

the Hardman Tire & Rubber Co. and quickly recognized the significance of the invention. It led his company to the production of a tire and tube combination; that is, a rubber tube inside an outer casing made of rubber and fabric using the Straus formula.

Meanwhile, in 1903, P.W. Litchfield of the Goodyear Tire Co. had been awarded a patent for a tubeless tire—one that integrated the hollow air tube and the protective outer casing into one unit. Since pneumatic tires with separate tubes and casings were hardly a



The demountable rim made tire-changing a practical, if not a speedy, proposition. After removing several nuts and lugs, the tire and rim could be removed from the wooden wheel. The rim was disassembled, the tire removed, and the tube extracted and patched.

No mow problems.

Yard work is no work at all for McCulloch's MAC™ 85-A string trimmer. Because it has the kind of features you can't do without. Like a rear-mounted 21.2cc engine. An automatic centrifugal clutch. Electronic ignition. Semi-automatic choke. And a large-capacity fuel tank.



Ingenious design of this homebuilt camper combines the roominess of a tent trailer with the luxury of a van. It's compact and thrifty on gas. Open it and you have spacious living quarters for full galley and two big beds. Fiberglass rig fits on any used VW bus chassis. Plans include 10 large drawing sheets, 24-page instruction manual. \$5.95 POPULAR MECHANICS, P.O. Box 1014, Radio City Station, New York, NY 10101.

success until eight years later, the tubeless tire was viewed as pie in the sky. It remained so for 51 years, until Packard brought out the first car sporting tubeless tires in 1954.

In 1908, Frank Seiberling invented a machine that cut grooves into the surface of tires to let them grip the road. Until this time, tire surfaces were smooth, which made driving on wet roadways hazardous and negotiating muddy roads difficult. In fact, motorists carried coils and rope with them to wrap around tires and gain traction. A later Firestone model had tread in the form of raised letters that spelled "NON-SKID" across the face of the tire.

A piece of necessary equipment carried by pioneer motorists was the Shales Vulcanizing Kit. It made roadside repairs of blowouts possible "in five minutes." However, it took a motorist almost 30 minutes to get a blowout tube off the wheel and out of the casing, and another 30 minutes to reinstall it once he had spent five minutes patching the tube.

The demountable wheel rim, which permitted motorists to repair a blowout at the roadside, was introduced in 1904 on a car called the Christie. A driver could raise the vehicle, remove the rim from the wheel, then slide the tire and tube from the wheel.

This setup went out of style in 1926 with the introduction by Ford of the drop-center wheel, which combined rim and wheel as a single unit, and the industry-wide acceptance of the spare tire. In fact, many cars of the late 1920s and early 1930s were equipped with two spares.

Now we hear that car manufacturers will soon do away with the spare, because the puncture-proof or run-flat tire has reached an acceptable level of performance. And about time, too. In 1904 the Tennant Co. developed the

first one. It had cushions of sponge rubber between the tire and tube that were said to keep penetrating objects away from the tube.

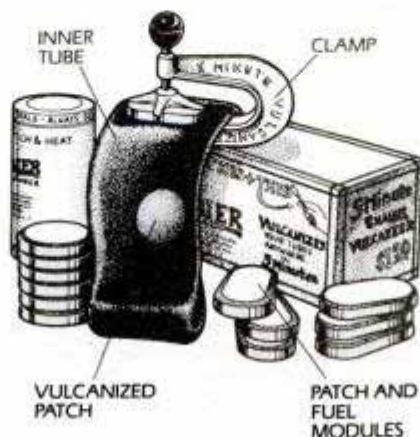
Then, in 1907, the American Motor Car Co. used tires that were "designed with a plurality of air compartments whereby if the tire should be punctured air would escape only from the punctured chamber."

Neither of these attempts at making a puncture-proof tire worked well, and the "run-flat" concept was shelved until recently (see *Technology Comes To Tire Design*, page 98, Apr. '85).

Making tires stronger

The history of tire development since those early days has been mainly one of the advances in materials that made tires stronger. For example, in 1910 BF Goodrich came out with a tire that used a tough cord material instead of fabric. In 1912, Goodrich began adding large amounts of carbon black to its tires to make the rubber more abrasion resistant. Until then, small amounts of carbon black had been used only as a coloring agent. By 1920, average tire life had more than tripled to 13,000 miles. To attain that life, car owners were warned to give tires proper care. "Nothing will destroy tires as quickly as

(Please turn to page 64)



To use "5-minute" patch kit, the module is clamped over a puncture and the fuel igniter, vulcanizing the patch to the tube.



Give him New Brush Plus shaving system, a shaving concentrate and brush in one from Gillette. The brush lifts his whiskers with a soothing warmth—the concentrate has extra softeners and lubricants that are massaged deep into his beard for a superior shave. Cartridge refills in Regular, Lime, Sensitive Skin.



Portable Tool Center and Deluxe Assembly Bench designed for POPULAR MECHANICS. Bench has a grid top to make clamping easier and can be covered with a sheet of plywood for other workshop projects. Mobile tool center holds portable tools and accessories. Complete plans, instructions and materials list \$15.00. POPULAR MECHANICS, P.O. Box 1014, Radio City Station, New York, NY 10101

100 YEARS

(Continued from page 63)

running them without enough air," the owner's manual for a Haynes Suburban warned.

What was considered "enough air?" Generally, 20 pounds of pressure for each inch of cross-section, which for the popular 3½-inch tire of the time was 70 pounds. If one did not have a gauge, he was advised to: "Inflate tires until they stand up full and round under the weight of the car. Kicking tires tells you nothing."

In 1920, Firestone introduced the first modern design, the low-pressure "balloon" tire, which required 40 percent less air than the skinny tires that had preceded it.

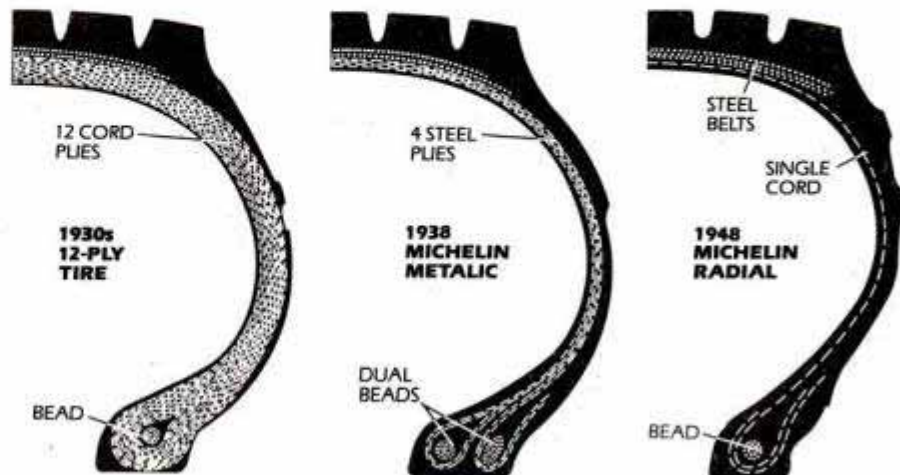
With the approach of World War II, when the shipping lanes to the natural rubber plantations in southeast Asia and South America were threatened by submarines, both Germany and America accelerated research on synthetic rubber made from petroleum products. Goodyear's Chemigum was patented in 1927, and the first tires were made from it in 1937. By the mid-'50s, U.S. tire production was split 50/50 between natural and man-made rubber, while

today the average tire combines about 40 percent natural rubber with several synthetics.

In 1948, Michelin made a tremendous breakthrough with its radical "radial" tire, featuring very flexible sidewalls that allowed the stiff, steel-reinforced tread to stay square on the ground, even during cornering.

Radials soon became the standard form of construction in Europe, but American manufacturers held out through the '60s, not wanting to re-

vamp their factories with the new machinery needed to build radials. Their answer was the belted bias-ply tire—a design that was stiff all over (in the sidewalls and the tread) and rode like a truck tire. In the early '70s, Ford opened the floodgates by making Michelin radials standard on many of its cars. All of Detroit soon followed suit and Akron was forced to bow to the carmakers' demands. American tire factories now have some of the newest and best tire-making machinery available. **FM**



Typical tire construction up through the '30s relied on many fabric layers, or plies, for strength. Michelin "Metallic" used steel-cord plies, each replacing four textile plies. Michelin's radical radial tire had only one textile ply in its flexible sidewall.

Utah's state backboard

Utah has a state mansion for the governor. It has a state bird: the seagull. It has a state everything, just like every other state. But Utah has something most other states do not have: a state basketball court. Located behind the governor's residence, it was recently the scene of a tough matchup between the staff of Gov. Norman Bangertner and the state legislature. The governor's office won. When we talked with Bangertner a month after the competition he was planning to put up yet another backboard. "My 16-year-old, Adam, wants me to put up an adjustable backboard," Bangertner said. "I'll do it myself once I find a good spot for it."

Since taking office last year, the extremely active former housing contractor has had to slow down on some of his best-loved pastimes, basketball being just one of many. Bangertner loves to build things. "But I'm not a workshop type. I like to see houses go up. But I'm not the one to finish furniture or do fine carpentry." Bangertner's last spare-time building project was completed before he took office. He and his sons built a log cabin.

"We like to get out and ride a little on horseback or take our motorcycles through the hills," the governor told PM. The family has three Yamahas and two Hondas. When the entire Bangertner clan gets together, those aren't enough bikes. The governor has six children and seven grandchildren.



Utah's handy governor hangs up a basketball backboard on his residence as the state bird, a seagull, ponders net effect of the addition.

PM ILLUSTRATION BY RICHARD ANDERSON

A perfect 10

Olympic gymnast Kathy Johnson was elated when we talked with her. The applause for her super performance in the Los Angeles Olympics was long gone. This time the thrill came because her father had driven the family's Model A from Florida to California.

"Dad and I spend hours working on the car," she said. "He really does most of the work, but I like to help out and I love to drive it." The ancient auto gets some extra pep from a rebuilt Ford Mustang engine. "It has great pickup, which surprises practically everyone on the street," Kathy noted.

The only problem is, "When I move my feet to shift gears, I disappear behind the dashboard," said the just-under five-footer.

Robot workshop

California State University art professor Clayton Bailey is frequently mentioned in the newspapers. He presents his robots both as works of technology and works of art. They also are works of controversy.

The lifetime reader of *Popular Mechanics* stresses that the art and science of robots is "a workshop endeavor," the kind of thing anyone with a minimum amount of workshop experience and maximum amount of imagination can build. In his *The Robot Builders Manual*, (Wonders of the World, Port Costa, Calif.), Bailey says any PM reader can put together a robot. Bailey's most controversial robot has a very accurate female shape. It made coffee for his staff, but drew criticism from feminists.

And Torn, too

For the critically acclaimed movie "Cross Creek," actor Rip Torn became a carpenter. Torn was working in the Florida Everglades—where he has a home—with the film's production staff as locations and props were being sought. One of the big needs was a dugout canoe. Torn, who has built several boats of his own, told the producers he'd like to try his hand at building a dugout boat from fallen trees. His first attempt, production company insiders say, was too realistic and rustic-looking for the cameras. So, Torn went back to the forest and cut down some better wood. Working with hand tools only, he came up with the boat featured in the film about the author of the classic novel *The Yearling*.

Presidential shop

We all know about Jimmy Carter's love for woodworking (see *Jimmy Carter, Craftsman*, page 73, Aug. '84). And the woodwork of George Washington and Thomas Jefferson is prominently displayed at their respective historic homesteads. But, for an upcoming display, researchers for the Smithsonian Institution have unearthed a great wealth of presidential woodwork which has not been widely seen. President Andrew Jackson did more than whittle away at hickory sticks. He also built hickory cabinets. And Teddy Roosevelt built a summer home in upstate New York. James K. Polk made his own leather riding saddle. And Abraham Lincoln built a scale model boat for patent.

PM

Convert Your Family Movies To VIDEOTAPE

Films dubbed to cassette are easy to view, enhance—and preserve.

BY FRANK VIZARD

You can keep the memories on family movies fresh and sharp by converting your Super-8 and Double-8 film to videotape. Though professional duplicating services can give the kids or the in-laws a magnetic new personality, you can do it yourself at home with a minimal investment in equipment.

Unlike film, videotape doesn't grow old and brittle. But preserving those aging, fading celluloid reels isn't the only reason for switching to video. You'll store lots of three-minute spools on a single cassette, and you can view them on TV instead of mounting screens and projectors and threading film with torn sprocket holes. Video also gives you an opportunity to edit your films, add titles, correct colors, dub in a soundtrack (including music) and even indulge in some special effects.

Film-to-video transfer is available commercially. *PM* checked the prices for Double-8 and Super-8, and found 7½ cents per foot to be the average, with a 400-foot minimum. That works out to \$30 for eight reels.

Telecine converter

The professional labs use equipment costing as much as \$30,000 and capable of the most sophisticated operations. But you can get satisfactory results at home with a simple accessory called a telecine converter. These range in price from \$50 to \$250 (depending on features and construction) and are available from many VCR makers (such as Akai, Quasar and Sony) and aftermarket accessory suppliers such as Ambico and Satter. We'll assume you have a VCR and TV, and access to a videocamera and film projector.

Use of the telecine converter is fairly straightforward. You aim the film projector into the designated port on one side, and focus your videocamera at the tiny screen on the adjacent side. A right-angle mirror within the converter reflects the images from your film onto the small rear-projection screen for videotaping. Once you've adjusted both the film projector and video camera for proper focus, you're ready to roll. Because the videocamera's lens is close to the telecine converter's super-bright projection screen, the room needn't be dark. You may, though, need a macro lens for your camera if it isn't equipped for close-up shooting.



Want to get the whole family on television? You can: A videocamera, VCR and a simple, inexpensive telecine converter (such as the Ambico model seen here between the film projector and TV) let you transfer 8-mm home movies to videotape—at home.

Keep in mind the importance of synchronizing the film speed to that of the TV/video system. Double-8 and Super-8 film are shot and projected at the rate of 18 frames per second (fps). The TV/video system used in the United States scans an image 60 times per second. The result of this mismatch is a black bar that will scroll down the images on your TV screen.

Some people don't find the bar objectionable, but it's still best to eliminate it.

Remember to synchronize film projection speed to TV/video scanning rate.

If your projector has a variable speed control, increase the film rate to 20 fps (if the control isn't calibrated, just adjust the speed until the bars disappear). Because 20 is a multiple of 60, you'll be in sync—and without speeding up the action to make it seem unnatural.

This technique for synchronizing film and video works fine with Double-8 and Super-8 silent film, but creates a complication if there's a soundtrack on your movie. Speeding up the film raises the pitch of the soundtrack, making voices

sound like Alvin and the Chipmunks.

Your VCR and camera enable you to narrate a new soundtrack to replace the old (and usually noisy) one on the Super-8 film. But if you really wish to retain the original soundtrack on your film-to-video transfer, *PM*'s found a way—without the chipmunk effect.

The solution is to use the Soundpacer audio cassette recorder from Variable Speech Control, available for about \$120. This audio recorder contains circuitry that maintains normal voice pitch even when the tape speed is doubled.

Use the Soundpacer to record the audio portion of your Super-8 at its normal 18 fps speed. Then, dub the audio cassette onto your videotape. To sync the voice track to the movie, you should play the audio cassette 11 percent faster than it was recorded: The proper setting on the Soundpacer will be just past the halfway point between the 1.0 (normal speed) and 1.2 (20 percent faster) markings.

Because your original soundtrack will probably be very noisy, dub with a good grade of audio tape to avoid adding more noise. The same applies to your video transfer itself. A high-grade or super-high-grade videotape will hold up best over time, and make for a good duplicating master for copies. **PM**

To match the speed of the Wagner® Power Scraper,TM just move one of these 3600 times a minute.



An old-fashioned scraper is good for a lot of things. Unfortunately, saving time isn't one of them. Which is why the new Wagner® Power Scraper™ makes so much sense. The Power Scraper blade moves back and forth 3600 times a minute. To remove loose and peeling paint in seconds.



For removing rust, or other surface build-up, there's a wire brush attachment.

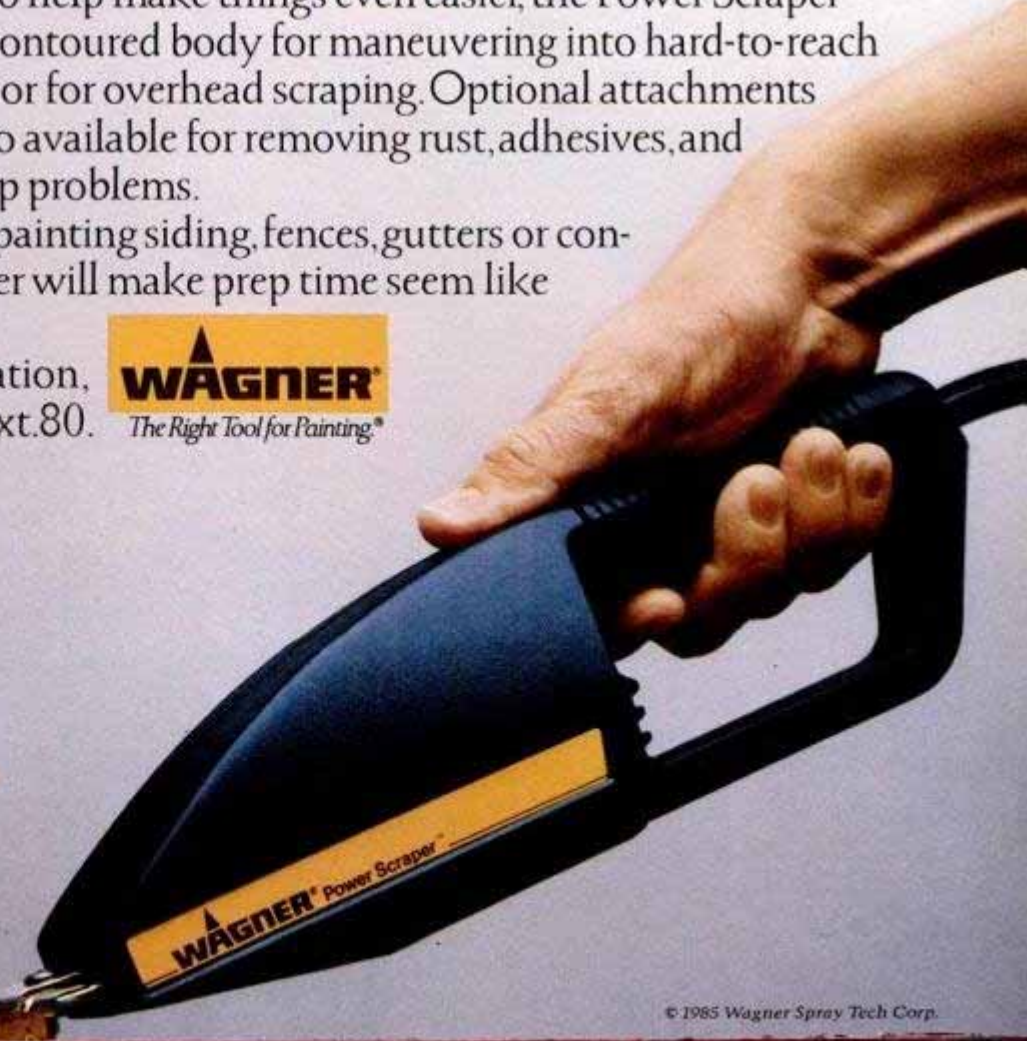
What's more, its powerful motor keeps going strong for as long as it takes to finish the job.

To help make things even easier, the Power Scraper has a contoured body for maneuvering into hard-to-reach places or for overhead scraping. Optional attachments are also available for removing rust, adhesives, and other difficult build-up problems.

Whether you're painting siding, fences, gutters or concrete, the Power Scraper will make prep time seem like no time at all.

For more information,
call 1-800-328-2285 Ext.80.

WAGNER[®]
The Right Tool for Painting.[®]

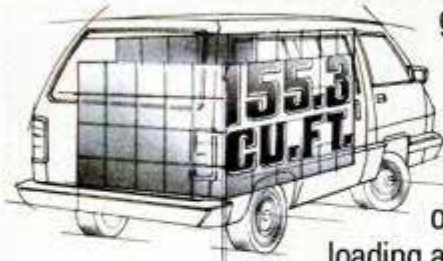


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Pack it full. Fuller. Pile it high. Higher. Whether it's a Cargo Van, a Standard Bed Truck, or a One-Ton Truck you need to get your work done best, chances are you'll find Toyota has the best selection for the job.

MORE CAPACITY. The 1985 Toyota Cargo Van gives you the most cargo capacity of any small van.



No discussion. The doors open wide for easy

loading and unloading of over 155 cubic feet. So you can carry more packages, pipes, plants or parts without going back to

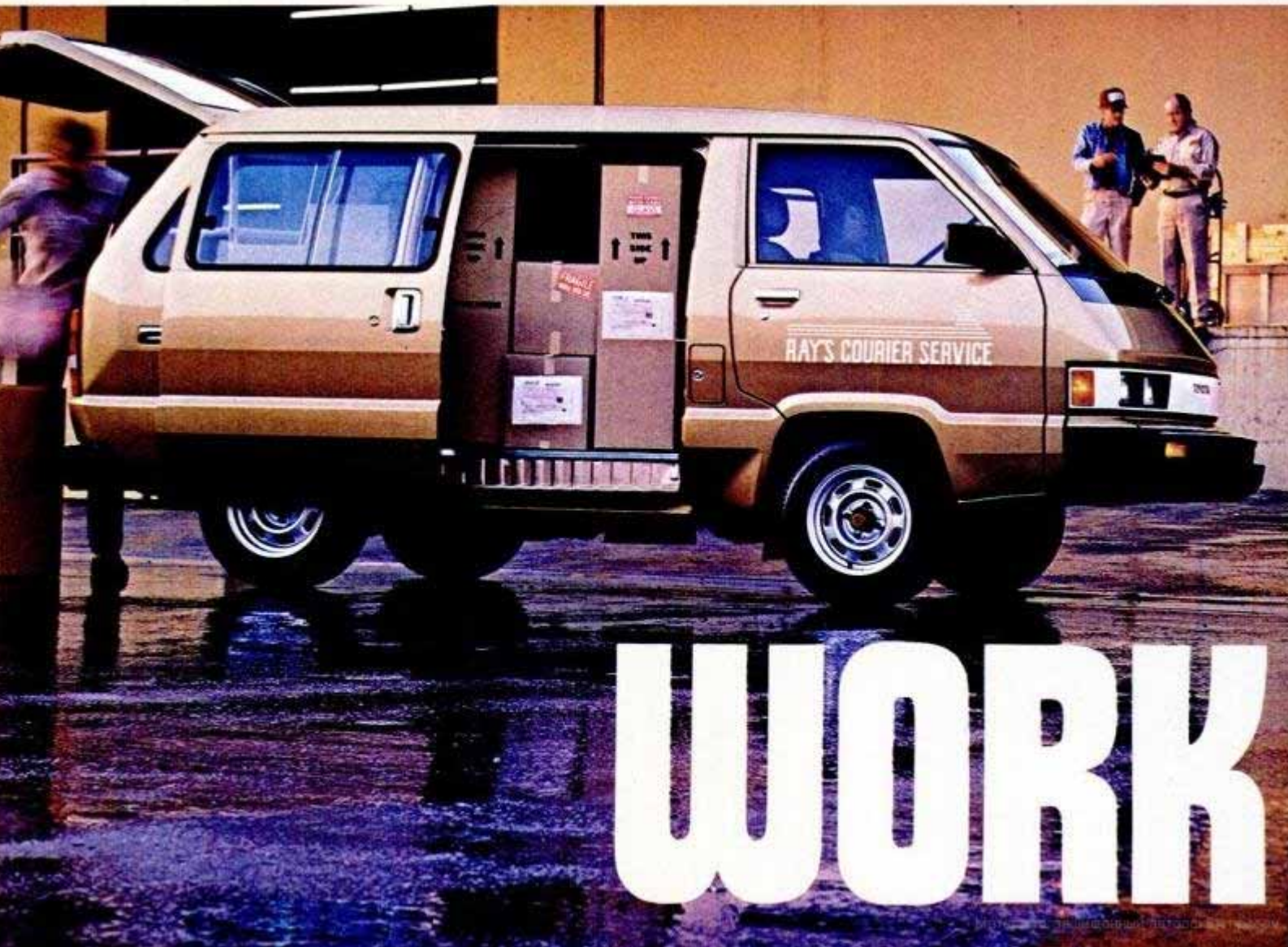
the store for more.

With the highest miles per gallon, 25 Highway MPG, (23) City MPG,* and the best service interval of any van in its class, you get even more on-the-road, on-the-job time, too. When it comes to exclusive features, it never quits either.

Consider: This is also the only van with platinum-tipped spark plugs designed to go 60,000 stop & go, grueling miles—without changing. And its 2.0 liter engine with Electronic Fuel Injection, like every Toyota engine, is built with dedication to avoid repairs like the plague.

MORE VALUE. For the money, \$5,998,** Toyota's **\$5998.**** 1985 Standard Bed Truck

**THE MORE YOU GET INTO YOUR VAN OR TRUCK,
THE MORE YOU GET OUT OF IT.**



gives you more than just a 1,400 lb. payload,^{***} rugged full-box frame construction, space in the cab for three without skimping on head or leg room, 31 Highway MPG,⁽²⁷⁾ City MPG* and a powerful 2.4 liter engine that works overtime without complaints.

Like all Toyota Trucks, Toyota's Standard Bed also gives you more confidence. Ask around. Toyota owners reported the lowest incidence of repairs for any small truck—imported or domestic.^{****}

That's one big reason why more than 95% of all Toyota Trucks ever sold are still on the road,[†] still working and still carrying spectacular resale value.

Maybe that's why nobody sells more small trucks than Toyota. Nobody. **MORE PAYLOAD.** If you need the highest payload of any small truck, you need the 1985 Toyota One-Ton Truck.

This heavyweight has double-wall construction, heavy-duty rear suspension and 8-ply, steel-belted

2500 lbs.^{*}
PAYLOAD**

OH WHAT A FEELING!

radial tires to keep doing business even when you're hauling 2,500 lbs.^{***}

Want more? Toyota's One-Ton can tow up to 5,000 lbs.^{***} with its optional towing package. **MORE INFORMATION.** Find out how the wide selection of Toyota Trucks and Vans can help you get more out of your work at your local Toyota Dealer. Take a Toyota out for a test drive today and learn firsthand.

* With Standard Transmission. Remember: Compare this estimate to the "EPA Estimated MPG" of other vans or trucks. You may get different mileage, depending on how fast you drive, weather conditions and trip length.

** Manufacturer's suggested retail price. Dealer's actual retail price may vary. Price does not include tax, license, transportation, optional or regionally required equipment.

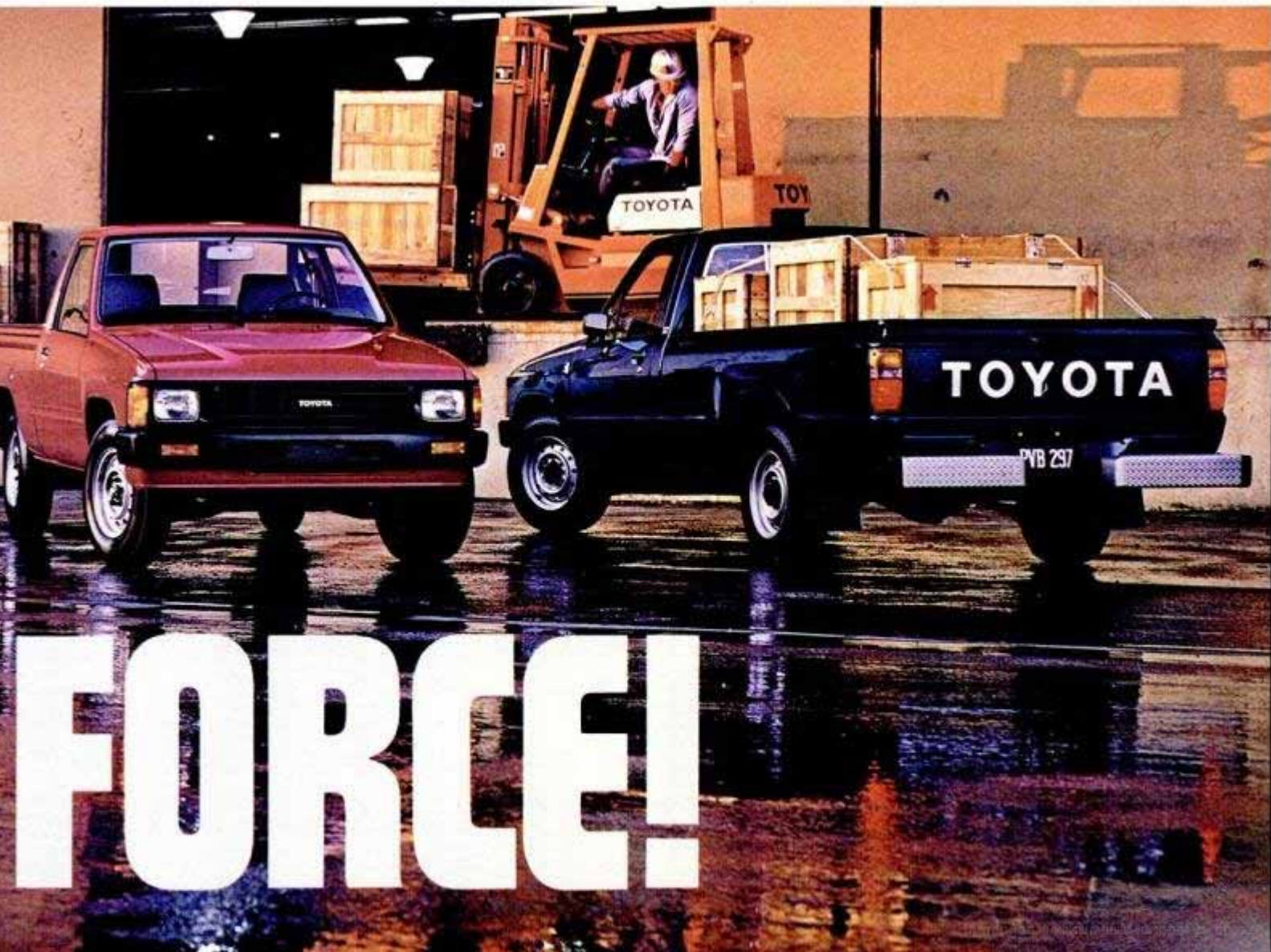
*** Including occupants, equipment and cargo. On One-Ton, max. GVWR not to exceed 8,500 lbs. for vehicle and trailer combined.

**** 1984 J.D. Power Compact Pickup Truck Survey

† R.L. Polk registrations.

†† Calendar year 1984, Ward's Automotive Reports.

#1 SELLING SMALL TRUCK IN AMERICA.††



Winston. America's Best.

Excellence.
The best live up to it.



16 mg. "tar", 1.2 mg. nicotine av. per cigarette by FTC method.

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



BREAKING THE SPEED BARRIERS

On land, sea and air and with or without a machine, give man a barrier and he'll break it.

"Thunder is great. Thunder is awesome. But it's lightning that does all the work."

—Mark Twain

They push through the water with such earthshaking power that few call them by their real names. Officially, they're hydroplanes, racing boats that leave the surface of the water, spewing rooster-tail plumes 100 yards behind them. Enthusiasts call them thunder boats. But thunder isn't enough for the man setting out to break the surface vessel speed barrier within the next year. He needs lightning.

The elusive barrier is Mach .5—one half the speed of sound—or 385 mph at sea level. (The speed of sound is roughly 700 mph. It changes with variations in air pressure and temperature.) The last man to try it was Lee Taylor, who took the sleek *U.S. Discovery II* to Lake Tahoe in November 1980. His 40-foot, 2,500-pound craft was powered by the brute force of 8,000 pounds of thrust in a 16,000-hp Woodruff rocket engine.

Writer: Dennis Eskow, Science Editor
Reporters: William Hoffer, Newport News, Va.; Lee Green, Bonneville, Utah; Ted Francis, Los Angeles; Allan Efrus, New York



PHOTO BY D. W. WOODRUFF

Lee Mize's *Screamin' Eagle* (top) will try breaking the Mach .5 barrier on water. The British Thrust 2 car (above) is being readied for an attempt at Mach 1 on land.

Fifty yards into the run an inspection plate blew off the side of the vessel, leaving a gaping hole. Unaware of the damage, Taylor blasted toward the measured straightaway. As he brought the craft over 280 mph, the hole began sucking in air like a jet engine. Suddenly, the entire boat exploded. Taylor was knocked unconscious and his motionless body, strapped into the bulky cockpit, sank into Lake Tahoe. It took

divers a full week to find his remains.

The tragedy left Taylor's friend Lee Mize as the only serious American challenger to the Mach .5 barrier.

"Taylor's boat had serious engineering problems," claims Mize, holder of four world records in various drag boat classes. "I saw problems with the way water was hitting his sponsons. I thought it would hammer his boat, breaking it apart. He didn't think I had

BREAKING SPEED BARRIERS

New rudders and body design will be used by *Screamin' Eagle* (left) to go for Mach .5 on water. Under water, the Soviet *Alfa*-class sub reportedly breaks the 42-knot barrier. *Thrust 2* uses big engine and high fins. It's going for Mach 1. Don Vesco's motorcycle has gone 318 mph. He's shooting for 425 mph. A futuristic SCRAMJET will eventually go for Mach 7. Far in the background are an aerodynamic Human-Powered Vehicle and a man.

MAN MILE:
3 MIN. 47.74 SEC.

HUMAN-POWERED
VEHICLE
65 MPH

SURFACE BOAT
MACH .5

a safe boat and I didn't think he did."

Five years after the tragedy, Mize is now certain his boat is ready to break the barrier safely. When he takes out his rocket-propelled *Screamin' Eagle* late this year or early next year, he'll rely on his own patented fish-scale design at the bottom of his sponsons that allows the boat to leave the water in stages as speed is increased. At 100 mph, only tiny fins beneath the sponsons will touch the water.

"At high speed, water is like glue," Mize explains. "If water touches the boat, it grabs it like brakes grabbing an icy road." At a speed of 200 mph, contact with 1 square inch of water will rob a hydro of 50 hp.

For safety and stability, the *Screamin' Eagle* has both an air rudder and a water rudder. Mize had warned Taylor that his oversized water rudder would create control problems once the craft left the water, which it must do as it approaches the speed barrier. The 20-foot *Screamin' Eagle* is designed to stay in control as its 95 percent hydrogen-peroxide fueled rocket booster revs up to 20,000 hp. The boat, Mize says, is pure lightning.

"If we were to set this boat on its tail, we have enough power to shoot it, with me in it, 60 miles straight up," he claims. In early test runs, Mize took the boat up to 180 mph using just 10 percent of its power. Taylor was asked just before the fatal run what his next goal would be after breaking Mach .5. "Break the sound barrier," he replied. Mize will settle for half that on his run.

The Mach 1 car

Since 1963, Mach 1 has been the speed barrier to a dedicated group of enthusiasts who haunt the salt flats of Bonneville, Utah. That was the year Craig Breedlove's three-wheeled *Spirit of America* brought jet power to Bonneville. Running his jet car over 400 mph for the land speed record, Breedlove brought a new dimension to this unusual class of vehicle.

By 1970, Gary Gebelich, driving the jet-powered *Blue Flame*, hit 622.407 mph for the "flying" mile. In 1973, Britain's team headed by Richard Noble set out to design the ultimate Land Speed Record Car. The machine was dubbed *Thrust 2* after a prototype was wrecked and sold for scrap for \$500. The 27-foot,

8,500-pound *Thrust 2* is powered by a modified Rolls-Royce Avon 302 jet engine with 17,000 pounds of thrust.

The Britons went to Bonneville in 1981 and 1983, but each time they arrived, flooding had made the track impassable. In '83, they attempted to break the Land Speed Record at Nevada's Black Rock desert. Noble ran *Thrust 2* beyond 633 mph, breaking the record by 33 mph. But it was far short of Mach 1, about 730 mph.

Noble and his team are working on the aerodynamics of the *Thrust 2* body this year. They are expected to raise the already 4-foot-high fins and to shave a fraction from the belly of the car. A larger engine is also on the drawing board. No announcement has been made as to when the Britons will try it, but the entire Land Speed Record community is expecting the Mach 1 barrier to fall by next year.

One Land Speed Record car already has gone Mach 1, but the speed wasn't documented according to the official rules. The *Budweiser Rocket* hit an unofficial 739.66 mph—Mach 1.01—in tri-



WINGED AIRCRAFT
MACH 7

MOTORCYCLE
425 MPH

LAND SPEED RECORD
MACH 1

SUBMARINE
42 KNOTS
76 KILOMETERS PER HOUR

als at Edwards Air Force Base in 1979. The rules specify that any new record must be the average of any two runs over a measured mile or kilometer conducted within 30 minutes of each other with all timing done by official observers using approved calibrated instruments. The *Budweiser Rocket* was clocked by an unsanctioned Air Force officer without the requisite equipment.

Will Mach 1 ever be reached on land? "I think it's quite possible," says Noble. "After all, we know the airspeed along

(Please turn to page 114)

PM DRAWING BY ED VALIGURSKY

STEVE HEGG'S TEAM PURSUIT BIKE



When the United States Olympic Cycling Team rode out onto the track in Los Angeles for the first time at last year's Olympic Games, most spectators had no idea they were witnessing history.

They looked at the bikes, a few of which looked kind of weird, and wondered what they were all about. But soon after, in the wake of nine medals—four of them won on those weird-looking bikes—the machines were soon forgotten as riders Steve Hegg, Nelson Vails and Mark Gorski soaked up the glory and the spotlight.

When the hype machine finally ground to a halt, bicycle enthusiasts realized that the U.S. Cycling Team had entered the games with some of the most sophisticated, technically advanced bicycles in the world—definitely an edge when you're engaged in world-class competition.

Perhaps the best part of the whole scenario is that there are indications that much of this design sophistication will filter down to the road bicycles you'll be able to buy very soon.

The "funny bikes," as they were called because of their small diameter front wheel, sharply down-sloping top tube and disc rear wheel, were built by the U.S. Cycling Team Technical Development

BY CLIFF GROMER

Center in Dayton, Ohio, a facility operated by the Huffy Corp. and its Raleigh Cycle Div.

All racing bikes shoot for light weight, high rigidity and low aero drag and rolling resistance, but the new Raleigh Technium race bikes scored higher and went further in these critical



Excellent aerodynamics helped riders draft each other at high speeds.

areas than any bike ever did before.

The search for a lighter, stronger frame led Raleigh's engineers beyond conventional chromium-molybdenum alloy steel thinwall tubing with welded and/or brazed joints, to aluminum. Unfortunately, when you go to a lighter weight construction, you have to trade off some rigidity.

Aluminum has another drawback. It's difficult to weld. But a brand new 7000-series aluminum alloy with high zinc content, developed by NASA for the Space Shuttle and the latest military jets, proved to be even stronger than steel, with an ultimate yield strength of 80,000 to 90,000 psi, compared to chromemoly steel's 79,000 psi.

The problem with this 7000-series aluminum was in joining the tubes. Welding didn't work and bonding was difficult because of the tiny contacting surface areas and high stress factors. The solution was a special bonding procedure developed by the Center known as the Technium process. The aluminum tubing was die-drawn to an aerodynamic teardrop cross section with a 3-to-1 length-to-width ratio. This made the frame appear more massive when viewed from the side, but the frontal area was reduced. The areas to be joined were specially shaped and prepared, the one-part epoxy aircraft structural adhesive specially applied and cured. Details on this part of the process are proprietary. The resulting bond was so strong, it exceeded the tensile strength of the tubes. Yet, the bike weighed just 12 pounds.

To get a low front profile, a sharply down-sloping top tube was used with

(Please turn to page 111)

PHOTO BY RON MODRA/SPORTS ILLUSTRATED

BREAKTHROUGH BIKE

It looks like it came from outer space. But actually it came from Dayton, Ohio, cost \$40,000 and is already obsolete.

Pat McDonough on his way to a team pursuit silver medal on a funny bike.





BRITISH ALIVE AND

A two-seater revival
is coming our way
from England.

By JOHN RETTIE



Most exotic of the upcoming English sports cars will be the Aston Martin Vantage Zagato, a limited-issue, 185-mph Anglo-Italian effort.

J. Rettie

Thirty years ago, the British had a virtual monopoly on the world sports car market. If you wanted a cheap two-seater convertible, you could buy an MG.

If you wanted a fast sports car at a reasonable price, Jaguar could sell you an XK-120. Or you could spend more and buy an exotic Aston Martin. But, in typical fashion, the major British manufacturers rested on their laurels and let the Germans, Italians and Japanese corner the market. Jaguar stopped producing the two-seat XK-E sports car in 1975, MG closed its factory doors in 1980 and Triumph sports cars disappeared in 1981. If you look hard, there are British sports cars on the market, but only ones produced by smaller companies such as Lotus, TVR and Morgan.

The current success of modern two-seaters like the Pontiac Fiero, Toyota MR2 and Honda CRX is encouraging several companies to take a hard look at the sports car market once again. Thanks to robots, it is much easier to build sports cars now, because they can be produced on the same assembly line as a sedan if the same major compo-



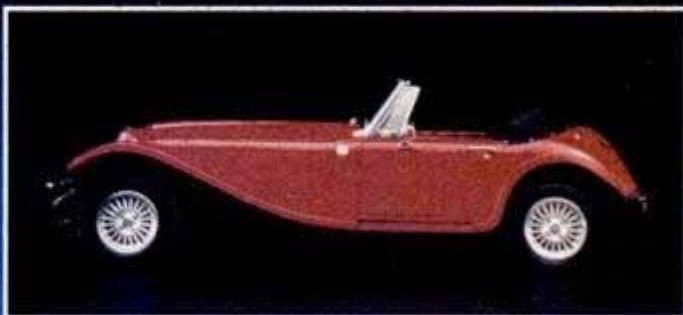
British Shelby Cobra of the '60s has been revived as the AC Mark IV. You can buy one with a U.S.-legal 302 V8 from Ford dealers.



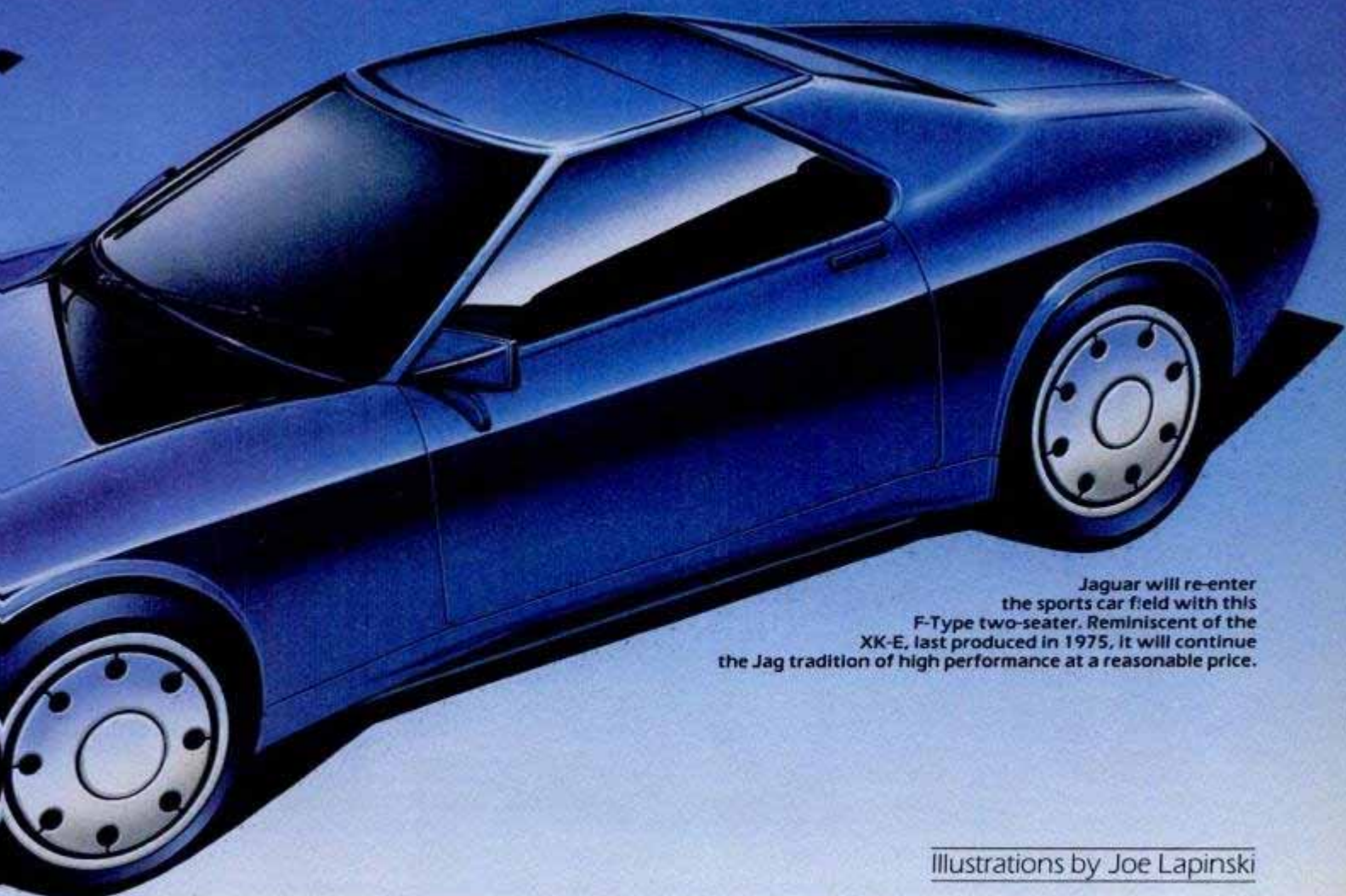
SPORTS CARS WELL, THANK YOU



Sleek mid-engined Lotus Etna combines radical all-plastic body and chassis construction with a new 360-hp V8 for Ferrari-like performance. Turbocharged 600-hp version will have four-wheel drive.



The Panther Kallista is a nostalgia-mobile styled after a pre-War Jaguar. It's available in America with a 2.3-liter Ford four-cylinder engine that gives the lightweight convertible peppy performance.



Jaguar will re-enter the sports car field with this F-Type two-seater. Reminiscent of the XK-E, last produced in 1975, it will continue the Jag tradition of high performance at a reasonable price.

Illustrations by Joe Lapinski



The Morgan roadster has been available, wood frame and all, since the mid '30s. You can buy one with a propane-powered four-cylinder engine or an aluminum Rover V8.

nents are used. America has always been the biggest market for sports cars. But tough smog and safety standards have made it expensive to produce low-volume sports cars. Similar standards are now appearing in other countries, so



Reliant Scimitar SS1 convertible, with Ford Escort engine and rear-wheel drive, is a modern-day MG Midget/Triumph Spitfire.

all cars are beginning to be built to the same standards. Also, if a sports car uses parts from an already certified car, then it is a lot easier and cheaper to federalize it for U.S. sale

because the major paperwork has been completed. Today, there is an exciting selection of British sports cars available, and more will be coming in the future.

AC Cobra

In the '60s, the name AC became synonymous with the Shelby Cobra, the most brutish car you could buy for general use. The Cobra started out as an ordinary English sports car but was transformed when a Ford V8 replaced the six-cylinder Bristol engine. Safety regulations that came into force in 1968 almost killed off the car.

AC Cars Ltd. is no longer producing sports cars, but rights to manufacture the Cobra have been sold to a company called Autokraft and it has reintroduced the Cobra as the AC Mark IV, since Ford owns the Cobra name. Strictly speaking, the last version of the original Cobra was officially called the AC Mark III. The Autokraft version is a real revival of the old Cobra, although it has been modified in many different ways. It is built using the original chassis jigs and body bucks, and the complete body is handmade from aluminum the same way as the Cobra.

Ford Motor Co. has been extremely helpful in getting the car certified so that it can be sold legally in the United

MG Isn't Dead Yet

When British Leyland closed the famous MG factory in England, many tears were shed by sports car enthusiasts because MG had long been a favorite.

At first, everyone feared the MG name would disappear forever. But in 1982, BL introduced the MG Metro, a sporty version of the small sedan sold by Austin. Since then Austin Rover, as the car company is now called, has introduced additional MG sedans and they are all selling well in Europe. The top-of-the-line MG Maestro 2.0 EFI is in the same class as the VW GTI and is reckoned by many auto enthusiasts to be just as good a car.

Back to the U.S.

Austin Rover will reintroduce its range of cars to the U.S. market in the next few years. At first, it will sell a new luxury sedan code-named XX, which is being jointly developed by Rover and Honda. Then it will probably introduce the next generation of MG sedans followed, hopefully, by an all-new MG Midget.



ILLUSTRATION BY JOE LAPINSKI

The next MG Midget roadster is likely to be a convertible version of the front-drive Honda CRX, built in England by the Austin Rover car company (above). Front-drive MG Maestro sedan (below) is a hot little econobox that competes with the VW Golf GTI.



Austin Rover says that it will not re-enter the sports car market until it has its mass-produced automobiles well established.

CRX convertible?

With the company's close ties to Honda, it is likely that the new Midget will be based on a Honda model, most logically the front-wheel-drive Honda CRX. It might be similar to convertible versions of the CRX that have been produced recently by customizers in California.—J.R.

States. It is powered by the latest 302 cu. in. Ford V8, which produces 210 hp—considerably less than the 271 to 485 hp of the original Cobras, though still enough to give the car a top speed of about 140 mph, and a 0 to 60 mph time of around 5.5 seconds.

Autokraft is selling the car through selected U.S. Ford dealers for \$39,950.

AC ME3000

After AC Cars stopped producing the Cobra, it began development of a small mid-engined sports car called the ME3000. The car first appeared in 1973 but did not go on sale until 1979. Less than 100 have been sold since that



Mid-engined Panther Solo uses a Ford Escort powertrain. To be built in California, the Escort Turbo GT engine is a likely option.

time and it has never been sold in the United States.

A newly formed Scottish company, called AC (Scotland) Ltd., has obtained the rights to manufacture the car. The company intends to produce an improved version with a slightly altered body design using fiberglass construction techniques borrowed from the boat world. It will probably be powered by a turbocharged Ford 2.3-liter engine, as used in the Merkur XR4Ti, or by the newly designed 2.9-liter V6 that's appearing in Ford cars in Europe. AC (Scotland) will market the car in the United States by 1986.

Aston Martin

Next year will see the introduction of an exotic, new sports car from Aston Martin—the 185-mph, 430-hp Vantage Zagato model. The lightweight two-seater will be a joint British-Italian exercise.

The Vantage running gear will be shipped to Turin where Zagato will build the body on a shortened, two-seat chassis. It will be very expensive and Aston Martin intends to build only 50 of them, to ensure its exclusivity.

Caterham Seven

Lotus Cars started business producing fun little two-seater kit cars. When Lotus moved out of the kit car business and into serious street and race car manufacturing, it sold the Lotus Seven manu-

TVR Tasmin is a \$28,000 rear-drive convertible powered by a Ford 2.8-liter V6. A hatchback is sold in England.



A cleaned-up version of the mid-'70s AC ME3000, the Ford-powered, mid-engined coupe, is now being built in Scotland.

facturing rights to Caterham Cars, which has been involved with Lotus for over 25 years. The popular Lotus Seven, which looks like a small Formula One racer with two seats, headlights and fenders, continued as the Caterham Seven. There are many companies producing replica Sevens, but the Caterham Seven kit car is the real thing. It has been refined over the years and can accept a series of Ford four-cylinder engines ranging from 84 to 150 hp.

Jaguar

Since 1975, the Jaguar badge has appeared only on the XJ6 sedan range and the XJ-S in the U.S., which is a fast GT car rather than a true sports car. The fabulous E-Type is one of the most desirable sports cars to own these days, since it looks as good as other exotic cars and yet is not nearly as expensive to restore or run. Jaguar enthusiasts have been hoping the company would introduce a worthy followup to the classic E-Type.

Now that Jaguar is back in private hands after being owned by British Leyland and the state for over a decade, management is keen to capitalize on Jaguar's past and is likely to introduce a new sports car in the near future. The F-Type sports car is expected to use components from the new XJ40 sedan, which will be introduced next year. It will be a two-seater with flowing lines in the E-Type tradition.

Lotus

Lotus's Turbo Esprit is now a viable alternative to an Italian sports car and is selling well. Next year, Lotus will return to the lower end of the market with an all-new 2+2 sports car code-named the X100. Lotus plans to sell the car for less than a comparable Porsche 944 (under \$20,000). Its monocoque body will be made entirely out of plastic with no separate chassis. To date, Lotus has been extremely secretive about the appearance of the car, but we know that it will revive the Elan model name, will be powered by a 1.6-liter

[\(Please turn to page 112\)](#)



COBIA 183 VBR · MARK TWAIN 190 BR · REGAL 195 MEDALLION · WELLCRAFT 180 ELITE

SMALL BOAT SHOOTOUT

Four similar family cruisers, in the water, head to head. It's amazing what you can learn.

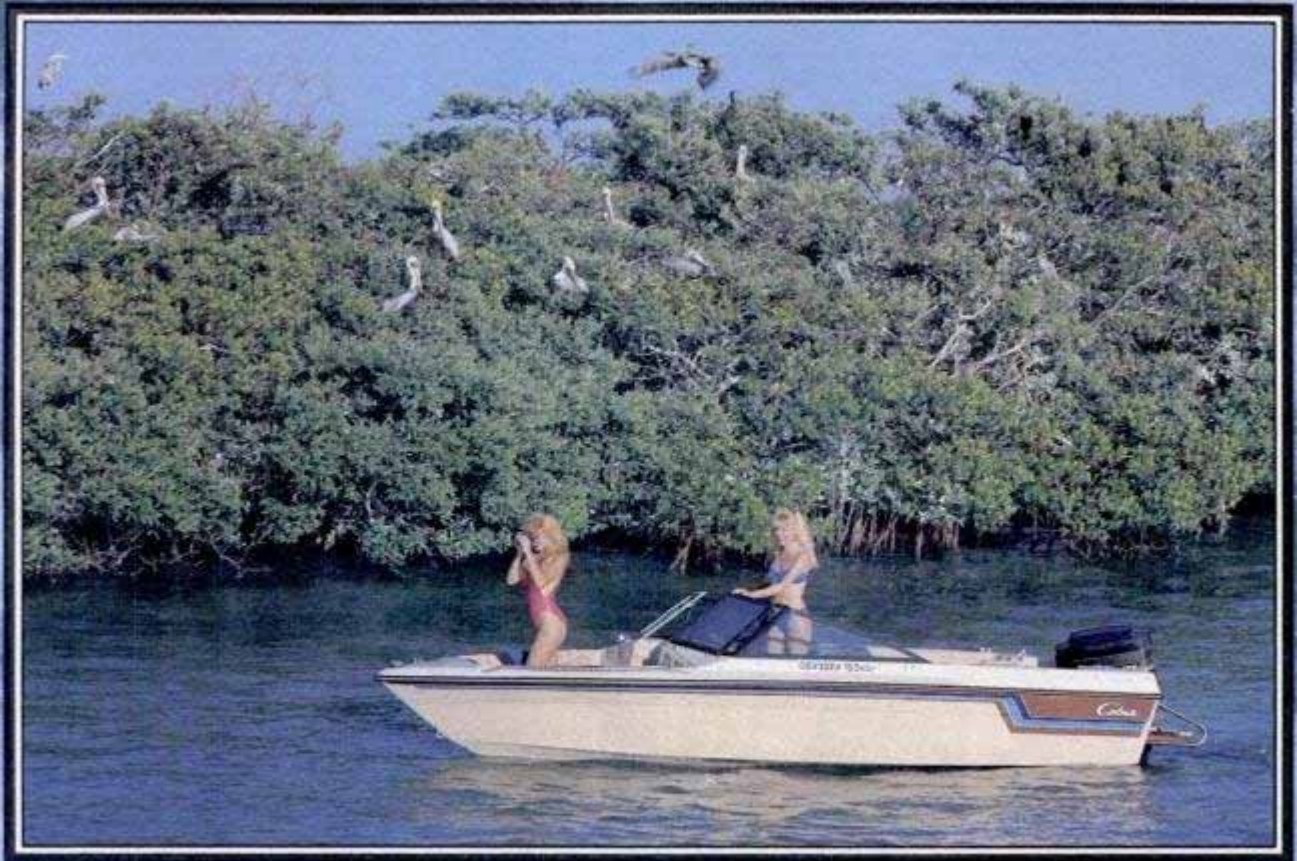
Family boating is back with a vengeance. Give much of the credit to the concept of a package boat—boat, motor and trailer all wired up and ready to roll. The package deal has brought prices down and interest in family boating up. Obviously, you can expect the deals to continue.

It wasn't by accident that boat manufacturers zeroed in on the bowrider-style runabout on which to base the industry comeback. Camping, skiing, fishing, cruising—whatever your pleasure, a bowrider can do it all without making your wallet too thin. They're fun to operate, easy to tow behind the average sedan, and inexpensive to store on their own trailer. Bowriders make up a solid segment of the outboard-powered pleasure boat market that has dominated the way Americans have enjoyed boating.



All four boats were bowriders between 18 and 19 feet in overall length. All were powered by 150 hp outboards. Mercury and Mariner outboards are identical under the cowling, so engine differences were eliminated and we could concentrate on hull performance and overall handling during our test.

By JOHN WOOLDRIDGE; Photos by Skip Gandy and Mac McCarthy





It's not inaccurate to think of a bowrider as everyman's sports car for the water, considering the kind of performance we wrung out of our four test boats—Cobia Odyssey 183 VBR, Mark Twain 190 BR, Regal 195 Medallion and Wellcraft 180 Elite.

With help from Mercury Marine's Clem Koehler, we secured the services of Mercury's fine testing facility at Placida, on Florida's southwest coast. More importantly, Koehler arranged to equip our test boats with four new 150-hp V6 engines, two Mariners and two Mercurys. Mariner and Mercury engines are identical under the cowling, so we were able to concentrate on the performance of the boats themselves, not the characteristics of the engines.

The selection of the Mercury/Mariner V6 150 was not impulsive. It features aluminum alloy construction and a loop-charged induction system resulting in an excellent power-to-weight ratio.

In 1984, Mercury introduced a new power trim system between transom plate mounts that requires no hydraulic

Wake jumping, crashing through head seas and generally blasting around were all part of the test procedure for all four boats.



Two Mercury 150-hp V6s and two identical Mariners powered the boats in our tests.

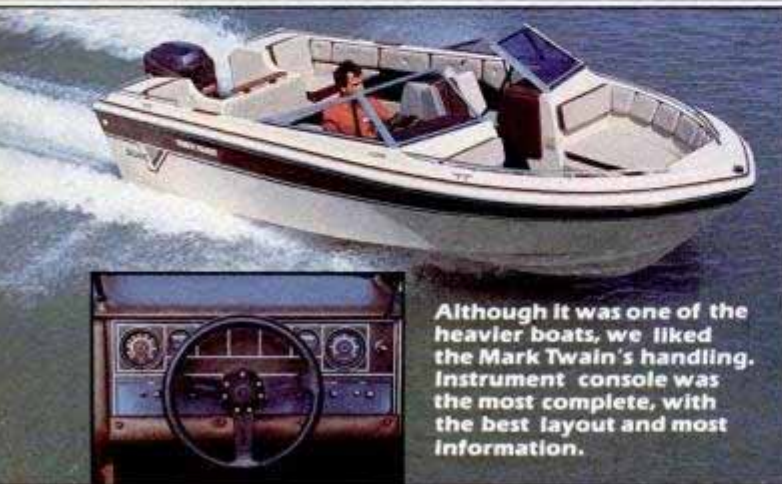
hoses. This permits the addition of oil injection from a separate oil pump and tank, with mixture at the fuel pump. The mixing is accomplished via a simple mechanism that allows a variable but precise oil blend to reach all cylin-

ders, ranging anywhere from 100:1 at idle to 50:1 at top speeds.

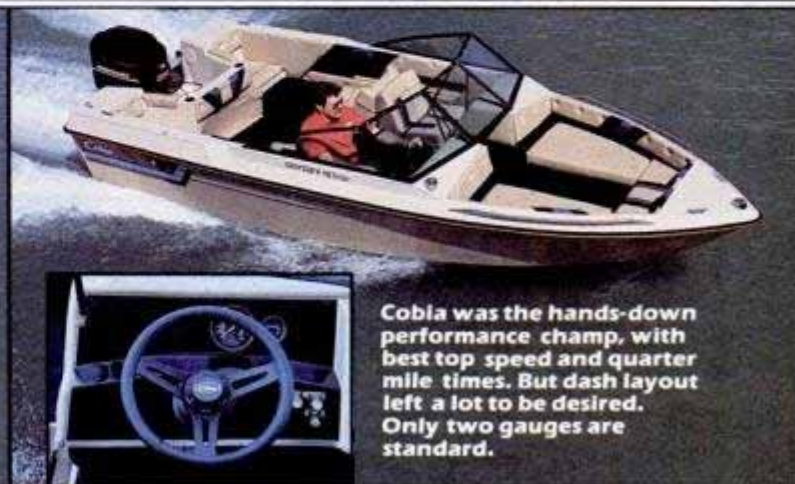
The three-gallon oil tank lets you burn approximately 150 gallons of gas before it's necessary to add more oil—a nice feature for those of us who sometimes lose track of how much oil we added last fillup. There's also a two-function alarm system keeping track of oil pump condition and oil supply levels in the tank. A reserve feature gives you about an hour's grace just in case.

All four test boats were rigged and readied at the Placida facility by Dave Martin and Phil Mazak. We put the test boats through numerous timed 1/4-mile runs, made 180°, full-lock turns at high speeds and at a radar-gun measured 35 mph, and ran over long stretches of both open and protected water to analyze how well the boats handled various wind and water conditions.

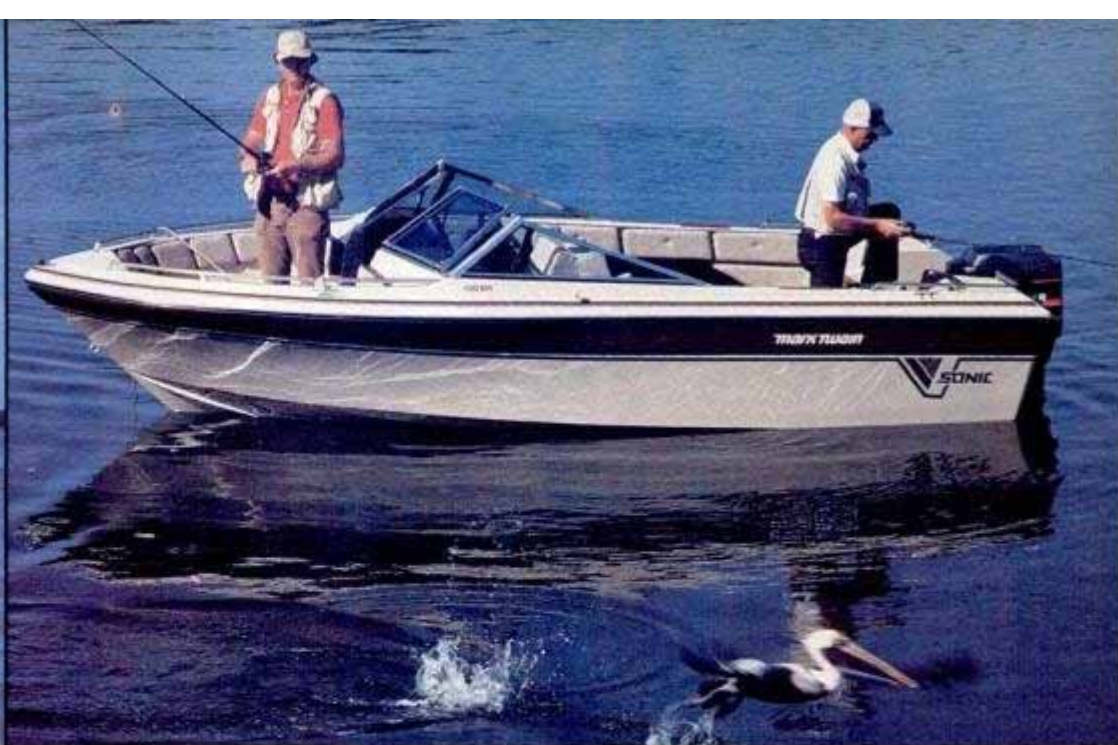
In addition to the instrumented performance test results, we ranked the boats according to subjective grades in each of 14 categories: braking and slowing ability; turning confidence; for-



Although it was one of the heavier boats, we liked the Mark Twain's handling. Instrument console was the most complete, with the best layout and most information.



Cobia was the hands-down performance champ, with best top speed and quarter mile times. But dash layout left a lot to be desired. Only two gauges are standard.



ward seating; main seating; aft seating; dash layout; dash control function; ride comfort at idle; ride comfort in a head sea; ride comfort in a following sea; turning feel; shifting feel; styling; and fit and finish. Each boat was given 1 to 5 points in each category, with 5 being the best possible performance. A perfect score is 70 points.

Our test boats had the new Laser stainless-steel propellers designed specifically for 150- to 200-hp powered boats. The Laser holds very well at high trim-out angles, and allows outboards to be raised higher on transom, reducing the drag of the lower unit through the water. Our props measured a 23-inch pitch at 14 1/4-inch diameter. The Laser is a through-prop exhaust design made from the same high-grade stainless steel as other Quicksilver props.

Mark Twain 190 BR

Weighing in as the third heaviest boat tested, and measuring nearly the same deadrise angle as the two fastest performers, the Mark Twain 190 BR

Test days had their quiet moments, too. The four boats were used to get to favorite fishing and swimming spots.



We used a radar gun to confirm our calibrated electronic tachometer readings.

only managed fourth place in our performance testing. Of the four boats tested, the 190 had the most nearly vertical transom angle, a factor that did not allow the more optimum trim angles found on the others. The observed

maximum reading of 5,100 rpm seems to bear this out, as well.

The Mark Twain, recorded third best port/starboard turning series times, showing a very curious yet consistent ability to complete a starboard turn in a much shorter time than any of the other boats tested. Storage capacity also ranked third.

But what the 190 BR lacked in top end performance, it more than made up in our testers' opinions on the water. "Effortless handling, a pleasure to operate," said one. Marks in braking/slowing and turning were very high. We made several full-throttle, high-speed turns of approximately 10 boat lengths in diameter, after exiting the speed trap and blasting across a small bay leading to the Gulf. Every time, we felt great confidence in the hull and in the turning ability of the boat/motor combination. In fact, this boat made us feel confident and secure no matter what we were doing in it.

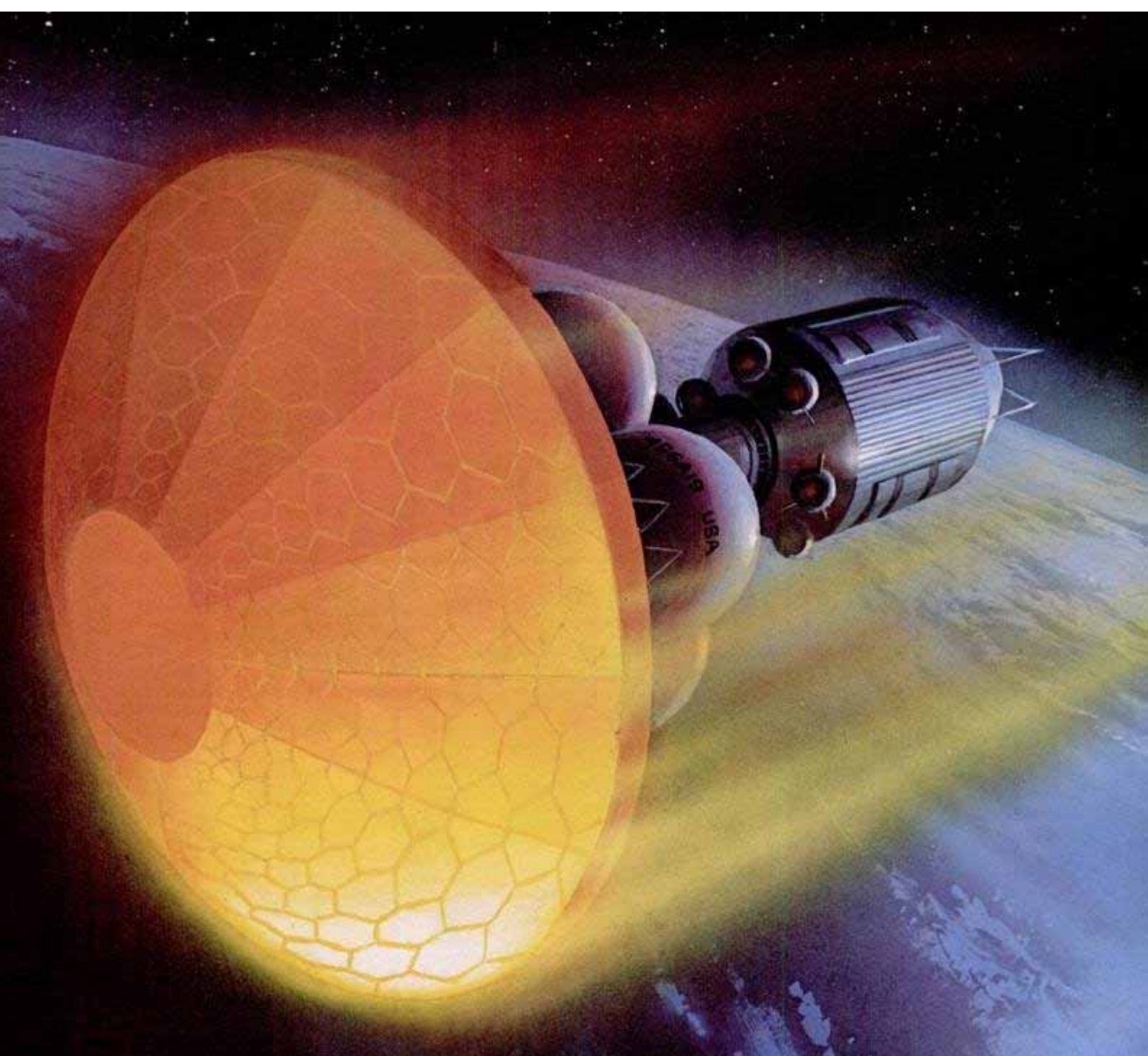
Fore and aft seating on the sun
(Please turn to page 116)



Regal was the heaviest and one of the longest boats in our test. Yet, it ran second in several performance categories. Padded dash didn't convey much information.



Wellcraft had the best turn efficiency scores and was within a fraction in most other performance areas. Dash had room for more gauges, and they'd be welcome.



NASA's Next Spaceships

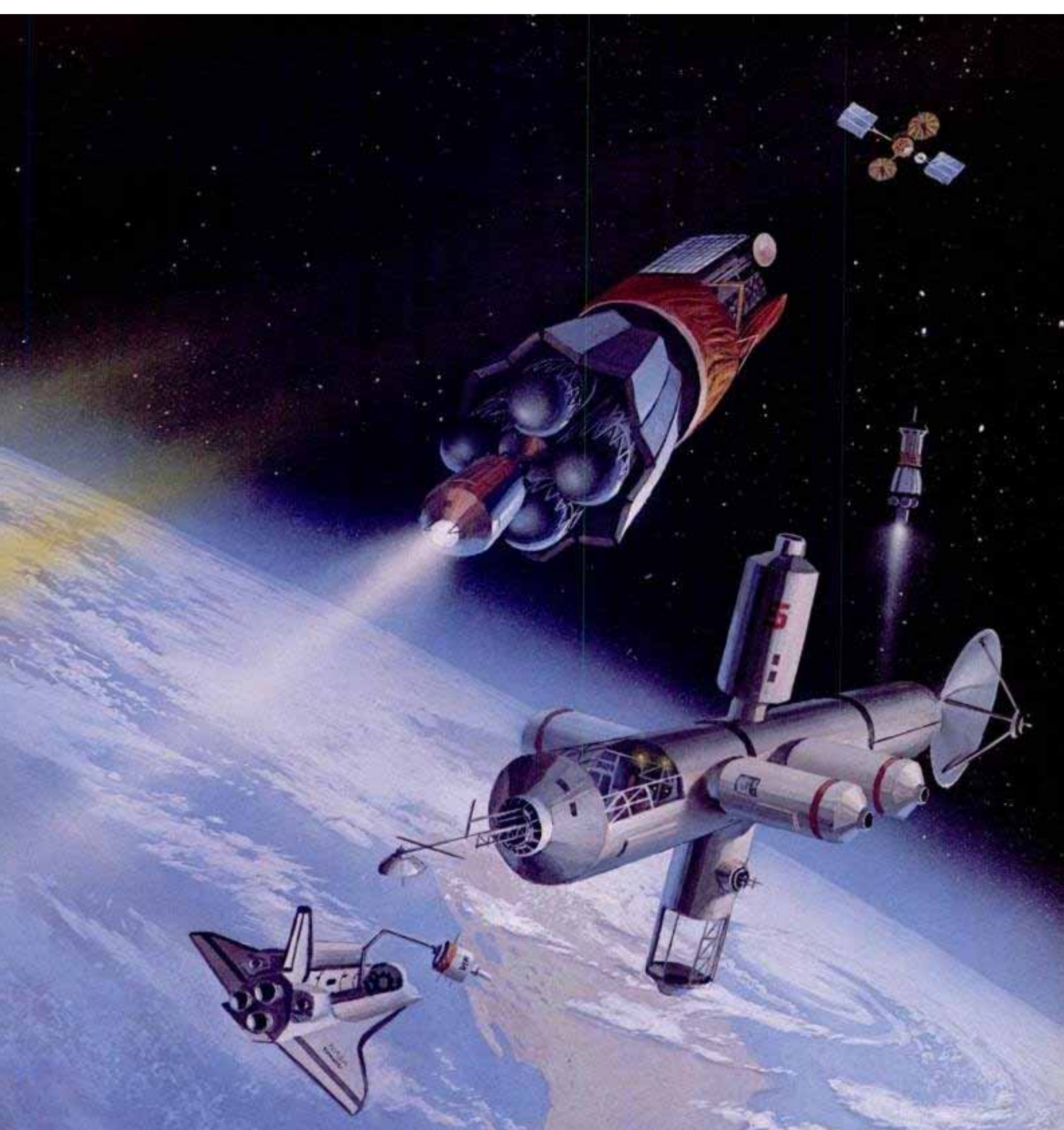
NASA's chief looks into the immediate future and sees two new spaceships to enhance space station commerce.

BY JAMES M. BEGGS, Administrator,
National Aeronautics and Space Administration

The time: 1997. The place: 22,300 miles above the Earth. A stubby cylinder about 4 meters in diameter, bristling at one end with a variety of antennas and instruments, and at the other with a powerful rocket engine, pulls into a parking space. It gently deposits its cargo—a communications satellite. Then, with a burst of rocket fire, it begins a return trip to its home base, a manned Space Station, orbiting about 300 miles above the Earth. Another routine working day has begun.

Indeed, for the six-person crew aboard the Space Station, the launch and return of the Orbital Transfer Vehicle is only one of many tasks they will perform over the next few hours. Twenty-four hours later, after 16 orbits of the Earth, 16 sunsets and 16 sunrises, another day in space will begin. The men and women aboard the Space Station will have new challenges and new work inside and outside their orbital home.

The workaday world of space, only a few years off, will be busy. It will be productive. And it will be exciting. We already are getting a glimpse of that world, and of the infinite variety of activities that can and will take place there, when people will live,



work and learn in space, not just for days at a time, but on a permanent basis.

Within the coming decade, we will begin to construct a permanently manned Space Station in near-Earth orbit. Last year, the world got a preview of what can and will be done in space, routinely, when the Space Station is in operation.

In April, astronauts retrieved, repaired and redeployed the Solar Max Satellite, a scientific spacecraft designed to study the Sun. In October, they successfully completed a satellite refueling experiment designed to demonstrate that satellites can be refueled in orbit. And in November, they completed a dra-

Its heat shield glowing, an Orbital Transfer Vehicle (facing page) carries a damaged satellite back from orbit. Meanwhile, an Orbital Maneuvering Vehicle delivers a satellite high above the Space Station. Both new spaceships will be in service by the turn of the century, after the Space Station becomes fully operational.

© NASA

matic 2.5 million mile space salvage operation by snaring two errant communications satellites and bringing them back to Earth for repair and eventual resale.

Each of these missions demonstrated a new capability for human beings to work in space. Each was a test of human ability to conquer the odds and complete exacting tasks in an alien environment, tasks relatively simple if done on Earth, but extremely difficult and challenging to do in space.

But most important, each mission opened a window to tomorrow, allowing us to glimpse the kind of operations that will become routine once the United States' permanently manned Space Station is operational in the early 1990s.

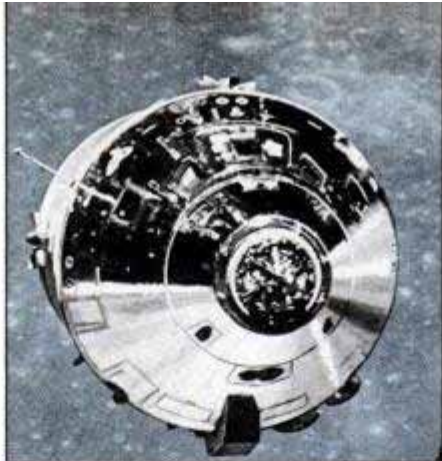
The Space Station, as President Reagan wrote in an article in this magazine last September (*Space Station: The Next Bold Step*, page 64), "will be a base for scientific and commercial activities. Scientists will do research that is only possible in the zero-gravity and vacuum of space. Private industry will manufacture new products and provide new services. But, most importantly, the Space Station will open the door to even greater progress in the future."

There is no question that the Space Station will be the key to our future in space well into the next century and beyond.

By the year 2,000, we expect that the Space Station will be equipped with supporting systems and vehicles that will enable us to operate routinely at both low Earth and geostationary orbits, and between them; and eventually, at distances as far as the moon and the inner planets.

Two key elements of this support system will be the Orbital Maneuvering Vehicle (OMV) and the Orbital Transfer Vehicle (OTV).

The OMV will be first to come on line. It is expected to be launched in 1990. With this vehicle, we will be able to



Gamma ray detection equipment used in Apollo capsules (above) will be taken off the shelf for a future Mars mission.

retrieve satellites from high orbits and return them—at first to the Shuttle, and later, to the Space Station—for maintenance and repair. The OMV will then be used to send the repaired satellites back into their operational orbits. The OMV will also be used to reboost into proper orbit satellites whose orbits had gradually decayed. This will eliminate the need for costly Shuttle missions launched specifically for that purpose.

The OMV will be a remotely piloted, unmanned spacecraft about 4 meters in diameter and 1 meter in length. With refurbishment and servicing in orbit, it will last about 10 years.

At first, the OMV would be deployed from the Shuttle for missions of short duration. Later, the vehicle would remain in orbit for longer periods during missions in support of both the Shuttle and the Space Station. The Orbital Maneuvering Vehicle will be used to help construct the Space Station and will become one of its essential operational elements.

Under present plans, the Orbital Transfer Vehicle would complement the OMV. The OTV will transport payloads from low Earth orbit to destinations much higher than the OMV can reach. The majority of the payloads transported by the OTV will be delivered to geostationary orbit, the location 22,300 miles above the equator where most communications satellites are fixed.

Most OTVs will be based at the Space Station, where they will be maintained, fueled and joined to payloads. In time, the OTV would also be used to transport people to geostationary orbit.

Contractors are now studying designs for the OTV. Among the alternatives are a stubby cylinder about 4 meters in diameter; or an engine nested between a set of spherical tanks. Although we do not know yet what the OTV will look like, we expect it will have at least one unique



The Viking orbiter, depicted following an asteroid around Mars in the 1970s, is coming off the shelf for new missions.

feature—a large diameter aerobrake, which would slow it down as it returns to the Space Station from geostationary orbit to low Earth orbit.

Eventually, the OTV could become vital in more advanced missions, such as revisits to the moon or manned voyages to the asteroids.

Thus, the Space Station and the vehicles to be built with it together will give us the means to expand both our manned and unmanned activities in space. We will be able to step up our efforts to explore the solar system and to open space for more commercial ventures. A permanent base in orbit will give us a place to learn more about Earth's climate, vegetation, weather and other natural features. The Space Station could also spawn new technologies such as satellite power systems and nuclear waste disposal systems in space.

And it will be the key to future, more ambitious missions, such as a return to the moon to mine lunar resources, a manned mission to Mars, the capture of an asteroid, or a deep space automated probe.

Many crucial considerations—technical, scientific, political, economic and social—will affect our expansion into space. But one fact is certain. Once the Space Station is operational, it will grow as the requirements for it develop. And this evolution will symbolize the U.S. commitment to a long-term future in space.

Indeed, it is precisely *because* the Space Station will continue to expand to meet new needs that I believe we must begin to focus soon on ways to make our Space Transportation System more flexible.

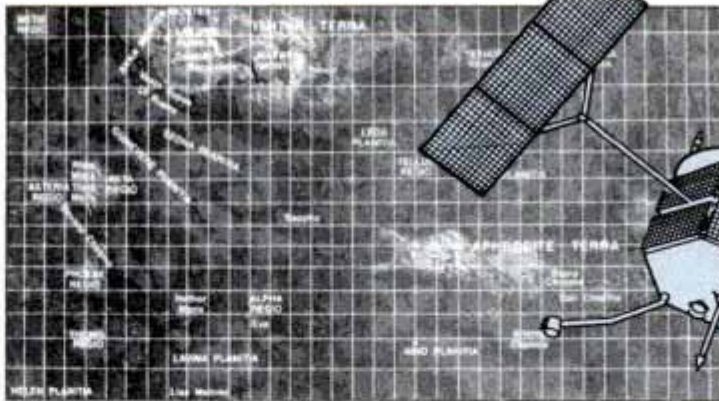
Sometime before the year 2000, we will need a new, unmanned, heavy expendable launch capability that will be able to orbit objects larger and heavier than we can orbit today. If we are to assemble large structures in low Earth orbit and use the OTV to lift them to geosynchronous orbit, we would no longer want to be limited by present launch constraints on either the Shuttle or expendable launch vehicles.

By the end of the century, it will be obvious, too, that our Shuttle fleet will be aging and will need to be replaced. Shortly after the turn of the century, I believe we probably will want to construct a new generation of Space Shuttles—these vehicles will be smaller, lighter, more flexible and less expensive to operate than the present generation of multipurpose vehicles.

This new generation of Shuttles would be an integral part of our people-in-orbit system. Their function would be to ferry men and women and supplies to the Space Station and to assist in the hands-on work of retrieving, repairing and maintaining satellites.

Clearly, both of these developments to extend our Space Transportation System's capabilities will not come about in a year, or even in a decade. But we must begin to think about them now, because they are the logical and rational extension of our activities today, and will be the building blocks of our progress tomorrow.

Even as we develop those new technologies, in propulsion and guidance systems, computer hardware and software and in many other fields, we will profit from using



Early grid map of Venus was made with several flyby missions and computer help. Venus Radar Mapper will make clear map itself.

time-tested technology to explore the solar system.

The first wave of planetary exploration in the 20 years from 1961 to 1981 was remarkably successful. More than 40 unmanned spacecraft, uniquely designed with advanced technology, allowed us to study most of the planets and moons of the solar system. But the increasing costs of these intricate spacecraft and elaborate missions in times of budgetary belt-tightening underscored the need for a new approach to solar-system exploration. And so we designed a program to give us double mileage from our space investments, one that will allow us to do the exploration we need and want to do at much lower cost.

It's called the Planetary Observer program. And it will use spacecraft developed from existing satellites designed for Earth orbit, streamlined management and operational techniques, and highly focused scientific objectives.

The Mars Geoscience/Climatology Observer (MGCO), to be launched in 1990, will be the first mission to use the new, low-cost Planetary Observer spacecraft concept. Instruments we are planning to put on the spacecraft all have a previous spaceflight heritage and are well understood. They include a gamma ray spectrometer, flown during the

Apollo program, which would be used to study the Martian surface; and a radar altimeter, flown on the Pioneer Venus missions, which would map the Martian topography.

The Venus Radar Mapper, though not a Planetary Observer, was derived from the more complicated and expensive Venus Orbiting Imaging Radar Mission, proposed earlier. To be launched in 1988, the VRM spacecraft will provide a radar map of the planet's cloud-enveloped surface.

Planetary Observer missions that may be proposed to follow the MGCO project could inherit the same operations system, use the latest advances in hardware and software, standardize some equipment and incorporate new technology developments. These measures would cut costs, but not at the expense of scientific returns.

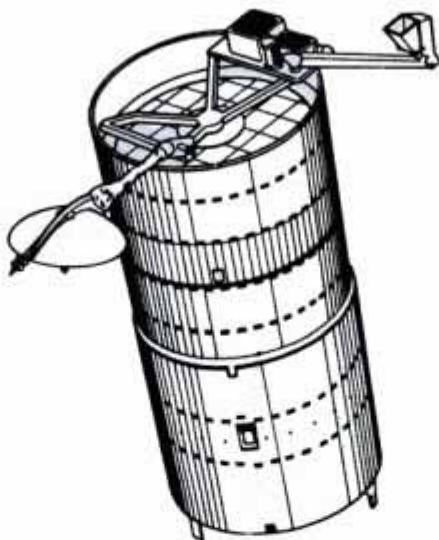
As a pioneer people, our visions and dreams are limitless. And we have

demonstrated time and again that we are able to make our dreams realities.

I see Apollo, the Space Shuttle and now, the Space Station and the opportunities it will open for the future, as links in the chain of our destiny in space.

And I am confident that chain will continue to grow stronger and more secure as we continue our voyage of adventure to the stars.

PM



The Mars Geoscience/Climatology Observer will be launched in 1990. It will be the first in a series of low-cost planetary craft.



One of the five men manning the Krupp furnace monitors the automated smelting.

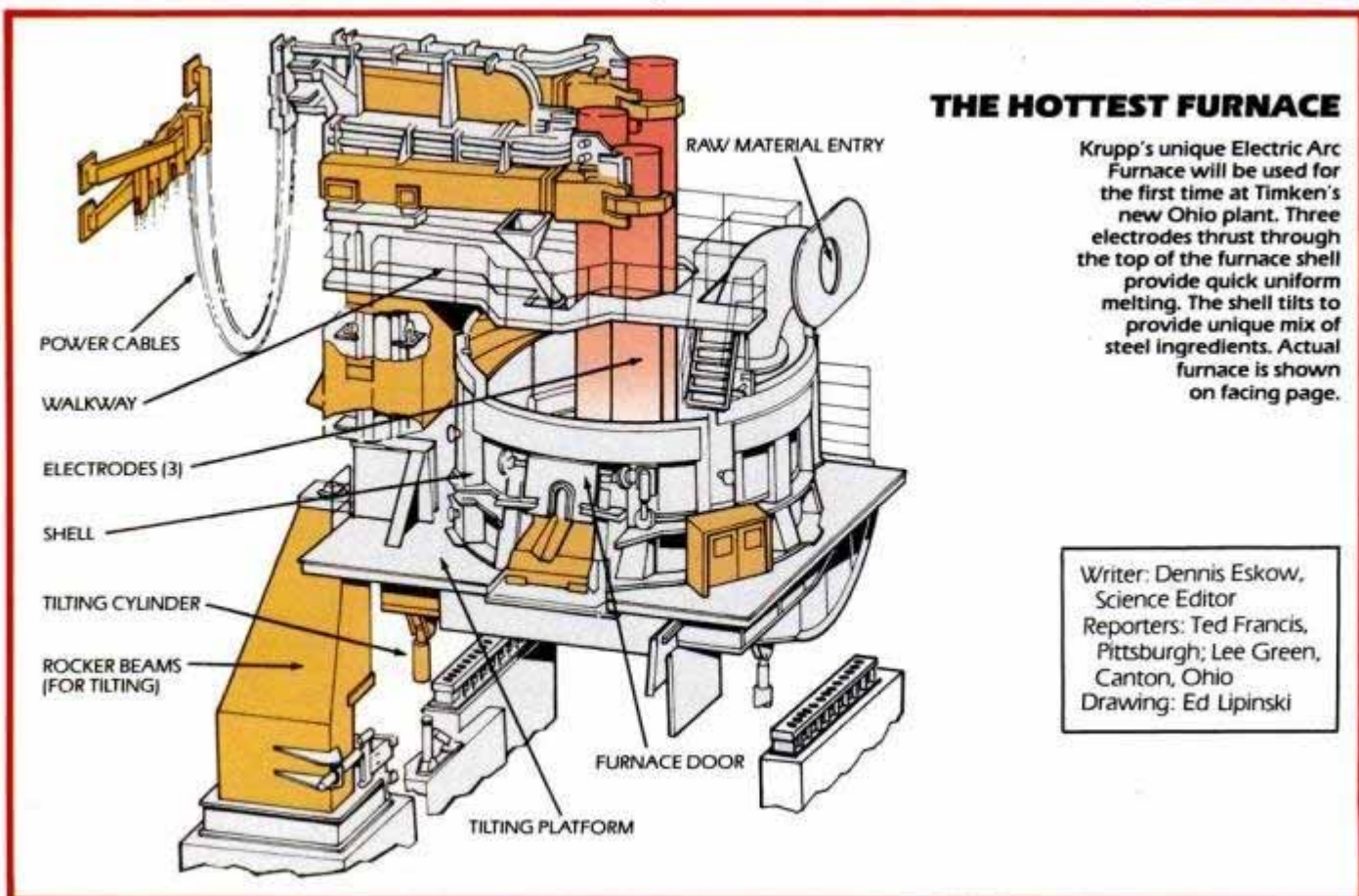
BUSTING THROUGH THE STEEL CURTAIN

Unique furnaces and new methods to alter steel molecules are helping America's steelmakers pierce a foreign-dominated market.

The resounding death knell can be heard halfway around the world: The American steel industry is in critical condition and the prognosis is poor. The giants of the steel industry are reeling from competition coming from Japan and Western Europe. In 1984, America imported 26 percent of its steel. With import curbs, the figure is expected to drop to 21 percent this year, but to an industry that once supplied much of the western world's steel, even 21 percent points toward disaster for some steel companies.

A major business publication has predicted at least one and possibly more bankruptcies in the steel industry this year. And with production expected to be about 75 million tons in 1985—compared with 100 million tons in 1979, before the current skid started—big steel companies are selling off some of their divisions to stay afloat. Through all the bad news, however, there are glimmers of new hope created by emerging technology. And with Japan and Western Europe tightening their

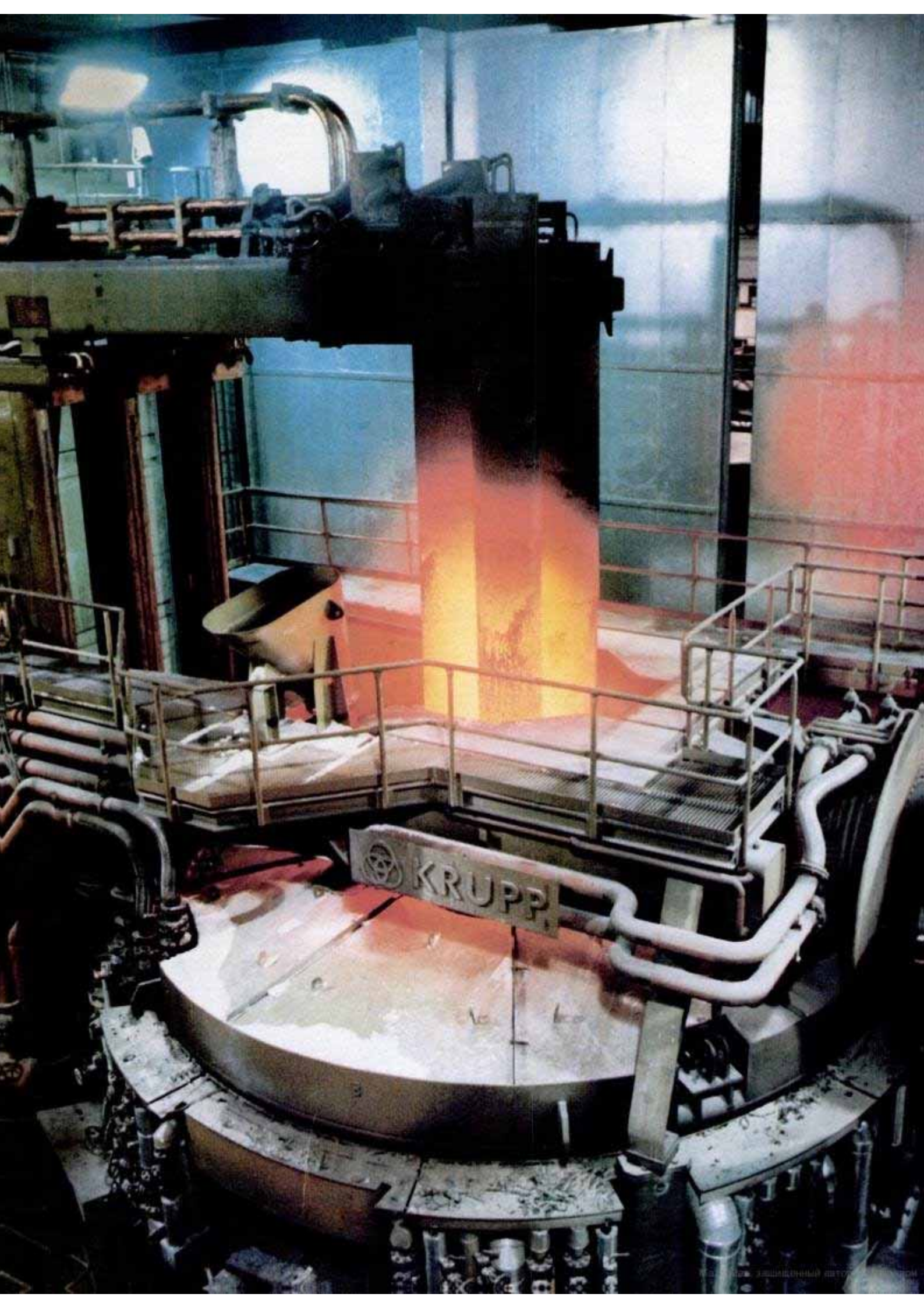
(Please turn to page 120)



THE HOTTEST FURNACE

Krupp's unique Electric Arc Furnace will be used for the first time at Timken's new Ohio plant. Three electrodes thrust through the top of the furnace shell provide quick uniform melting. The shell tilts to provide unique mix of steel ingredients. Actual furnace is shown on facing page.

Writer: Dennis Eskow,
Science Editor
Reporters: Ted Francis,
Pittsburgh; Lee Green,
Canton, Ohio
Drawing: Ed Lipinski



This TWO-LEVEL DECK Is Loaded With Good Ideas

The lower level is great for entertaining, the upper one is ideal for family use.



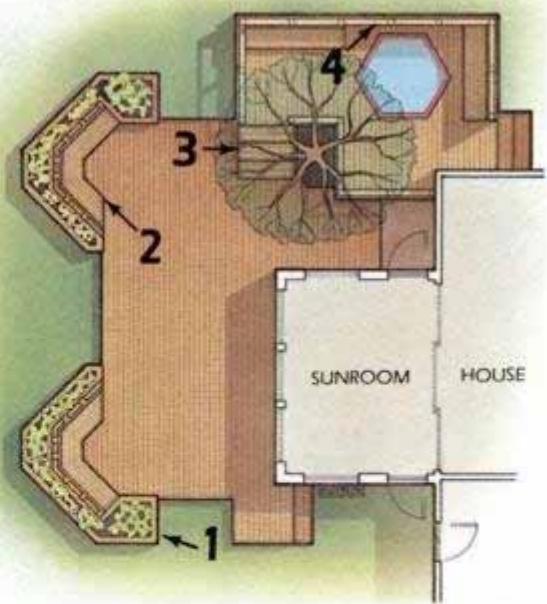
Made of pressure-treated lumber, this deck features two-level construction, built-in planters and benches, and a handsome privacy fence around the hot tub area.



1 The deck's built-in planters form half octagons around seating benches. They are anchored to individual concrete slabs.



2 The seating benches are integrated into the structure of the planters. Each can comfortably accommodate five or six people.



This deck is more than just an attractive addition to your back yard. It serves as a focal point for a wide range of outdoor activities. The expansive lower section makes a great transition area between back-yard sports activities and indoor living. And with its built-in benches and oversized planters, it creates a comfortable environment for large-scale entertaining. The upper deck section is more private. Its hot tub and surrounding privacy fence let your family relax without intrusion. The joists, beams, decking and other structural members for both decks are pressure-treated lumber, used for its high resistance to moisture and insect damage.

However, not everyone has room for a large deck like this. So, on the following pages we show not only how to build the entire deck, but also how to construct each separate feature if you want only a part of what you see here. Also, if you'd like to review other interesting designs, a 32-page booklet called *The Deck Book* is available for \$2 from Georgia-Pacific Corp., Dept. PM 10200, Box 48408, Atlanta, Ga. 30362.

Illustration and technical art: Eugene Thompson

Photos: Karliss Grants

Reporting: Cathy Howard

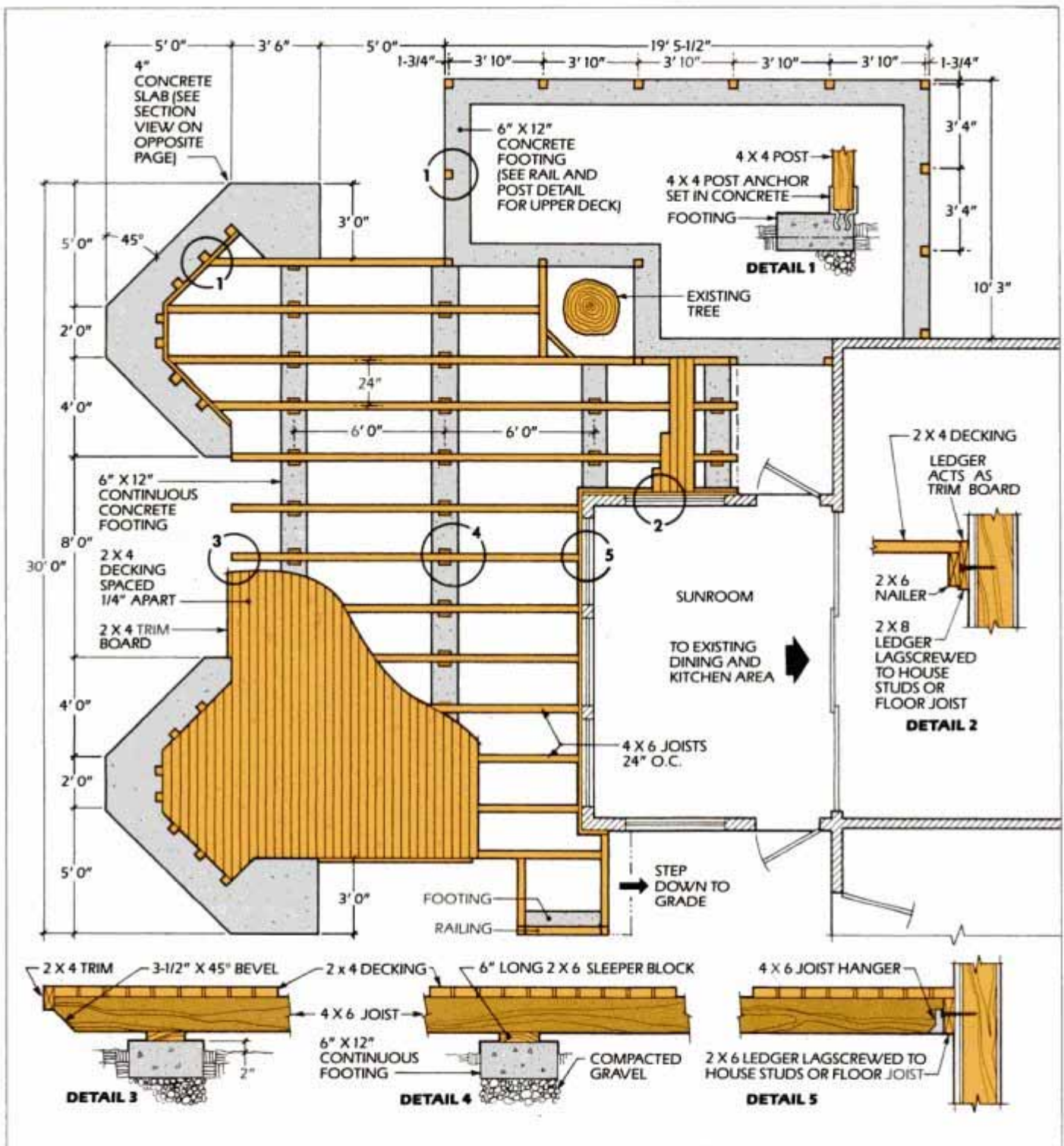
Deck design: Heartwood Building & Design, 5331 S.W. Macadam, Portland, Ore. 97201

Lumber: Georgia-Pacific Corp., 133 Peachtree N.E., Atlanta, Ga. 30303



3 Three steps form the transition between the two decks. The lattice skirt on the upper deck hides the framing underneath.

4 Upper deck features two built-in seating benches, a hot tub and surrounding privacy fence topped with lattice panels.



Foundation, joist layout and decking

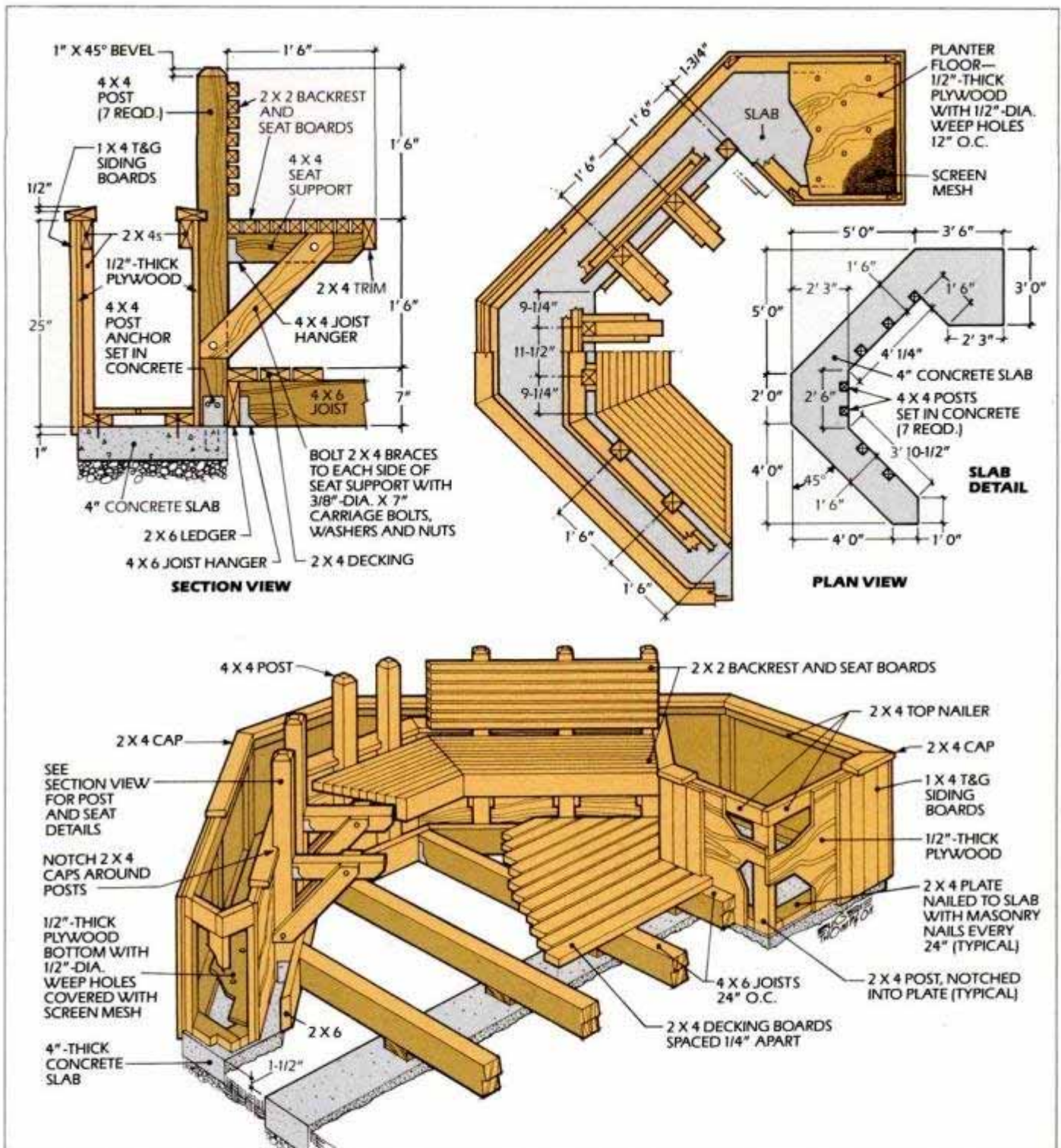
Begin by laying out the position of the footings as shown in the drawing. Then, excavate below the frost line and fill the trench with gravel. Because this deck was built in a warm climate, our trench was very shallow, but those who live in colder regions will have to go deeper. Be sure to check your local building code before proceeding.

Next, build concrete forms for the footing using 2 x 8 stock. Make sure the forms are parallel to each other, square to the house and level—both within each form and across all forms. The height of the forms is determined by the elevation of the house.

We wanted a 4-in. step below the sunroom entry and we wanted to support the joist with 2 x 6 blocks on top of the footings. These "sleeper blocks" permit easy shimming of any joist that might fall over a slightly low or high point in a footing. They can be trimmed to proper thickness or

replaced with 1-in. stock and doubled-up cedar shingles. Therefore, we added 4 in. for the step down, 1 1/2 in. for the decking, 5 1/2 in. for the 4 x 6 joists and 1 1/2 in. for the sleeper blocks. The total was 12 1/2 in. below the floor of the house.

Keep in mind when building the forms for the planter slabs that these are 1 1/2 in. higher than the continuous footings for the joists. Pour the concrete for the footings and slabs and set the post anchors into the edge of the planter slabs as shown in Detail 1. Let the concrete cure and attach the ledger strips to the house, using Detail 5 and Detail 2 as reference. Lagscrew both to the header joist—or wall studs—on the house wall. Then install the joist hangers and slide the joists in place. Be sure to cut the 45° bevel on the ends of the joists that fall under the planters and on those that fall between the planters. Once all joists are nailed in place, attach the decking boards with 16d double-dipped galvanized or aluminum nails.



Planters and benches

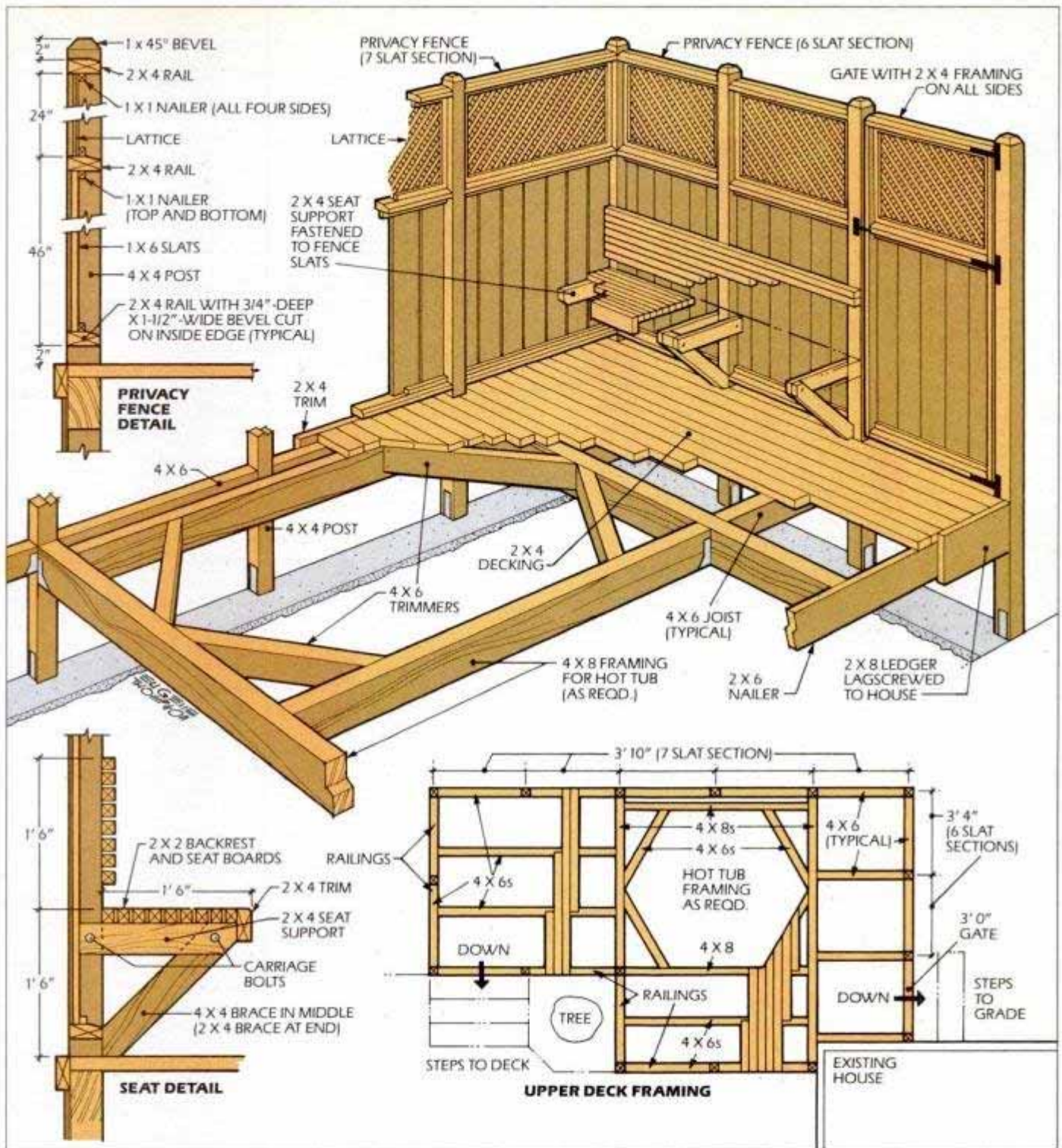
Both planter-and-bench units are the same size and configuration and because they're built together—but not as an integral part of the deck "system"—they are natural candidates for adding onto an existing deck. The layout for their foundation slabs is shown on the opposite page. The post layout is shown above.

After the lower deck is completed, attach the 4 x 4 posts to the post anchors as shown in the Section View. Then cut the 2 x 4 bottom plates for the perimeter of the slabs and cut notches in the plates for all the 2 x 4 studs. Nail the plates onto the slab using masonry or cut nails, making sure to keep the plates 1/2 in. back from the slab edges to allow for the plywood sheathing. Cut and nail the studs into the notches in the plates. Then join the tops of the studs with 2 x 4 plates nailed on edge as shown in the Section View. Cover the structure with 1/2-in.-thick exterior plywood. Then nail

through this plywood into the back of the bench posts.

Next, cut the plywood for the planter bottoms to size and shape and bore the weep holes as shown in the Plan View. Staple aluminum screening to the top of the plywood and nail the panels in place. Then cover the sheathing with tongue-and-groove cedar siding, nailing into the bottom and top plates as you go. Let these siding boards extend 1 in. below the top of the concrete slabs. Bevel and miter lengths of 2 x 4 stock to form the caps around the top of the planters and nail these in place. The inside cap boards must be notched to fit around the posts.

Attach joist hangers to the posts and hang the 4 x 4 seat supports in place. Brace these in a level position and attach the diagonal 2 x 4 braces to each side using a carriage bolt on the top and bottom. Next, attach the 2 x 2 backrest and seat boards, leaving a 3/8-in. space between each. Then, trim out the edges with 2 x 4 stock as shown.



Upper deck, benches and privacy fence

The upper deck portion of this project was specifically designed as a private family retreat. It features a built-in hot tub, two seating benches and a high fence topped with lattice panels. Because of these amenities, this structure can easily stand on its own as a full-purpose deck, especially for those with smaller yards. Keep in mind when laying out the structure that the footings are at the same elevation as the planter slabs, that is, 1½ in. higher than the continuous footings for the lower deck. This allows for the 1½-in.-thick sleeper blocks mentioned before.

Begin by setting the posts and hanging in place all the joists around the hot tub. The specific rough opening for the tub varies depending on the make and model you choose. Some may require heavier framing. Be sure to decide before you start building.

Once all joists are nailed in place, cover them with

decking boards spaced ¼ in. apart. Then build the privacy fence between the posts using the detail above as a guide. Notice that all rails in the fence have an inside bevelled edge that must be cut before the rails are nailed in place, and that the cedar slats and lattice panels are held in place with 1 x 1 nailers attached to the posts and rails. Build the swinging door like the fence, with the addition of a 2 x 4 stile on each side to give it stability. Hang it in place with strap hinges and a gate latch or other hardware of choice.

When the fence is complete, construct the seating benches. The bench near the stairs is shown on the facing page. The one next to the door is shown above. The back slats are made of 2 x 2 stock nailed directly to the posts, spaced ⅓ in. apart. The seats are supported similarly to the built-in benches on the lower deck except that 4 x 4 stock is used for the center diagonals only. The ends of the benches are supported by 2 x 4 stock.

PM



BUILD A SHADY RETREAT

When covered with vines or other plants, this structure will provide privacy as well as shade from the sun.

BY BILL HARTFORD
Managing Editor

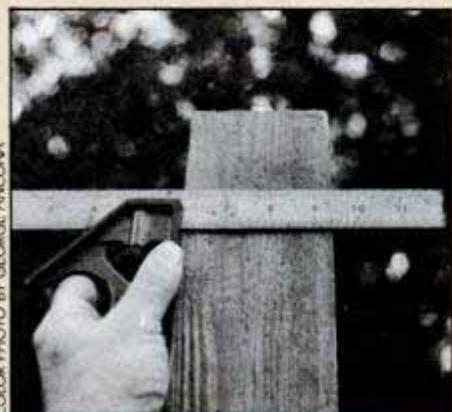
Little sitting nooks in your garden and back yard are perfect places to add the cover of an arbor. Our breakfast table and chairs are in a 4 × 12-ft. area notched out of a larger patio. For intimacy and shielding from the summer sun, we wanted an arbor to support a thick cover of wisteria. Traditional four-post construction is unnecessary for such a small arbor, so we designed one that uses a single post at each end.

We built the arbor entirely of pressure-treated lumber to provide the best defense against the elements, although the uppermost parts of the arbor could be built with construction-grade lumber and then treated with a brush-on wood preservative. It is important, however, to use pressure-treated wood for the two 4 × 4 posts since they are sunk in the ground.

Start by cutting all the parts to size as given in the materials list. Note that the arbor is built of readily available nominal lumber sizes—1 × 2, 2 × 3, 2 × 4, 2 × 6 and 4 × 4. The 1 × 2 slats could be ripped from a larger pressure-treated board, if necessary. Next, cut a 3/4-in.-deep × 5 1/2-in. notch in the top of each post to serve as a shoulder for the 2 × 6 crossarms. Form the notches by making several passes with a circular saw in the waste area. Then, clear out the waste with a hammer and chisel. You could also cut the notches with a handsaw.

Now, cut the 2 × 6 crossarms, 2 × 4 beams and 2 × 3 rafters to length. Then, transfer the end details from the grid drawing directly to a respective arbor member. Cut the shaped ends on

COLOR PHOTO BY GEORGE ANCONA



Use a square to mark each post for a notch to hold crossarm. Then, use a circular saw to cut the 3/4-in.-deep × 5 1/2-in. notch.



After sculpturing the ends of one crossarm with a sabre saw, use it as a template to lay out and mark the other crossarm.



Hold crossarm level while boring pilot holes. Note that screw locations are counter-bored to accept screwhead and washer.

one crossarm, beam and rafter with a sabre saw. Next, use these three end-shaped members as templates to mark and cut the remaining members.

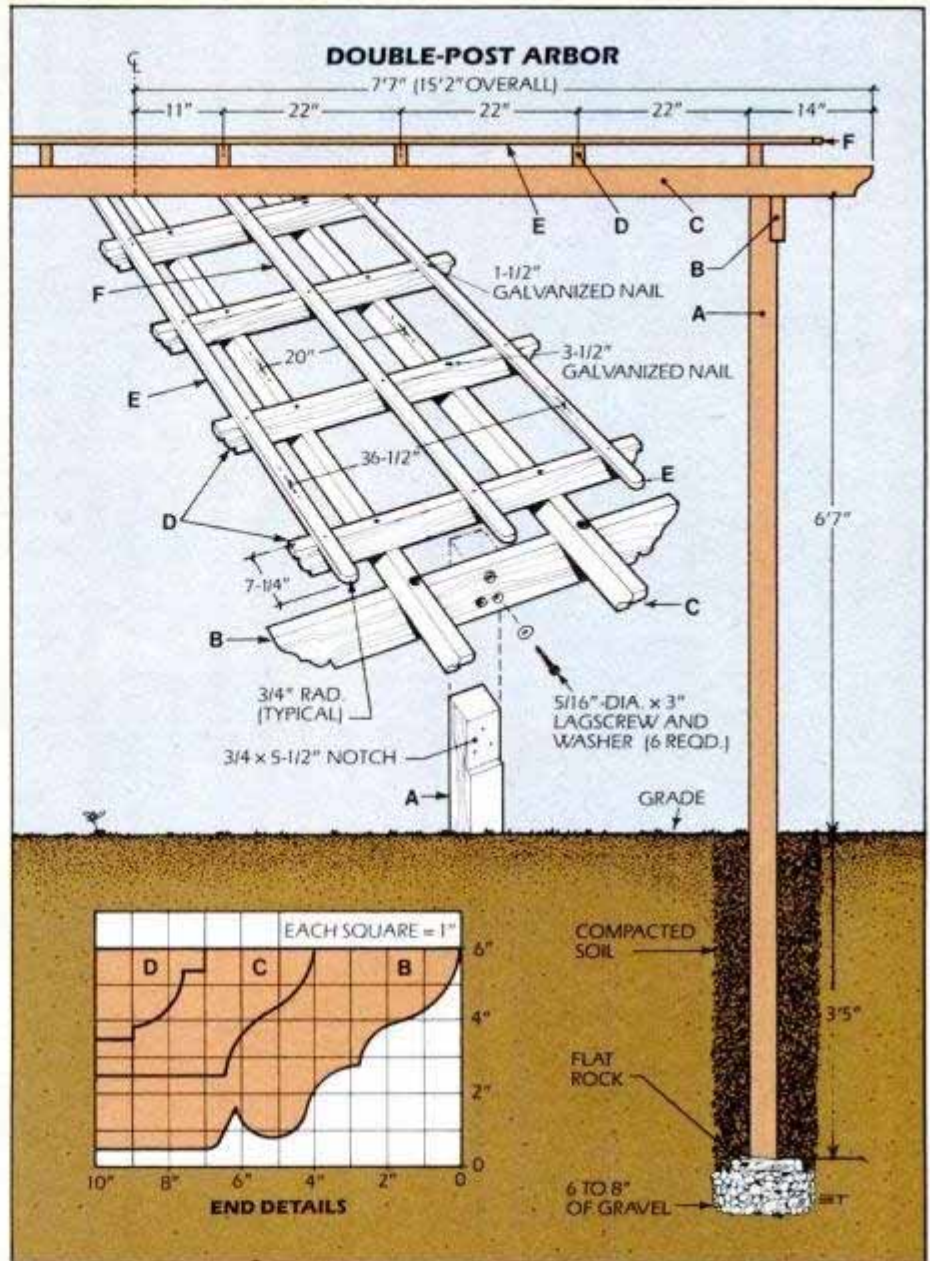
Now dig a 12- to 14-in.-dia. hole about 50 in. deep for each post. Be certain the holes are 13 ft., 1½ in. apart center-to-center. Next, pour 6 to 8 in. of gravel into the holes to ensure proper drainage. Then, position a broad, flat rock on top of the gravel, as shown, to act as a footing. Now place the posts in the holes and backfill around them. Check each post for plumb in two directions with a level before compacting the soil.

Next, drill a ½ × 1¼-in.-dia. counterbore at the three lagscrew locations on each 2 × 6 crossarm. Then, bore ⅜-in.-dia. screw shank clearance holes. Position the crossarms on the notches cut in the posts, bore pilot holes and install ⅝-in.-dia. lagscrews with washers using a ratchet wrench and socket. Check the crossarms for level before tightening the lagscrews.

The remaining arbor members—beams, rafters and slats—can be assembled on the ground and lifted onto the crossarms as a single unit, or attached piece by piece. Fasten each 2 × 4 beam to the crossarms with two ⅝-in.-dia. × 4-in. lagscrews.

First, drill a 1-in.-deep × 1¼-in. counterbore at each screw location, then bore ⅜-in.-dia. screw shank clearance holes. After tightening the lagscrews, plug the counterbores with silicone caulking. Next, fasten the 2 × 3 rafters to the beams with 3½-in. galvanized nails. Be certain to bore pilot holes through the rafters first. Finally, attach the 1 × 2 slats to the rafters with 1½-in. galvanized nails. Note that the middle slat is 2 in. longer than the other two slats.

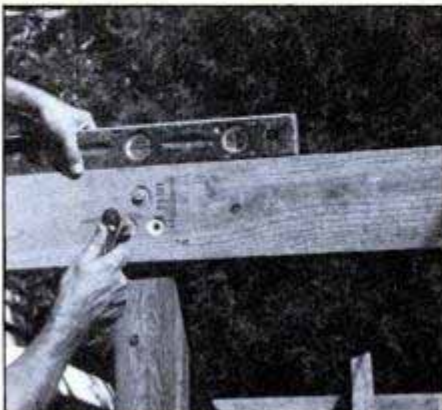
Now apply an exterior oil-base stain to all wood surfaces. Give all exposed end grain an additional coat of stain. Don't allow plants to come in contact with the arbor until the stain is thoroughly dry. **PM**



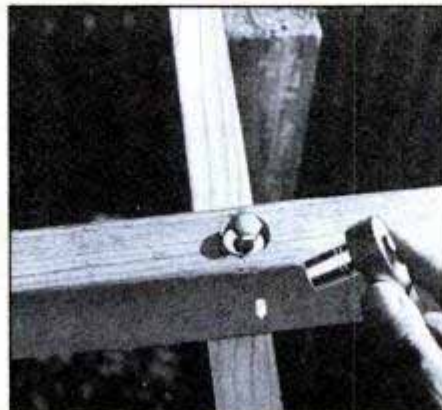
MATERIALS LIST—DOUBLE-POST ARBOR

Key	No.	Size and description (use)	wood (rafter)
A	2	3½ × 3½ × 10' pressure-treated wood (post)	2
B	2	1½ × 5½ × 48" pressure-treated wood (crossarm)	2
C	2	1½ × 3½ × 15'2" pressure-treated wood (beam)	1
D	8	1½ × 2½ × 42" pressure-treated wood (slat)	

Misc.: Four ⅝-in.-dia. × 4" lagscrews to fasten beams to crossarms, Olympic Beachwood linseed oil stain, 3½" and 1½" galvanized nails.



Fasten the crossarm to the post using three ⅝-in.-dia. × 3-in. lagscrews. Check for level before tightening the screws.



Attach the beams to the crossarms with 4-in. lagscrews. Drill a 1-in.-deep × 1¼-in. counterbore at each screw location.



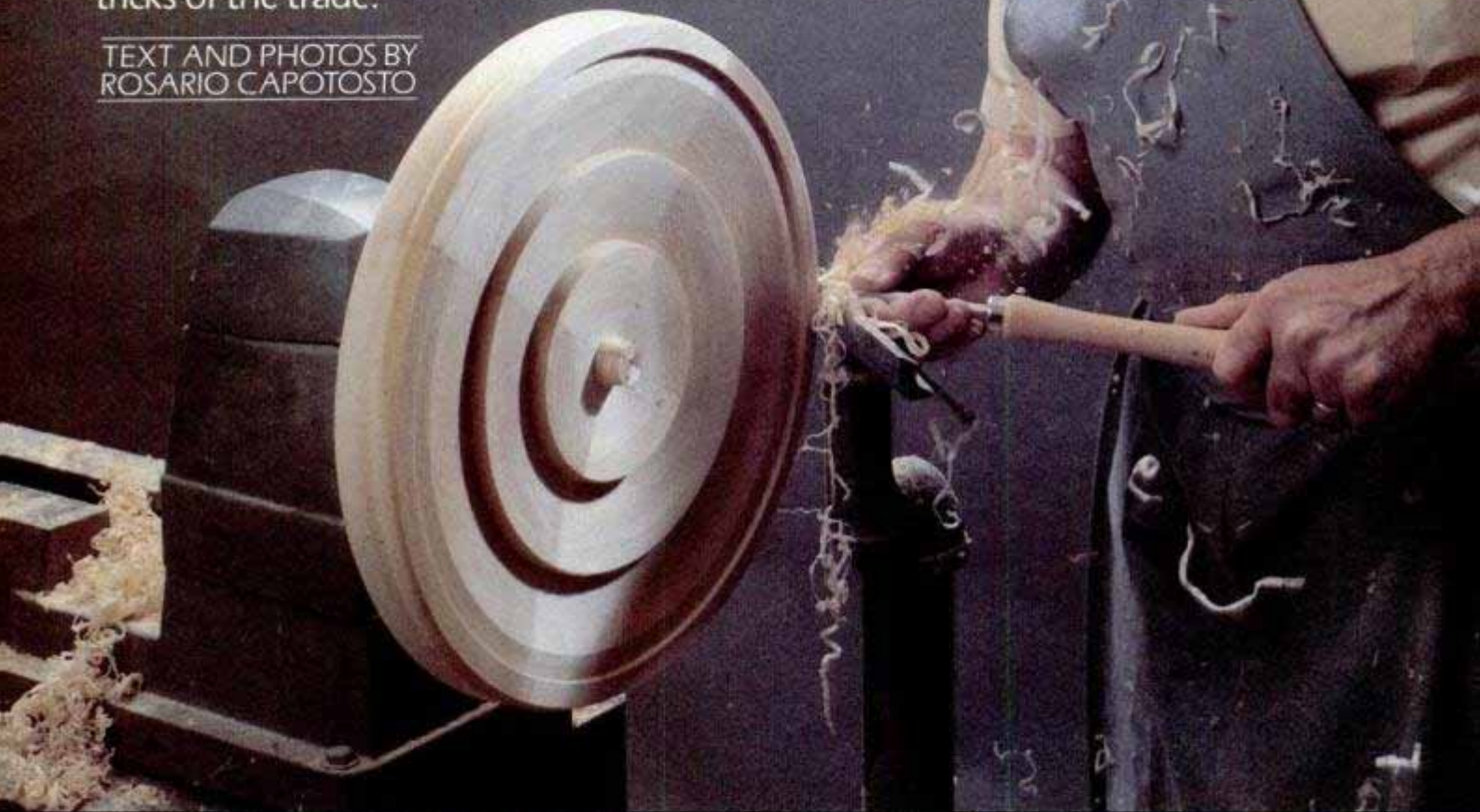
After tightening the beam-to-crossarm lagscrews, plug the counterbore with silicone caulking to seal out water.

PART TWO:

Become A Woodturning Expert

Here in Part Two, learn advanced wood lathe techniques and discover our Master Craftsman's tricks of the trade.

TEXT AND PHOTOS BY
ROSARIO CAPOTOSTO



In Part One in our April issue (page 102), we discussed woodturning fundamentals. This included an introduction to the wood lathe, the proper use of turning tools and basic spindle turning techniques. Now that you've had a chance to practice and become acquainted with the machine and the different tools, you're ready to try the advanced turning techniques presented here. Be certain to obey the safety guidelines shown in Part One on page 106 before attempting any woodturning technique.

Face plate turning

Bowls, vases, trays and similar round objects are produced by face plate turning. A face plate is simply a flat



A large tray is being turned on the outboard end of the spindle (top). Note the use of a floor-standing toolrest holder. Tray bottom has a glued-on base for mounting the face plate (above).

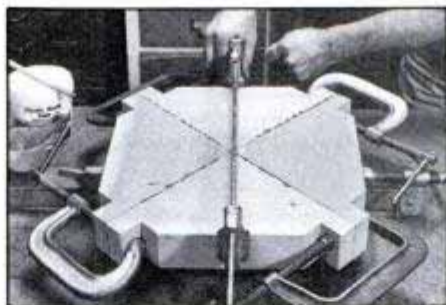
metal disk that is screwed to the back of the turning blank and then threaded onto the headstock spindle. Attach the face plate to the blank using short, stout screws. If the screw penetration interferes with the turning, glue a 1-in.-thick scrap block to the workpiece with a sheet of paper between the two parts. This allows the parts to be separated easily afterward. If the workpiece diameter is too large to be turned over the lathe bed, turn it on the outboard end of the spindle.

To form the turning blank for a large project such as the 16-in.-dia. tray shown here, first glue together four triangular-shaped pieces of stock. Cut each 90° segment from a board slightly wider than one-half of the tray's finished diameter. In this case, the segments

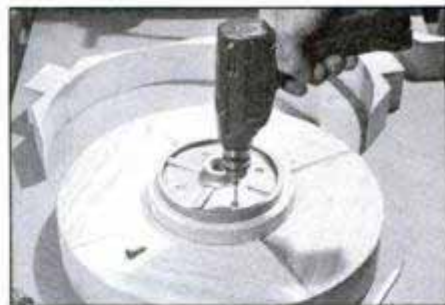
were cut from a 9 1/4-in.-wide board. Also, notch each segment to form ears for the C-clamps to grasp. Glue and clamp the four parts together using plastic resin glue.

Once the glue dries thoroughly, rough-cut the blank to within 1/8 in. of the finished diameter on a band saw. Next, glue and clamp a 1 x 7 1/2-in.-dia. wood disk permanently to the blank backside to serve as the tray's base. Let the assembly dry, then screw the faceplate to the base and mount the blank on the lathe's outboard spindle end.

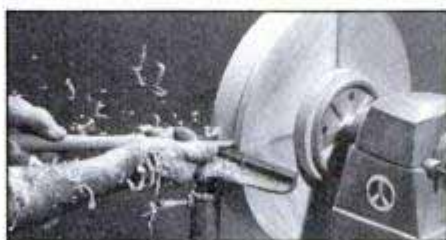
Next, use a spear-point chisel to trim the blank edge to obtain the desired diameter. Then, reposition the toolrest and use a gouge to rough-cut the tray's face. Make light finishing cuts with a spear-point or round-nose tool. *Caution:* Never attempt to cut across the entire diameter. Cut only on the downward rotation half of the blank. Any of the basic turning tools can be used for face plate work, but with the scraping technique only.



Glue together four triangular-shaped segments to form the turning blank. This will produce a diamond-matched grain pattern.



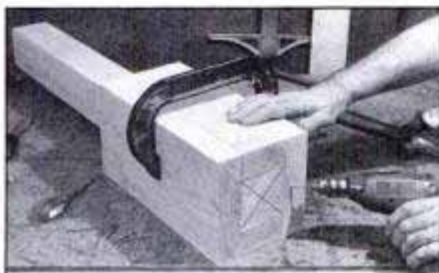
Rough-cut the blank close to the finished diameter on the band saw. Then, bore pilot holes and screw the face plate to the blank.



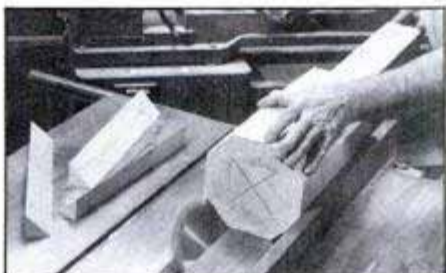
Scrape across the blank edge with a spear-point chisel to form the desired diameter. Use scraping action only for face plate work.



Make light, finishing cuts with a spear-point or round-nose tool. Work on the downward rotation half of the blank only.



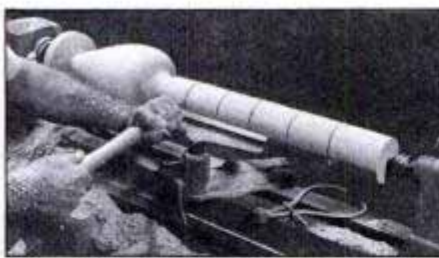
Before gluing blocks, bore nail pilot holes. Then, apply glue and nail blocks temporarily to prevent sliding when clamped.



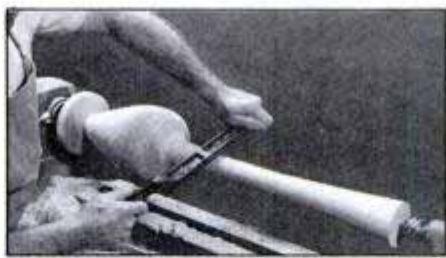
Adjust the table saw blade to 45° and chamfer the corners of the built-up section of the blank to make turning it easier.



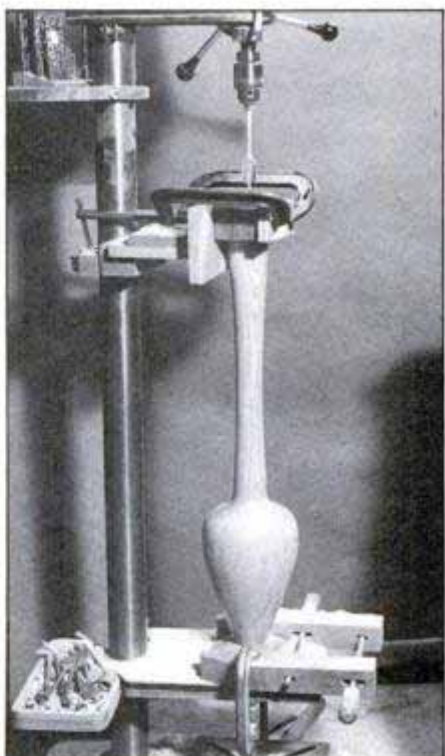
Carve the built-up section of the blank first using a gouge. Cut diameter-sizing grooves to help guide the final shaping.



After cutting diameter-sizing grooves with a parting tool, rough-shape the long, narrow section of the blank with a gouge.



Finish-shape the long, subtle curve with a Surform tool. Take light, sweeping passes with the lathe running at 2,000 rpm.



Try this drill press setup when turning is too long to allow boring the end hole on a lathe. Clamp piece at top and bottom.

Large post blocking

There are two ways to turn a very wide project in only a portion of its length. One method is to start with a blank that is slightly greater in diameter than the widest part of the finished project. Then, cut away all the waste to form the narrow section of the project. A quicker, less wasteful way is known as post blocking. Glue blocks to the turning blank to build up its diameter in a specific area.

First, cut the turning blank square and mill all four sides perfectly flat on a jointer. Next, glue and clamp two blocks to opposite sides of the blank. Cut the blocks about 1/8 in. wider than the blank

to permit flush planing.

To prevent the glued blocks from sliding when they are clamped, toenail them temporarily to the blank until the clamps are tightened and the glue has set. When the glue dries, trim the blocks flush with the blank. Then, glue blocks to the two remaining sides of the blank.

Next, set the table saw blade to 45° and chamfer the corners of the built-up section, as shown. Mount the blank in the lathe and start turning the built-up section first.

You can finish-shape the narrow neck using a Surform tool with the lathe running at about 2,000 rpm.

Turned box with lid

Start with a square wood block slightly wider and longer than the finished box and lid. If necessary, glue up stock to obtain a turning blank of the desired size. Next, cut the lid section from the blank on a band saw. Then, trim the headstock end of the blank square and



Mount blank to headstock with a face plate. Advance the tailstock center into the spinning blank to locate its true center.

attach a 3-in.-dia. face plate. Although the blank is face plate mounted, use the tailstock center to stabilize the blank while shaping the box exterior.

After turning the box exterior, replace the tailstock center with a geared chuck fitted with a 1 to 1½-in.-dia. drill bit. Now advance the tailstock to center-



Tailstock center stabilizes blank while exterior is shaped. Keep parting cut at base shallow until turning is completed.

bore the blank end. Bore as close to the finished depth as possible.

Next, slide the tailstock out of the way and start hollowing out the box interior using a skew or spear-point chisel. Finish turning the box interior with a round-nose chisel. Be certain to check the wall thickness frequently with calipers.

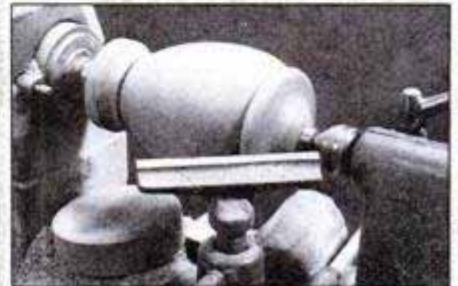
Now remove the box and mount the lid blank to the headstock with a 3-in.-dia. face plate. Turn the lid to the finished diameter and shape the underside to fit snugly in the box opening. Next, remount the box to serve as a chuck while shaping the lid's top surface. Replace the tailstock center point with a pad insert. Then, as a safety precaution, be sure to position the tailstock so that the pad will hold the lid on the box, as shown.



After centerboring the blank, move tailstock out of the way and start hollowing out the box using a skew or spear-point.



Check the wall thickness frequently with calipers while hollowing out. Toolrest is positioned for maximum support.



Use the box to hold the lid while shaping the lid's top surface. Tailstock center pad insert prevents lid from spinning off.

Log turning

A dry, knot-free log makes a suitable turning blank for many projects, including the vase shown here. Our walnut turning blank was rescued from the firewood pile.

Select a straight log that is free of long, gaping end checks (cracks). Be sure to cut the log several inches longer than necessary to permit squaring the blank ends with a parting tool.

Mount the log lightly between the headstock and tailstock centers. Then, spin the log by hand. Shift the log on the centers until it spins with the least amount of wobble. Now seat the centers firmly in the log ends.

Next, with the lathe set at low speed, rough-cut the log round using a gouge. **Caution:** Be certain to wear a face shield to provide maximum protection from large pieces of bark. Keep a firm palm-down grip of the gouge during this operation and feed the tool slowly into the log.

Then, it's necessary to square the blank ends using a parting tool. Make a deep parting cut, down to about 1 in. dia., a couple of inches in from each end of the log. Be certain that the parting cuts are clear of any minor checks in the log ends.

Now remove the log from the lathe and cut through the remaining 1 in. on

each end of the log with a handsaw. Remount the blank on the lathe using a 3-in.-dia. face plate and proceed to turn the vase as shown below. Note that after the blank is hollowed out, a ¾-in.-thick hardwood plug is used to help



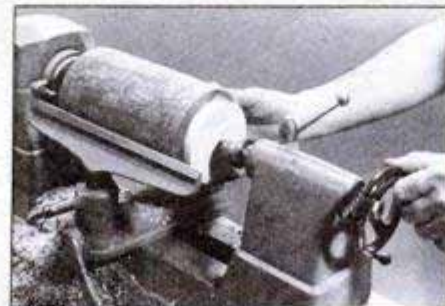
Cut the log several inches oversized and mount it between centers. Grip the gouge firmly while rough-cutting the log round.

stabilize the spinning piece.

First, cut the plug slightly greater in diameter than the blank's inside diameter. Bevel the plug's edge to provide a snug fit. Then, advance the tailstock center into the plug.



After squaring the log ends, mount it back on the lathe using a face plate to permit hollowing out the vase interior.



To help stabilize the blank while shaping the outside, use this ¾-in.-thick hardwood plug and tailstock center setup.

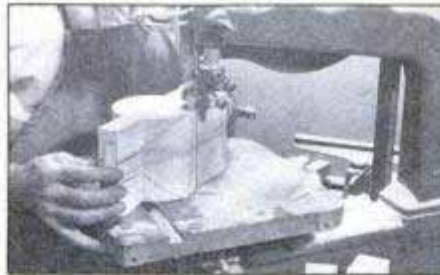


Increase the lathe speed as the vase nears completion. Faster rotation and light finishing cuts produce a smooth surface.

Turning a wood ball

Start with a blank that is slightly wider and about 8 in. longer than the ball. The extra length creates a 1 × 1 × 4-in. turning post on each end, providing tool clearance for shaping the ball.

Draw the ball diameter and two posts on two adjacent sides of the blank. Using a band saw, cut along the lines on one side of the blank. Then, tape the cutoffs back to the blank and saw along the lines on the adjacent side. Now mount the blank between centers and mark centerlines on all four sides with a heavy felt-tip marker. Begin turning with a gouge until the inked centerlines are barely visible. Take finishing cuts with a skew and spear-point chisel. Next, cut *partially* through the posts close to the ball with the parting tool. Then, remove the blank, cut off the posts with a handsaw and remount the ball between a cup chuck and a pad insert, as shown. Realign the ball frequently while sanding with 120-, 220- and 240-grit abrasive paper.



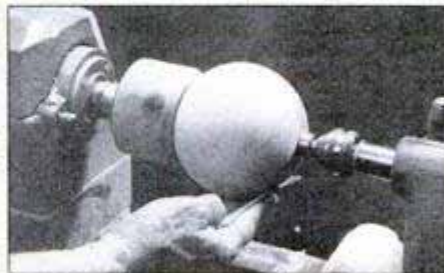
Rough-cut the blank to shape on a band saw. Tape the waste from the first cuts back in place to permit making the second cuts.



Mark centerlines on the blank so that when the piece spins, the ball's outline will become visible and help guide the cutting.



Turn the blank until the inked centerlines are barely visible. Then, finish-shape the piece using skew and spear-point chisel.



After sawing off the turning posts, mount the ball between a cup chuck and a tailstock pad insert to permit finish-sanding.

Cabriole leg

Although this Queen Anne style cabriole leg is rough-cut on a band saw and finish-shaped by hand, the lathe is used to accurately form the circular foot and step and even a small portion of the contoured ankle. When rounding the front of the ankle—the area just above the toe of the foot—it's necessary to reposition the tailstock end off-center.

Start by tracing the profile of the finished leg on two adjacent sides of the blank. Next, locate and mark the centers on each blank end. Then, use a compass to draw two circles on the leg

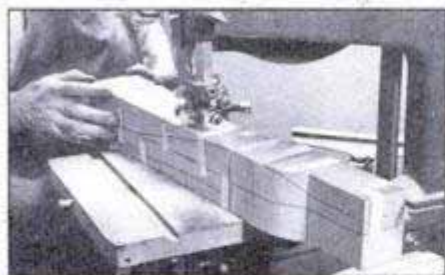
bottom (the tailstock end). Draw one circle to represent the step diameter and another slightly larger circle equal to the diameter of the foot. Use these circles as guides when turning the foot and step. Now draw a diagonal line across the leg bottom from the toe to the heel. Mark the off-center location on this diagonal line about $\frac{3}{16}$ in. inside of the small (step) circle. Be certain to locate the off-center mark closer to the heel of the leg, not the toe.

Next, cut along the leg profile on a band saw. Then, tape the waste cutoff back to the blank and saw along the

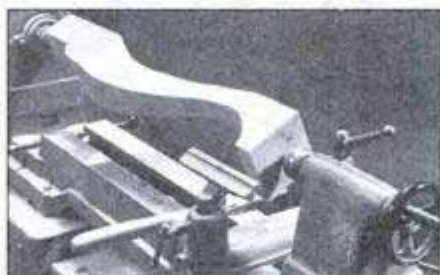
adjacent side profile. Mount the leg on the lathe using the true center marks. Turn the foot and step using skew and spear-point chisels, as shown. Also, use the spear-point to round the *back* of the ankle. Now shift the tailstock end to the off-center mark and round the front of the ankle with a gouge.

Finally, engage the indexing pin in the headstock pulley to keep the leg from rotating. Then, shape the leg's final contour, making use of a variety of hand tools, including a rasp, file and spokeshave.

(Please turn to page 108)



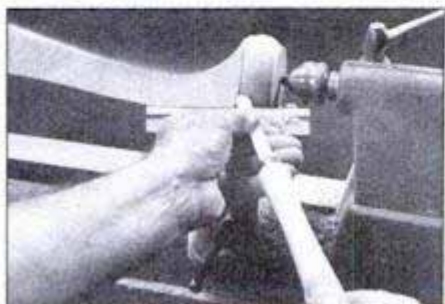
Cut the cabriole leg to shape on a band saw. Tape the cut off pieces back to the blank to permit cutting the adjacent side.



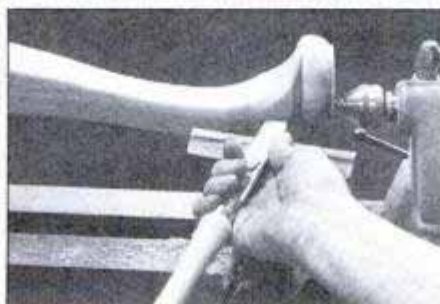
Mount the leg between centers for turning the foot and step. Note the two circles and the off-center mark on the leg bottom.



Form the round foot by working a skew slowly from the end—that is, right to left. Light passing cuts will prevent splintering.



Use a spear-point tool to round the top of the foot and to shape the back portion of the ankle. Again, take light cuts.



To shape the ankle front, shift the leg off-center on the tailstock. Note that the off-center location is closer to the heel.



Engage the indexing pin in the headstock pulley to keep the leg from rotating. Then, finish-shape with assorted hand tools.

5

TABLES

For A Movable Feast

BY GENE AND KATIE HAMILTON AND STEVE WOLGEMUTH



TRAY TABLE



TABLE CUBE



SNACK TABLES



ROLL-UP TABLE



THREE-POSITION TABLE



Here are a variety of attractive and useful fold-up, slide-together or adjustable tables designed to meet almost any serving and eating need. Yet they take up minimal space when not in use. Each table or set can be built in a weekend using basic tools and readily available materials.



Snack tables

This sturdy set of four oak snack tables stores on its own stand that also serves as a carrier. The leg configuration allows you to sit with your knees under the table for comfortable eating.

Begin construction of the tables by gluing up the tops. We edge-glued two $\frac{3}{4}$ x $5\frac{1}{2}$ -in. pieces and one $\frac{3}{4}$ x $7\frac{1}{4}$ -in. piece to form the 18-in.-wide top, but any size lumber can be used. After the glue has dried, cut the tops to final size. Use a router and a $\frac{1}{4}$ -in. rounding-over bit to ease the outside edges of the tops.

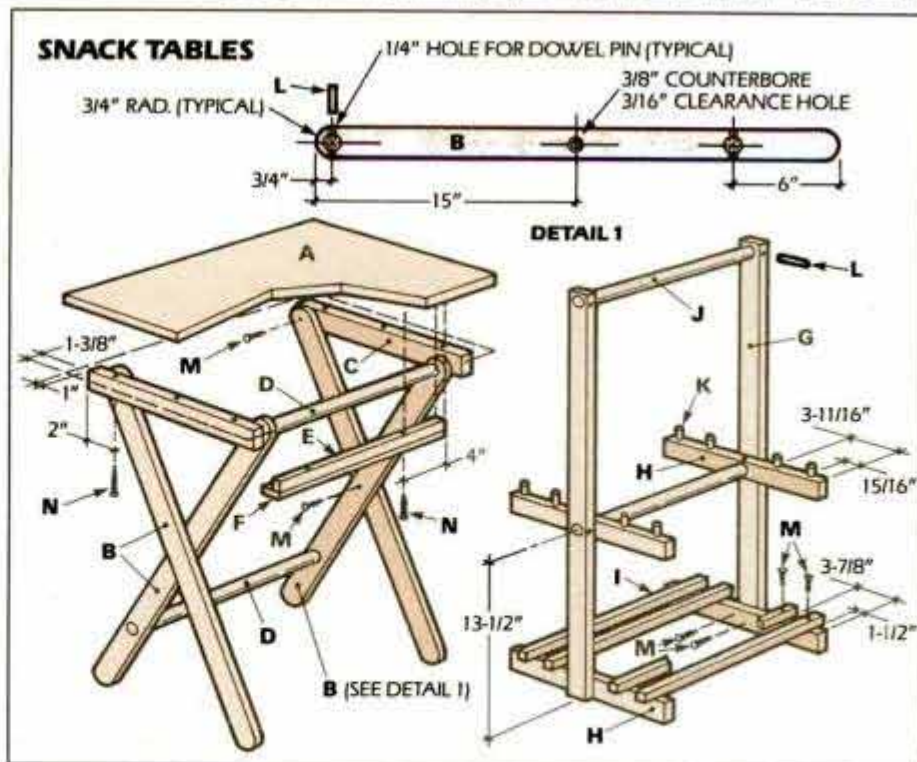
Cut the brackets, stops, caps, legs and cross dowels to size. Mark and bore $\frac{3}{4}$ -in. holes for the cross dowels. Mark $\frac{3}{4}$ -in.-dia. arcs on the ends of all the legs, then cut them with a coping saw or jigsaw. Place the two legs of each table that receive cross dowels on a flat surface, and bore a $\frac{1}{4}$ -in.-dia. hole for the dowel pins into each joint. Glue and pin the leg pairs and let them dry.

Bore holes for the two center and two upper pivot screws. Screw the two pairs of legs together and screw these leg pairs to the table brackets so the leg ends and bracket ends align. Then, glue and screw the brackets to the underside of the table. Bore clearance holes through stops and caps, and glue and screw them to the underside of the table, aligning the outside of the stop with the bracket ends. Countersink screwheads.

Cut the parts for the stand to size. Glue the $\frac{3}{8}$ -in.-dia. dowel pegs into $\frac{3}{4}$ -in.-deep holes bored in the upper cross trees. Glue and screw the bottom cross trees to the uprights.

Use dowel pins to strengthen all cross-dowel joints. Bore the dowel-pin holes for the cross trees first, then for the uprights, leaving one side pinned temporarily and clamped, while boring the other upright.

Apply a drop of glue to the dowel pins and drive them into all joints. Glue



MATERIALS LIST—SNACK TABLES

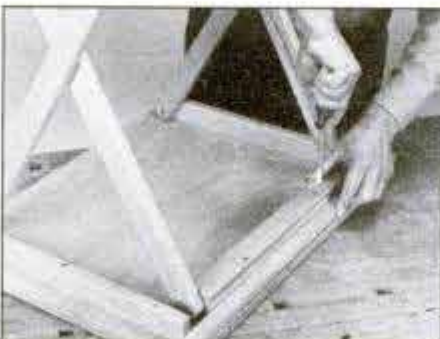
Key	No.	size and description (use)	H	4	$\frac{3}{4}$ x $1\frac{1}{2}$ x 14" oak (cross tree)
A	4	$\frac{3}{4}$ x 18 x 24" oak (top)	I	4	$\frac{3}{4}$ x $\frac{3}{4}$ x $17\frac{3}{4}$ " oak (runner)
B	16	$\frac{3}{4}$ x $1\frac{1}{2}$ x 30" oak (leg)	J	2	$\frac{3}{4}$ "-dia. x $17\frac{3}{4}$ " hardwood (cross dowel)
C	8	$\frac{3}{4}$ x $1\frac{1}{2}$ x 16" oak (bracket)	K	8	$\frac{3}{8}$ "-dia. x $1\frac{1}{2}$ " hardwood (peg)
D	8	$\frac{3}{4}$ "-dia. x $18\frac{1}{4}$ " hardwood (cross dowel)	L	22	$\frac{1}{4}$ "-dia. x 2" hardwood (dowel pin)
E	4	$\frac{3}{4}$ x $1\frac{1}{8}$ x $16\frac{1}{2}$ " oak (stop)	M	28	1" No. 8 fh screw
F	4	$\frac{3}{8}$ x $1\frac{1}{2}$ x $16\frac{1}{2}$ " oak (cap)	N	32	2" No. 8 fh screw
G	2	$\frac{3}{4}$ x $1\frac{1}{2}$ x 32" oak (upright)	Misc: Carpenter's glue, wood plugs, 120- and 220-grit sandpaper, stain, polyurethane varnish.		



Strengthen leg joints with dowel pins. Place assembly on flat surface and bore $\frac{1}{4}$ -in.-dia. holes. Glue pins before inserting.



Join the two pairs of legs, then the leg assembly to the brackets, with pivot screws. Glue and screw brackets to table bottom.



Open legs and position the stop and cap assembly flush with ends of leg brackets. Butt scrap against bracket ends as a guide.



Clamp one cross tree and pin temporarily while boring for dowel pin on opposite upright. Then reverse the procedure.

and screw the runners to the bottom cross trees. Countersink screwheads deep enough to accept wood plugs.

Plug screwhead holes, then sand all

parts with 120-grit sandpaper. Finish-sand with 220-grit paper and apply a light coat of golden oak stain and three coats of polyurethane.



Table cube

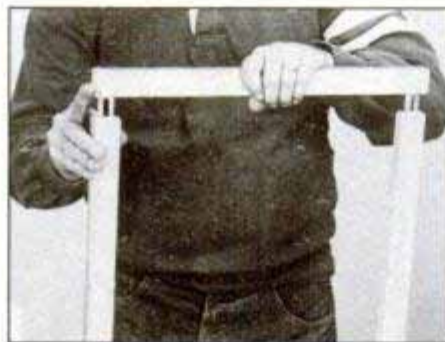
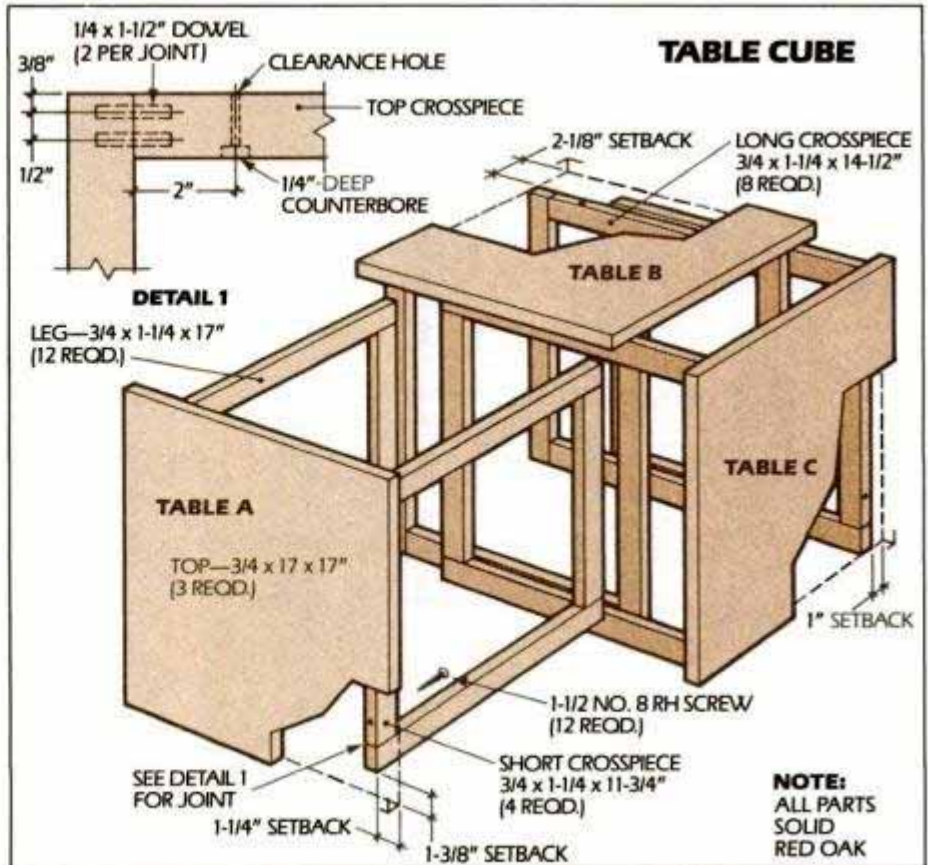
Use these three handy oak tables separately, or slide them together into a cube. Straight, contemporary lines make them easy to build. Begin by edge-gluing and clamping the tops. We used two pieces of $3/4 \times 5\frac{1}{2}$ -in. oak and one piece of $3/4 \times 7\frac{1}{4}$ -in. oak. When dry, trim to exact size. Use a $1/4$ -in. rounding-over router bit to ease the top edges.

Cut the legs and crosspieces to size and assemble the legs with two dowels in each corner joint. Glue and clamp, then sand the legs with 120-grit sandpaper, easing all edges except those that contact the underside of the top.

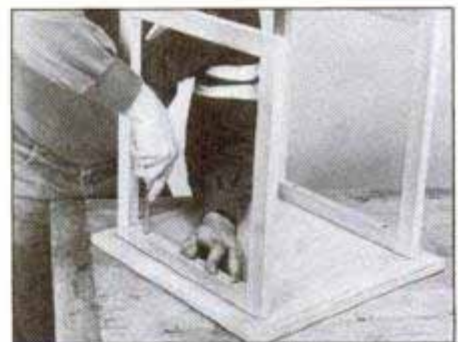
Mark, then bore clearance holes and $1/4$ -in.-deep counterbores in the leg assemblies for the screws that hold the legs to the tabletops. First, mount the legs— assembled from the four short crosspieces—on table A. Allow a $1\frac{3}{8}$ -in. setback from leg edges to table edges; allow a $1\frac{1}{4}$ -in. setback from leg sides to table edges.

The leg edges on tables B and C are all flush with table edges. However, the leg sides of table B are set back $2\frac{1}{8}$ in.; the leg sides of table C are set back 1 in.

Be sure to position the legs on the underside of the top so they are aligned at right angles to the grain direction of the tops. Then, mark screw locations, bore pilot holes in the top and screw the legs in place. Finish-sand the tables with 220-grit paper and wipe on a light-colored stain. We used golden oak. When dry, apply two coats of oil finish.



Assemble legs and crosspieces with glue and two $1/4$ -in.-dia. dowels per joint. Glue and clamp, then check for squareness.



Bore clearance holes and $1/4$ -in.-dia. counterbores in crosspieces. Position legs, make pilot holes in table bottom and mount legs.



Tray table

Our tray table doubles as a bookstand and its legs fold away for easy storage. When the center section is laid flat it provides a sturdy surface for eating or writing. When raised it holds a book at comfortable reading position.

Cut the frame parts to size from $3/4$ -in.-thick clear pine. Then, set up your saw to cut the dados and rabbets in the sides. Also cut a $1/2$ -in.-wide x $1/4$ -in.-deep groove down the center of the end

pieces to receive the fixed end trays. Cut all the remaining parts to size from $1/2$ -in. clear pine. Cut two $1/2 \times 1\frac{1}{2}$ -in. notches in each leg to receive the leg crosspieces.

Assemble the tray frame without glue and clamp it, checking the fit of all parts. Then using a doweling jig, bore $3/8$ -in.-dia. x 1-in.-deep holes for the leg hinge dowels and $1/4$ -in.-dia. x $3/4$ -in.-deep holes for the tray hinge dowels. Also bore the dowel holes in each leg. Cut $1\frac{1}{2}$ -in.-long sections of dowel and glue them into their respective holes in the legs and tray. Disassemble the frame, then reassemble it with glue and $3/4$ -in.-long wire brads. Make sure the movable tray is in place.

Insert the leg dowels into the side frame holes. Holding the paired legs in position against the sides, glue and nail the leg crosspieces into their notches.



Glue hinge dowels into leg holes. When dry insert dowels into sides; then nail and glue leg crosspieces into notches.

Before the glue dries check the legs for free movement. Glue and nail the bottom crosspiece and the two tray cleats in place.

Bore $1/4$ -in.-dia. holes for the tray support hinge. Use a doweling jig to

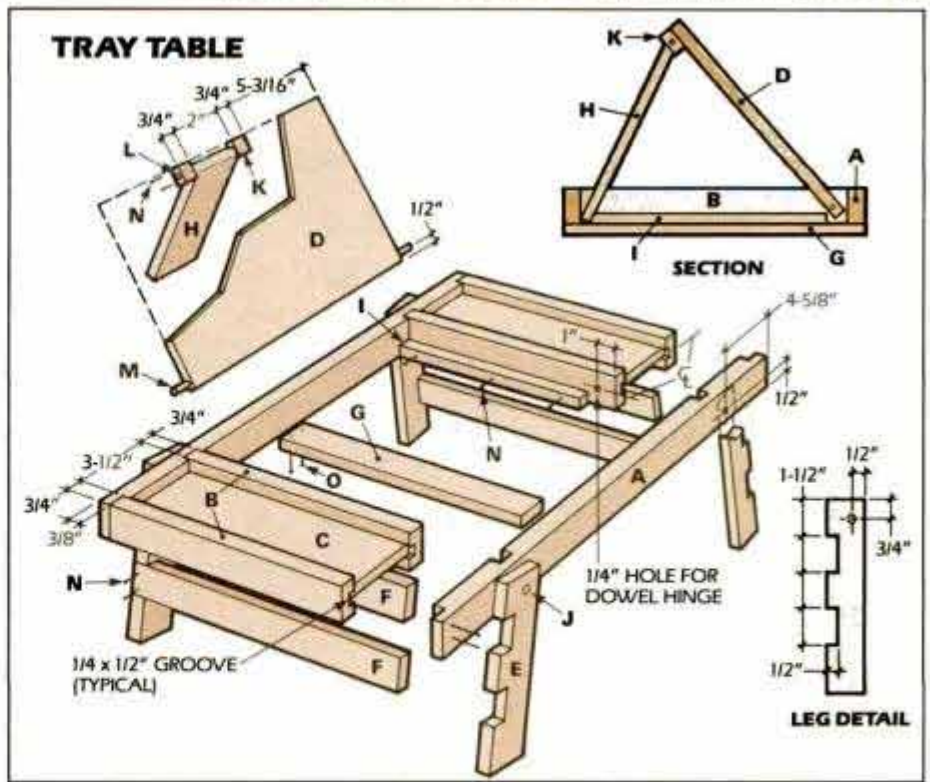
guide the drill through the width of the tray support, $\frac{1}{2}$ in. back from the edge. Make the holes in the hinge blocks slightly oversize so the hinge dowel will move freely. Mount the tray support and hinge blocks with glue and $\frac{3}{4}$ -in. wire brads.

Sand all pieces, especially the exposed end grain of the crosspieces and sides, and ease all sharp corners and edges. Use 120-grit paper, then 220-grit paper. We applied several coats of satin finish polyurethane varnish.

MATERIALS LIST—TRAY TABLE

Key	No.	Size and description (use)
A	2	$\frac{3}{4}$ x $1\frac{1}{2}$ x 24" pine (side)
B	4	$\frac{3}{4}$ x $1\frac{1}{2}$ x $11\frac{1}{4}$ " pine (end)
C	2	$\frac{1}{2}$ x 4 x $10\frac{1}{2}$ " pine (end tray)
D	1	$\frac{1}{2}$ x $10\frac{1}{4}$ x $13\frac{7}{8}$ " (movable tray)
E	4	$\frac{1}{2}$ x $1\frac{1}{2}$ x 8" pine (leg)
F	4	$\frac{1}{2}$ x $1\frac{1}{2}$ x 13" pine (leg crosspiece)
G	1	$\frac{1}{2}$ x $1\frac{1}{2}$ x 12" pine (bottom crosspiece)
H	1	$\frac{1}{2}$ x 2 x 8" pine (tray support)
I	2	$\frac{1}{2}$ x $\frac{1}{2}$ x $9\frac{3}{4}$ " pine (tray cleat)
J	4	$\frac{3}{8}$ -dia. x $1\frac{1}{2}$ " hardwood dowel (hinge)
K	2	$\frac{1}{2}$ x $\frac{3}{4}$ x 1" pine (hinge block)
L	1	$\frac{1}{4}$ -dia. x $3\frac{1}{2}$ " hardwood dowel (hinge)
M	2	$\frac{1}{4}$ -dia. x $1\frac{1}{2}$ " hardwood dowel (hinge)
N	26	$\frac{3}{4}$ " wire brad
O	4	4d finishing nail

Misc. Carpenter's glue, 120- and 220-grit sandpaper.



Roll-up table

Roll it up and take it along. This 30-in.-square table is just right for the beach or a picnic. It's made from pine, with a canvas-backed top.

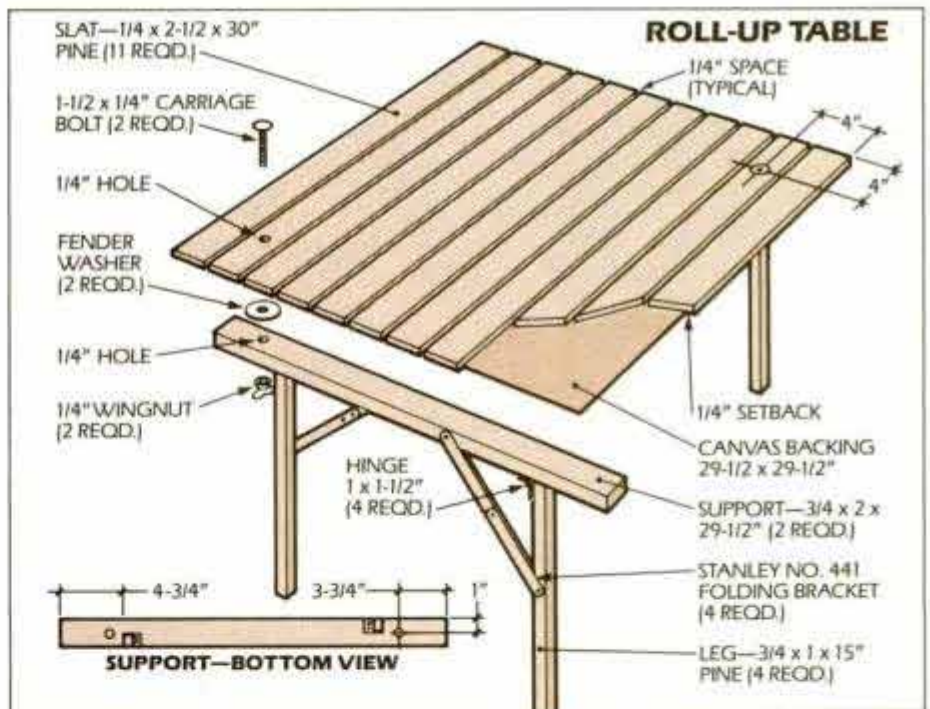
Cut $2\frac{1}{2}$ -in.-wide lattice to length for the top slats. Sand the slats with 120-grit sandpaper. Cut the canvas for the top slightly oversize, then lay it on a flat surface. Glue the slats to the canvas with aliphatic resin glue, and use $\frac{1}{4}$ -in.-thick scraps to maintain uniform spacing between slats. Cover the assembly with a piece of plywood and two layers of brick or other heavy objects. Allow the glue to dry overnight.

Cut the legs and supports from $\frac{3}{4}$ -in.-thick pine stock. Sand the pieces with 120-grit sandpaper, then finish all the wood parts with several coats of satin finish polyurethane, sanding lightly between coats.

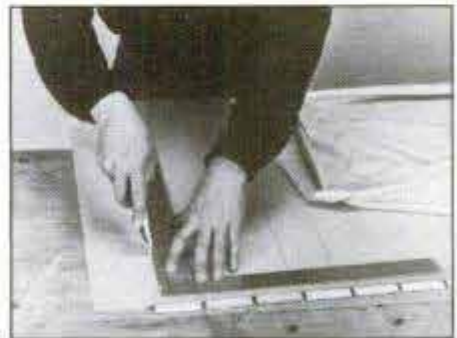
Install the hinges on the supports and legs. Mount four folding brackets on the legs and supports to lock the legs in an open position.

Trim the canvas backing $\frac{1}{4}$ in. from the edge of the table with a sharp knife or razor blade. Check for lifting along the trimmed canvas edges, and reglue any loose spots.

Position the leg assemblies on the



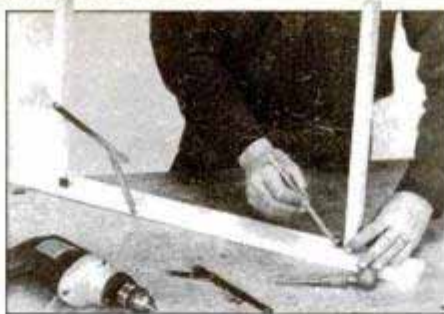
Lay the canvas on a flat surface then glue the table slats, with all ends aligned square. Use $\frac{1}{4}$ -in.-thick scrap as spacers.



Trim the canvas backing $\frac{1}{4}$ in. from the edge of the table with a sharp utility knife. Reglue any loose edges of canvas.

bottom of the table and mark the location of the carriage bolt holes. Bore the holes through the top and supports, and insert the bolts. Place large washers between the supports and the table bottom. Secure the supports with wingnuts, making them as tight as possible, while still allowing the assembly to swivel on the washers.

To store the table, swivel the leg assemblies parallel to the slats and roll it up. Cut a tie strip from the extra canvas or use a leather thong to tie up the rolled table.



Hinge legs to opposite sides of supports so legs fold flat next to one another. Folding brackets lock legs in open position.



Attach leg supports to tabletop with carriage bolts and wingnuts. Washers between supports and top allow supports to swivel.



Three-position table

Our folding table adjusts to three different heights—16, 24 and 29½ in.—making it a versatile addition to any home or patio. We used pine for the top and the legs, and hardwood dowels for the stretchers.

Cut the tabletop slats and supports from 1x6 stock. Assemble the top on a flat surface with glue and 1½-in. No. 8 fh screws. Countersink screwheads flush with the surface. Make the cleats from 2x2 stock and cut the caps from 1x2 stock. Glue the caps to the cleats and tack with 3d finishing nails.

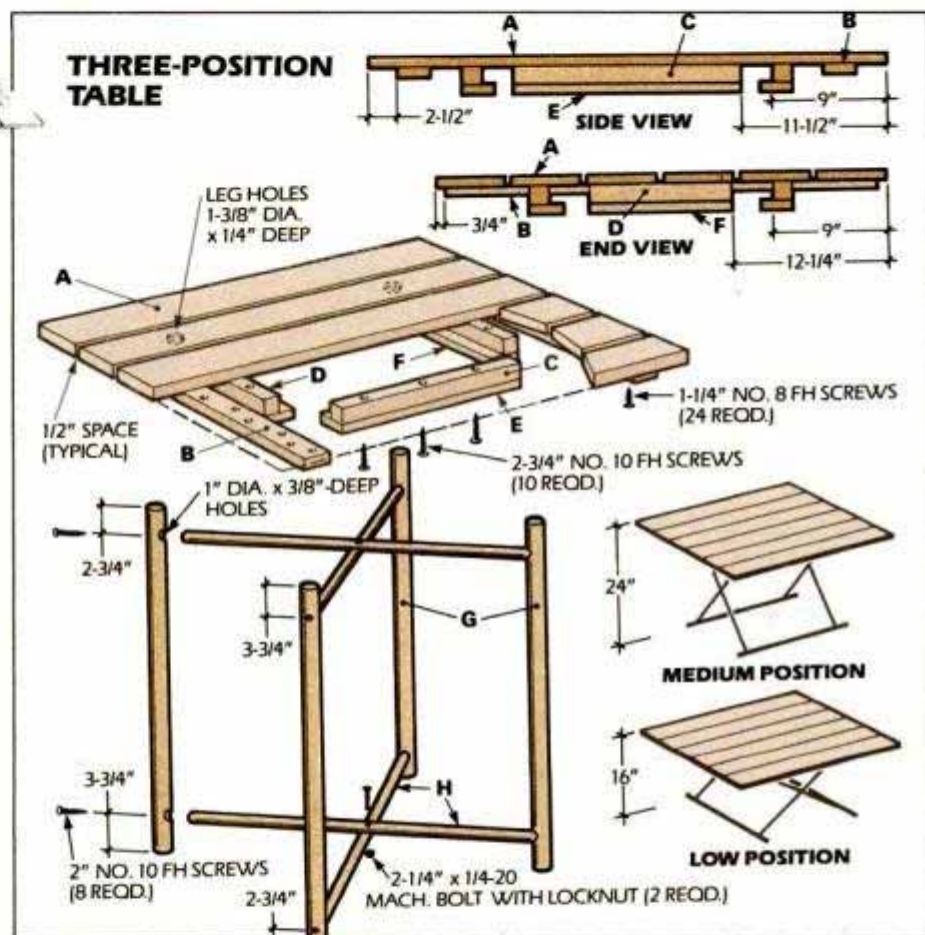
Cut the legs from 1½-in.-dia. round closet pole stock. Cut the stretchers from 1-in.-dia. hardwood dowels. To lay out the stretcher locations on the legs, draw a centerline along the length of the leg, then mark the stretcher locations on this line. Use a 1-in. spade bit to bore the ¾-in.-deep holes to receive the stretcher ends.

Assemble each set of legs with glue and one 2-in. No. 10 fh screw per joint. Countersink the screwheads. Then, bore ¼-in.-dia. holes in the center of each stretcher and join the two sets of legs with machine bolts and locknuts, as shown in the drawing.

Lay out the location of the cleat and cap assemblies on the underside of the table. Bore clearance holes and counter-bore for screwheads, then glue and screw the assemblies in place. Mark the location of the ¼-in.-deep leg holes on the bottom side of the tabletop by positioning the leg assemblies with an equal overhang in both directions. Bore the holes.

Sand the tabletop and legs with 120-grit sandpaper. Ease all sharp edges and corners. Then, finish-sand with 220-grit sandpaper. We finished our table with three coats of clear polyurethane varnish.

PM



MATERIALS LIST—THREE POSITION TABLE

Key	No.	Size and description (use)	F	2	¾ x 2½ x 11" pine (cap)
A	6	¾ x 5½ x 42" pine (top slat)	G	4	1½-in.-dia. x 29" pine (leg)
B	2	¾ x 2½ x 34" pine (support)	H	4	1"-dia. x 29" hardwood dowel (stretcher)
C	2	1½ x 1½ x 19" pine (cleat)	Misc: Carpenter's glue, 120- and 220-grit sandpaper, 1¼" No. 8 fh screws, 2" No. 10 fh screws, 1¼" No. 8 fh screws, 2¼" x ¼-20 machine bolts and locknuts.		
D	2	1½ x 1½ x 11" pine (cleat)			
E	2	¾ x 2½ x 19" pine (cap)			



Mark stretcher locations on legs. Then, using a portable drill press attachment, bore holes with 1-in.-dia. spade bit.



Place leg assembly in position and mark locations of the ¼-in.-deep leg holes. Keep tabletop overhang equal in both directions.



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Extra long turnings

Here's an easy way to turn columns and spindles of virtually any length regardless of your lathe's capacity. Simply make the turning in two or more sections that are joined by a round mortise and tenon. Be certain to locate the joint where it won't be visible, such as at a shoulder or between beads.

First, shape one section of the turning. Then, support the tailstock end



Support the column end using a steady rest while boring the mortise. Advance the drill bit slowly into the spinning column.

using a steady rest and bore the mortise. Install a geared chuck in the tailstock and advance the drill bit into the end of the spinning turning.

Next, shape the second section and turn a mating round tenon on the tailstock end. We used a diameter sizing attachment on a parting tool, as shown, to cut the tenon to the exact size. Then, dry assemble the sections, checking for a snug fit between



Cut mating tenon to exact size with a diameter-sizing attachment on a parting tool. Note hardwood pad on column end.

tenon and mortise. Turning blanks of cedar, redwood and other softwood species often begin to wobble on the lathe because the headstock and tailstock centers lose their grip in the soft end grain. The solution is to glue hardwood pads temporarily to the softwood blank ends. Glue the hardwood pads to the softwood blank separated by a sheet of paper to allow easy removal.



Use this mortise-and-tenon technique to produce columns and spindles of virtually any length. Join the parts with glue only.

Split turnings

Half or split columns and spindles are used frequently as decorative accents on walls, doors, cabinets, desks and tall clock cases. The trick to making split turnings is to glue up the blank, turn the spindle on a lathe and then split it in half.

First, form the turning blank by gluing two pieces of stock together separated by a sheet of slick magazine paper. Chamfer the stock ends slightly to make it easier to pry the spindle apart with a chisel. After the glue dries, mount the blank between the headstock and tailstock and turn the spindle to the desired shape.

Now use a chisel to carefully split the

spindle in two. The paper sandwiched in the middle will allow the halves to separate easily. Be certain to scrape or sand the back of the split turnings clean of any paper before installing them.



Glue up the turning blank separated by a strip of slick magazine paper. When the glue dries, turn the spindle on the lathe.

This technique can be used to make split turnings of any size.



Use a chisel to separate the spindle halves. Slight chamfers on the ends of the parts make it easy to insert the chisel.

Small post blocking

This technique is very similar to the large post blocking procedure shown on page 99. Small post blocking is used almost exclusively to produce a square-shouldered spindle with a large diameter midsection.

First, mill the turning blank square and joint the four sides perfectly flat. Next, glue two wood blocks to opposite sides of the blank's midsection. Be certain to position the blocks where the

large diameter of the spindle is to be turned. When the glue dries, trim the glued-on blocks flush with the blank. Then, glue and clamp blocks to the two remaining sides of the blank and let dry. Now mount the blank between the headstock and tailstock centers. Turn the spindle to the desired shape, working the built-up section first. If the blocks are glued on carefully, the spindle will appear to have been turned from a single piece of stock. **PM**



Mount the blank between centers after building up the mid-section with glued-on blocks. Be sure the glue dries thoroughly.



Finished turning produces a square-shouldered spindle with a large diameter mid-section carved from the glued-on blocks.

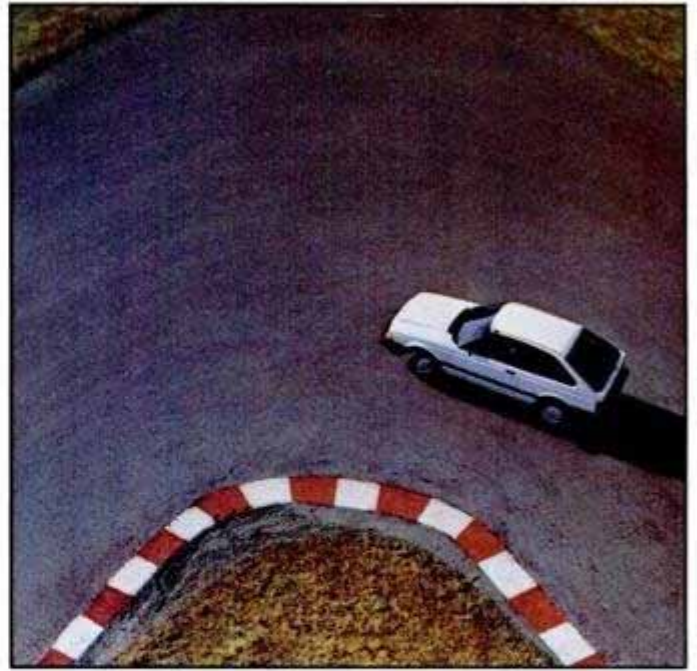
SOURCE LIST

Contact the following lathe manufacturers and suppliers for more information on their products.

- Advantage Machinery Co., 40 Whites Path, South Yarmouth, Mass. 02664
- American Machine & Tool Co., Fourth Avenue and Spring Street, Royersford, Pa. 19468
- Conover Woodcraft Specialties, 18125 Madison Rd., Parkman, Ohio 44080
- Harrison, Craft Supplies, 1644 South State St., Provo, Utah 84601
- Delta International, 400 North Lexington Ave., Pittsburgh, Pa. 15208
- Dremel Tool Co., 4915 21 St., Racine, Wis. 53406
- Hegner, AMI Ltd., Box 312, New Castle, Del. 19720
- IMTA Tooling, 1263A Rand Rd., Des Plaines, Ill. 60016
- Inca, Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013
- Master Woodcraft & Hobby Machine Co., 800 Spruce Lake Dr., Harbor City, Calif. 90710
- Mini-Max Inc., Box 440666, Miami, Fla. 33144
- Myford, Woodcraft, 41 Atlantic Ave., Box 4000, Woburn, Mass. 01888
- Powermatic, Morrison Rd., McMinnville, Tenn. 37110
- Sears, Roebuck & Co., Sears Tower, Dept. 703-PM, Chicago, Ill. 60684
- Shopcraft, Benchmark Tool Co., 315 Ellis Blvd., Jefferson City, Mo. 65101
- Shopsmith, 6640 Poe Ave., Dayton, Ohio 45414
- Total Shop, Box 16297, Greenville, S.C. 29606
- Williams & Hussey, Elm St., Milford, N.H. 03055



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The Hairpin.



The S's.



The Loop.

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HONDA

The Accord Hatchback

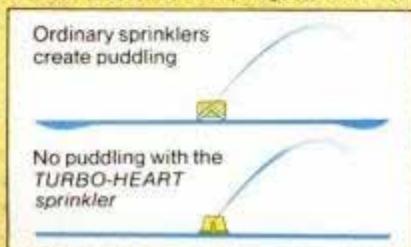
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BREAKTHROUGH BIKE

(Continued from page 74)

inverted handlebars that simply hooked forward instead of making the usual twists and turns. The structural triangle formed by the center of the handlebars, the center of the saddle and the center of the bottom bracket was in the same place on the aero bike as it is on a conventional racing bike. But less tubing was needed in the head area, making the Technium frames about 20 percent lighter in weight.

Frame dimensions and geometry were optimized for each cycling team member. Data on the individual's size, shape, weight and riding style was fed into a computer, which came up with individualized specs. Frame variations for different riders amounted only to fractions of centimeters, but it was all part of that extra edge needed to win.

One goal in building a bike with a smaller frontal area is reducing the diameter of the head tube from the conventional 1 1/4-inch size down to 1 inch. The key here was to come up with a small headset bearing. A smaller bearing means a smaller head tube. Looking at components that were commercially available, the builders used a combination of needle and nylon bearings small enough to be enclosed totally inside the head tube.

The small front wheel also shrinks the aerodynamic profile, but is even more important in team events where four-rider teams compete than in individual pursuit events. Team bikes often use small wheels on front and rear so riders can get closer together for a better draft. Drafting—riding as close as possible to the bike in front of you so it cuts through the air for you—is an important rest period for the riders.

Wheel aerodynamics

The disc wheel design is an interesting trade-off of weight for aerodynamics. A bicycle wheel has to deal with two aerodynamic considerations. First, there's the drag and turbulence created as the wheel rotates on its hub. Then, there's the additional drag and turbulence as the bike moves forward.

The drag and turbulence generated by spoke wheels requires overproportionate amounts of energy in relation to the speed of the wheel. Each spoke acts like a miniature fan blade, breaking up the air as it slices through. At racing speeds, the aero drag of a spinning spoke wheel is greater than the drag of the bike moving through the air.

The disc wheel doesn't break up the air as it spins, and its shape improves the airflow around the bike, further reducing forward drag. But the disc wheel is heavier and requires more effort to accelerate up to racing speeds.

All this looked good on paper, and looked even better on the track. As expected, the disc wheel bikes turned in slower times, compared to spoke wheel bikes, for the first kilometer of distance races. But, as the race progressed, their times picked up as less energy was needed to keep the rear wheel rotating once it reached speed. The disc wheel was a definite factor in American cyclist Steve Hegg's blitzing of the North American record in the 4,000-meter individual pursuit event, with a time of 4 minutes, 41.43 seconds—good enough to win a gold.

Two types of wheels

Two types of disc wheels were developed, with construction differences depending on wheel size. The larger, black 27-inch wheel used a graphite/honeycomb sandwich disc. Graphite skins were mated to a honeycomb disc made of Nomex fabric. The wheel used an aluminum hub and graphite rim. Everything was bonded together with aircraft structural adhesive. Even the tire inflation hole in the rim was covered with a strip of Mylar to achieve optimum aerodynamics. Attention to detail wins Olympic medals.

The 24-inch wheels, used mainly on the front, were made of stressed Kevlar skins stretched like a drum head between the flanged hub and rim. This construction was lighter than the graphite/honeycomb composite, but the technology for stretching the Kevlar to work on a 27-inch wheel hasn't been perfected to date.





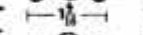



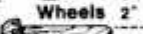
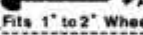
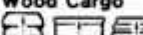

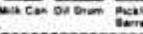







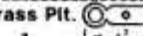




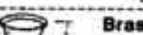


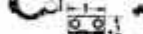
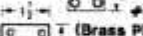




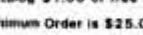
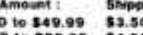
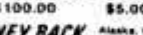

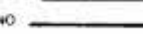





In tires, the U.S., for some reason, doesn't have the advanced technology needed to make its own Olympic-grade racing rubber. So imports from West Germany, Italy, Argentina and Japan were used. The tires measured a mere 18-mm across and were made of aramid fiber or silk with a latex or butyl tube hand-sewn inside. Tires were glued to the rims and pumped rock hard with 200 psi of helium.

Steve Hegg's pursuit bike also sported a set of exotic pedals. Hand made from titanium, each pedal and toeclip assembly on Hegg's bike weighed as little as a 50-cent piece.

According to Mike Melton, coordinator for the Tech Development Center, the bicycles the U.S. team brought to the 23rd Olympiad were three years ahead of the pack in technology. Melton says our bikes already are obsolete as the technology is moving rapidly into the area of all-composite construction, expected to pave the way for the first under-10-pound bicycle.

And as Raleigh said in one of its recent ads, someday you'll be able to ride a Technium bike. And you won't have to be a member of the United States Olympic Team.

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	7/8" \$7.95/C \$4.77/C	
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	1 1/4" \$13.95/C \$8.01/C	
	1 1/2" \$18.95/C \$11.01/C	
	2" \$30.95/C \$18.00/C	
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	1 1/2" \$2.40/10 \$1.84/10	
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	928 Butt Hinge (Brass Pit.) \$2.88/10 \$1.68/10	
	F124 Screw for Above \$4.00/C \$2.40/C	
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	6" \$.99/ea. \$.59/ea.	
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BRITISH SPORTS CARS

(Continued from page 79)

twin-cam Toyota engine, and use many other Toyota components.

Last year, Lotus unveiled an exciting Giugiaro-designed prototype of a new top-of-the-line sports car, called the Etna, which will go into production in 1988. The 2,600-pound Etna will be powered by a new four-liter four-cam aluminum V8 with four valves per cylinder that will produce 360-hp and give it performance to rival Corvette, Ferrari and Porsche; 0 to 60 mph in 4.3 seconds, 0 to 100 in 10.6 seconds and a top speed of 180 mph. Advanced features will include an all-plastic body and chassis, computer-controlled hydraulic suspension and an optional CVT automatic transmission. A turbocharged 600-hp version will need four-wheel drive to get its power to the ground.

Marcos

In 1963, Marcos introduced its first Volvo-powered sports car. Over 1,000 were produced before the car went off the market. In 1981, the company reintroduced the car in kit form. It can be powered by a V6 Ford or V8 Rover engine. Unlike many kit cars, the Marcos has retained its value and is regarded as a classic. Marcos intends to again market the car in the United States, powered by either the Buick V6 or 2.3-liter Mustang engine.

Morgan

Morgan, a family-owned auto company, has been in business for 76 years and is still producing a range of open two-seaters that capture the true essence of what a British sports car is all about. Unfortunately, emission standards in the U.S. do not allow a stock Morgan to be sold, though a version fueled by LPG is available. You'll need patience if you want a Morgan. At present, there is a wait of four to five years for delivery. The wait has been as long as 10 years.

Panther

Panther is a fairly new name on the British sports car scene. The company has been producing a '30s-style car since 1972, but it's a company you will be hearing a lot more about.

Since 1981, Panther has been a Korean-owned concern that produces a traditional-looking two-seater convertible called the Kallista. The aluminum body and chassis are made in Korea and shipped to England for painting and final fitting with a Ford engine and suspension. The car has been certified and is on sale in the United States powered by the ubiquitous 2.3-liter Mustang engine. Although it looks very different, the Kallista captures the spirit

of the old convertible MGB. It's a lot more powerful and is a practical run-about, especially on fair weather days.

Last year Panther announced a striking mid-engined two-seater called the Solo, powered by a 1.6-liter Ford Escort engine and transaxle. Panther plans to put the Solo into production next year with a target price of under \$12,000. A faster, more expensive turbo version is likely. By 1987, the company intends to manufacture the car in California.

Reliant

Reliant has been producing fiberglass sports sedans and three-wheelers for a number of years and is actually the fifth largest auto company in Britain. The company has now entered the sports car business with a straightforward front-engined two-seater, designed by the Italian coach builder Micholetti, called the Scimitar SS1. The car uses the same kind of impact-resistant plastic body panels as the Pontiac Fiero. It's powered by a Ford Escort engine and has very much the same feel as the old MG Midget and Triumph Spitfire. Reliant will start exporting the car to the United States at the end of 1986 and hopes to keep the price around \$10,000. It will be powered by a different engine in order to meet emission standards.

TVR

TVR's latest Tasmin model has more modern lines, but still maintains the muscular front-engined appeal of its V8-powered products of the '60s. The U.S. version is powered by a 145-hp 2.8-liter V6 Ford engine, and last year TVR actually outsold Lotus in the U.S.

Alive and well

Far from being a dead breed, the British sports car is alive and thriving.

The future for British sports cars looks bright, and the range should continue to expand in the coming months and years.

PM

SOURCES

- AC Mark IV: Autokraft Ltd., Unit 815, Brooklands Industrial Park, Weybridge, Surrey, England
- AC ME3000: AC (Scotland) PLC, 123 Johnson Ave., North Cardonald, Hillington, Glasgow, Scotland
- Aston Martin: Aston Martin Lagonda Inc., 342 West Putnam Ave., Greenwich, Conn. 06830
- Caterham Seven: Super Seven (Florida) Inc., 1913 Terrace Dr. E., Lakewood, Fla. 33461; or Sevens & Elans, 248 Hampshire St., Cambridge, Mass. 02139
- Jaguar: Jaguar Cars Inc., 600 Willow Tree Rd., Leonia, N.J. 07605
- Lotus: Lotus Performance Cars, 530 Walnut St., Norwood, N.J. 07648
- MG: Austin Rover Group Ltd., Canley Rd., Canley, Coventry, England
- Marcos: Marcos Sales Ltd., 153/154 West Wilts Trading Estate, Westbury, Wilts., England
- Morgan: ISIS Imports Ltd., Box 2290, U.S. Custom House, San Francisco, Calif. 94126
- Panther: Panther Cars, c/o Jindo America, 132 West 36th St., 3rd Fl., New York, N.Y. 10018
- Reliant: Reliant Motor PLC, Tamworth, Staffs., England
- TVR: TVR of America Inc., 7749 Bayberry Rd., Jacksonville, Fla. 32216

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BREAKING SPEED BARRIERS

(Continued from page 73)

the skin of *Thrust 2* was in the supersonic range."

A wall of air

The history of aviation is marked by daredevil feats in which man—told he could not do something—laid down his life to prove the experts wrong. The one aircraft tied securely into this folklore is the X-15 rocket plane—the craft that broke the sound barrier and five more speed barriers after it.

The X-15 had already broken Mach 5 when Air Force test pilot William J. "Pete" Knight arrived at Edwards Air Force Base in the mid-'60s. The XLR-99 powerplant, which delivered three times the thrust put out by all four engines of a Boeing 747, seemed to have reached its limits.

But engineers figured they could add auxiliary fuel tanks that would increase the X-15's firing time from 80 seconds to 140 seconds. That would give it the extra kick needed to reach Mach 7. Two 23-foot external fuel tanks added 13,500 pounds of liquid oxygen and ammonia to the X-15's arsenal. When the fuel was consumed, the tanks would be jettisoned.

Everything was ready on Oct. 3, 1967. The X-15 was dropped from the belly of a B-52 mother ship. Knight ignited the rocket engine and was slammed against the rear of his seat as the craft screamed upward, knifing through the rarefied atmosphere at 4,543 mph or Mach 6.72. It was the fastest aircraft flight ever.

The rocket plane's silicon-based paint was designed to withstand heat generated at Mach 7.5. But long before he could pull to Mach 7, Knight saw a hole burned into the fuselage. Superheated air streamed into the cockpit and the plane's internal structure began to creak. The external tanks would not jettison, leaving Knight flying a plane that was a ton heavier than planned.

The skilled pilot brought down the X-15 successfully—to the amazement of engineers who viewed its blackened fuselage. One witness said it resembled burned firewood.

Mach 7 has not been seriously threatened since. But renewed interest in high-speed craft has sent aerospace experts back to the drawing boards. The heat that charred the X-15 continues to be one of the most critical barriers. Unlike a missile, which travels beyond that speed, an aircraft must sustain high-temperature flight for an extended period.

One solution now being explored is to create new shapes to disperse surface heat more efficiently. Surprisingly, the noses and leading edges of hypersonic

craft have to be blunted and not needle-like, as previously thought. The blunting creates a strong shock wall that disperses air before it reaches the surface. But the blunt leading edge increases drag. To counter this, the wings must be swept back—or forward as in the case of the merely supersonic X-29—quite radically. The wings must be swept as much as 80°.

Licking the problem of the supersonic shock wave is just the beginning. At higher Mach numbers, the aircraft encounters "hypersonic" shock waves.

"This creates a local hot spot that has to be actively cooled," explains Louis

Kaufman, senior staff scientist at Grumman. "Shock impingement melted a fin off one X-15." Kaufman is conducting wind-tunnel studies to recommend design configurations that will at least reduce shock impingement. If the hot spots can't be designed out of future aircraft, other researchers are working on localized internal cooling systems.

Aside from heat, the powerplant is a considerable barrier in the way of Mach 7. A rocket engine probably is not the answer for sustained hypersonic flight because it has to carry its own supply of oxygen. An air-breathing engine would be 10 times more efficient.

Is your filter straining your engine while it's straining the air?



Mr. Good

For two decades now, engineers at NASA's Langley Research Center in Newport News, Va., have been quietly working on an air-breathing engine that might propel an aircraft beyond the barrier. Last summer, they announced a breakthrough in the SCRAMJET, a supersonic combustion ramjet engine.

Once a rocket or conventional turbojet engine boosts an aircraft beyond Mach 2, the ramjet takes over. The forward speed of the aircraft rams air into the engine so no turbine is needed. The result is a lightweight, highly efficient powerpack. The ramjet at Langley had problems slamming past Mach 4 in

early tests. But recently, Langley researchers developed a new combustion system that brought it to Mach 7. It might have gone faster, but the wind tunnel's limit was Mach 7.

Meanwhile, the Air Force has under wraps plans for a Trans-Atmospheric Vehicle (TAV) whose flight profile would sling it over the atmosphere on its way from one point to another (see *Coming: A Mach 20 Airliner*, page 97, Nov. '84). It is being designed for Mach 20 flight, but the official date set for that is sometime in the late 1990s. Before that, a prototype TAV, using other technologies already developed,

may well break the Mach 7 barrier.

The lowest barriers

While speeds like Mach .5, Mach 1 and Mach 7 are impressive, they aren't the only barriers being tackled by man in his quest for greater speeds.

Beneath the water, submarines today are moving faster than most surface vessels of World War II. Although exact figures are kept secret, military observers say a fast American submarine can do over 30 knots beneath the surface. Despite the fast clip (modern surface ships are considered fast at 40 knots), the supersubs are not fast enough to suit the Defense Department.

The undersea barrier today is believed to be 42 knots, slightly faster than the fastest Russian sub. According to Jane's Publishing, the *Alfa*-class Russian attack sub has a reported but unconfirmed speed of just under 42 knots at a depth of 3,000 feet. Only sparse information is available on the 260-foot-long, torpedo-shaped subs. Experts believe the Soviets have incorporated new aviation materials into the sub bodies along with compact nuclear reactors developed for the Russian space program. This year's Defense budget says only the following: "Development funds include work on high-speed attack submarines."

On land, another group of engineers and enthusiasts is working on the "human-powered vehicle" record. This is the high-speed bicycle. It looks more like a jet car, although all the power in the sleek vehicles of this class is provided by pedal-pushing. DuPont Co. has challenged the human-powered vehicle community to come up with a 65-mph vehicle by Dec. 31, 1987. The record is 56.49 mph set by the *Vector* at the Ontario Motor Speedway in California in 1980. The challenge is to build an aerodynamic lightweight vehicle with a drive system that matches to the power curve of the driver's legs.

Take this vehicle away and you still have a speed barrier challenge. The mile. For most of this century, human beings tried to run the mile in less than four minutes, described by Teddy Roosevelt as "nothing less than impossible for a mortal man" in 1905.

But on May 6, 1954, Dr. Roger Bannister stunned the racing world by becoming the first man to break the tape at a hair under four minutes. Today, mile racers don't see a barrier like that. They just go for the fastest mile (the record is 3:47:33 run by Sebastian Coe in 1982). But British mathematician Trevor Ritson has done computer studies of all mile runs since the turn of the century and his research indicates a man will run the mile in 3:47:14 by 1999 (see *Science World-wide*, page 24, Dec. '84).

PM

Breathe easy.



Did you know that your car's engine uses 15 times as much air, by weight, as it does gasoline? That's a lot of air. And it must be clean. Or dirt can get into the engine and cause excessive wear.

That's where your air filter comes in. But as Mr. Goodwrench explains, "The air filter itself needs to be clean. If the filter gets clogged with dirt, your engine gasps for air. That may cut your gas economy."

"That means you should have your air filter changed regularly. The gas filter needs to be clean, too, of course."

"And don't forget to have your oil filter changed when necessary to help keep your engine oil clean."



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Goodwrench

KEEP THAT GREAT GM FEELING WITH GENUINE GM PARTS

SMALL BOAT SHOOTOUT

(Continued from page 83)

loungers was excellent, although the angular wedge shapes drew a few comments. Seating forward in the bow was luxurious in terms of space, and comfortable for long periods. The twin jump seats aft were just usable.

The Mark Twain's instrument console was the most complete in the test group, with the best layout and the

most information available. Large tach and speedo gauges were set out where they could be seen at a glance, although the fuel gauge and voltmeter were partially obscured by the upper rim of the wheel. Accessory switches were neatly laid out along the bottom of the console, paired with fuse holders, and there was even a cigarette lighter.

The 190 BR received good marks for ride comfort in every category, as well as for flawless turning and shifting performance.


Styling marks were also good, though one tester commented that the side padding cushions seemed curiously out of harmony with the flowing lines of the hull graphics.

TEST RESULTS

BOAT	TOP SPEED @ RPM ¹	STANDING START ¼-MILE ¹	180° PORT/ STARBOARD TURNING TIME (sec.) ²	STORAGE CAPACITY (cu. ft.) ³	ON-WATER TEST RANKING ⁴
Cobia Odyssey 183 VBR	52.55 mph (@ 5,200 rpm)	41.96 mph (@ 5,200 rpm)	4.6/4.4	22.10	3
Mark Twain 190 BR	47.43 mph (@ 5,100 rpm)	37.46 mph (@ 5,100 rpm)	5.4/3.9	20.86	1
Regal 195 Medallion	51.58 mph (@ 5,200 rpm)	40.18 mph (@ 5,200 rpm)	5.5/5.4	26.11	4
Wellcraft 180 Elite	51.65 mph (@ 5,200 rpm)	39.09 mph (@ 5,200 rpm)	4.5/4.4	16.51	2

1. Average of four runs through ¼-mile trap, two runs in each direction to minimize effects of current, wind and wave. RPM taken from auxiliary test tachometer. Running starts of approximately ¼ mile for top speed runs only.
2. Average time for four hard-over turns to port, then four to starboard, running at radar-gun measured 35 mph. Sufficient time allowed for boat to regain speed before beginning next turn in series.
3. Measures all designated storage areas, either molded-in or otherwise structurally created, including ice chests where present, but not including under-seat storage of sun lounger/jump seats. No allowance made for tapering volumes.
4. Subjective ranking on the water based on grades in 14 major areas as explained in text. Bold numbers indicate best performance.

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Fit and finish markdowns included some edges finished in metal molding with exposed fasteners, and the occasional use of plastic buttons covering fasteners. But the net on-water test ranking was 65 points, good enough to be tops in our test.

Wellcraft 180 Elite

Wellcraft's 180 is not called Elite by accident. Top speed runs were fractions of a second different from the lighter weight Cobia, and cumulative port/starboard turning times were second to none in both categories.

The low storage capacity figure deserves further comment. Recessed cockpit hatches down the boat's centerline sported heavy teak hatch covers, the smaller of the two being conveniently located between the driver and passenger seats and lined to accept ice and drinks. Just forward, a teak grate conceals a long, deep storage locker that's just fine for storing a couple of pairs of skis.

However, Wellcraft elected to eliminate the traditional shelves under the gunwales that usually run the full length of the main cockpit. Although this gives the interior of the boat a stylish, uncluttered look, it cuts down the storage figure quite a bit.

We ranked braking/slowing as excel-

lent. But we marked down turning confidence somewhat because of a tendency to chine walk during high-speed turns when lightly loaded. This effect disappears as weight is added. Seating for passenger and driver ranked very high, with a slight markdown for a smallish forward seating area and for uncomfortable jump seats aft.

Tach, trim indicator and fuel gauges graced the nice console, along with a simple toggle switch panel that had blanks for three more switches. There's room for further instrumentation in the Wellcraft, and several testers remarked that the tach was partially obscured at the lower and upper ends of the scale. Controls were optimally placed for ease of use, and the steering wheel drew favorable notes for its thick padding and good grip.

The Wellcraft 180 Elite exhibited just a slightly quick motion at idle, but more than made up for the deficiency by handling chop to 1- and 2-footers comfortably. Tracking downwind was really excellent. Turning/shifting feel both received very high marks.

When it came to ranking styling and fit and finish, our test team was unanimous in its praise of the Wellcraft 180 Elite. One notable comment from the group was: "They are supreme stylists. All of the visual lines (graphics, hand-

rails, upholstery panels, windshield rake) contribute to a single, sleek, unified, aerodynamic look." Fit and finish in this boat were flawless as well, with very few exposed fasteners. Hull glasswork was smooth and free of blemishes or mat print-through. Upholstery work was first-rate throughout.

Cobia Odyssey 183 VBR

The Cobia Odyssey was our hands-down performance champ, turning in the best top speed and standing start 1/4-mile figures for the group. Admittedly, the Odyssey weighed in with a 55-pound advantage over its nearest rival, the Wellcraft 180 Elite. In most other categories, both boats seemed very closely matched, right down to the V-shape of their hulls.

But the Cobia had something more going for it—a perceived ability to pop up onto plane faster than any other boat we tested. However, it was just that—perception. The spread between the first three boats in our 1/4-mile testing was just about 1 mph.

The Odyssey had the second largest storage capacity of all the boats, a real plus for family boaters who invariably bring along too much for a typical outing.

On the water, our testers gave the *(Please turn to page 118)*

SMALL BOAT SHOOTOUT

(Continued from page 117)

Cobia Odyssey good marks for braking/slowing and turning confidence, and all seating positions were graded high, particularly the twin seats aft that flank the engine well.

However, there were only two instruments on the dashboard—a Det-Mar speedo and a fuel gauge, along with some fairly primitive push-pull switches. The speedometer was not readable without craning forward or laying back while under way. It was a real nuisance and could be a safety hazard on a traffic-busy weekend. An hour meter, tachometer and voltmeter are all optionally available, and there's plenty of room to mount them. One tester complained about the glare off the black fiberglass instrument panel.

Marine outdoor carpet and vinyl are used to good effect on the Odyssey 183, and it was difficult to fault it. The loose-fit look of the seating upholstery drew several negative comments, mostly for prolonged comfort next to the skin. The only real mark-downs here were for the plastic buttons covering upholstered panel fasteners, a problem for which there is no easy solution. It's a compromise many manufacturers use to speed production of the boats and hold down the cost.

Being one of the deepest V-shapes among our test boats, the Cobia received good marks for idling comfortably, for running at speed into both bay chop and 1- to 2-footers out in the Gulf, and excellent marks for running with waves behind and on the stern quarters. Steering worked smoothly and the Quicksilver Commander Side Mount Trim Control shifted flawlessly. The trim switch button right at your thumb is very convenient, and there's also a clever ignition safety stop switch feature built into the unit.

The Cobia Odyssey 183 VBR scored 63 points out of a possible 70, just two less than the Mark Twain.

Regal 195 Medallion

We would never have guessed that one of the two longest boats in our test, specifically the one that was the heaviest, would garner second place in standing start acceleration.

Part of the explanation may include the flatter 15° transom deadrise angle—the flattest aftersection of any boat we tested. This may also account for the fourth place turning times the boat racked up. A flatter stern would tend to slide sideways just a shade more than a stern with a deeper V.

The Regal Medallion also garnered the storage capacity category win with a whopping 26-plus cubic feet, including the only proper glovebox.

And although the on-water test ranking was a fourth, the total of 62 points in this category is only three points below the first-place Mark Twain. Our testers marked braking/slowing and turning confidence as excellent on the Regal 195 Medallion.

They were also praiseworthy of the comfortable seating in all areas except the aft jump seats, which could have been a little higher to provide better back support.

The console was nicely padded, a plus that escaped us all until the glaring sun began to eat away at our late afternoon vision, reflecting off the other boats' fiberglass consoles. Push-pull switches cropped up here, and they weren't marked for function, nor were they fused. The big Faria speedo was partially obscured by the steering wheel, but the fuel gauge was readable. One tester remarked that the reach for the steering wheel was greater than

most, giving him that elbows-slightly-bent, both-hands-on-the-wheel sports car feeling.

The Regal 195 Medallion received good marks for ride comfort in various wind and wave combinations at different speeds. Everyone liked the foot rests for driver and passenger. Turning was ranked quite high by one tester, who noted "the smoothest wheel feel of the lot." Shifting was flawless.

Styling comments produced top marks for graphics and hull lines, with special notation for well-padded side panels and the belted look of the seating. The medallions in the belting did draw fire, as did the lack of a passenger safety handrail. Fit and finish were quite good, with no exposed fasteners and no unfinished edges.

Summing up

All of our test boats had the same problem with walk-through windshields. Try as they might, manufacturers have yet to come up with the answer for the ever-present sharp edge in the metal frame. Perhaps there's just no easy solution, no way to ensure a solid fit by cutting down the sharp corners. Better yet, maybe common-sense labeling should prevail, something like, "Pass through only when boat is at rest."

Which one should you buy? If high performance is your main criteria, then you must look at the Cobia and the Wellcraft first. That's not to say that the Regal 195 Medallion is that much slower. It's not, and it has considerably more storage than either the Cobia or Wellcraft. If top end performance means less to you than family comfort, excellent water manners and a wonderful feeling of security, then the Mark Twain will be your choice.

FM

SPECIFICATIONS AND DIMENSIONS

BOAT*	BASE PRICE ¹	PRICE AS TESTED ²	ENGINE	MFRS. SUGGESTED MAX. HP	LENGTH OVERALL (LOA) ³	MAX. BEAM (WIDTH) ³	DRY WEIGHT (lbs.) ³	WEIGHT AS TESTED ⁴	DEADRISE AT TRANSOM ⁵
Cobia Odyssey 183 VBR	\$4,874	\$12,120	Mercury 150 60° V6	150	17'6"	88"	1,240	2,250	19°
Mark Twain 190 BR	\$5,255	\$12,325	Mariner 150 60° V6	175	18'6"	90"	1,400	2,410	18°
Regal 195 Medallion	\$6,665	\$13,911	Mercury 150 60° V6	160	18'6"	86"	1,425	2,435	15°
Wellcraft 180 Elite	\$6,995	\$14,065	Mariner 150 60° V6	150	17'7"	86"	1,295	2,305	19°

*All are six-passenger bowriders.

1. Price stated is FOB at manufacturing facility. It does not include transportation, dealer prep and optional equipment.

Prices may change before story goes to press.

2. Includes Mercury or Mariner outboard, new Laser s.s. prop, Quicksilver Commander Side Mount Trim Control, Quicksilver Throttle and Shift Cables.

3. As measured at Mercury Marine test site, Placida, Fla.

4. Includes dry weight, 380-lb. engine, 200-lb. rigging and 430-lb. test crew.

5. Measurement of angle from horizontal plane below keel centerline at transom up to bottom of planing surfaces, indicating degree of hull V remaining at transom.

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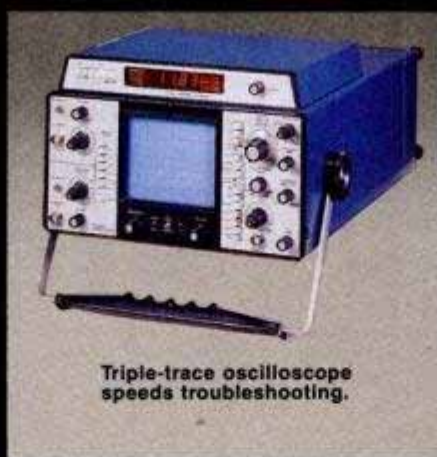
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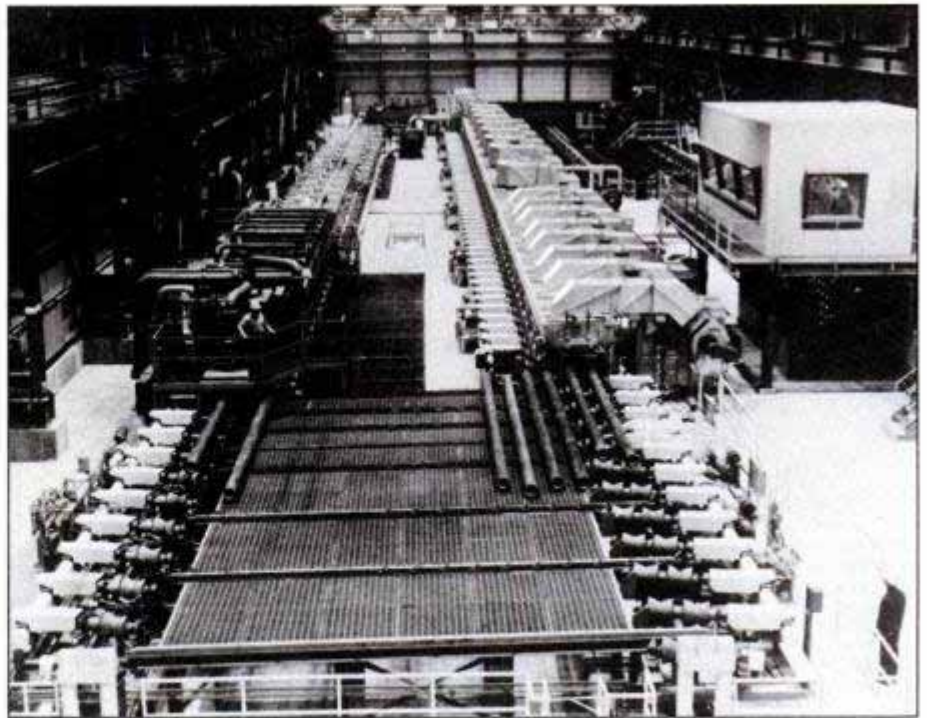
(Continued from page 88)

grip on the market with stronger and cheaper steels, industry experts believe that only a technological miracle will help us bust through the steel curtain.

One such miracle is scheduled to swing into full operation this summer. The Timken Co., whose 17,000 employees produce mostly roller bearings, will soon be offering specialty steels priced and formulated to compete with the best imports. Timken's new \$500 million Faircrest plant near Canton, Ohio, includes a Continuous Thermal Treatment Facility (CTTF) and a unique, high-capacity, computer-controlled electric arc furnace that together will double the capacity of any existing Timken plant. The quality of the steel also will be upgraded dramatically.

"We have tentative plans which carry this plant to the year 2,000," Timken President Joseph Toot told a press briefing. The CTTF, in operation since last year, heat-treats a wide variety of steels to hardnesses specified for construction, machinery and automotive industry needs. Automation is expected to cut prices by as much as 20 percent.

The plant's Krupp Electric Arc Furnace features capabilities not included even in Krupp furnaces now operating



Timken's Continuous Thermal Treatment Facility produces a variety of steels specified for automotive, machine or construction use, and produces them at the lowest cost ever.

in Europe. "The furnace will operate at some three times the speed of existing furnaces," says Faircrest plant director Bill J. Bowling. It will be manned by no more than five men, half the number

required at previous furnaces.

The furnace looks like a giant spaghetti pot with a set of three rods thrust through the center of its 22-foot-diameter

(Please turn to page 124)

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Scott isn't just quick on his feet. He set a parachute-skiing record by soaring 70 stories higher than the world's tallest building. That record caught the attention of the FAA. "I actually needed flight clearance," notes Scott.

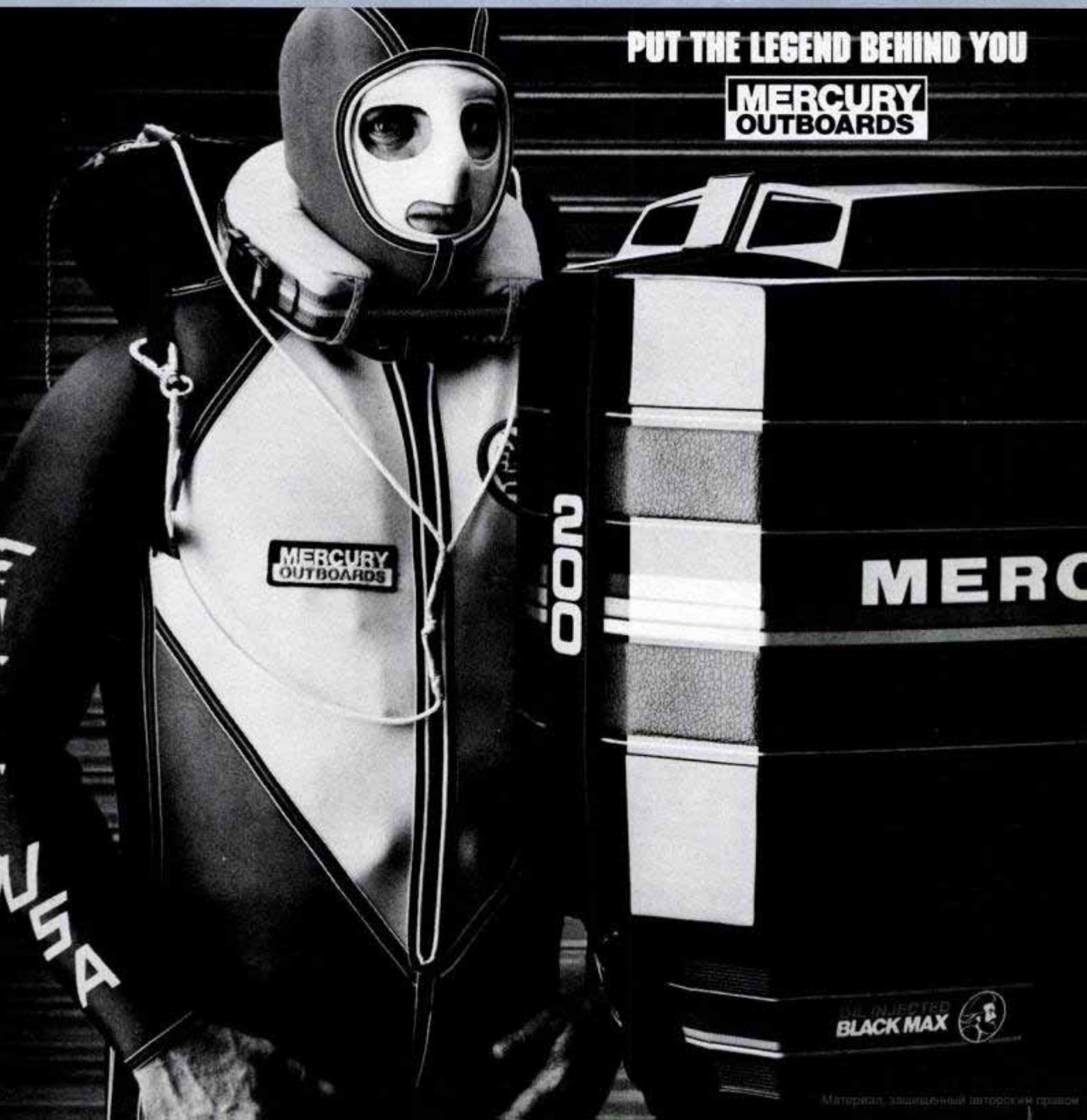
THE MERC

When Scott isn't holding a supercharged hydroplane by the tail, he's skiing behind his 200-horse Mercury® Black Max® Big brother to the Merc 150 that beat every outboard and inboard in American Water Skiing Association performance tests. "It just cruises when inboards are straining for RPM's," testifies Scott.

Performance like that is everything to speed legend Scott Pellaton, who believes there are only two kinds of people on the water. Those who ski. And those who ride the wings of Mercury.

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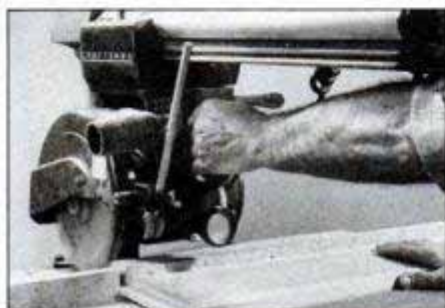
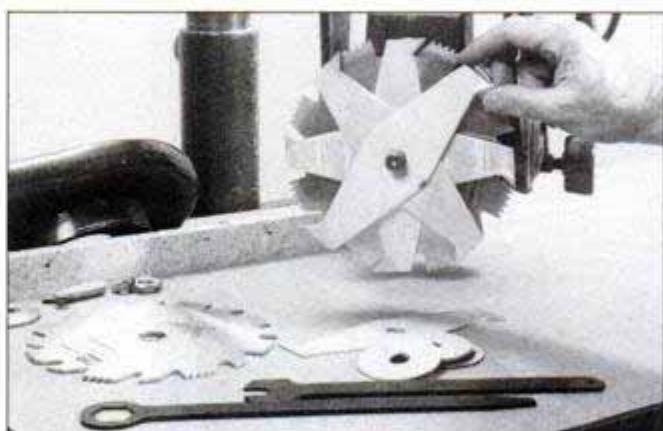
Using dado blades: Part III

In the last two months, we showed how to use dado blades on a table saw. This month we concentrate on the radial-arm saw. For this tool, two critical precautions apply.

First, because dado blades take a bigger "bite," the natural tendency for the saw to self-feed when crosscutting is increased greatly. Therefore, be sure to grip the carriage handle firmly and pull it slowly across the work. Second, when rip cutting with the grain, always feed the work *against* the blade rotation and be sure to keep the blade guard and antikickback fingers in place at all times.

—Rosario Capotosto

To reduce vibration, make sure interior chipper blades are spaced evenly around the circumference of outside cutting blades.



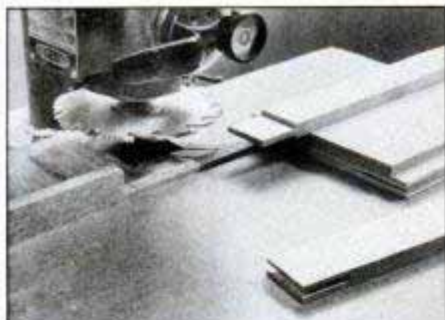
If board is bowed (above), angled cut will result. To correct, clamp stock to table or shim other end of board so board lays flat.



To cut grooves, set up saw for ripping. Adjust blade height, keep kickback fingers on top of stock and use push stick.



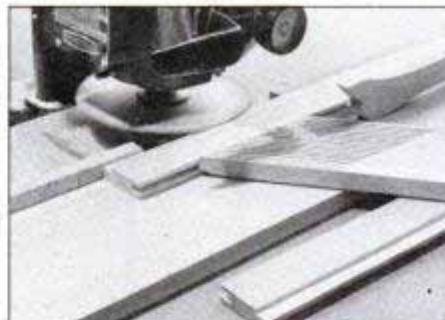
To cut precise stopped dados across the surface of board, firmly attach clamp to saw arm to limit outward travel of the carriage.



To form tenons, align blades horizontally and cut one side of board, then other. Guard removed in photo (and others) for clarity.



To groove an edge, align blade, lock yoke, feed work against blade rotation. Feather-board keeps work against fence.



Matching tongue is cut in same manner as groove. Adjust blade height, make first cut, flip board end-for-end to make second cut.



To cut stopped dados or blind grooves, clamp stop blocks to fence. Butt stock to rear block, then swing into rotating blades.



To cut rabbet on round stock, clamp mitered guide boards against fence and lock saw yoke in place. Rotate stock against blades.



To cut cove, tilt and angle blades, then lock in place. Feed stock between double fence and cut no more than 1/8 in. on each pass.

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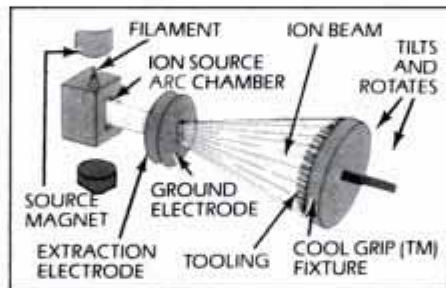
(Continued from page 120)

ter lid. These are the electrodes which zap the raw iron and carbon materials with a constant power of 750 volts. At temperatures of up to 3,000°F., the quickly heated and quickly cooled furnace can produce steels with extreme hardness or added resilience, depending on the carbon content in the pot, which is called the shell. The Krupp furnace shell can be tilted in any direction during melting, providing an added means of mixing carbon and iron.

The rate at which carbon and iron mix and the rate at which the mixture is heated and cooled determines the structural properties of the steel. Japan, whose arc furnaces outpaced ours in technology for the past three decades, will have to play catch-up.

While price and quality of the steel itself have given foreign competitors the edge, the newest methods of strengthening steel after processing also have been introduced overseas. Coated steels, whose surfaces are painted with chemicals that extend the life of the metal in machines, have become a mainstay of the international market. But something is emerging from American technology that may make most coated steels obsolete.

It's called ion implantation, and until five years ago it was used only in the semiconductor industry. On a microchip, an ion (an atom with one more or one less electron than it should have), helps form the carrier for electronic bits of information. On steel, the ion makes a tight bond with carbon and iron atoms, delaying the time it takes to scrape away the surface.



In ion implantation, nitrogen gas is fired at the steel on a beam of electrons to harden the steel better than surface coats.

"All parts made of steel can be made more wear resistant through this process," says Andrew Wittkower, president of Zymet Inc., a pioneer in ion implantation. "Ion implantation has been shown to extend the life of a steel product by two to 12 times."

In the ion-implantation process, nitrogen gas is accelerated through an arc

chamber to the surface of the steel. Electrodes at the ion source hit the gas molecules with electrons sending a stream of ions to the surface of the steel, which is rotated and tilted on a "cool grip fixture." Through the rotation, the entire surface of the metal is implanted. As the surface starts to wear, the nitrogen ions combine with iron and carbon ions deeper into the metal so the hardening is prolonged.

Among Zymet's earliest customers have been Japanese steel producers. But the Zymeting process is scheduled to go into a half-dozen American steel plants this year and the advantage is said to be on America's side.

In another innovative process, Armco has developed a line of stainless steels with high strength and unusually high corrosion resistance. The "nitronic" steels use nitrogen gas in the cooling process to strengthen the surface of a specialized steel alloyed with chromium, nickel and manganese.

Before the Tsukuba Expo '85, Japanese industry and technology ministry spokesman Eguchi Ohiru said: "Looking to America, we see new steel technologies coming into use, and we must wonder if we are in for a new round of competition." That appears to be just what the doctor ordered for America's ailing steel industry. **PM**

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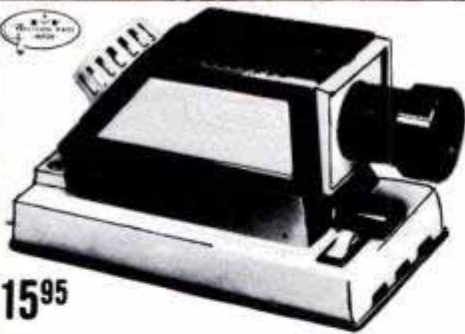
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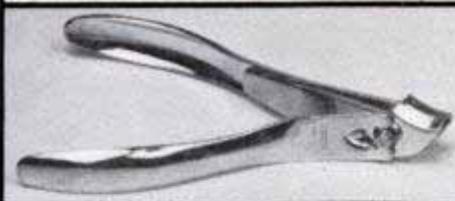


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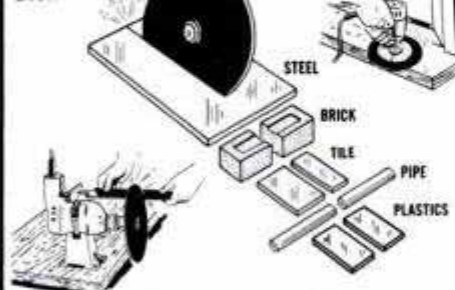


Problem Nails? Use these specially designed Clippers to cut through thickened nails safely and easily! Here's the answer to ingrown nails. Contoured Clipper Blades cut nails at the right angle... reduces the chance of ingrown nails. Fine quality Surgical Steel.

No. 3167—Toenail Clipper\$2.98
Save More! 2 for 4.99

WHIZZ-DISC SLICES THROUGH STEEL & STONE!

WITH SILICONE CARBIDE CUTTING WHEEL AND SANDING DISK



Zips Through The Toughest Materials:

- Brick
- Steel
- Pipe
- Tile
- Plastics
- Cement
- Fiberglass
- Sheet Metal
- Stone

Turns any electric drill into a powerful cutter! Makes quick work of the toughest materials. Man-made Silicone Carbide even zips through concrete and brick... effortlessly! Use it sideways and it becomes a speedy sanding disk for removing layers of paint and rust. Sharpens tools too! 101 uses around the home and shop. WHIZZ-DISC is shatterproof and completely safe to use.

No. 4699—Whizz-Disc Cutting Wheel\$4.99

Recharge Old Batteries... For Less Than a Penny!



Don't throw batteries away! Now, recharge weak or worn down batteries for less than a penny! Use it for any make, type or size: "A", "C", "D", Penlight, Transistor, etc. Actually gives them new life many times over! Recharges 1 to 4 batteries at the same time! Just plug Charger into outlet—see batteries come back, fresh and powerful!

No. 4104—Battery Charger\$14.95

CHANGE YOUR OIL AUTOMATICALLY!

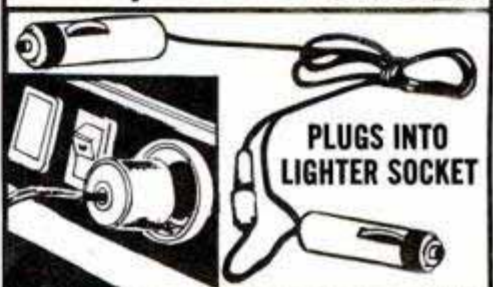


Takes Only Minutes—Works From Under The Hood! No Squeezing Under Car—No Mess!

Now, if you can open your car's hood — you can change the oil. Our powerful OIL CHANGER PUMP finishes the job in mere minutes. No squeezing under the car... no mess... done in no time. Pump attaches to car battery with alligator clips. Suction Tube goes down dip-stick tube — other end to bucket or receptacle for disposal of old oil. Pumps up to 2 liters per minute... pays for itself.

No. 1120—Oil Changer Pump\$14.98

NEW, CAR STARTER



PLUGS INTO LIGHTER SOCKET

JUMP YOUR CAR RIGHT FROM THE DRIVER'S SEAT WITHOUT DANGEROUS CABLES!

No need to mess around under the hood — now there's a better way! Battery too weak to start? Jump it... just plug into your car's lighter receptacle — other end plugs into car with good battery — in a few seconds, you're on your way! Has a big 16 foot cable with built-in heavy duty fuse.

No. 1118—Car Starter\$9.99
Special Price For 2... ONLY 17.95

DELUXE HEAVY-DUTY MODEL FOR TOUGHEST STARTS!

Built in Heavy Duty Circuit Breaker and Plugs gets you started under the worst conditions. Vinyl carrying case.

No. 1135—Deluxe Car Starter\$14.95

Foster-Trent inc

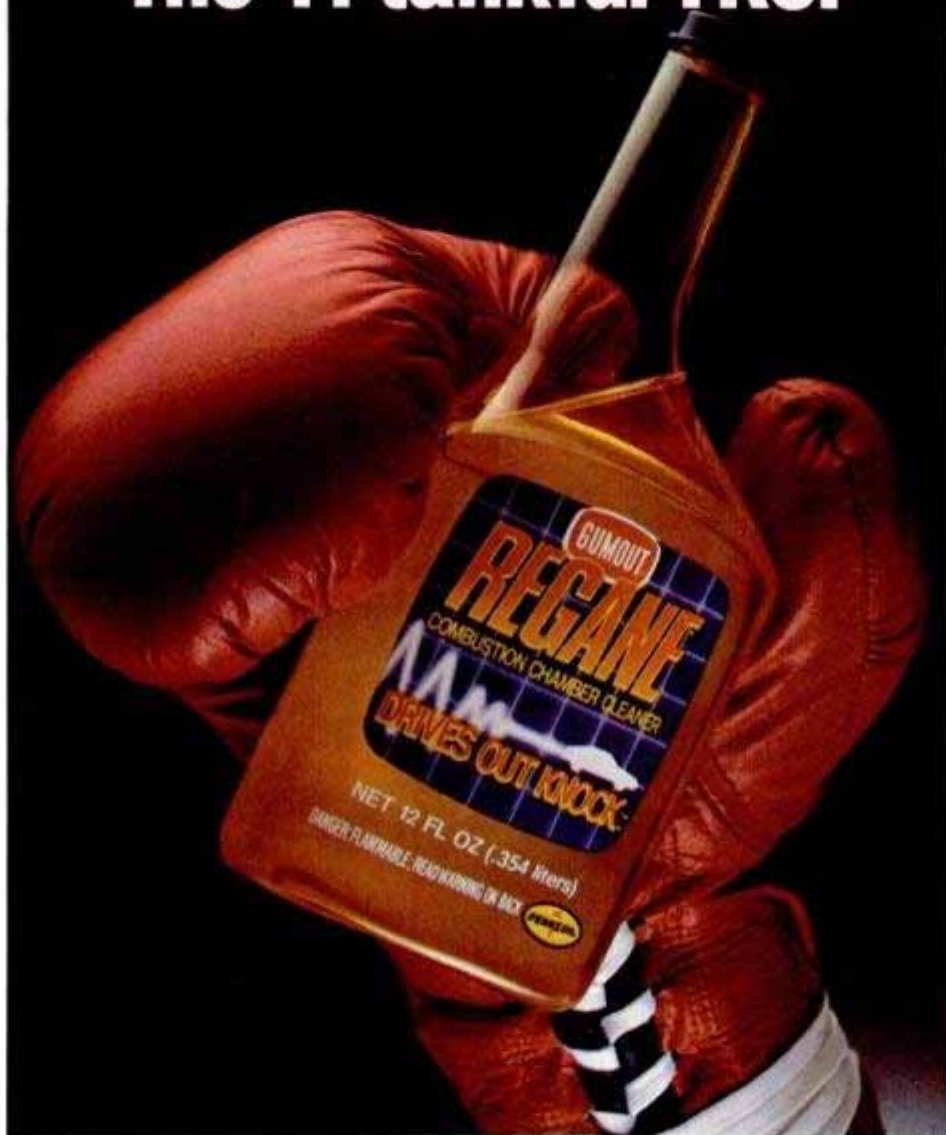
2345 Post Road, Dept. 522-F Larchmont, N.Y. 10538
RUSH the items ordered below on 30 DAY TRIAL — complete satisfaction GUARANTEED or my money back (except postage & handling) my payment is enclosed including 1.65 for postage & handling, (sorry no C.O.D.).

QUAN.	SIZE	ITEM NO.	DESCRIPTION	PRICE
SHIPPING & HANDLING			1.65	
N.Y. Residents Must Add Sales Tax				
Total Enclosed				

For FASTER U.P.S. Delivery Use Street Address & Apt. #
Print Name _____
Address _____ Apt. # _____
City _____
State _____ Zip _____

NEW REGANE™

The 11 tankful TKO.



Win the fight against engine knock with Regane, the longer, stronger Technological Knock Out.

Knock is caused by dirty combustion chambers, valve stems and pistons. Switching to a higher octane fuel, or using octane boosters doesn't solve the problem. It merely avoids it. For one tankful.

Regane treats the cause. It begins cleaning as soon as you pour it into your gas tank and start the engine. And Regane so thoroughly cleans that the effects last an average of 2,700 miles or 11 tankfuls.* Which means Regane is not only more effective, it's a lot cheaper than using premium gas or octane boosters every tankful.

So get a glove on Regane, the winner and new champion by an 11 tankful TKO.

*Based on average miles driven per tank. Source: Motor Vehicle Manufacturers Assn. 1982.

DRIVES OUT KNOCK FOR 2,700 MILES!

A quality product of the Pennzoil Company. 



15 COMMON HOUSE PROBLEMS

(Continued from page 48)

13 Hot water heater, missing controls and improper installation—21 percent of all homes inspected.

Domestic hot water in a house is produced either through the heating system by means of a tankless coil or through a tank-type unit that is heated by either gas, oil or electricity. When the domestic hot water is produced through the heating system, there often is no relief valve in the hot water piping by the tankless coil. A relief valve both temperature- and pressure-sensitive is necessary for safety.

The water heater shown is not connected properly to the gas line. Because a water heater is considered stationary equipment, it should be connected to the gas line through rigid black pipe rather than through a flexible pipe. Also, the exhaust stack should slope upward from the top of the water heater to the chimney connection.

14 Windows with damaged sash cords—20 percent of homes inspected.

Quite often, the sashes of double hung windows in older homes are balanced using cords and counterweights. Cords fray, break and need replacing. They can be replaced with new cords or metal chains, or the counterweight system can be replaced with a pressure-balance system.

15 Garage problems—18 percent of all homes inspected.

When a house has a detached garage, the problems normally encountered are termites and rot, especially in the sill plate. In older detached garages, the sill plate often is mounted directly on the ground, where it rots.

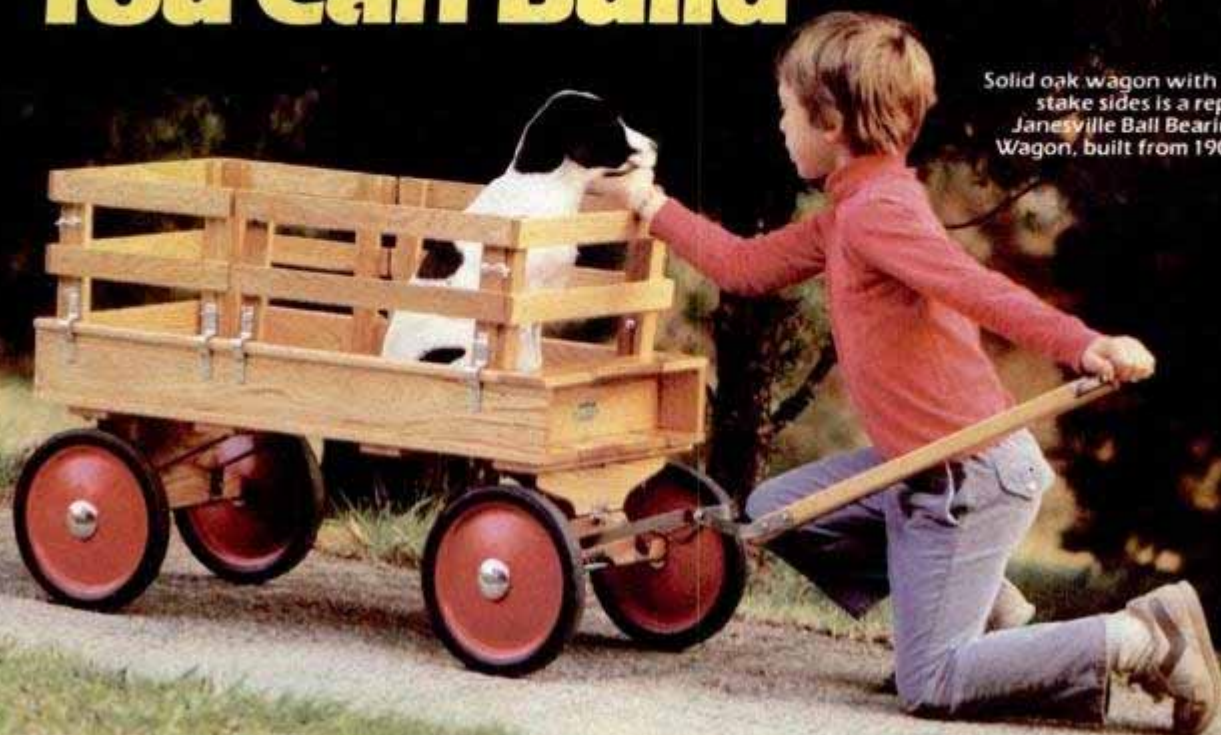
Another common problem in a detached garage is a concave rear wall, nudged by parking cars. Correcting this requires resetting the wall.

In an attached garage, the floor slab is often at the same level as the adjacent interior room. The exhaust gases from a car are heavier than air and consequently tend to accumulate near the floor, where they could easily enter the adjacent room. To minimize this possibility, the joints around the interior door should be weatherstripped and the door should be self-closing. Also, the garage ceiling and walls adjacent to habitable rooms should be covered with fire-rated gypsum board. **PM**

For more information on house problems and how to inspect a house, see *The Complete Book Of Home Inspection* by Norman Becker, P.E. To purchase a copy, send \$8.95 plus state tax, noting the book title, to: McGraw-Hill Book Co., General Books Div.-35 HD, 1221 Avenue of the Americas, New York, N.Y. 10020.

CHILDREN'S TOYS

Three Classics You Can Build



Solid oak wagon with removable stake sides is a replica of the Janesville Ball Bearing Coaster Wagon, built from 1900 to 1934.

These classic hardwood toys recall the utilitarian playthings of yesteryear.

In an age of disposable products, toys that work and last a lifetime may come as a surprise. But Wisconsin Wagon Co. of Janesville, Wis., builds replicas of toys that in the past would have been handed down from one generation to the next. The coaster wagon, wheelbarrow and kiddy car shown here are examples.

You can build these three time-honored toys from our drawings on the following pages. Or you can order full-size plans for each toy from Wisconsin Wagon Co., 507 Laurel St., Janesville, Wis. 53545.

Wisconsin Wagon Co. also sells hardware packages for each toy, including wheels. The parts included in these packages, and the cost, are given at the end of each materials list.

Coaster wagon

All the body and trim parts of the coaster wagon are made from $\frac{1}{2}$ -in.-thick red oak. The handlebar and bolsters—the vertical supports that join the body of the wagon to the wheels—are $1\frac{1}{16}$ -in.-thick red oak. When you are



Wheelbarrow with 10-in. wheel and lift-off sides is scale model of a traditional turn-of-the-century wheelbarrow known as the "Missouri No. 3." Kiddy car, left, has 5-in. wooden wheels with rubber tires.

purchasing the wood, be sure to choose stock that is warp-free, and as straight-grained as possible.

Begin by cutting the wagon body and trim parts to length and width. Rout the four $\frac{1}{8}$ -in.-deep \times $\frac{1}{2}$ -in.-wide dados in

Text: Arthur Rooze, Associate Home and Shop Editor

Photos: George Ancona

Technical art: Dyck Fledderus

the sides to accept the body end pieces. Now mark the $8\frac{3}{4}$ -in.-rad. handlebar guide on the dashboard, and cut with a jigsaw.

Assemble the body and trim with screws only; no glue is used. In all cases bore pilot holes and clearance holes for the screws, and counterbore to set

(Please turn to page 130)

If you've ever had a Wagner® Power Painter Without lift

You won't have to haul out a drop cloth. Or pull on an old pair of jeans.

Learning to use a Wagner® Power Painter® will take under three minutes. Less time than it would take to boil an egg.

So, sit back. Relax. And let's go.

1. Assemble your Power Painter.

When you open your Power Painter kit, you'll find an assortment of accessories to help you with all kinds of painting jobs.

But there are only two basic steps to assembly. Attach a plastic tube. And screw on a plastic paint container.

2. Prepare the paint.

Some paints are fine for spraying right out of the can. These include most enamels and oils.

Latex, on the other hand, is often too thick. So you may have to mix in a little

water. (Don't worry. With a Power Painter you'll still get complete coverage.)

To find the right consistency, use the viscosity cup. (A fancy name for what's really just a funnel with a handle.)

Dip it into your can of paint. Then time how long it takes to empty. For latex, 75 to 85 seconds is just about right.

When the paint is ready, just fill your container and screw it onto the gun.

3. Check the spray tip.

You'll find it mounted conveniently on the front of your Power Painter.

Just give it a twist to make sure it's on tight.

4. Plug it in.

(We told you this would be easy.)

5. Adjust the spray.

Hold the Power Painter upright, about a foot away from a drop cloth, or last week's newspaper. Pull the

trigger and start spraying.

In the back of your Power Painter you'll notice a knob. Turn it until you get a good, even pattern.

6. A few last tips.

To get a nice even coat without any runs, move your Power Painter at a steady speed.

Then, at the end of each stroke, release the trigger.

This will also help give you the smoothest possible finish.

7. Clean-up.

We'd like to tell you there's nothing to it. The truth is, you'll have to spend all of ten minutes. And you'll need a little solvent, soapy water, or Wagner Power Painter Cleaner/Lubricant.

That's it. That's all there is to mastering a Wagner Power Painter.

In real life, of course, getting it up to speed will take longer than boiling an egg.

d the urge to try ter,[®] here's your chance. ing a finger.

But not a lot longer.

If you're handy, you'll be off and running in, say, the time it would take to cook a whole breakfast.

For more information on the Wagner Power Painter, just call toll free 1-800-328-2285.



*The Right Tool for Painting.**



screwheads 1/32 in. below the surface of the wood.

Begin by assembling the bottom boards. Lay them upside down on a flat work surface, separated by 1/4-in. spacers, with the 3 1/2-in.-wide boards on the outside. Square the corners, align the board ends and hold them in position by tacking strips to the work surface around the perimeter. Mark the posi-

tion of the four cleats, then attach them to the bottom boards with two screws at each board.

Assemble the body side and end pieces and join the assembled rectangle to the bottom boards with 1 1/4-in. No. 8 fh screws. Allow 1/4-in. setback at the sides. Secure the end trim, side trim and dashboard in place with screws as shown, allowing 1/4-in. overhang at sides and back. Ease the top inner and outer edges of trim and dashboard with a router, using a 1/4-in.-rad. rounding-over bit.

Assemble the six stake sections with 7/8-in. No. 8 fh screws, allowing all horizontal strips to overhang the verticals 1/2 in. Cut the handlebar to size, and ease the edges with a 1/4-in.-rad. rounding-over bit.

Now you should cut the front and rear bolster parts to overall size. Outline the

contours and cut them to shape with a jigsaw or band saw. Rout a 1/4-in.-rad. groove in the bottom edges for the axle, and bore the holes for the vertical axle and the axle clips, yoke and bolster braces.

Before proceeding further with assembly, sand all the wagon parts, first with 120-grit sandpaper, then 220-grit sandpaper. Ease all corners and edges slightly. Apply three coats of clear polyurethane varnish, sanding lightly between each coat.

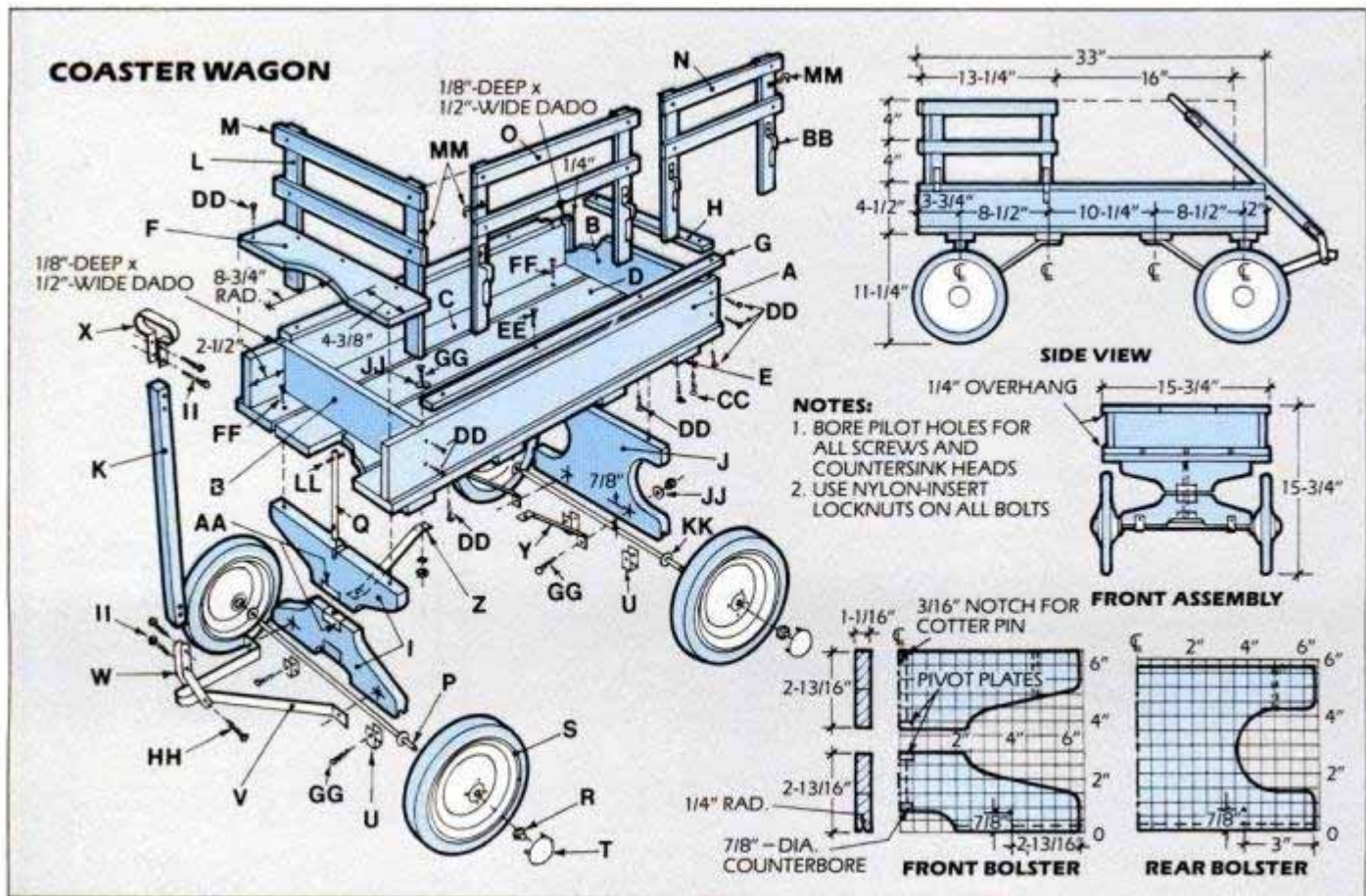
After the finish is dry, mount the pivot plates to the top and bottom front bolster pieces, then slide the vertical axle through these pieces with the bolster brace between them. Insert cotter pins at each end of the vertical axle.

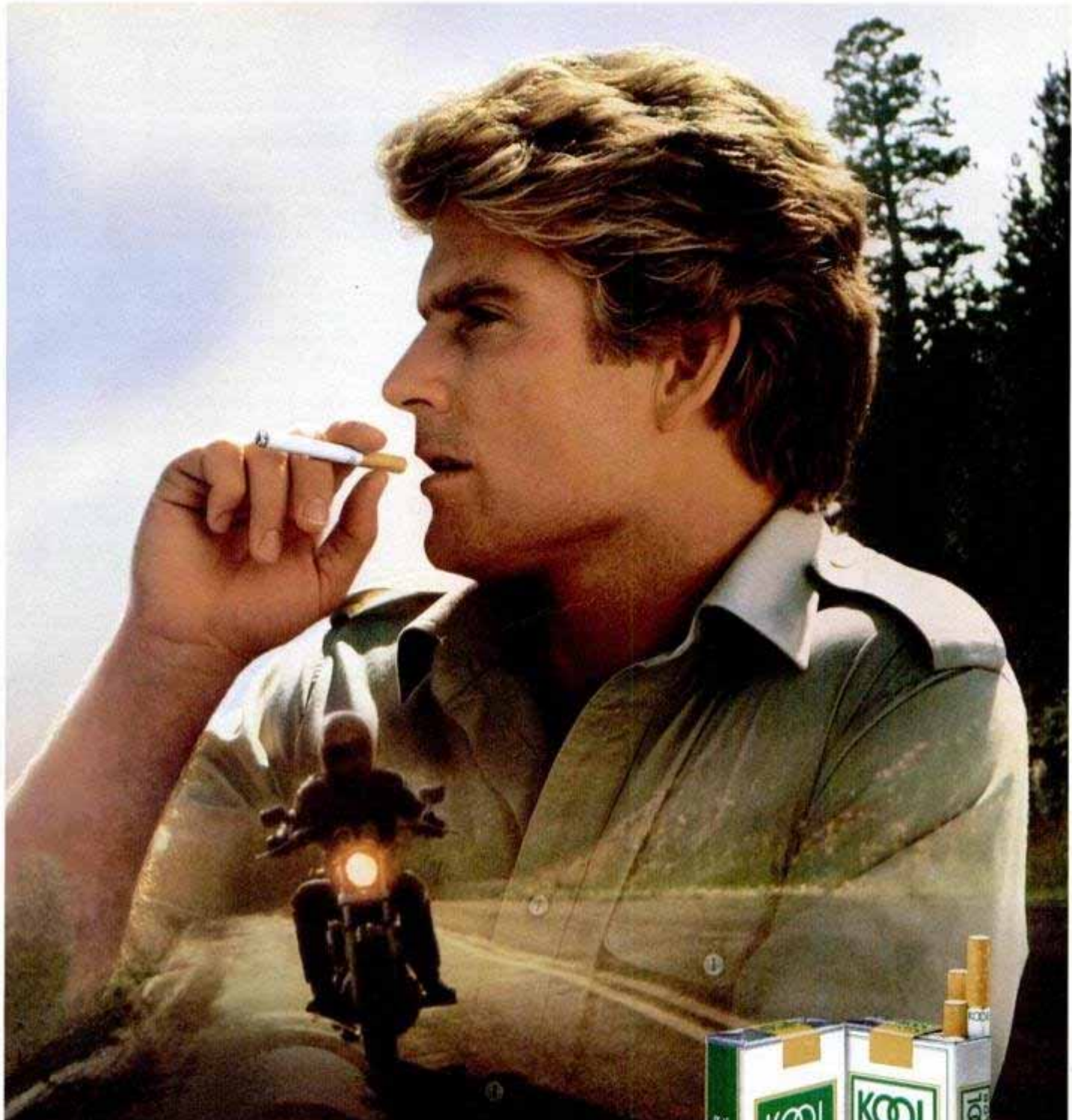
Bore holes in the bolsters for the 1/4-in.-dia. carriage bolts that secure them (Please turn to page 132)

MATERIALS LIST—COASTER WAGON

Key	No.	Size and description (use)	O	4	1/2 x 1 1/2 x 16" oak (stake long side)	EE	11	1" No. 8 fh screw
A	2	1/2 x 3 1/2 x 33" oak (side)	P	2	1/2"-dia. steel (axle)**	FF	4	1/4-20 x 3" carriage bolt
B	2	1/2 x 3 1/2 x 14 1/2" oak (end)	Q	1	1/2"-dia. steel (vertical axle)**	GG	7	1/4-20 x 1 1/2" carriage bolt
C	2	1/2 x 3 1/2 x 33" oak (outer floorboard)	R	4	1/2"-dia. pushnuts**	HH	1	1/4-20 x 4" machine bolt
D	2	1/2 x 4 x 33" oak (inner floorboard)	S	4	10"-dia. ball-bearing wheel*	II	4	3/16-24 x 1 1/2" stove bolt
E	4	1/2 x 2 1/2 x 15 1/4" oak (cleat)	T	4	chrome-plated hubcap*	JJ	7	1/4" flat steel washer
F	1	1/2 x 3 x 15 1/4" oak (dashboard)	U	4	axle clip**	KK	4	1/2" flat steel washer
G	2	1/2 x 3/4 x 30" oak (side trim)	V	1	yoke, zinc-plated steel***	LL	2	1/16 x 1" cotter pin
H	1	1/2 x 3/4 x 14 1/4" oak (end trim)	W	2	handlebar bracket, zinc-plated steel***	MM	4	1" hook and eye
I	2	1 1/16 x 2 13/16 x 12 3/4" oak (top and bottom bolster)	X	1	handle, zinc-plated steel***			
J	1	1 1/16 x 5 3/4 x 12 3/4" oak (rear bolster)	Y	2	rear bolster brace, zinc-plated steel***			
K	1	1 1/16 x 1 1/16 x 23" oak (handlebar)	Z	1	front bolster brace, zinc-plated steel***			
L	12	1/2 x 1 1/2 x 12" oak (stake upright)	AA	2	pivot plate, zinc-plated steel**			
M	4	1/2 x 1 1/2 x 15 1/4" oak (stake front and back)	BB	8	stake side clip, zinc-plated steel, with machine screw and wingnut****			
N	4	1/2 x 1 1/2 x 13 1/4" oak (stake short side)	CC	56	7/8" No. 8 fh screw			
			DD	31	1 1/4" No. 8 fh screw			

Misc: 120- and 220-grit sandpaper, clear polyurethane varnish.
 *Hardware kit 1: \$35.50. **Hardware kit 2: \$27.50. ***Hardware kit 3: \$26.50. ****Hardware kit 4: \$6.50. Kits 1 and 2 ordered in combination: \$54. Kits 1, 2 and 3 ordered in combination: \$78.50. Full-size plans: \$7.50. Prices include shipping. Available from Wisconsin Wagon Co., 507 Laurel St., Janesville, Wis. 53545.





Break away to refreshing taste.

Come up to Kool.



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

© 1997 B&W T Co.
Milds, King's, 10 mg. "tar", 0.7 mg. nicotine av. per cigarette, FTC Report Feb. '85.
Filter King's, 16 mg. "tar", 1.0 mg. nicotine av. per cigarette, FTC Report Feb. '85.

NOW GETTING RID OF RUST IS NO SWEAT.



Eliminate rust without sanding or priming. Just apply Rust Reformer™ to rusty surfaces and it will chemically convert rust to a protective coating.

RUST-OLEUM
Nobody fights rust like Rust-Oleum.

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THREE CLASSIC TOYS YOU CAN BUILD *(Continued from page 130)*



to the body. Position the bolsters, allowing equal overhang on each side of the body. Bore matching holes through the cleats and bottom boards, then bolt the bolsters in place.

Place the axles in the bolster grooves and attach the wheels. Bolt the axle clips, yoke and rear bolster braces to the bolsters. Bore three holes for the bolster braces in the wagon bottom and cleats, and bolt.

Bore holes in the handlebar for the handle and handlebar bracket, and bolt the handlebar assembly to the yoke.

Attach hooks and eyes to the stake sides and mount the stake side clips with $1/8 \times 3/4$ -in. bolts and wingnuts.

Finally, put on your crash helmet and take your wagon for a test ride.

Wheelbarrow

Our wheelbarrow is $14\frac{1}{2}$ in. wide and has an overall length, including the wheel, of $38\frac{1}{2}$ in. The handles are made of maple; all the other wood parts are red oak.

To begin construction, cut the handles to size, then radius the ends and cut the grip contours with a jigsaw. Round all edges with a $1/4$ -in.-rounding-over bit in a router. Mark and cut the angled notch to accept the bottom molding of the front boards.

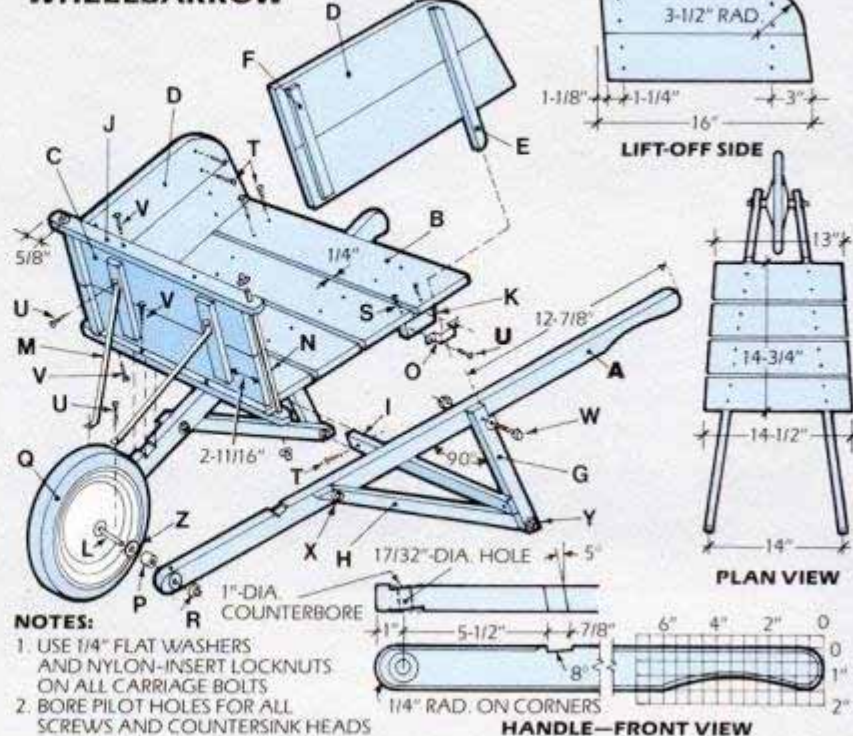
Bore $17/32$ -in.-dia. holes for the axles at 5° angles. Counterbore these holes at the same angle, on both sides of each handle, so the aluminum sleeves and pushnuts will rest flush against the handles.

(Please turn to page 140)

MATERIALS LIST—WHEELBARROW

Key	No.	Size and description (use)		
A	2	$1 \times 1\frac{1}{2} \times 34\frac{1}{2}$ maple (handle)	O	2 $\frac{1}{2} \times 2\frac{1}{2}$ " steel strap (stake pocket)*
B	4	$\frac{5}{16} \times 3\frac{1}{2} \times 14\frac{1}{2}$ " oak (floorboard)	P	2 $\frac{1}{4}$ "-dia. \times $\frac{1}{2}$ " aluminum sleeve*
C	2	$\frac{1}{2} \times 3\frac{1}{2} \times 12$ " oak (front board)	Q	1 10"-dia. ball-bearing wheel*
D	4	$\frac{1}{2} \times 3\frac{1}{2} \times 16$ " oak (side board)	R	6 $\frac{1}{4}$ "- and $\frac{1}{2}$ "-dia. pushnuts*
E	2	$\frac{1}{2} \times 1 \times 8\frac{1}{4}$ " oak (stake)	S	4 $1\frac{1}{4}$ " No. 8 screws
F	4	$\frac{1}{2} \times \frac{3}{8} \times 6\frac{1}{2}$ " oak (cleat)	T	42 $\frac{7}{8}$ " No. 8 fh screws
G	2	$\frac{3}{4} \times 1\frac{1}{8} \times 9$ " oak (leg)	U	8 $\frac{1}{2}$ " No. 8 panhead screws
H	2	$\frac{3}{8} \times \frac{3}{8} \times 14\frac{3}{4}$ " oak (diagonal bracket)	V	6 $1\frac{1}{4}$ " No. 6 fh screws
I	1	$\frac{1}{2} \times \frac{3}{8} \times 11\frac{1}{4}$ " oak (horizontal bracket)	W	2 $\frac{1}{4}$ -20 \times $2\frac{1}{2}$ " carriage bolt
J	2	$\frac{1}{2} \times \frac{3}{8} \times 14\frac{1}{2}$ " oak (top and bottom molding)	X	2 $\frac{1}{4}$ -20 \times $2\frac{1}{4}$ " carriage bolt
K	2	$\frac{3}{4} \times 1 \times 3$ " oak (stake block)	Y	2 $\frac{1}{4}$ -20 \times $1\frac{1}{2}$ " carriage bolt
L	1	$\frac{1}{2}$ "-dia. \times $5\frac{1}{4}$ " steel axle*	Z	2 $\frac{1}{2}$ " flat steel washer
M	2	$\frac{1}{8} \times \frac{1}{2} \times 7\frac{1}{2}$ " steel brace*		Misc. 120- and 220-grit sandpaper, clear polyurethane varnish.
N	2	$\frac{1}{4}$ "-dia. \times $8\frac{1}{4}$ " steel side-		*Hardware kit: \$22. Full-size plans: \$7.50. Prices include shipping. Available from Wisconsin Wagon Co., 507 Laurel St., Janesville, Wis. 53545.

WHEELBARROW



NOTES:

1. USE $1/4$ " FLAT WASHERS AND NYLON-INSERT LOCKNUTS ON ALL CARRIAGE BOLTS
2. BORE PILOT HOLES FOR ALL SCREWS AND COUNTERSINK HEADS

PM TECHNOLOGY UPDATE 6/85

Big brain on wheels

Designers of high-performance, high-tech racing cars will travel far and wide to bring their emerging wheels to test facilities. It's important to try new auto technologies in the lab before they are tried on the road. Until recently, the testing procedure has been a hassle since the cars have had to be delivered thousands of miles across country. But, thanks to Buick's breakthrough computer technology, the lab can now come to the racing team.

We were given a vivid demonstration at the New Smyrna Beach, Fla., airport during Daytona Speed Weeks. Buick's On Site Computer Aided Research (OSCAR) van was pulled up to the tarmac and plugged in. We were taken for a high-speed slalom ride in a Grand National equipped for the occasion. In its trunk was OSCAR's battery-powered memory.

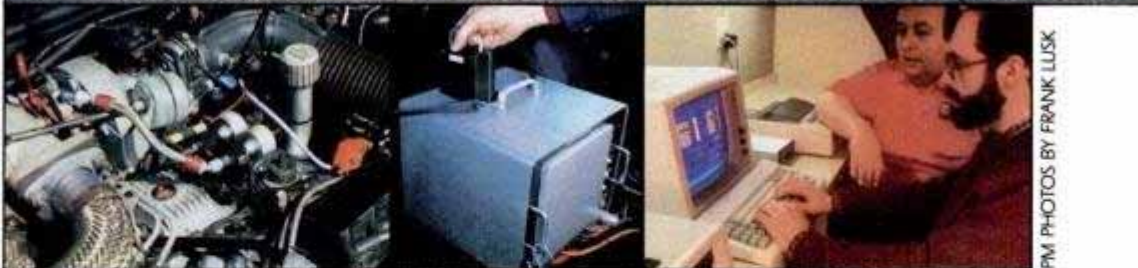
Buick engineer George Claypole, in charge of the project, inserted a 65K memory device into the module, which is wired to 16 sensors that measure everything from exhaust temperature to vehicle yaw. Off we went, zooming down the runway at a tad over 100 mph running a half mile course in a blink of an eye.

After the ride, the memory device was removed and brought into the OSCAR van where it was inserted into an IBM PC. A few numbers were punched in, and up on the computer screen came a graph that measured speed against steering, oil pressure, exhaust temperature and sparking. OSCAR measures 25 inputs per second.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager,
Todd James, Michael Fillon,
David Lampe and Chris Mitchell.



The OSCAR van stands beside a Grand National equipped with 16 sensors to measure car performance. Inside, the van is equipped with computers. Outside, it monitors the weather.



Computer screens (top) show charting of car performance. Colored sensors (above left) hook to memory module in trunk.

SPORTS

Cover your mouth when batting

Baseball batting helmets have had ear guards to protect the player's jaw for 15 years. But this year, little leaguers will have their first face guards. Face Guards Inc. of Roanoke, Va., is introducing the helmets with a snap-on Lexan plastic resin face protector. It protects a batter from shock and im-

pact if he's hit in the facial area. And it allows a clear view of the approaching ball, so the batter will have no trouble seeing when he should swing. The masked helmet costs about \$20. The helmet's designers say it will cut serious little league injuries by more than 20 percent.



PM PHOTOS BY FRANK LUSK

TECHNOLOGY UPDATE

MILITARY



Bell 406 Combat Scout (above) and Hughes 530MG Defender (right) are both equipped to fire deadly wire-guided antitank missiles from outrigger pods.

Sneaky snoopers

Combat helicopters are getting smarter and sneakier every day. Two of the newest and meanest are the Bell 406 Combat Scout (upper left) and Hughes 530MG Defender (lower left). The Defender has a mast-mounted gunsight above the rotor that allows it to spot enemy targets while remaining hidden behind a hill or trees. It can also fire wire-guided TOW antitank missiles without revealing its position. As a missile is launched, it automatically climbs to a height that coincides with the sight's line of view. It can then be guided to the target using the sight to track it. In addition, the Defender has a chin-mounted infrared imaging sensor that gives the pilot a clear view of the terrain ahead even in darkness and bad weather.

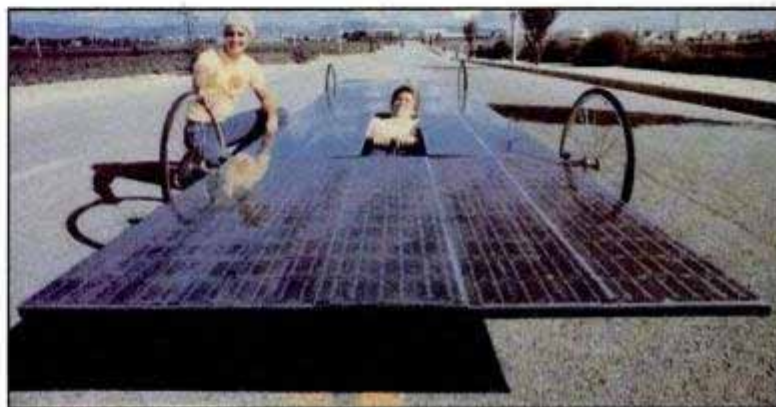
The Bell Combat Scout, a five-place combination scout/attack helicopter, has a roof-mounted sight and also fires TOW antitank missiles. It features a quick-change weapons system that enables it to carry a variety of missiles, rockets and machine guns interchangeably, depending on mission requirements.

SOLAR The fastest solar car

You wouldn't try getting onto the Santa Monica Freeway in the Sunrunner. But this sheet of textured glass on wheels is the fastest solar-powered car in the world. In its most recent run, the Sunrunner went 24.76 mph. Designers Greg Johanson and Joel Davidson of Solar Electrical Systems

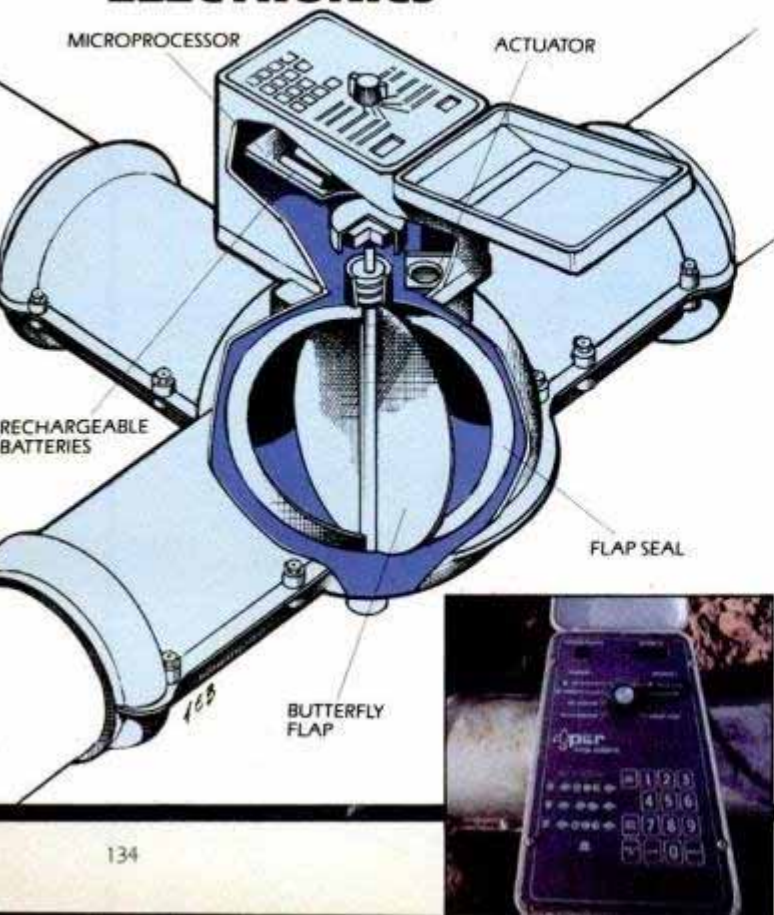
hope to do better this summer.

Sunrunner is lined with 24 photovoltaic cells capable of producing 1,000 peak watts at 68 volts and 16 amps. There is no battery or electric storage device aboard. The one horsepower direct current motor drives a 10-speed gear and chain assembly. Sunrunner is five feet wide and 20 feet long. Its frame is constructed of 3/4-inch chrome tubing. It cost just over \$14,000 to build.



With 24 photovoltaic cells, Sunrunner can hit nearly 25 mph.

ELECTRONICS

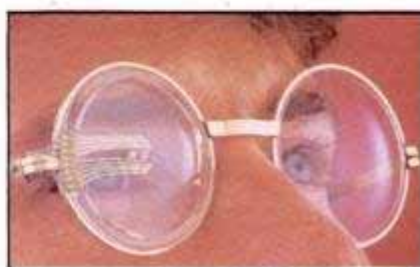


Water surge irrigation

The standard form of irrigation runs water slowly along a field. That method has two problems: as water slogs through the pipes some of it spills out of the irrigation ditch. And slow running water doesn't soak in uniformly. Texas High Plains farmers this year are experimenting with a computerized water surge irrigation system developed by SCS Inc. A surge unit is computer operated, shunting large volumes of water down each planting row. A battery operated timer throws a pair of butterfly valves open and shut so two rows can be watered at a time. With the surge system, U.S. Agriculture Department studies have found, the water soaks down deep, promoting faster and stronger root growth. Surge systems may be available next summer.

Eyeglasses to hear with

The eyeglasses shown in the photo below have light-emitting diodes etched into the glass. Hooked to a mini-computer, the glasses translate sounds into tiny visual cues—a kind of sign language for a deaf person. By reading the lips of the speaker and watching the visual cues, the wearer can engage in normal conversation. The Autocuer, developed by Research Triangle Institute's Robert Beadles, will be commercially available by late 1987.



Wings of the future today

It's no accident that all four of the planes shown here are pusher-powered turboprops and that three of them sprout canard mini wings on their noses. They're the latest in small, fast, six- to 10-seat corporate aircraft designed to combine luxury travel with fuel-efficient economy.

Turboprops offer near-jet speeds at much less cost than jets. Pusher props permit smoother airflow over the wing, reduce prop-wash drag and lessen cabin noise. Canards add lift, save power and help prevent stalls.

The Lear Fan has twin engines driving a single prop, providing redundant power with the safety of centerline thrust. Price of the 1,300-hp, 414-mph craft: about \$2 million. The 1,500-hp, 425-mph Avtek 400 is about \$1.65 million; the 1,600-hp, 460-mph Gates-Piaggio GP-180, about \$2.7 million. Least costly is the single-engine, 700-hp, 300-mph Laser 300. It's all yours for just \$550,000.



LEAR FAN

LASER 300

GATES-PIAGGIO GP-180

AVTEK 400



Spinproof sports plane

According to NASA, 30 percent of all fatal crashes of small aircraft are caused by stalls and the deadly spins that often follow. Now, NASA's Langley Research Center is developing a stall-recovery system that might make light planes virtually immune to spins. It consists of a pair of drooped lips fitted to the wingtips of a Piper Arrow test plane.

The downward-curving lips act somewhat like leading-edge flaps, maintaining airflow over the ailerons even after the inboard sections of the wing have stalled. With the ailerons effective, a plane can be kept wings-level during a stall recovery without falling off into a treacherous spin.



Twin with a twist

This unusual new amphibian can lose one engine and fly right on as if nothing had happened. Because the engines are in line with each other—one pulling, one pushing—a power loss does not result in the violent off-center thrust that can cause serious control problems in conventional twin-engined craft.

Sponsons built into the sides of the hull provide stability in water, eliminating the need for drag-producing outrigger floats. Called the Seastar, the nine-passenger utility transport was developed by the West German firm of Claudius Dornier Seastar. It's intended for military patrol and search and rescue missions as well as short-haul commercial operation.

ENGINEERING

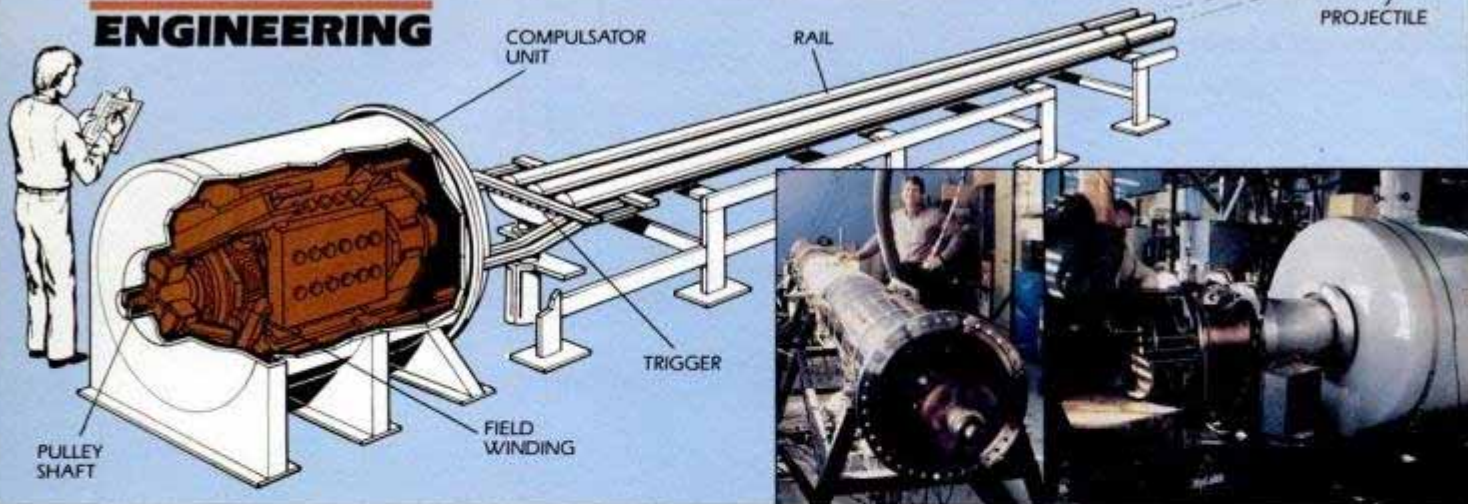


PHOTO BY DAVID LAMPE

Introducing the repeating rail gun

The rail gun is a Star Wars weapon that connects a long rail to a trigger activated by a powerful electric generator. With such a gun, a projectile sits on a pair of conducting rails that are magnetized. When the generator is switched on, a strong magnetic field is generated opposite the rail field and the projectile is launched like a maglev train. It reaches hypersonic speeds in a few minutes, giving a small projectile with no explosives enough force to destroy a guided missile or other target. The problem with rail guns has been that the generator needs stand-down time between shots to cool off and restart.

But researchers at the Center for Electromechanics in Texas think they have licked the problem. Using a new "Compulsator Generator," the CEM rail gun can fire projectiles repeatedly with no stand-down time. The generator's field windings—made of high-tech metal alloys—are able to take repeated jolts of electricity. Instead of grinding into operation, the CEM generator puts out power in pulses, each separated by a few seconds.

The Compulsator Generator may have more peaceful uses than a Star Wars weapon. Designers say future models will be able to launch small packages into low Earth orbit.

America's newest waterway



Floating cargo down the Mississippi from Minnesota to New Orleans has been a mainstay of business in America's breadbasket. New Orleans, the major Gulf of Mexico port, opens a huge number of export routes to the Midwest. The port of Mobile, Ala., could also have been used to carry out produce from the Midwest but for 234 miles of land between the Tennessee and Tombigbee rivers.

This summer, the Army Corps of Engineers and agencies in Tennessee and Alabama are putting an end to that with the opening of the Tenn-Tom Waterway. The \$2 billion project took 10 years to complete. It includes five dams and 10 locks. It will cut the trip from Kansas City to Birmingham by 740 miles and from northern Florida to Pittsburgh by 400 miles. Construction has resulted in the creation of 42,000 acres of recreational lakes in Alabama and Tennessee.

Thanks to the Tenn-Tom, for the first time Americans can make a nonstop boat trip from central Minnesota to either Pennsylvania to the east or the Gulf to the south. Our map shows the results of the new system. The photo (left) gives an aerial view of the Aliceville, Ala., Lock and Dam. The lock includes a gated spillway with four 60-foot gates. The dam has created a 28-mile-long lake, which will be used for fishing and recreation.

In all, the Tenn-Tom connects about 16,000 miles of inland waterways. Its 300-foot-wide navigation channels will be open to all traffic 24 hours a day. There will be no lockage fees for recreational users.



A gem of a discovery



The tiny globe gripped in the tweezers (inset photo) is a rare stone called jadeite. In fact, it's the rarest jadeite in the world. It's man-made, the first of its kind. Created under extremely high pressure and temperature in a thimble-sized furnace (held by scientist in photo above), the jadeite is the product of research at General Electric's Research and Development Center. GE says it has no immediate plans for artificial jadeite, but it may eventually become a competitor with the real thing as jewelry.

MARINE



High living on the high seas

Ever go on an ocean cruise and get stuck in a windowless cabin with no view of the sea? You won't find this aboard the glamorous new *Royal Princess*, the first cruise ship to have no inside cabins. All cabins are on the outside with big picture windows, and some even have their own private balconies. To make this possible, the ship's utilities are concentrated in a central core, leaving the outside spaces for staterooms.

You won't be bored either. Among the ship's many creature comforts are four swimming pools, a gymnasium with sauna, two theaters, a library, nightclub, casino and numerous dining facilities, game rooms, shops and bars. The 758-foot, 45,000-ton luxury liner accommodates 1,260 passengers and a crew of 500. It was built by Wartsila, a prominent Finnish shipbuilder, and will be operated off the West Coast by P&O Cruises.



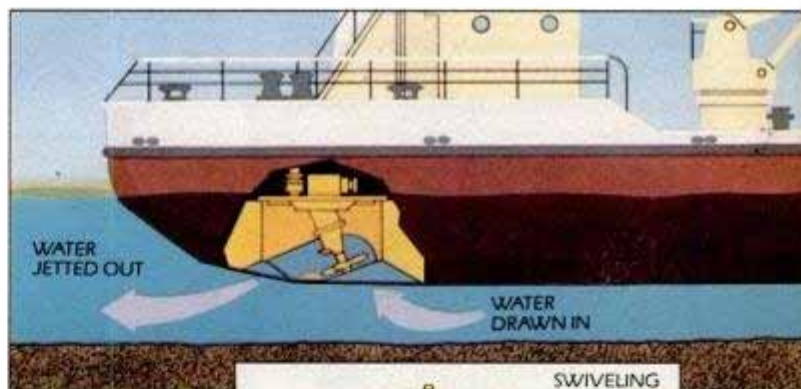
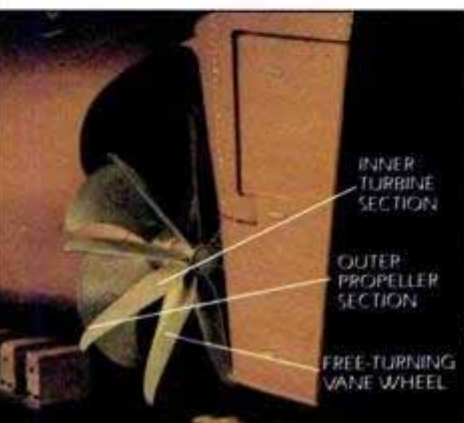
New life at sea

Workers trapped in a submerged vessel or oil rig have to be rescued and decompressed immediately to avoid the bends. Rescue is easy, but decompression is usually a problem if more than two divers are rescued. Britain has come up with a solution: It's a 30-foot-long, reinforced-plastic, pressure rescue vessel. It can rescue up to 70 men at once.

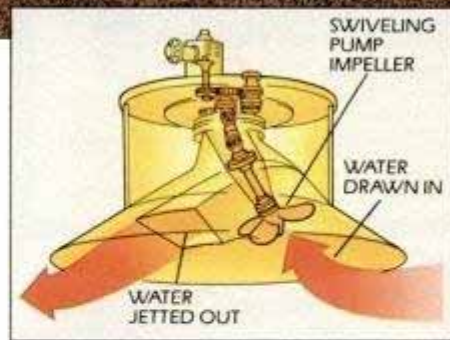
Wasted power put to work

To push a ship forward, its propeller must also push a lot of water backward, wasting energy. Now a multibladed auxiliary propeller, turning freely behind the ship's regular propeller, is putting this energy to work. At its center, the blades are shaped like a turbine's, while at the tips they're shaped like a propeller's. Thus, it's driven like a turbine by the backward flow of water, at the same time functioning as a propeller to convert the lost energy into added thrust.

Invented by German Prof. Otto Grim, the device reduces fuel consumption by as much as 13 percent. It's being installed on cargo vessels by Bremer Vulkan.



Completely recessed in bottom of hull, water-jet drive can't foul on underwater obstacles. It can be installed as a conventional stern drive or as a bow thruster for added maneuverability in tricky waters. Screen keeps out debris.



Jet drive for tricky waters

Vessels operating in very shallow waters face the risk of damaging their propellers on obstructions or running aground because of insufficient maneuverability. Now, an ingenious water-jet drive solves both problems. A pump draws in water through an inlet and discharges it under pressure through an outlet, producing a powerful jet stream. The entire unit rotates 360° so it can turn a ship sharply in any direction, push it sideways, even provide reverse thrust for braking and backing.

The German-designed system, called Cone-Jet, is distributed here by Schottel of America Inc., Miami, Fla.

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TRAILER PARTS

TRAILER FENDERS

Item #	Fits		Length	Weight	Sale/ea
	Wheel	Width			
1260	8"	6"	15 1/2"	2 lbs.	\$5.50
1261	8"	6"	19"	3 lbs.	6.00
1262	12"	7"	22 3/4"	4 lbs.	8.50
1263	12-13"	7"	25 1/4"	5 lbs.	10.00
1264	13-15"	9"	28 1/2"	7 lbs.	17.50



HIGH SPEED HUB and SPINDLE SET

High speed hub and spindle set. 2000 lb. capacity. 4" bolt circle, 4 hole, 2 hubs & 2 spindles. dust caps, tapered bearings, lug bolts & cotter pins...**\$37.50/set**



TRAILER SPRINGS

Item #	Capacity	Capacity	Springs	Leafs	Sale
1250	1000 lb.	2	2		\$22.00/pr
1251	2000 lb.	2	3		\$24.00/pr
1252	3000 lb.	2	3		\$27.00/pr



HIGH SPEED TRAILER WHEELS and TIRES

High speed trailer wheels & tires, fit all 4 hole boat and snowmobile trailers.

Item #	Size	Ply	Cap.	SALE	Tire Only
1211	480x8	4	590 lb.	\$24.00	\$15.50
1212	570x8	4	715 lb.	\$33.00	\$22.00
1216	480x12	4	780 lb.	\$36.00	\$22.00



HAND WINCH



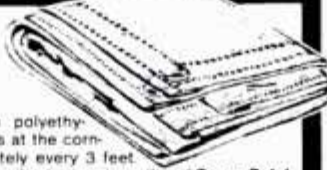
1000 Lb. Capacity, 4.1 to 1 gear ratio. 6 lbs. #1294.....**On Sale Now.....\$14.95**
2000 Lb. Capacity, heavy duty 2 speed with quick disconnect handle. 4.1 to 1 and 9.8 to 1 gear ratio. Ship wt. 14 lbs. #1297.....**On Sale Now.....\$42.00**
(Electric Winches Available at Discount Prices!)

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Waterproof woven polyethylene with grommets at the corners and approximately every 3 feet. This sturdy material will not rot or mildew! **Super Sale!**

Item #	Size	Ship Wt.	SALE PRICE
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1771	8'x 10'	4 lbs.	\$4.95
1772	10'x 12'	4 lbs.	\$5.95
1773	12'x 16'	8 lbs.	\$9.95
1774	12'x 20'	11 lbs.	\$12.95
1775	16'x 20'	12 lbs.	\$19.95
1776	20'x 30'	23 lbs.	\$39.95
1777	30'x 40'	39 lbs.	\$69.95
1778	30'x 50'	49 lbs.	\$89.95



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"One Dozen" Buy the Bundle and save! Heavy duty high tensile rubber complete with two strong steel hooks.

Item #	Length	Stretch	Sh. Wt.	SALE
170914	18"	24"-26"	5 lbs.	\$3.44
170921	24"	29"-33"	6 lbs.	\$4.44
170931	34"	41"-46"	7 lbs.	\$5.44



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1000 PSI @ 2.2 GPM with 2 piston hydro pump and 1.5 HP motor. Includes 20 ft. of hose and non-shut-off hand gun. Sh. wt. 74 lbs. List \$525! Item #157161.....**ON SALE NOW.....\$399.95**



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5 HP, 60 GALLON

Vertical Campbell/Hausfeld two cylinder single stage. Lists for \$1160.00! Item #15955.....**ONLY \$579.95**

5 HP, 60 GALLON

IMC, 2-stage, 17.3 CFM at 100 PSI #15975, \$1202 List.....**\$964.00**
(Will ship above compressors 45 States \$50, Cal., Oregon & Wash. \$60.00 Prepaid with order.)

1 HP, 11 GALLON

Super Pal Campbell/Hausfeld single stage horizontal, 100 PSI, includes 15' of hose and tire chuck. Wt. 90 lbs. #159501, \$425.00 List...**\$259.95**
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ST-80 GASOLINE POWERED STRING TRIMMER

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GAS ENGINES



(HORIZONTAL)

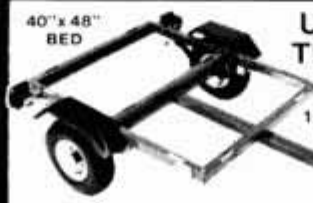
- 5 HP Tecumseh, 1/2" Shaft, #6051.....\$139.95
- 5 HP Briggs, 1/2" Shaft, #6052.....\$139.95
- 5 HP Briggs I/C, 1/2" Shaft, #6054.....\$181.95
- 8 HP Briggs, 1" Shaft, #6080.....\$215.95
- 10 HP Tecumseh, 1" Shaft, #6010.....\$232.95
- 10 HP Tec., (Elec Start), 1" Shaft, #60101.....\$278.95

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- 3 1/2 HP Tecumseh, 1/2" Shaft, #7031.....\$98.00
- 3 1/2 HP Briggs, 1/2" Shaft, #7030.....\$121.95
- 5 HP Briggs, 1/2" Shaft, #7050.....\$165.95
- 8 HP Tecumseh, 1" Shaft, #7082.....\$198.95
- 8 HP Briggs, 1" Shaft, #7080.....\$217.95
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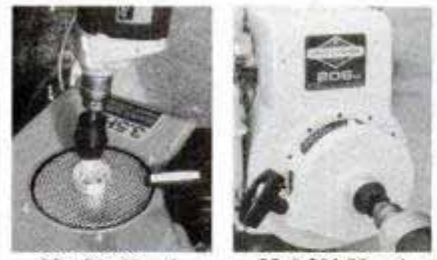
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Model SS-1 fits all Briggs & Stratton, Lawn-Boy, and Tecumseh (Sears) engines equipped with a vertical-pull starting cord mechanism as shown.

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 MO residents add sales tax: (SS-1 \$1.18) (SS-2 \$1.27)

THREE CLASSIC TOYS YOU CAN BUILD (Continued from page 132)



Cut the floorboards to size. Clamp the handles in position on a flat work surface, maintaining proper spacing at both the grip ends and the wheel ends of the handles. Then screw the floorboards to the handles, countersinking the screwheads 1/32 in. below the surface. Bore clearance holes and pilot holes to avoid splitting the wood. Mark and cut the floorboard ends to the proper angle.

Cut the front boards, sideboards, cleats and stakes to size, and assemble them with screws; then cut the angles at each end of the sides, and the 3 1/2-in. rad. on the top rear corners. Cut the top and bottom molding pieces, round the ends, and bore holes for the 1/4-in.-dia. side-retaining rods. Secure the moldings to the front boards, then fit the assembly in the handle notches and screw it into place. Cut the legs and leg brackets, and bore holes for the carriage bolts.

Sand the wheelbarrow with 120-grit, then 220-grit sandpaper. Ease all sharp edges and corners. Apply three coats of clear polyurethane varnish. When the finish is dry, assemble the legs and leg brackets. Attach the steel

front braces, side-retainer rods and stake pockets, and mount the wheel.

Kiddy car

The kiddy car's seat, bolster and bolster brace are made of pine; the front assembly parts are maple. Begin by cutting the pine parts to shape. Round the top edges of the seat with a router and a 1/2-in. rounding-over bit. Bore the 1 1/4-in.-dia. hole for the bearing block.

Turn the yoke and bearing block from 2-in. stock. Cut the front wheel fork into the yoke using a band saw. Bore 5/16-in.-dia. holes for the axle in the yoke and the vertical 3/4-in.-dia. hole for the stem. Bore a slightly oversized, 3/4-in.-dia. hole through the bearing block so the stem will turn freely. Turn the handle to shape from 1-in. stock and bore the 3/4-in.-dia. x 1/2-in.-deep hole for the stem.

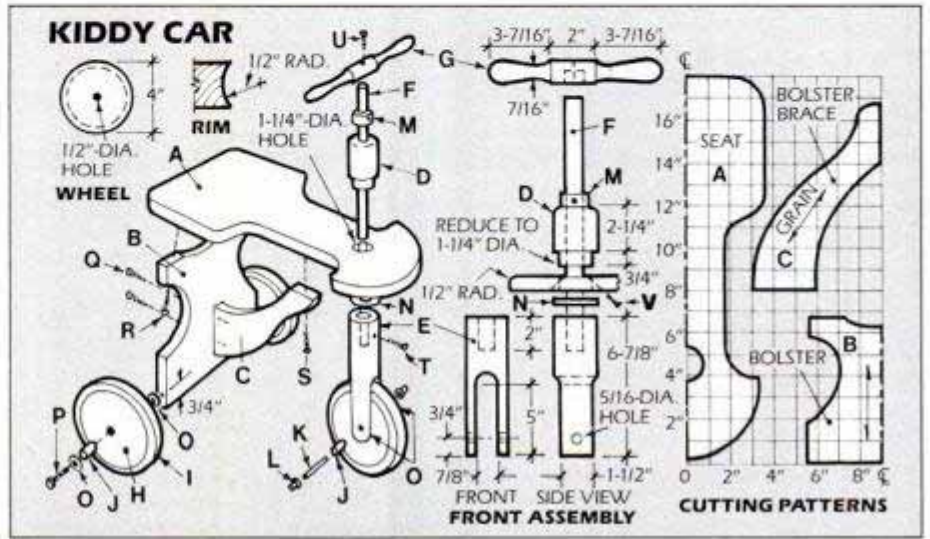
Sand all the wood parts, first with 120-grit, then 220-grit sandpaper. Ease all edges, especially the top circumference of the bearing block.

Install the front assembly parts in the seat hole. Secure the assembly with the steel shaft collar, a 1-in. No. 8 panhead screw through the yoke and into the stem, and two screws through the seat bottom into the bearing block. Screw the bolster and bolster bracket in place. Attach the handle with glue and a 1 1/4-in. No. 8 oval head screw. In all cases, bore clearance holes and pilot holes for screws to avoid splitting the wood.

Finish the kiddy car with three coats of polyurethane varnish. When the finish is dry, attach the wheels. **PM**

MATERIALS LIST—KIDDY CAR

Key	No.	Size and description (use)	N	1	3/4" flat steel washer
A	1	3/4 x 7 1/2 x 18" pine (seat)	O	6	5/16" flat steel washer
B	1	3/4 x 7 x 7 1/2" pine (bolster)	P	2	5/16 x 2" hexhead lagscrew
C	1	3/4 x 4 x 11" pine (bolster brace)	Q	2	1/4 x 1 1/2" hexhead lagscrew
D	1	2"-dia. x 3" maple (bearing block)	R	2	1 3/4" No. 10 panhead screw
E	1	2"-dia. x 6 1/2" maple (yoke)	S	1	2" No. 10 panhead screw
F	1	3/4"-dia. x 10" maple (stem)	T	1	1" No. 8 panhead screw
G	1	1"-dia. x 9" maple (handle)	U	1	1 1/4" No. 8 oval head screw
H	3	3/4 x 4"-dia. maple (wheel)*	V	2	1" No. 8 fh screw
I	3	5"-dia. rubber tire*	Misc:		120- and 220-grit sandpaper, clear polyurethane varnish.
J	3	1/4 x 1 1/16" brass bushing*	*Hardware and wheel kit:		\$18.75. Full-size plans:
K	1	5/16"-dia. x 2 1/16" steel axle*	\$5.		Prices include shipping. Available from Wisconsin Wagon Co., 507 Laurel St., Janesville, Wis. 53545.
L	2	5/16"-dia. pushnut*			
M	1	3/4"-dia. steel shaft collar*			





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

(You can get the same one for considerably less)

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

Credentials

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

Our Responsibility

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

50 States Only

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

"Dear Sir..."

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



This 1/2 page ad was a total surprise.

Econ 101

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

Easy Access

Of course, it's easy for you to get an ESCORT—just call us toll-free or write us at the address below. The price is the same as it's been for the last five years: \$245. Quite a deal for what the Japanese must think is the best radar detector in the world.

Try ESCORT at no risk

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

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

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



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

ESCORT

RADAR WARNING RECEIVER

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**YOU'RE
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A
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You're in for flavor that's as good as it can get.
At a price that can't get any better. Dutch Treats.[®]
About 52¢ a pack. Also available in economical cartons.



Price may vary depending on state taxes.

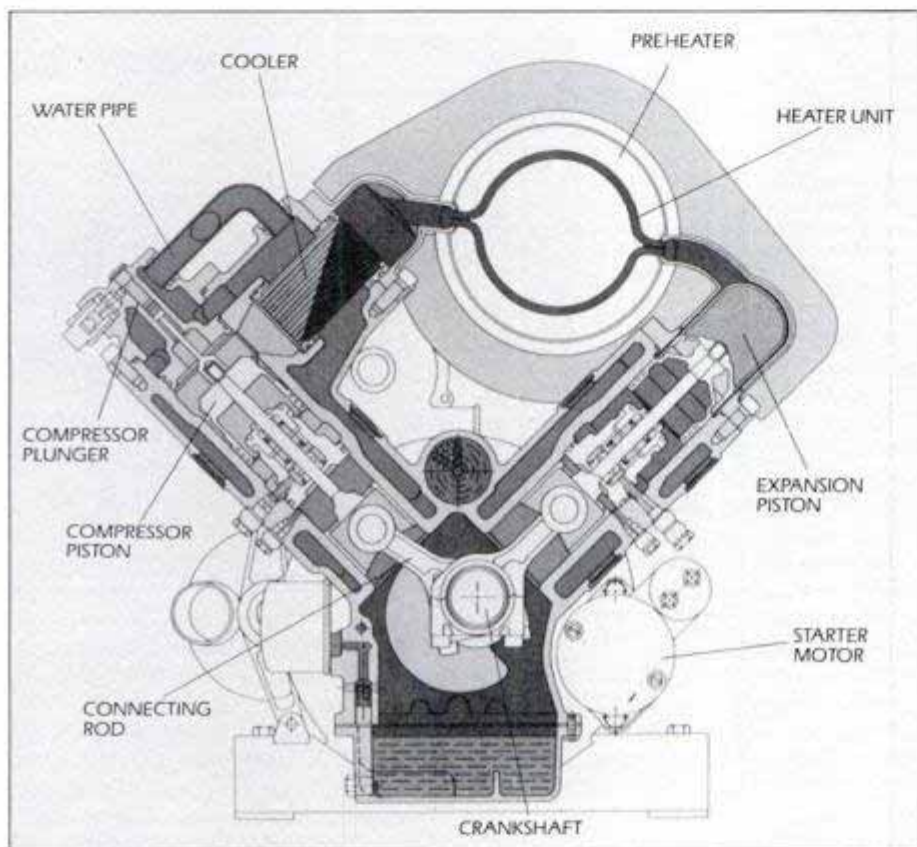
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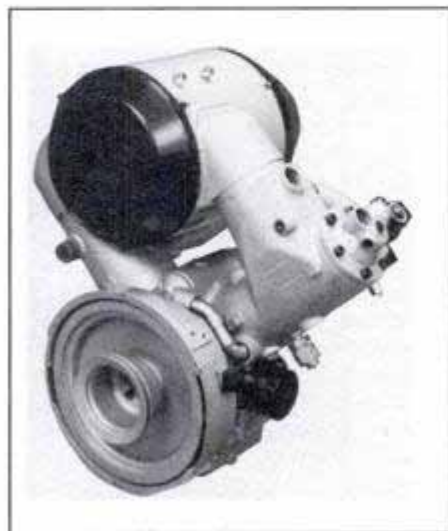
STIRLING CYCLES BACK

High technology is bringing the Stirling engine off the shelf. And this time it may catch on.

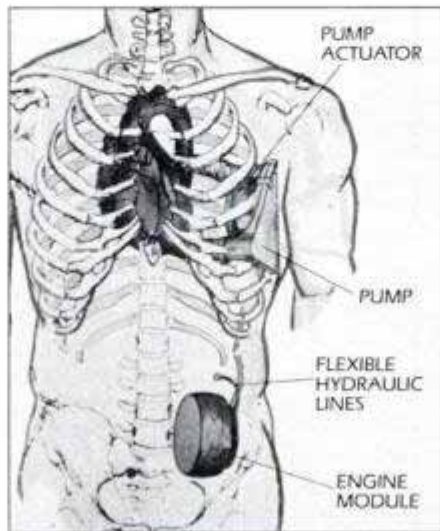
BY JEFF RICHMOND



A typical Stirling engine uses an external source of heat to push an expansion piston. As it moves, hot gas forces out cooler gas and compression starts.



The Stirling engine is small and lightweight. It has few parts to break down.



The Stirling-powered heart pump will run 10 hours without outside power input.

About every 15 years or so since 1818, an engineer has stepped up to the podium somewhere in the United States to announce the arrival of the "new" Stirling engine. Stirling has always had a certain allure with its external combustion, small number of moving parts and ability to run on any fuel. But the Otto engine, with its internal combustion and better performance, has never given an inch to the Stirling. This year, several engineers stepped up to podiums across the nation and Stirling was back off the shelf. This time, however, it may find a permanent place.

Medical researchers at the University of Washington in Richland think the Stirling may find a home in the hearts of thousands of sick people—literally. The Washington team is working on an artificial heart—a 2.5-pound, mechanical pump driven by a Stirling engine. Maury White, a top engineer on the heart pump, says the Stirling engine is a perfect replacement for the left ventricle, the organ that pumps the blood out of the heart and into the body and the one that usually fails first.

The simple Stirling engine is packed into a softball-size housing. It weighs 370 pounds less than the externally operated pump that kept Barney Clark alive for 111 days last year. Unlike Clark's heart, the Stirling will have no outside parts.

The heat source for the engine is a thermal battery that stores energy in molten lithium salts. Terminals to the skin or an electromagnetic field placed next to the body would provide means for a daily battery charge. The fully charged Stirling heart pump would run for 10 hours with no outside help.

Heart of the Stirling

The very heart of the Stirling engine—no matter what its use—is a working gas heated in an enclosed cylinder. When heat is applied, the gas expands and pushes a piston. As the gas cools and contracts, the piston is drawn back into the cylinder.

The classic Stirling engine cylinder is similar to that of a gasoline engine without the valves in the cylinder head. Between the piston and the cylinder head is a second, loosely fitting plunger called the displacer. The working gas can move freely around the displacer from one end of the cylinder to the other end.

In operation, the cylinder head is always heated. At the start of the cycle, the working gas pushes the piston. As the piston moves, a linkage, usually attached to a flywheel or a bell crank, moves the displacer into the hot end of the cylinder. This forces the hot gas into the cool end, drawing the piston back

(Please turn to page 144)



POWER For Your Pickup! With New Econo-Power Maximum Velocity Cams!

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The secret is in our new Maximum Velocity cam lobe design. Maximum Velocity cams use the latest in computer cam technology, like that used in our racing cams, but designed instead for low-end torque, mid-range power and the absolute reliability you need with any pick-up or 4 x 4. For everyday back-and-forth driving or weekend off-road use and trailer towing, a Crane Maximum Velocity cam actually "wakes up" the power and torque in your engine!

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For mud-slingin', ridge-hoppin', trailer-pullin' torque and horsepower the answer is a Crane Econopower Maximum Velocity cam. It makes on and off-road driving fun again!

ALWAYS INSTALL NEW CRANE LIFTERS ON YOUR NEW CAM FOR EXTRA PERFORMANCE AND RELIABILITY!



All Crane products are available by direct mail. Prices vary according to application. Send \$3.00 for catalog and Resale price list.

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McDonnell Douglas makes a solar concentrator that focuses sunlight on a Stirling-powered Power Conversion unit. When gases are heated the Stirling engine generates 25 kw of electricity efficiently.

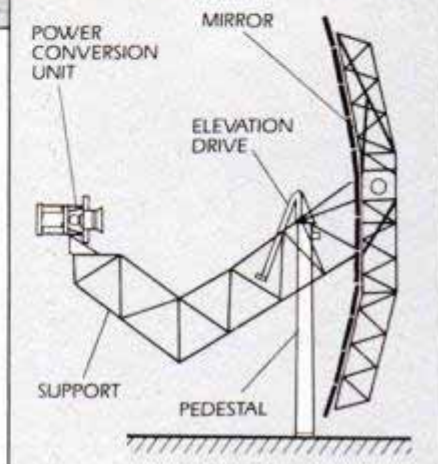
into the cylinder. Again, the linkage between the piston and displacer draws the displacer out of the cylinder head. The cooled working gas is then forced back into the cylinder head and the cycle starts again.

In the simplest Stirling engines the working gas is air. However, a number of refinements have been developed to increase the power, efficiency and utility of the traditionally slow-moving engines. For instance, substituting helium or hydrogen under high pressures increases engine speed and power. For further efficiency, some engines use one cylinder for expansion and the other for contraction. In such an arrangement, the working gas shuttles between the two cylinders.

The resurging interest in Stirling is no mere matter of the heart. Several industries and the U.S. Army are experimenting with the old engine. In an international development, McDonnell Douglas is working with United Stirling of Sweden to develop a solar-powered electric generating system with a Stirling engine at its hub. A giant reflecting dish called a concentrator collects solar heat to be concentrated at a target containing refrigerant.

Each of the concentrators, which are 968 sq. ft. of curved glass, faces a Power Conversion Unit. When the heat is beamed on the unit, the Stirling engine is powered as a 25-kw generator. A series of 400 mirrors would produce enough electricity to light up a sizeable suburb.

Also in the energy field, the Stirling Power Systems company is experimenting with a new heat pump powered by a Stirling motor. In addition to a low-level outside heat source such as a small



household furnace, the new heat pump would use ambient air to run the engine and its air circulating system. The V160 heat pump engine is also being used in industrial applications. But if the heat pump tests are positive, Stirling may eventually become a household word.

The V160 recently joined the U.S. Army under a \$3 million contract to produce and evaluate 10 generators. The Army likes the engine because it runs at a steady temperature and has a low radar profile. The fact that it can run on any fuel also is attractive to the Army, which might have difficulty finding any one specific fuel to use in a combat situation.

At sea, the Stirling engine will soon see duty as a backup in non-nuclear submarines of the Swedish Navy. Conventional diesel subs can operate submerged using a snorkel to get air. But they run an increased risk of being detected because of the exhaust snorkel or diesel engine noise. When powered by fuel burned with oxygen, a quiet Stirling-equipped sub can stay submerged for 14 days. The system has been tried on small-crew submersibles and will see duty in a full-sized sub in Sweden later this year.

NASA has proposed using Stirling
(Please turn to page 148)

Don't get caught with your hood up!



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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.

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Quick do-it-yourself installation. If you can change the oil in your car, you can make this installation using simple hand tools and Hayden's patented Quik-Mount™ and Quik-Connect™ systems.



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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.

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“With all I’ve learned about helicopters, my future is no longer up in the air.”

SGT Kevin Quinn, Aircraft Fire Control

“I used to say to myself, sooner or later you’re going to have to make a goal for yourself. What do you want to do with your life? It was indecision time.

“I decided on the Army as a stepping stone.

“The way the Army works, they find out what your interests are, and your abilities. What you would be best at. And they find a job that would suit them, and you, in an area that would give you a direction.

“Myself, I’ve always been into the physical-type job, where you actually get in there and get your hands into it.

“I spent six months in Army school, learning about the basic electronics and mechanics of armament. How machinery works. Aircraft hydraulics, electrical circuits and drive motors, and much more.

“Now I’m working mechanical and hydraulic systems on the Cobra helicopter. Every nut and bolt is beautiful.

“When you work these birds, you get to feel that spark that says, ‘I actually did it: it’s working.’ You have a sense of pride when the bird works. A great feeling.

“Basically the tools we use are the same ones you probably use to fix your car. We get our hands dirty quite a bit. Plenty dirty. I don’t mind; it’s part of the job.

“My future? I know right where I’m heading.

“Straight up.”

If you’d like to get your hands on a challenge that can lead to a rewarding future, talk to your local Army Recruiter. Or call toll free 1-800-USA-ARMY.

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STIRLING CYCLES BACK

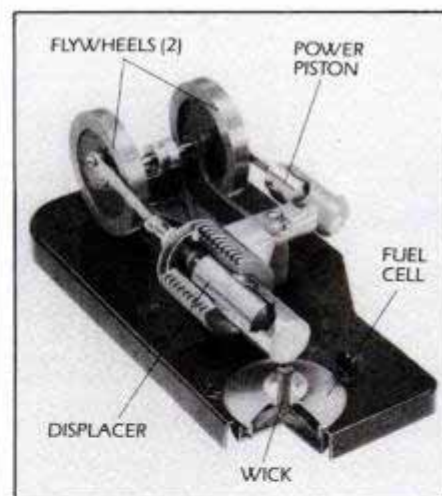
(Continued from page 144)

engines aboard the Space Station, where they will be able to draw heat directly from the sun and run on almost no fuel. Since the Stirling has no exhaust, the fuel in small amounts can last almost indefinitely in a vacuum.

In America, the traditional test of the value of an engine has been its usefulness to the automotive industry. In past years, Stirling has struck out as an automotive engine, largely because it can't produce the power of an Otto engine. But the problem also has been in Stirling's lag behind other technologies.

Even in the 1800s, the Stirling engine failed to keep up with steam because the Stirling required an iron cylinder head to withstand extreme temperatures. By the time metal alloys were good enough to make a working Stirling that could compete with steam, electric motors came along. Stirling had begun to get a foothold as the driving power for mills. But electric motors knocked it out of the box.

With the advent of aviation materials and aerated metals—the lightweight but very strong versions of steel and copper—Stirling may now even get a shot at the auto industry. The Federal Department of Energy has funded a test



A flywheel Stirling uses the wheels to run through the power/displacement cycle.

program that puts Stirling engines in cars. Initial testing has given Stirling-equipped cars 30 percent better fuel economy than gasoline-powered vehicles of the same weight and power.

Part of the advantage is achieved by the fact that a Stirling provides a constant level of torque throughout its operating range. Consequently, low engine speeds provide adequate power for hills without using the fuel-guzzling engine speeds that are typical of gasoline engines.

The experimental literature skirts the [\(Please turn to page 150\)](#)

Know your car inside and out.

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TOTAL SERVICE MANUALS are digests of official

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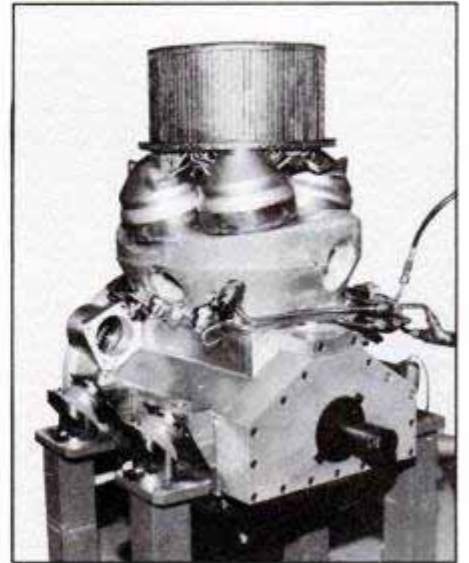
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STIRLING CYCLES BACK
(Continued from page 148)

issue of performance, a key point on fast-moving American highways. The last Stirling tested under federally approved conditions—in the 1960s—took 11 seconds to run from 0 to 50. That is not the kind of figure that moves cars



Swedish Navy showed off this Stirling engine that allows a sub to submerge longer. out of the showroom in America. But Japan is also experimenting with the Stirling in a small subcompact "town car," something that can push from home to shopping center and back.

The Ministry of Trade Stirling experiment puts the engine in a car body less than 1,200 pounds. It would carry two passengers with a hatchback area for groceries. Early tests show the Stirling would get the equivalent of just under 90 mpg of gas. The Japanese experimental vehicle however has a reported 0-to-50 rating of 10 seconds, still not up to the stuff American highways are used to carrying.

One of the American experimental vehicles is a hybrid. No figures are available on its performance yet, but the very fact that it's being tested suggests that some researchers see the car as getting pickup from a gasoline engine and tooling along where speed doesn't count on the Stirling.

In its previous incarnations the Stirling engine has made an impressive entry, then a quick retreat from the scene. But this time in the spotlight may prove to be different.

Maury White thinks the Stirling will be around at least for another decade. Part of his optimism has to do with his own invention, the heart pump. The device, now undergoing animal tests, could be implanted in tens of thousands of humans per year. "It could be implanted in humans by the end of this decade," he told an interviewer. It's news that gives hope to the latest backers of the old Stirling engine. **PM**

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HINTS FROM READERS

Brush wiper

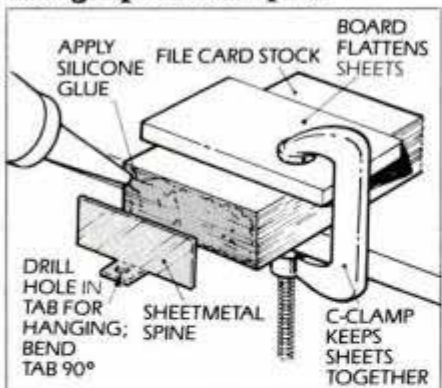


Use a common nail to punch a few holes in pairs opposite each other in the lid groove of a paint can. Bend 1-in. legs that fit in mating holes on a length of coat hanger wire.

The wire serves as a brush wiper. It can also support a brush that is laid over the edge of the paint can. The extra holes in the can groove will let paint drain back into the can, instead of running over the outside edge.

—Alice and Robert Tupper

Hang-up scratch pad



I made this hanging scratch pad for shop use. Cut file card stock to the desired size. Stack the sheets together, spine end overhanging the workbench. Then, put a board on top of the sheets and clamp the sandwich to the bench. Next, apply silicone glue to the spine end of the pad. Then, cut a sheet-metal spine with a hanging tab and secure it to the pad by using more silicone glue.—Don Butler

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Tested in France, this U.S.-spec car features a new "soft" nose with an intake slot for the intercooler and 16-in. 928-style "telephone" wheels. Drag coefficient for this Porsche is a low 0.33.



PM DRIVES THE PORSCHE 944 TURBO

Teutonic attention to detail provides V8 performance from a four-cylinder engine.

BY WADE HOYT, Auto Editor

If you take a wonderful sports car like the Porsche 944 and increase its power by more than 50 percent, the result is a truly fantastic car. That's exactly what Porsche has done with its new 944 Turbo. Of course, the Porsche engineers didn't simply bolt on a turbocharger and go home for the day. Improvements were made to the brakes and suspension to handle the increased performance and, while they were at it, they updated the body and interior.

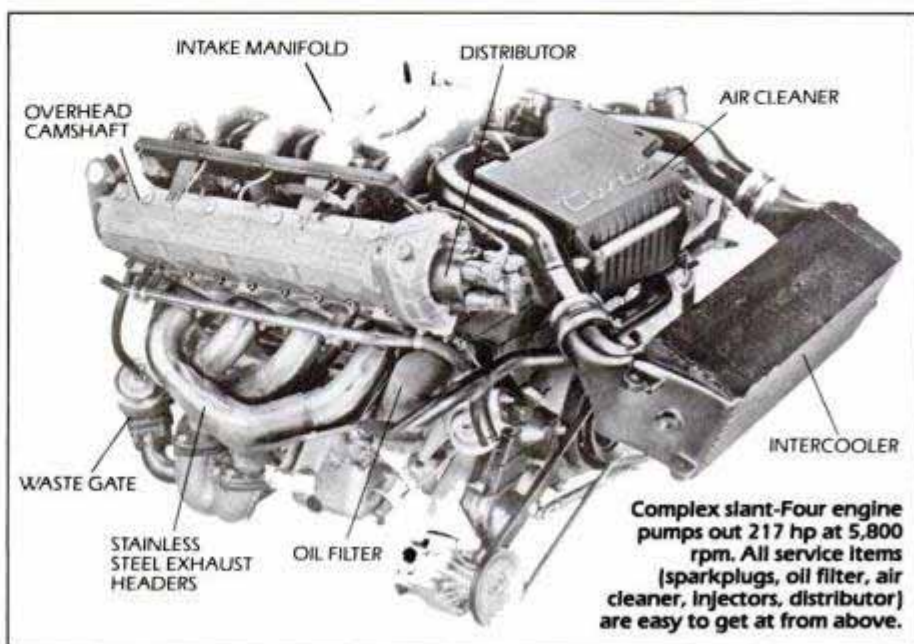
But it's the overhead-cam slant-Four engine that is the engineers' *tour de force*. Output has been increased from 143 to 217 hp by the addition of a German-built KKK turbocharger and an intercooler. The sophisticated system includes a computer-controlled wastegate. Even the turbo's water-cooled bearing has its own thermostat and little electric water pump! Ceramic inserts in the exhaust ports keep heat

away from the cylinder head and pass it along to the turbocharger and catalyst, where it's needed.

An Active Knock Control system has a sensor in the engine block that can spot knock from individual cylinders and retard the spark as much as 6° only

at the offending cylinder(s). If knock continues, boost is reduced. The engine can therefore run on any unleaded fuel from 87 to 91 pump octane, or higher, with minimum performance penalty.

The compression ratio of 8:1 gives
(Please turn to page 156)



PM PHOTO HINTS

Easy loading



You can load film onto a developing-tank reel more easily if you trim the leader in the light instead of fumbling in the darkroom. Leave a couple of inches outside the cassette by rewinding exposed film until sprocket releases leader.—*Kenn Oberrecht*

Freeze your film



Save money by buying film in large quantities and storing it in a freezer. Divide the boxed rolls into portions you'll use quickly. Wrap each portion in freezer paper, seal it with moisture-proof tape and date it. Allow frozen film to reach room temperature before using it.—*Kenn Oberrecht*

Rockin' roller



A tray rocker can easily be made from discarded 120 roll-film spools. Cut the spool in half with a hacksaw and cement it to the bottom of the tray. Black Plastic Rubber will do the job.

—*William J. Frazier*

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Start up a new Power King garden tractor and you sense something different. Right away.

Serious power. From 12, 14 or 17 hp engines with automotive type components. On a welded steel frame. With up to 300 lbs. more working weight.

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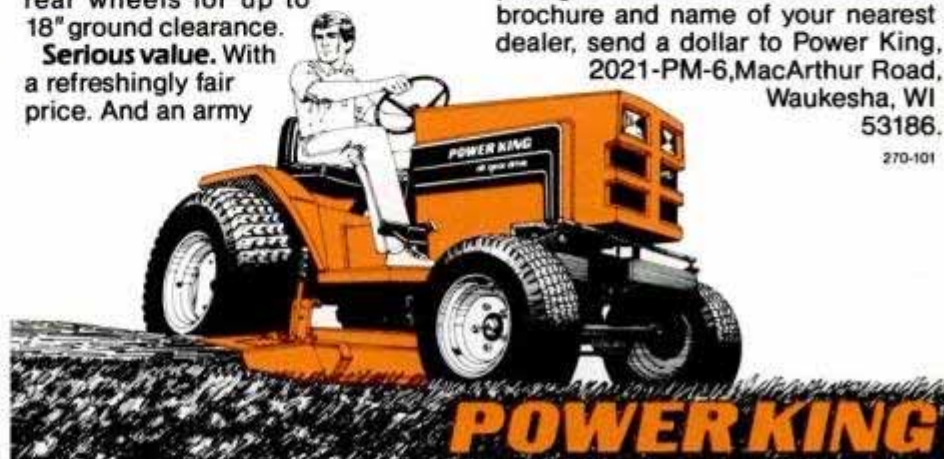
Get a free mower deck and hitch (\$650 to \$700 value) when you buy a new Power King tractor! See a participating dealer for details. For a color brochure and name of your nearest dealer, send a dollar to Power King,

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for a small job



If your garden is an acre or less, hire somebody to plow it once a year... and buy a Mantis-20 for yourself. Mantis tills and weeds a practical 6" to 9" wide, turns on a dime and weighs only 20 pounds! Simply turning a 300-pound tiller in a backyard garden is a challenge.

Most big tillers were designed to just till (but many now offer clumsy "add-on" attachments as an attempt to justify their high cost). The Mantis was designed from the beginning to precisely match a small, powerful engine to a variety of useful attachments for your yard and garden.

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3-WEEK TRIAL

Most machines are partially covered for 90 days to a year. Mantis has a Lifetime Warranty on the tines, a Lifetime Replacement agreement on the engine. Best of all, you get a 3-Week In-Your Garden Trial (if you don't like it we'll buy it back for every penny you paid!).



Tines so strong they're guaranteed for life!

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PORSCHE 944 TURBO

(Continued from page 154)



Interior features new gauges, vents, pin-stripe upholstery and six-way power seats.

adequate around-town performance. When you floor the pedal, there's some turbo lag, but the power comes on with a rush, giving 0-to-60 mph times of just over six seconds and a top speed of 153 mph. Out on the French *autoroute*, we actually touched 150 a few times, and the engine still had a bit left, but the highway wasn't straight enough for a flat-out run. That's Corvette performance from a four-banger!

The single-piston sliding-caliper disc brakes of the normal 944 have been replaced by complex racing-type four-piston fixed-caliper vented discs. Wheels are 928-style 16-inchers with 7-in. rims and 205/55VR Dunlop Sport radials in front and 8-in. rims with 225/50VRs in back.

The rear-mounted, five-speed transmission gives nearly perfect 50/50 weight distribution. Add gas-filled shocks and antiroll bars and you get phenomenal handling. The 944 Turbo is neutral and well-balanced, with none of the tricky oversteer found on some Porsches. It is very fast without being scary to drive, the way some high-powered cars can be. The ride is quite firm, and while it's not exactly harsh, it won't win over many Oldsmobile fans.

The new interior's pin-striped uphol-

stery is luxurious without being flashy. A simple 911-style instrument cluster replaces the garish yellow-on-black dials in the old model. There are seven easy-to-read gauges—including turbo boost—in a neat oval cluster flanked by an industrial-size air vent that is part of an all-new ventilation system. The automatic climate control has a manual override for the truly fussy, and the air channeled through the dash vents always is cooler than the air going to the footwells or windshield.

The unobtrusive power steering provides lots of road feel, perhaps a bit too much, as the wheel will pull on some road surfaces.

Porsche intends this car to be a front-engined alternative to the rear-engined 911, matching it in performance, and unfortunately, in price as well, which is likely to be on the wrong side of \$30,000. For that much, you could buy a Corvette and get 1 1/2 Yugos in change.

Of course, the price includes a lot of equipment from power windows and seats to a four-speaker stereo, oil coolers for both engine and transmission, heated windshield washer nozzles and a seven-year antirust guarantee.

The factory is not worried that the 944 Turbo will steal sales from the 911, because there seem to be two entirely separate camps of Porsche lovers—rear-engine fans and front-engine fans—with very little crossover between them. **PM**

THE PM REPORT CARD

PORSCHE 944

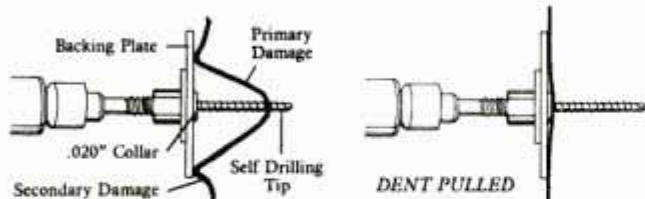
TURBO	GRADE	COMMENTS
Acceleration	A	Some turbo lag; 0-60 in 6 sec.
Handling	A+	Well-balanced; sticks like glue
Braking	A	Stops sure and smooth from over 100 mph
Steering	B+	Unobtrusive power assist; lots of road feel
Transmission	A	Slick-shifting transaxle with positive linkage
Ride	C	"Sporty" ride; bumpy but not harsh
Fuel economy	B	19.2 mpg in European City test; 21-gal. tank gives 300-mi. range
Seating	A+	Firm support; 6 adjustments (6 power)
Vision	A	Good in all directions
Gauges/controls	A	Easy to read/use
Ventilation	A	Automatic climate control with manual override
Noise @ 55 mph	B-	Lots of road noise comes through suspension
Cargo capacity	B	Good for a sports car
Engine serviceability	A	Easy access through hood
Fit and finish	A-	Good paint; uneven hood gaps



Fuse box contains puller, spares and fuse tester—green light means the fuse is okay.

Eastwood Auto Restoration Tools

Take The Guesswork Out Of Dent Repair



IF YOU CAN DRILL A HOLE YOU CAN FIX A DENT

The Eastwood **BODY-MAN** tool replaces expensive, hard-to-use body tools. It lifts out dents and saves hundreds of dollars in repair bills. The unique all-metal design uses a self-drilling tip combined with a backing plate; automatically pulling damaged metal (with a vise-like pressure) back to original shape.

FAST, PROFESSIONAL RESULTS THE FIRST TIME

Simply install the tool in your 1/8" power drill. Place the self-drilling tip in the deepest damage area. By starting the drill, the point enters the metal and threads onto the tip. Each drill rotation brings the damaged metal closer to the backing plate. While the tip pulls out the main dent, the backing plate pushes in secondary damage. The tool knows exactly how much to pull and when to stop. When the dented metal returns to its original shape, the tip will release automatically. A .020" collar on the backing plate insures space for body filler to cover the 1/4" hole left in the metal.

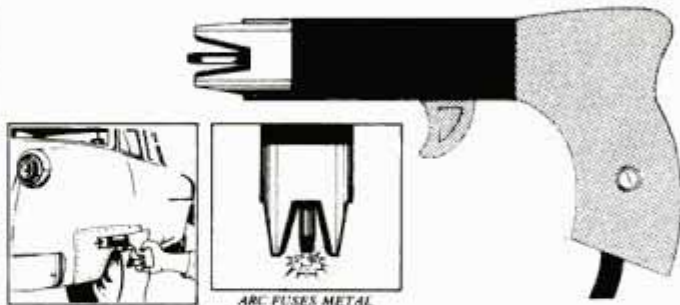
WORKS FROM ONE SIDE EVEN ON LARGE DENTS

No need to remove door panels or work around inner panels. Repairs any automotive sheet metal—even pickup tailgates. The heavy-duty version straightens dents up to 12" wide; basic unit has a 4" range. On larger dents secondary damage must be tapped flat with a hammer; multiple holes may be necessary (complete instructions included). The **BODY-MAN** dent removal set comes complete with basic tool for small dents (parking lot dings and hail damage) and heavy-duty 12" model for larger collision damage, package of 10 replacement tips and complete operating instructions.



- #6799 Body-Man Tool Set \$29.95
- #6796 Replacement Tips, pkg of 50 \$8.50

Spot Weld Perfectly In Just 6 Seconds



MAKE FAST DISTORTION FREE WELDS

Spot welding has some distinct advantages. It's very fast - a few seconds for a sound weld. Because the heat is confined to a small area (the 1/4" dia. electrode) it avoids warpage or distortion. Allows for accurate control that lets you make consistently uniform welds.

EASY TO USE - EVEN FOR BEGINNERS

Become a pro in just a few minutes. Hook it to the electrode holder of your arc welder (50 amp or better) and ground to car body. Just pull back the trigger to retract electrode, line up weld point and press head against the metal. Metal must be free of paint, rust or grease. Release the trigger and allow the electrode to contact the metal and glow for 1-2 seconds. Then raise the electrode with the trigger and allow an arc to form a molten puddle of metal (always use welding goggles or shield). Each weld takes about 5-6 seconds. Automotive manufacturers used spot welds to build your car and you can restore it with the same authentic technique.

CONVERTS AN ARC WELDER TO A SPOT WELDER

It welds any steel between 18-26 gauge. (Auto body steel metal is between 18 and 22 gauge). Ideal for welding replacement panels, floors, brackets, clips, braces, channels, etc. Welds from one side so it can even do blind panels that ordinarily can't be spot welded. Comes with two pressure heads — four prong for control on flat areas and two prong for reaching into edge and recess work. Proper replacement electrodes available through Eastwood. Gun comes complete with connection wire, spare electrode, 2 pressure heads and complete instructions.

- #4355 Spot Weld Gun \$35.95
- #4321 Package of 10 extra electrodes \$9.75
- #4367 Welding Goggles \$6.95

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When rust cuts deep, the only way to get it out **completely** is with a sandblaster. With thousands sold, our sandblaster is field-proven and cost-effective. This tool will let you do the jobs you once had others do: Dispose of rust, scale, paint and corrosion in minutes.

The Eastwood professional sandblaster package includes our all-metal, power gun (same as used on our larger units), ten-foot hose, 14" pickup tube, spare nozzle and detailed instructions. Just hook up to a one H.P. compressor, insert the pickup tube into dry sand or other abrasive and you're ready to go. The blaster's suction head draws abrasive easily. No surging. No skipping.

Three operations in one: Sandblaster, liquid blaster, air gun. With degreasing solutions, you can use it to remove buildup on engines and parts. Also get a high-velocity flow of air to dry or clean parts. All spare parts are available through our catalog.

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- OPTIONAL: Sandblast hood with replaceable lens.
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PM PHOTO BY FRANK ZAGARINO

The Grumman boat, Mariner motor and Cox trailer could all be yours if you're our winner.

It's a hot morning. But the lake is only an hour away, and you'll soon be there. You hitch up the Cox trailer, check all safety equipment and you're off.

Once at the lake, it's a simple launch. The Cox trailer backs beautifully. Your Grumman Skidaddle boat glides off the trailer and into the water, and the big, brawny Mariner 75 engine fires instantly. A few minutes later you're away, cool breeze in your face, the sky blue and the water placid. This is the good life.

And it can be yours if you're the winner of our latest contest. That's right, *Popular Mechanics* is doing it again. Last year, we gave away our Forest Ranger project pickup, a customized Ford Ranger 4x4 pickup truck. This year, our contest is waterborne and the top prize is the PM Water Sportster, our project boat that you saw in the February 1985 issue (page 80).

The best photograph

This year's contest is simple. Just send us the best photograph you've ever taken. If our editors think it's the best photo received from all the entrants to the contest, you'll win the Grumman boat, the Mariner 75 engine, the Cox trailer plus all the custom equipment we've added to it, including a convertible top for the boat, Cybernet 2010 VHF-FM radiotelephone, Aqua Meter Ensign tachometer, Aqua Meter Graduate



depthsounder/fishfinder, Step-On swim platform, Electro-Voice paging projector, Mitsubishi stereo set-up, Zebco fishing gear, and even a Thermos cooler to keep 'em cool on those hot fishing trips.

Not a bad bunch of gear for just taking a photo.

If all this weren't enough, if you live outside the New York area, we'll fly you (or reimburse your driving expenses) to New York where you'll be our guest at a luxury hotel for the night. After breakfast the next day, you'll come to the *Popular Mechanics* offices, meet our editors, and take possession of your prize. The winner's name and photo will also appear in *Popular Mechanics*.

Potential candidates

As for subject matter, we leave that up to you. But you can't go wrong choosing a subject from the many different editorial areas we cover in the pages of *Popular Mechanics* each month. Things like boats, classic or race cars, astronomical objects, planes, nature, architecturally interesting structures, trains, sports, hot air balloons, even projects you make yourself in your shop are all potential candidates for beautiful photos.

Before submitting your entries, you should keep a few things in mind. First, we'll accept only color photos. No black and white photos will be accepted.

Second, your entry must be a 35mm transparency or 8x10 color print. No other sizes will be considered. The complete rules and entry form are print-

ed here. Read them before you send in your entry. So get out your camera, load up the film and start shooting. Then fill out your entry and send it in today. **FM**

OFFICIAL CONTEST RULES

1. On the entry blank printed below, or on a separate sheet of paper, give us the information on how you took your photo: make and model of camera, type of film, accessories used, such as special filters or lighting. Also tell us when and where you took the photo and anything unique about the circumstances or the way you set up the camera.

2. Your name and address must be written on each slide or print submitted.

3. There is no limit to the number of entries you may submit. However, each entry must be mailed separately and be accompanied by its own entry blank.

4. Entries must be in the form of a 35mm color transparency or an 8x10 color print.

5. Transportation of the prize away from the *Popular Mechanics* offices is the responsibility of the winner.

6. All entries become the property of *Popular Mechanics* and cannot be returned unless accompanied by a self-addressed, stamped envelope of appropriate size.

7. Entries will be judged on originality, imagination, visual impact and photographic technique.

8. Preliminary judging will be done by the editors of *Popular Mechanics*. From initial selections, the final winner will be selected by *Popular Mechanics* Editor-in-Chief John Linkletter.

9. The decision of the judges is final. No correspondence or telephone calls regarding the contest will be accepted or entered into.

10. The winner will receive the Water Sportster, a 1985 Grumman Skidaddle boat modified by the *Popular Mechanics* staff. In addition, the winner will also receive a Manner 75 outboard motor, Cox trailer and certain other equipment that has been added to the Water Sportster to enhance its value and usefulness. The Water

Sportster will be turned over to the winner in as-is condition at the time the prize is awarded. All taxes, licenses, insurance, transportation and other fees are the responsibility of the winner. If applicable, we will provide coach travel with a commercial air or rail carrier or reimburse driving expenses to New York, and provide one night's accommodations in order to accept the prize.

11. No cash payment will be made in place of the prize.

12. Contest is open to anyone residing in any of the 50 United States except employees of The Hearst Corp. and their families.

13. Entries should be mailed to: Water Sportster Contest, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019.

14. Entries must be postmarked before midnight Oct. 14, 1985 and received by Oct. 18, 1985.

15. The winner will be notified by Nov. 15, 1985, and may be asked to execute a qualifying affidavit to the effect that he is the photographer of the winning photo.

16. After the winner is notified, *Popular Mechanics* will provide the winner's name to anyone who wishes it and who sends us a stamped, self-addressed envelope with the request.

17. The winner must agree in writing to be photographed with the Water Sportster boat and various members of the *Popular Mechanics* staff, and consent to his name and photos being used in conjunction with this contest and its result in a future issue of *Popular Mechanics* and for all media, advertising and/or trade.

18. All entries must comply with all Official Rules. Entries which do not comply with all rules will not be considered.

19. This contest is void where prohibited by law.

OFFICIAL POPULAR MECHANICS WATER SPORTSTER ENTRY BLANK

Here is my entry. I agree to abide by the rules.

Camera Make and Model: _____

Camera Lens: _____

Film Brand and Type: _____

Filters, Lights, Accessories: _____

When and Where Photo Taken: _____

Special Circumstances (use separate sheet of paper if necessary): _____

Name _____

Address _____

City _____ State _____ Zip _____

Clip and mail to: Water Sportster Contest, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. Entries must be postmarked before midnight, **Oct. 14, 1985**, and received by **Oct. 18, 1985**.

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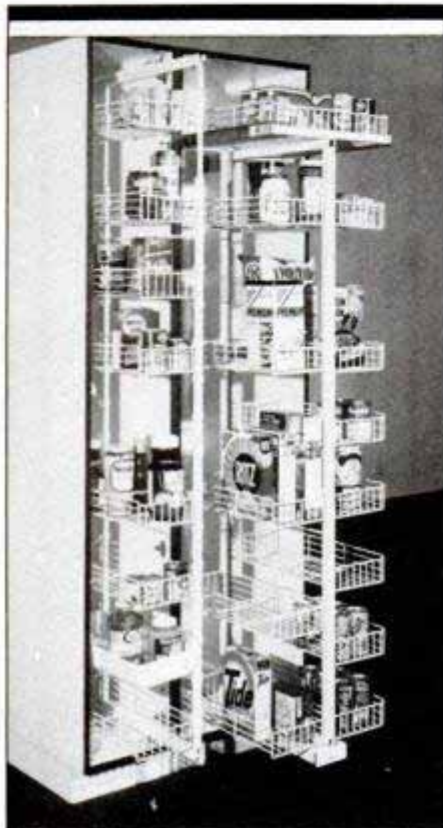
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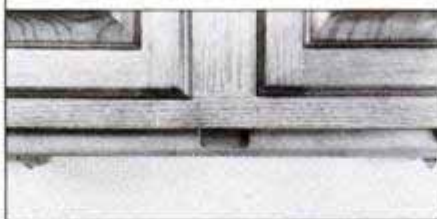
Pullout pantry

Tiratell (right) and Tiratell Econo make stored pantry items reachable. The steel units fit cabinets from 10⁵/₁₆ to 22¹/₈ in. wide inside. Tiratell is 65 in. high, holds 220 pounds and has two vertical frames, a bottom slide and two horizontal frames. It costs about \$210. Tiratell Econo holds 150 pounds and costs \$85. Baskets for both are \$10 each. Both units are made by Hafele America, Box 1590, High Point, N.C. 27261.

Under-cabinet rack



One way to add more storage space is with this spice rack that mounts under kitchen cabinets. The rack stores the most common sizes of spices. When you need them, simply pull down the rack. When it's not in use it remains out of the way (below). The 1¹/₄ × 10³/₄ × 19¹/₂-in. under-cabinet wood spice rack sells for about \$29 and is manufactured by Amerock Corp., 4000 Auburn St., Rockford, Ill. 61101.



À La Cart

Wheel this cart with butcher block top wherever you need it to help serve or prepare food. Three shelves will store kitchen items or other equipment readily at hand. The frame is steel with white baked-enamel finish, and the shelves are adjustable. Metal sides accept standard perforated board hardware inside or outside the frame. À La Cart, by Clifford Pierce Inc., sells for \$60.50 postpaid from The Joan Cook Co., 3200 Southeast 14 Ave., Fort Lauderdale, Fla. 33316.

Spray faucet with spray attachments



The Ladylux kitchen faucet with counter or wall-mount tool caddy has a pull-out spray that can be replaced by a brush spray for china or a scraper spray for pans. It comes in combinations of color: white, mocha, beige, red, matte or polished chrome.



The Ladylux faucet (\$262.50), two tools with holder (\$36.50), escutcheon plate (\$23.50) are by Grohe, 2677 Coyle Ave., Elk Grove Village, Ill. 60007.





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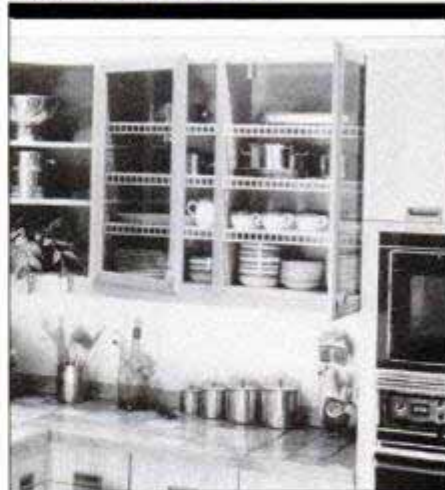
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(Continued from page 160)



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Closet Maid shelving, made of vinyl-coated steel rods, will never need painting, even if you store damp dinnerware in it. It is available in four widths, 9, 12, 16 and 20 in., and in any length up to 12 ft. It can be cut to size with a hacksaw and is available in brown or white vinyl. Use the shelving inside cabinets, or exposed in the kitchen to display china or cooking utensils. The 12-in.-wide shelving costs approximately \$1.50 per linear ft. Closet Maid shelving is manufactured by Clairson International, 720 South West 17th St., Ocala, Fla. 32674.

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Le Bin

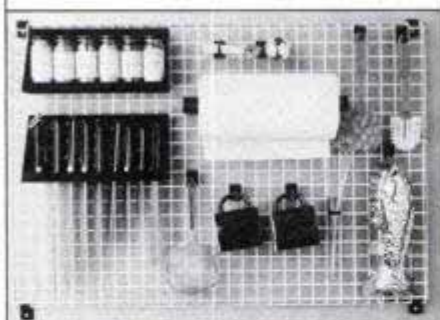
This under-cabinet storage bin takes up no counter space. It holds 5 1/2 pounds of coffee, flour or other bulk food. The bin tilts open for one-hand use and is removable for cleaning. It comes in smoked charcoal and is priced at \$30 postpaid from Popular Merchandise Club, 22 Lincoln Place, Garfield, N.J. 07026. GM Products, 1610 La Pradera Dr., Campbell, Calif. 95008 makes it.

Creative organizers

The Elfa storage system consists of steel wire frames, shelves, drawers and wine rack with a baked-on, white epoxy finish. The open design helps air circulate. Free-standing frames cost \$29 to \$92 (below, left) and range from 17³/₈ to 80¹/₂ in. high, and from 9⁷/₈ to 21³/₄ in. wide. All are 21¹/₄ in. deep. The drawers (\$8.50 to \$21) are 3³/₈ to 15¹/₄ in. deep. Separate runners for built-in storage (below, right) are available for \$3.50 a pair from Elfa Corp., Box 861, Norcross, Ga. 30091.



Wall-hung storage



This storage system consists of a 25 x 37¹/₂-in. wall grid (\$17.95) and accessories to hold or hang items. All parts come in white and most come in red and black as well. Shown here are: utility/spice shelf (\$5.50); paper towel holder (\$4.50); curved hooks, wall-to-grid clips and ring hooks—all four per pack (\$2). The system is sold at Pottery Barns and is made by Heller Designs Inc., 41 Madison Ave., New York, N.Y. 10010.

(Please turn to page 166)

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Kit includes PISTON RINGS CL77 ROD BEARINGS CL77 MAIN BEARINGS ENGINE GASKET SET OIL PUMP TIMING CHAIN SET

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- PERFORMANCE GRINDING
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Your Low Price

Part No.	Price
AMC 199-222-250	158.00
267-296-340-327	209.00
343-360-411	209.00
BUICK 151-30	204.00
300-340-350	209.00
400-427-425-430-450	215.00
CADILLAC 396-424-472-500	263.00
CHEVROLET 194-230-250-260	154.00
265-283-317	154.00
305-307-360	154.00
396-400	184.00
402-427-434	184.00
FORD 144-170-200-250	154.00
260-289-302-310-311	154.00
351-C 351M-400	184.00
392-396	184.00
429	184.00
429-480	204.00
MOPAR 170-190-225	154.00
273-318-340-360	154.00
384-400-425-450	204.00
PONTIAC 154-30	204.00
230-250	204.00
324-350-389-400-450	204.00

Patrons available in all major cities and states. California residents add 4% sales tax and Low Rider & Main Bearing tubes if not standard. Camshafts are available upon request. High Performance Camshaft section or stock camshaft will be substituted. For Letters & Catalogs: \$1.00. For Merchandise: \$1.00. Many businesses with substitutions at \$2.00 each.

SUPER STOCK CRANKSHAFT KIT




Includes:

- PISTONS & PINS
- PISTON RINGS
- CONNECTING RODS
- CON ROD & MAIN BEARINGS
- CRANKSHAFT

Your Low Price

Part No.	Price
AMC 199-222-250	298.00
267-296-340-327	349.00
343-360-411	349.00
BUICK 151-30	303.00
300-340-350	303.00
400-427-425-430-450	309.00
CADILLAC 396-424-472-500	449.00
CHEVROLET 194-230-250-260	154.00
265-283-317	154.00
305-307-360	154.00
396-400	184.00
402-427-434	184.00
FORD 144-170-200-250	154.00
260-289-302-310-311	154.00
351-C 351M-400	184.00
392-396	184.00
429	184.00
429-480	204.00
MOPAR 170-190-225	154.00
273-318-340-360	154.00
384-400-425-450	204.00
PONTIAC 154-30	204.00
230-250	204.00
324-350-389-400-450	204.00

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Includes:

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- CONNECTING RODS
- CON ROD & MAIN BEARINGS
- CRANKSHAFT
- LIFTERS - SPRINGS
- TRAINING CHAIN SET
- OIL PUMP
- CAV BEARINGS
- GASKET SET

Your Low Price

Part No.	Price
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300-340-350	503.00
400-427-425-430-450	509.00
CADILLAC 396-424-472-500	649.00
CHEVROLET 194-230-250-260	154.00
265-283-317	154.00
305-307-360	154.00
396-400	184.00
402-427-434	184.00
FORD 144-170-200-250	154.00
260-289-302-310-311	154.00
351-C 351M-400	184.00
392-396	184.00
429	184.00
429-480	204.00
MOPAR 170-190-225	154.00
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384-400-425-450	204.00
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GM	63-74	VR14	\$ 7.95
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FORD	63-78	VR136	\$ 7.95
MOPAR	63-69	VR126	\$ 5.95

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NOTE: THE ABOVE KIT WILL REQUIRE HARMONIC BALANCER AND FLYWHEEL FROM ANOTHER SOURCE.

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Your Choice 9 or 10:1 COMPRESSION RATIO


SHORT BLOCK: Sealed block, bored overcast, compaction honed, forged pistons, chrome moly 2-stroke rings, connecting rods, fitted chrome moly rod bolts, crankshaft custom ground for precision tolerance with matching bearings. Your choice of solid or hydraulic camshaft. Double color casting chain set. Bearings for maximum performance.

Your Low Price \$995.00

LONG BLOCK: 85 block with cylinder heads, compaction valve job, hi-performance valve springs, chrome moly push rods, NO lock, hi-volume oil pump. Others. **Great Buy!**

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1-84 Intake	1476	2.55
2-02 Intake	1650	4.00
1-80 Exhaust	1077	2.65
1-60 Exhaust	1649	5.95

BIG BLOCK CHEVY

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S.B. MOPAR

1-88 Intake	1778	3.55
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2-08 Intake	1316	3.35
1-74 Exhaust	1265	3.85
1-74 Exhaust	1717	4.55

S.B. FORD 288 (Non Rail)

1-78 Intake	1628	3.35
1-48 Exhaust	1567	3.85

S.B. FORD 302 (Rail)

1-78 Intake	1732	2.95
1-48 Exhaust	1771	4.05

351C 4 BL HEAD FORD

2-02 Intake	1762	4.55
1-70 Exhaust	1763	4.55

351C 2 BL HEAD FORD

2-04 Intake	1764	3.45
1-66 Exhaust	1765	4.35

351W FORD 65-74

1-84 Intake	1760	2.85
1-56 Exhaust	1761	2.85

351W FORD 75-77

1-78 Intake	1830	3.00
1-48 Exhaust	1831	3.00

352-360-428 FORD

2-02 Intake	1418	2.45
1-56 Exhaust	1355	3.45

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1-65 Exhaust	1731	4.05

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Ford 429-480	99.95
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Ford 351C-400	109.95
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Chevy V8	89.95
Ford 289-302	99.95
Ford 351C-400	99.95
Ford 429-480	99.95
Mopar 318-360-360	99.95

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HOW TO REBUILD BOOKS

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S.B. Ford 289-302 351W	\$9.95
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S.B. Mopar 413-4400	\$162.95
S.B. Ford 289-302	\$149.95
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Make _____ Model _____ Year _____ Engine Size _____

NOTE: P.A.W. is not responsible for typographical errors in pricing or applications, including all contents of this advertising.

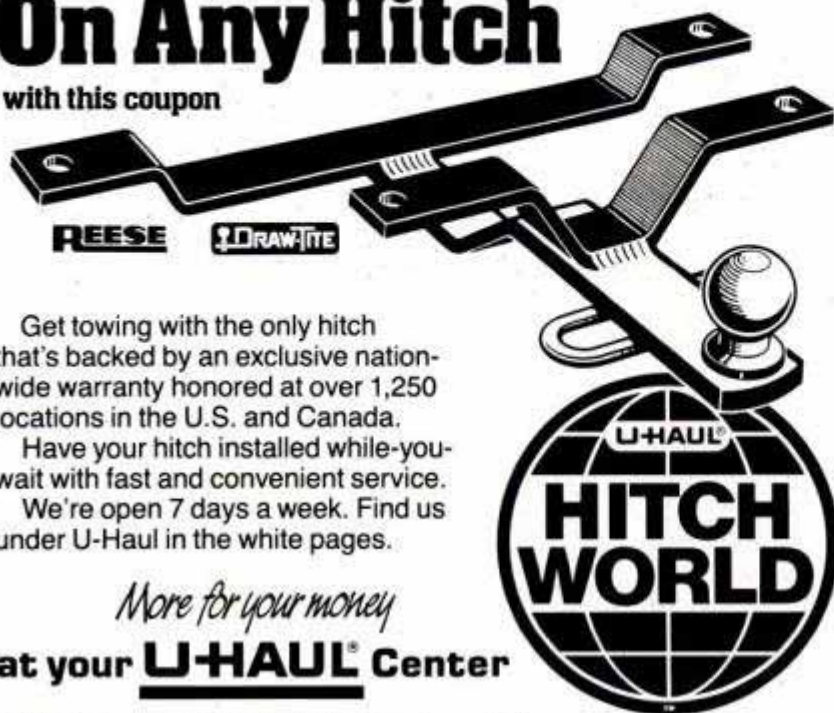
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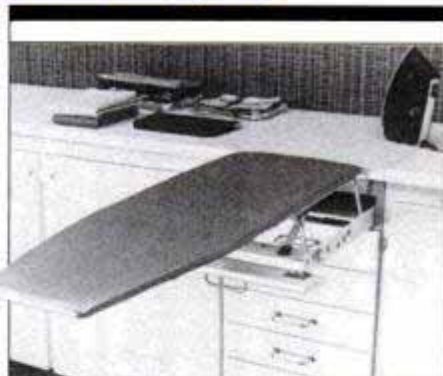
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SUPER STORAGE IDEAS

(Continued from page 163)

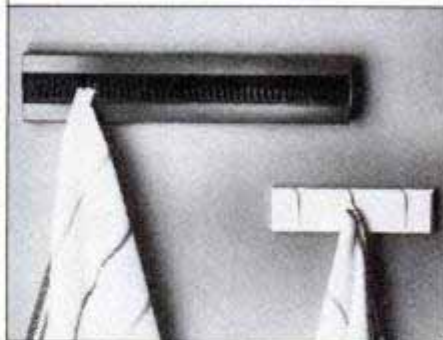


Ironing board in a drawer

This ironing board collapses (below) to fit into a drawer as small as 2⁵/₈ in. high, 14¹/₄ in. wide and 20 in. deep. It comes with hardware, foam-rubber pad and heat-resistant cover. The only piece of equipment you'll need to install the ironing board is a screwdriver. The board can also be fitted with brackets for mounting underneath countertops. It's available through kitchen cabinet makers and home center stores, or for \$99 postpaid from Scanimport, Box 204, Staten Island, N.Y. 10306.

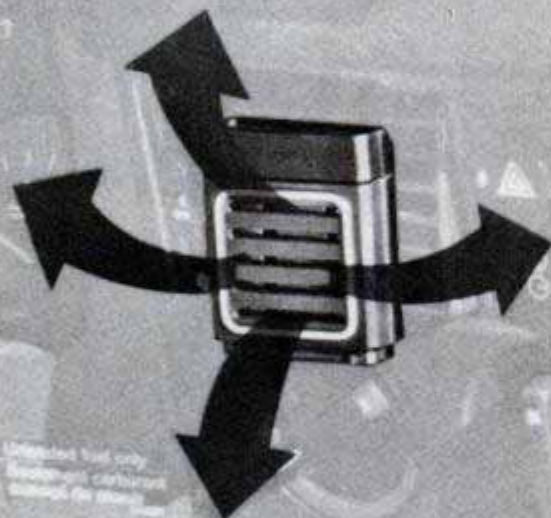


Hang it all



Keep towels within easy reach with these adhesive-backed hanging accessories. The Clencher (left, \$8) is of hard plastic with flexible teeth that grab towels or hot pads. It comes in white, red and black and is 12 in. long. The Jiffy (right) has three slits that grip towels. It's 6 in. long, comes in 13 colors and costs about \$3. They're at Ace Hardware and Crate & Barrel stores, or write to SFC Associates, 1160 Park Ave., New York, N.Y. 10118. **PM**

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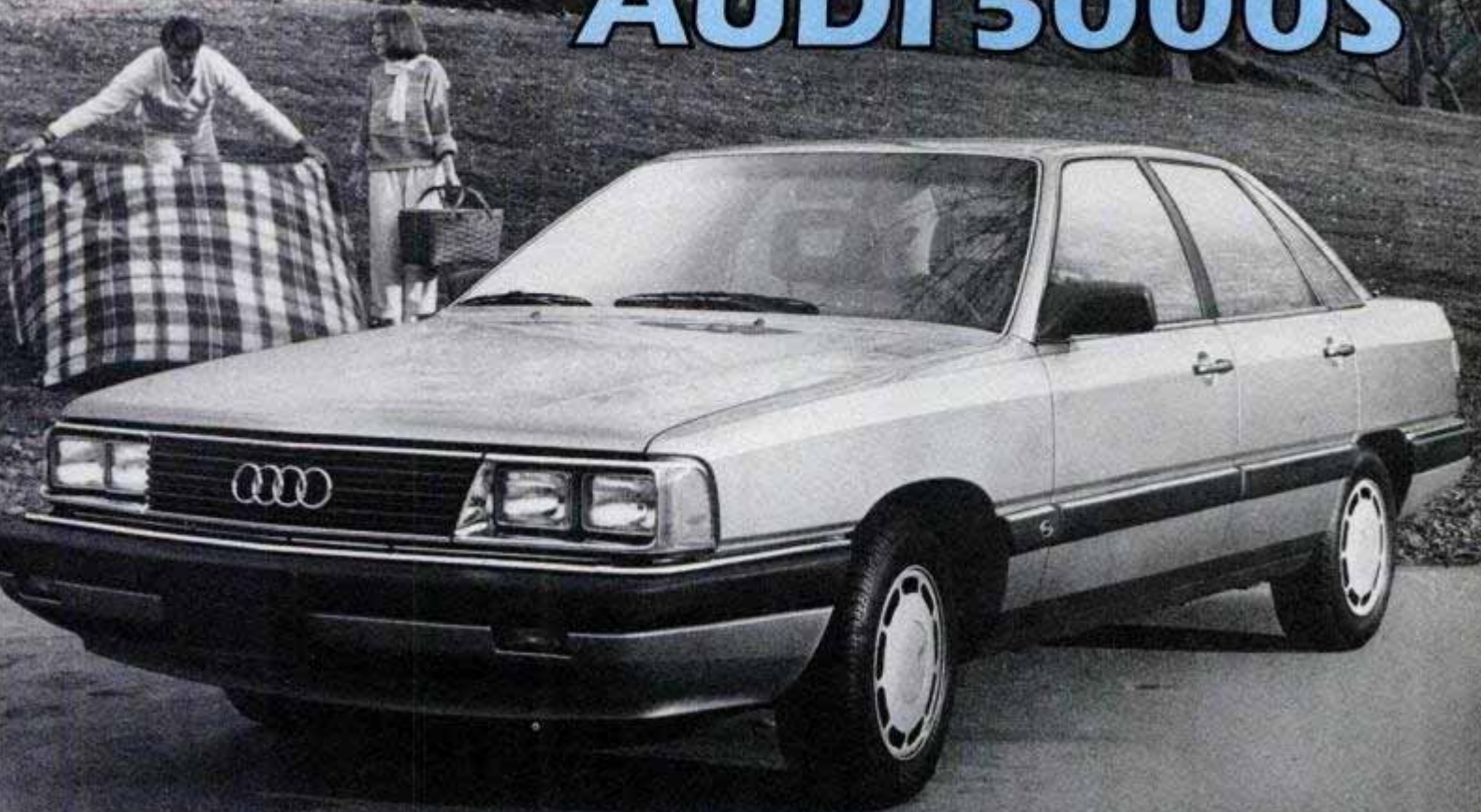


Does your auto smell like the local kennel? Refresh it with new Vent Fresh from Medo. Vent Fresh clips onto the vent in a snap to circulate automatically! A flick of a finger shuts it off, so it lasts longer than ordinary fresheners. Get Vent Fresh today. In six brisk fragrances at the automotive department in nearby chain stores.

VentFresh

PM OWNERS REPORT:

AUDI 5000S



Audi buyers find the 5000S sleek and silent, but they still need the repair shop.

BY MICHAEL LAMM,
West Coast Editor

The Audi 5000S's styling, more than any other attribute, put owners behind this car's wheel—58.6 percent in our sampling. But owners say the Audi's sleek, aerodynamic looks run more than skin deep.

"Most beautiful sedan in America," waxed a Texas consultant. "It's also got Mercedes quality, BMW performance, Cadillac comfort, all at a relatively Japanese price."

In a P.S. to his questionnaire, this same Texan wrote: "The turbocharged five-cylinder engine feels like a V8. I enjoy terrorizing Mercedes sedans, BMWs and Jaguars on our Texas highways. Most victims stop me to ask what the Audi's got in it."

Just over a third of our survey respondents ordered the 5000S Turbo. The Turbo costs \$5,815 more than the normally aspirated Audi 5000S automatic sedan and averages about 1 mpg

"Exceptional gas mileage."
—MINNESOTA MANUFACTURER'S REPRESENTATIVE

"Smooth clutch, smooth shifting, good acceleration and excellent handling."
—NEW HAMPSHIRE ENGINEERING TECHNICIAN

"One of the finest cars I've ever driven."
—FLORIDA MANUFACTURER

"Engine needs more power."
—MISSISSIPPI REALTOR

"The air-conditioning system is very noisy."
—UTAH RETIREE

"Cost of service and repairs is too high."
—MICHIGAN EXECUTIVE

lower fuel mileage. The Turbo package includes, among many standard items, 15-in. alloy wheels and 60-series tires, firmer suspension, and four-wheel disc brakes. The 5000S Turbo delivers 140 hp, versus 100 for the normal engine.

As expected, performance and handling rate high with all Audi owners. A Tennessee dietician summed up han-



PHOTOS BY BILL ASHE

Besides using flush-mounted glass to become a leader in the low-drag aero department, the luxury 5000S sedan also has an unconventional five-cylinder powerplant.

dling for many when she stated, "My Turbo feels secure and surefooted, and is very responsive."

A New Hampshire chemist amplified: "The Audi can be driven very hard or very sedately and feels competent in both situations. Actually, the harder

A NATIONWIDE SURVEY BASED ON 1,139,874 OWNER-DRIVEN MILES

you drive it, the better the car feels!" And an Ohio chemical engineer: "This car handles so well and is so quiet on
(Please turn to page 168)

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FIX-IT FASTENING JOBS**

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AUDI 5000S

(Continued from page 167)

the highway that the speedo's up to 85 and 90 mph before you realize it."

However, a few owners admitted having reservations. A Florida doctor, for example, remarked, "I like the way our Audi Turbo handles, but my wife doesn't. The lack of front-end caster forces you to *drive* the car; the steering wheel doesn't automatically snap back to center after a turn. I love it, but it's not for everyone."

Talking about workmanship, a California company president says: "Beautifully put together at every joint. Doors fit perfectly, windows seal tightly and, with its aerodynamic styling, it's absolutely soundproof."

Audi designers worked hard to cut wind noise, first by doing away with bulky fender lips, replacing conventional drip rails with roof grooves and then by carefully blending in such items as outside mirrors, window glass and even the wheels themselves. The 5000S sedan boasts a Cd of 0.33; the wagon 0.35. "The interior sound level is about the same

SUMMARY OF AUDI 5000S OWNERS REPORTS*

Total miles driven	1,139,874	Workmanship opinion:	
Average miles per gallon		Excellent	79.2%
2.1-liter normally-aspirated ohc Five		Good	19.3
In town	20.9	Average	1.6
On the highway	25.8	Poor	0.0
Turbocharged 2.1-liter ohc Five		Comfort opinion:	
In town	19.0	Front seats	
On the highway	24.6	Excellent	77.9%
Five-speed manual		Good	19.6
In town	22.7	Average	1.5
On the highway	28.3	Poor	1.0
Three-speed automatic		Rear seats	
In town	19.9	Excellent	68.4%
On the highway	24.9	Good	30.1
Engine choices:		Average	1.6
2.1-liter ohc Five	64.4%	Poor	0.0
Turbocharged 2.1-liter ohc Five	35.6	Had any mechanical trouble?	
Transmission choices:		No	51.7%
Three-speed automatic	85.3%	Yes	48.3
Five-speed manual	14.7	What type of trouble?	
Body-style choices:		Air conditioner	22.7%
Four-door sedan	95.5%	Electrical	21.6
Five-door wagon	4.5	Sunroof mechanism	14.4
Why did you choose this car?		Brake fluid leaks	10.3
Styling	58.6%	Cold starting	10.3
Performance	22.7	Dealer repairs satisfactory?	
Past experience	16.0	Yes	77.4%
Reputation	14.9	No	22.6
Comfort	11.0	Dealer service opinion:	
Handling	11.0	Excellent	36.5%
Specific likes:		Good	46.6
Styling	72.5%	Average	14.9
Handling	49.5	Poor	2.0
Comfort	40.7	Number of vehicles owned:	
Performance	26.9	This car only	12.6%
Riding qualities	26.9	Two cars	52.0
Specific dislikes:		Three cars	23.2
No complaints	13.1%	Four or more cars	12.1
Not enough power (non-turbo)	11.3	Makes of other cars owned:	
Turbo lacks cruise control	9.4	Chevrolet	19.7%
Air conditioner lacks settings	9.4	Oldsmobile	13.3
Poor radio controls	5.6	Audi	13.3
Dealer service (waits for parts)	5.6	Ford	12.1
What changes would you like?		Honda	11.6
More horsepower	12.8%	Volkswagen	11.6
Cruise control with turbo	12.8	Would you buy an Audi again?	
No changes	10.5	Yes	78.4%
Handier radio controls	9.3	No	3.1
Better air conditioner	9.3	Maybe	18.6
How much did you pay?		Age distribution of owners:	
Average	\$20,472	Under 29 years	7.2%
Range	\$16,675-25,000	30-49 years	61.8
		50-plus	30.8

*Percentages might not equal 100% due to rounding or insufficient data.

at 100 mph," wrote a sly California octogenarian, "as at 30."

Only 4.5 percent of our sampling had purchased the 5000S wagon, but those who did praised the wagon for its roominess and adaptability. A California musician commented, "I like the ease with which the rear seatbacks fold down, either singly or doubly. I can get my string bass in with one or two people back there."

Audi workmanship got an extremely high rating, with 79.2 percent of our respondents voting it excellent and 19.3 percent rating it good. No car in recent memory has received a better workmanship score than that.

Yet when we asked about mechanical problems, 48.3 percent in our survey confessed that, yes, they'd had a few. Most glitches weren't serious, but even so, half our sampling having to go back to the dealer's shop isn't an exemplary showing. In fact, a Subaru we surveyed recently registered half as many problems as the Audi, and a fwd Toyota Corolla a third as many.

A California interior designer noted, "I really like my car, but I'm almost afraid to drive it very far because of all the problems I've had with it. In less than 10,000 miles, I've had to replace the water pump and sunroof motor, found a leak in the power steering/brake system and pinholes in the wheel rims. Has Audi developed a car with such great possibilities, only to destroy it with mechanical bugs?"

Surprisingly roomy

When we asked about comfort, nearly everyone agreed that the 5000S is surprisingly roomy. Only two minor annoyances mar an ideal interior.

The first is "the automatic climate control," according to a California physician. He pointed out that, "In the Econ mode, there's no way to regulate fan speed. It's either on HIGH or OFF."

Audi uses an automatic air conditioner that holds a preset cabin temperature when it's on, but when the driver wants unrefrigerated air or less cooled volume, he runs into the system's lack of manual control. Also, the a/c system—partially supplied by GM and partially by VW—accounted for 22.7 percent of Audi's mechanical hiccups—from burst hoses to inaccurate thermostats.

The second annoyance involved the tiny and poorly placed buttons on the vertical console. "The controls, especially for the radio and climate control, are virtually impossible to operate," grumbled a Georgia housewife.

But all complaints faded into insignificance when owners talked about their Audis as a whole. A Missouri teacher repeated that, "It's those body lines; my car looks new and will stay ahead of the pack for many years." **PM**

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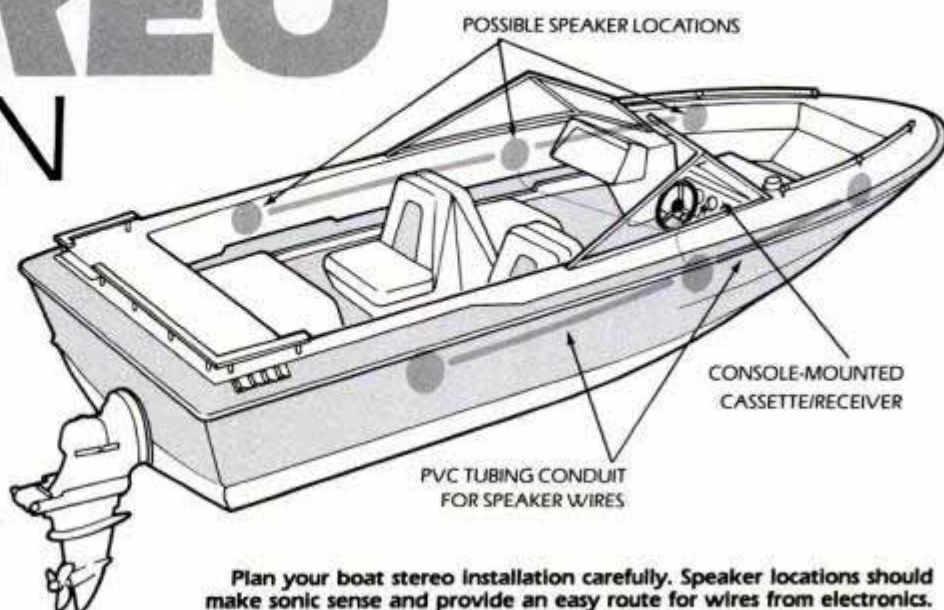
SEAWORTHY STEREO FOR OPEN BOATS

You can beat the environment with proper materials and careful installation.

BY MARC STERN

The marine environment presents problems encountered nowhere else. Moisture and salt air invite corrosion, and temperature extremes stress speaker materials. Acoustically, an open boat—a runabout or daysailer—is a nightmare. Because of the craft's configuration, speaker placement is less than optimal for good stereo imaging. And, with few surfaces and no ceiling to contain and reflect soundwaves, music disperses quickly, especially when you're underway.

Keep these environmental and acoustical handicaps in mind when you de-



Plan your boat stereo installation carefully. Speaker locations should make sonic sense and provide an easy route for wires from electronics.

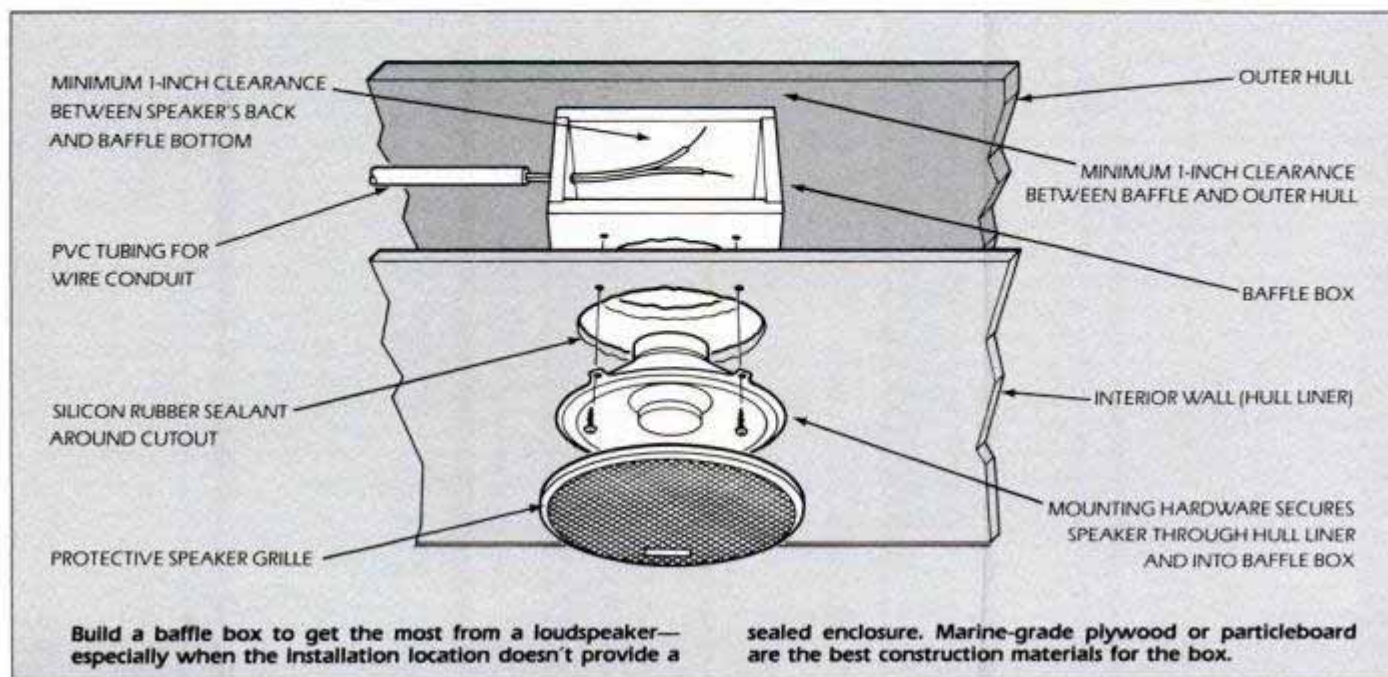
sign your "aquasound" installation. The first step is to eyeball potential loudspeaker sites that are fairly well-sheltered, and which can focus sound on the cockpit area where you're most likely to be listening.

A good speaker-mounting location in a runabout is the footwell area below the two consoles. If possible, install the left and right speakers facing the boat's stern—not each other—and space them as far apart from each other and as close to the interior hull as you can. If you plan on using four speakers, mount the second pair behind the console seats,

somewhere in the stern seating area and as close to the corners as possible. Ideally, you should install all the speakers angled downward directing sound into the boat—never upward and away from the cockpit listening area.

Your electronics—source unit and amplifier—should be stowed in a well-protected location, yet accessible for ease of use. Installation in the glove or map compartment is ideal, and mounting in or under the instrument console is second best.

Automotive sound components are a good choice. They're designed to run on



12-v.d.c. power, and can handle temperature extremes.

An autosound cassette/receiver will let you play tapes and radio. The most powerful of these offer about 20 watts of internal amplification—enough to produce clear, undistorted sound at moderate volume levels through four speakers. This will be more than adequate for most boats, especially if you plan to do most of your listening when trolling or at anchor.

For thunderous sound under full throttle, you'll need a separate, higher-powered amplifier. According to Dave Howe, an audio engineer at loudspeaker maker Bose Corp., an open, outdoor sound system requires four to 10 times more power than an enclosed one. Consequently, you'll want at least 40 watts to match the levels your 10-watt, four-speaker car system pumps out with the windows closed.

Speaker selection

The speakers you choose will depend on three factors. One is the mounting depth available in the installation area you've chosen. Another is power-handling ability, relative to your amplifier. Additionally, the speakers must be weatherproof and waterproof.

Again, automotive components are the best choice. They're designed for installation in shallow areas, such as car doors, and can weather temperature extremes and water that seeps down car doors through the windows. Moreover, autosound speakers are highly efficient. Their low, four-ohm impedance (compared to eight ohms for home speakers) is meant to make the most of relatively low-powered source units. One final benefit: The tweeters on some car speakers can be angled to direct the high frequencies where you want them—plus firing into the cockpit.

As obvious as it might seem, don't underestimate the importance of weatherproof and waterproof loudspeakers. This includes the frame: Untreated metals will corrode in a salt-air environment. Many of today's car speakers have a sturdy, plastic frame, or anodized aluminum. As for the speaker cone itself, waterproof paper cones are more plentiful today than ever in the past. Plastic cones are available too, and while these are a good choice, it's wise to install them away from direct sunlight. Extreme heat might deform a plastic cone, and cause the voice coil to misalign. Regarding voice coils—always wound from metal wire—look for corrosion-proof construction in the speakers you choose.

Before you install the sound equipment, make a diagram of the craft—or use an already-published diagram—to plan the wiring of your system. When

(Please turn to page 172)

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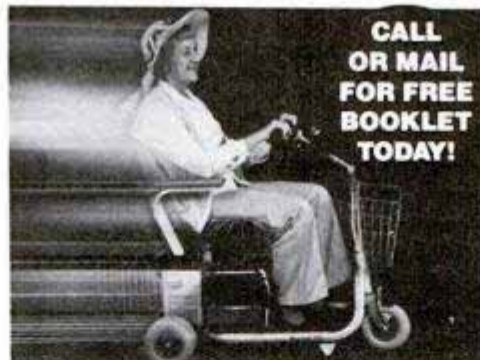
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SEAWORTHY STEREO

(Continued from page 171)

you are mounting the electronics, be sure to use the hanger strap. Never rely on the front plate to bear the weight of the source unit.

Make sure you have a good ground to prevent extraneous noise—ignition noise, for example. Either run the ground to the proper terminal on your boat's battery, or connect it to a copper foil attached to the length of the boat's beam. It's best to use a copper braid, with good connectors, for ground hook-up wires. And before you bolt the electronics in place, be sure to connect the ground wire and speaker leads. This is easier than trying to attach the wiring after the installation is complete. The same rule applies to the speakers.

Wiring for sound

With the electronics installed in their sheltered niche, run cables to the speakers. Use large-gauge twin-lead wire for electrical efficiency; 14-gauge should do the job. Try to keep the runs of wire as short as possible. If you're running multiple leads, bundle the wires every 18 inches or so, for neatness and safety. Secure them to an adjacent surface (such as a thwart). Another idea is to use PVC tubing as conduit—for a more weatherproof installation and to eliminate headaches when snaking wires through your craft.

Most speakers will come with a template you can lay out and use as a guide for cutting the hole and placing the grille. If not, use the speaker as a template by turning it upside-down and tracing its outline before you cut.

Now's the time to bolster your bass output with proper baffling. In a car stereo installation, the doors themselves provide the enclosure for door-mount speakers. Similarly, the trunk serves as an enclosure for speakers installed in the rear deck. For your boat, though, you might want to build a baffle box between the inner liner and the hull, or behind any opening you cut in the console. Build the box deep enough to leave at least an inch between the back of the speaker and the bottom of the baffle box. Also leave an inch or more between the baffle box and the outer hull. The best material for the box is weatherproofed particleboard, or marine-grade plywood.

After you've cut the hole and run the wires through the baffle, attach them to the speaker. Run a bead of silicon rubber around the hole and bolt or screw the speaker in place. The silicon will ensure stability, protect the speaker from excessive vibration and help with weatherproofing. Now, just snap the protective grille into place and you're done.

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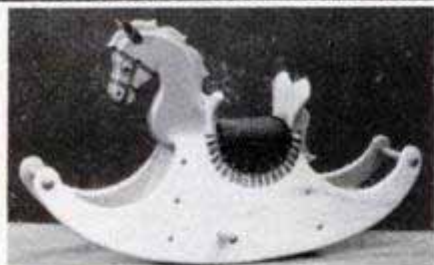
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FIRSTHAND REPORT



Aero nose treatment and Goodyear gatorbacks give the GT its most aggressive stance ever.

PM DRIVES THE FORD MUSTANG GT

By upgrading the 5.0-liter V8 model with SVO chassis tricks, Ford's built a grown-up hot rod.

BY RICH TAYLOR

A year and a half ago, we tested 10 sports/GT cars against the then-new *Corvette* (see *Corvette Takes On The World*, page 88, Jan. '84). The last-place finisher and greatest disappointment was a Mustang GT. We thought the poorly controlled suspension, numb steering and mediocre brakes weren't up to dealing with the V8's obvious superabundance of horsepower.

After labelling the 1983 Mustang GT "dangerous in the hands of an inexperienced driver," we concluded: "Our unanimous advice to the Ford Motor Company: Put the excellent SVO suspension under the GT V8 and forget about the 2.3 Turbo. Ford could sell that car for \$12,000, and have a worthy competitor for the Z28."

We never expected it, but Ford has done exactly what we suggested. The 1985 Mustang GT chassis is very similar to that under the SVO, and the result is virtually the same—a stable, good-handling platform more than capable of coping with the V8's power.

Instead of the \$12,000 we estimated, Ford has brought in the improved Mustang GT for a base price of just

Quadra-Shock rear axle works to keep the back end firmly planted on the asphalt.



\$10,250—\$4,250 less than the SVO, as well as significantly less than arch-rival Camaro Z28 or any comparable import sports/GT.

Engineer Jim Kennedy, Ford's manager of mid-size car development, proudly went through the Mustang GT for us. Most unusual is the unique Quadra-Shock rear axle setup. According to Kennedy, the Quadra-Shock was engineered for the GT, then borrowed for the SVO after it had proved itself.

The Quadra-Shock has two horizontal fore/aft dampers mounted at a splayed angle. This reduces rear compliance oversteer, according to Kennedy, which allows the front suspension to be retuned to reduce understeer. All four rear shocks and the front MacPherson struts are nitrogen gas-filled.

In addition, all springs are now progressive climbing rate, which means as the suspension is compressed—in a

hard corner, for example—the spring rate becomes stiffer. This is a clever way to obtain flatter cornering without unduly affecting smooth-road ride.

Last year, says Kennedy, the front springs were rated at 425 pounds; the



The 302 c.i. V8 has been pumped up to 210 hp with a roller tappet cam, dual exhausts.

rears were rated at 200 pounds. For '85, the fronts are progressive 425/535 pounds; the rears are progressive 200/300. Coupled with more rebound control in the shock absorbers, it virtually eliminates the tail-happy handling we disliked in previous Mustangs.

Compared to the old Mustang GT, the '85 has bigger antiroll bars front and rear, mounted in urethane bushings with less compliance. Like progressive springs, antiroll bars are an easy, inexpensive way to add roll stiffness without denigrating ride quality. The theory works beautifully in practice on the Mustang GT.

A good portion of the handling gains can be attributed to Ford's choice of tires. Standard on the Mustang GT are P225/60VR15 Goodyear Eagle GT "gatorback" tires, derived from those designed for the new Corvette.

The SVO Mustang also comes with gatorbacks starting in 1985½, but in a 50-series profile to fit a 16-in. wheel. In our experience, the performance difference between 50-series and 60-series tires can only be measured on the race track, while the 50-series tires produce a noticeably bumpier ride and are much more difficult for most tire installers to handle. The 60-series tires—as fitted to the Mustang GT on new, wider, 15×7-in. alloy wheels—are a perfect choice for aggressive street driving.

'85 Improvements

Other improvements for '85 are a different torsion bar in the steering gear that improves steering feel, new transmission synchros for smoother shifting, plus stiffer brake calipers and a larger brake master cylinder to improve stopping. The GT still has rear drum brakes but we'd say the brakes are now up to the performance of the V8.

In the '85 models, says Jim Kennedy, all the seams around the cowl and rear wheelwells are bonded with structural adhesive, while the central chassis area has been stiffened. This allows the suspension to do the flexing, not the unibody. There's some cowl shake over potholes, but noticeably less than before.

Under the hood, the timeless 5-liter V8 has been given roller tappets—remember when those came only in "built" racing engines?—a new camshaft and real dual exhausts. This mildly hot-rodded V8 is rated at 210 hp, and it moves the Mustang GT smartly.

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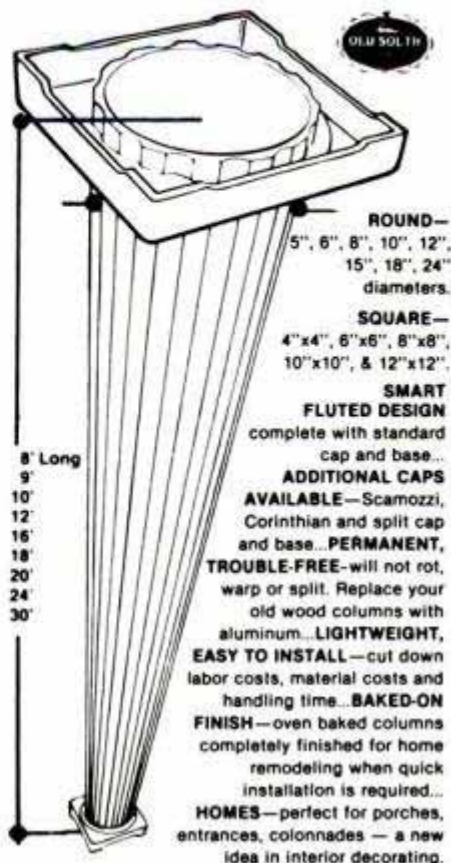
Happily, the Mustang GT has been massaged in other ways, too. The exte-

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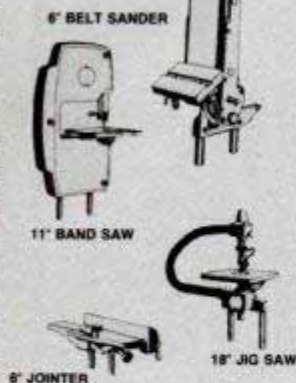
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FORD MUSTANG GT

(Continued from page 175)

rior styling is cleaner than before, with an aerodynamic new nose. And the interior has been done over in SVO trim—gray velour Recaro-copy seats, padded door panels and a padded steering wheel that would look like it belonged in a Mercedes.

What didn't we like? The clearances on the plastic dash panels and console are pretty sloppy, and fit/finish throughout the interior reflects the low price tag. The steering, while greatly improved, is still a bit insensitive when you're trying to go fast. Neither would keep me from buying this car, and the Mustang GT is near the top of the short list of "New Cars I Would Buy."

It's not too hard to see that the Mustang hatchback is more practical than a Corvette, Camaro or 300ZX—two full-size adults even fit in the rear seat—as well as dependable, fully sorted-out and easy to work on.

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THE PM REPORT CARD

FORD MUSTANG GT	GRADE	COMMENTS
Acceleration	A+	Faster than any other American car except Corvette
Handling	A	Stable and easy to drive, tail-wagging is gone
Braking	B	Spongy pedal, some nose dive, but shorter-than-average stops
Steering	B-	Too light, not enough road feel
Transmission	A	Excellent, relocated shift lever a great improvement
Ride	B+	Surprisingly soft, considering lack of body lean in hard corners
Fuel economy	A	Terrific considering the performance available
Seating	B+	Surprising rear head-room/legroom. Front seats need more lumbar/lateral support
Vision	B	Heavy C-pillars
Gauges/controls	B+	Typical Ford corporate... effective but not fancy
Ventilation	B	Shows age of basic body now six years old
Noise @ 55 mph	A	Very quiet, nice exhaust burble
Cargo capacity	A	Hatchback gives lots of room
Engine serviceability	B	Good, lots of hoses, but basics are easy to reach
Fit and finish	B-	Worst part of car is interior/dash plastic parts, exterior good

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Homebuilt contact printer can give results on a par with professional models that cost \$30 or more. Follow PM's plans for this printer and it will look professional, too.

BUILD YOUR OWN CONTACT PRINTER

With readily available materials, simple tools and an hour's spare time, you'll be able to print your own contact sheets.

BY KENN OBERRECHT

Every photographer with a home darkroom needs a printer for making contact sheets. This piece of equipment costs anywhere from \$16 for the least expensive to \$30 or more for the best models. You can beat those prices and still have a professional product if you build your own.

PM's contact printer project takes about an hour to build, not counting paint-drying time. You'll have to shop for some of the required materials; others you're likely to have around the house.

For the printer's lid, you'll need a 10 × 13-in. piece of quarter-inch plate glass. Have the glass shop seam or bevel the edges. A pair of glass-door

hinges (like those used for stereo cabinets) and a strike plate (used as a lift tab on the printer's lid) should also be available at the glass shop.

Other construction parts include a square foot of 3/8-in. polyfoam, four self-adhesive rubber protector pads (for the printer's feet) and two self-adhesive, cork, cabinet door protectors. For the basic assembly, the project requires a 10³/₈ × 13³/₈-in. piece of 1/2-in. plywood, two pieces of 1 × 2 cut 10³/₈ in. long and two more 14¹/₈ in. long. Necessary supplies include latex paint, glue, brads, double-sided tape and medium- and fine-grit sandpaper.

1. Trim the plywood and 1 × 2s to the proper size and sand with medium-grit sandpaper. Bevel the long pieces of 1 × 2 at a 45° angle, if you wish.

2. Measure 1³/₈ in. from the rear end of each long piece of 1 × 2 and scribe a line across the inside surface. Then, mark for a drill-starter hole on each line 1¹/₁₆ in. from the bottom edge, and punch a drill-starter hole at each spot with a center punch. Clamp each piece to a solid working surface with a pair of C-clamps and clamp cushions. Then, you should drill an 11/32-in.-dia. hole 3/8-in. deep in each. Be sure to erase the layout lines.

3. Next, run a bead of glue along a short edge of the plywood, and attach the short piece of 1 × 2 flush with the bottom, using three 1/4-in. brads. Countersink the brads with a nail set and hammer. Similarly, attach the long pieces of 1 × 2 to the side edges of the plywood base with glue and brads, and

countersink the brads. Make certain that you wipe away any glue seepage with a damp sponge.

4. Fill the brad holes and conceal any plywood laminations. Use spackling paste spread with a putty knife. When the spackling paste hardens, you should sand the unit and round-over all corners and sharp edges with medium-grit and fine-grit sandpaper. Clean the unit to remove dust, and apply two coats of latex paint. When the paint has dried, attach a self-adhesive rubber protector pad inside each corner on the underside of the plywood base.

5. Using a straightedge and hobbyist's razor knife, trim the 3/8-in.-thick foam to 9 x 11 1/2 in. Cover one surface of the foam pad with strips of double-stick tape.

6. Measure 7/8 in. from the front edge of the top surface of the plywood base and make several light pencil marks. Measure 5/8 in. from each side 1 x 2 and make similar marks along each side on the plywood base. Next, you should press the taped pad into position atop the plywood base, inside the pencil marks. Be sure to press the entire surface with your hands to seat the pad firmly.

7. Peel the backing from the self-adhesive hinge plates and attach these to the rear corners of the plate glass. Remove the backing from the self-adhesive strike-plate cushion and position the cushion at the center of the front edge of the plate glass. Then, carefully press the strike plate onto the cushion to attach it.

8. Press a plastic hinge grommet into each hole drilled in the long pieces of 1 x 2. If the fit is tight, use a block of wood and hammer to tap the grommets in gently. Slide the hinge pins into the plastic grommets.

Clean the plate glass with window cleaner and paper towels and slide it into the hinges. Then, tighten the hinge screws. To protect the finish of the rear 1 x 2, stick a self-adhesive, cork cabinet-door cushion on the rear 1 x 2 where each hinge rests when the printer is in the open position.

Your professional contact printer is now ready for use, and it should serve you well for many years. **PM**

MATERIALS—CONTACT PRINTER

- 3/8" plywood—10 3/4 x 13 3/4" or larger
- 1 x 2—3 ft. long
- Carpenter's or white glue
- Spackling paste or compound
- 1/4" brads
- Medium- and fine-grit sandpaper
- Latex paint
- 10 x 13" piece of 1/4" plate glass with seamed edges
- One pair of glass-door hinges
- One glass-door strike plate
- 1 sq. ft. of 3/8" polyfoam
- Four self-adhesive protector pads
- Two self-adhesive cabinet-door cushions
- Double-stick tape
- Window cleaner
- Paper towels

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Enlarged cross section shows a typical Beta or VHS super-high-grade videotape. Tapes of this grade add an undercoating and backcoating treatment, which accounts for their higher quality—and higher price. Particle density and antistatic properties are greater, too.

Buying a video cassette recorder might prove to be less confusing than choosing the blank videotape to use with it.

At the very least, most manufacturers offer two grades of tape: standard and high grade. Others offer as many as five. And now, the new wave of hi-fi VCRs has spawned an additional grade of tape, designated "Hi-Fi."

Because pricing among the relative grades can vary from store to store according to discount policies, it's certainly no arbiter of quality. Neither are the brand designations you'll read on the cassette package. Designations such as TDK's Super Avilyn, Fuji's Beridox, Maxell's Epitaxial, Sony's Dynamicron and BASF's Chromium Dioxide are no more than the respective manufacturers' trade names for their proprietary chemical formulation. Current 1/2-inch (Beta and VHS) formulations always use some form of metal oxide.

'Specs' for the eyes

The lack of technical data on most cassette packages makes direct comparison between brands and grades impossible. Even where the manufac-

turers provide specifications, they're virtually useless because the comparison relates to that manufacturer's own reference tapes—not to any industry standard.

The only measurements that have any meaning are those reported by independent, third-party tests, which should compare all brands against a common reference. In this case, the important specifications are:

Chroma—the amount of noise or distortion in a color picture, visible as periodic alterations in color shades.

Luminance—the amount of "snow" or noise in a black and white picture, visible as imperfect contrast.

Drop-outs—minute imperfections in the blank tape coating that visibly result in anything from tiny, white spots in a picture to thin, horizontal white lines, and in worst cases, a rolling picture.

Chroma and luminance readings are expressed as "signal-to-noise" ratios (S/N) and are measured in decibels (dB). In each case, the higher the number the better. Readings of 40 dB for chroma and 44 dB for luminance are average for standard-grade tapes. Drop-outs are measured by their quantity and frequency: A count of 15 drop-

outs per minute is average for standard-grade tape. The fewer drop-outs the better. Generally, the higher grades of tape have better measurements. In chroma, for example, a premium tape might register a 3 dB improvement over the standard formulation.

In the absence of third-party test reports, you'll do best to ignore manufacturers' formulation names and rely instead on the grade designation. For both the Beta and VHS formats, there are four general grades: standard, high-grade (sometimes called premium), super-high-grade and hi-fi. However, some companies raise the ante with an ultra-high-grade for the most demanding tasks—usually, recording with a camera.

Ultimately, the best way to determine which tape to buy is a method based upon application. For instance, while most of the new hi-fi grades may work best when used with hi-fi VCRs, they actually vary very little from super-high-grade blank tapes except in one regard: durability.

Why durability?

The importance of durability to a hi-fi tape is illustrated by the way people

generally use cassettes. A person recording *Sherlock Holmes Faces Death* may view that movie only three or four times a year.

By contrast, users of hi-fi VCRs generally are music fans, and are likely to view a recording of a video concert as many times as someone else might play the record on a turntable. The tape, therefore, has to be more durable and less drop-out prone, the shell and internal mechanism must be stronger, and better antistatic guards also have to be included. Ultra-high-grades are much the same, but boast better color saturation ability.

Fidelity with economy

Similarly, purchasing by application extends to the other tape grades. High-grade and super-high-grade tapes exhibit their best characteristics when shooting live footage with a video camera. The use of a high-grade tape for your master will provide better quality on any copies you might make. These "dubs" of family events and the like will in turn look best if they're copied onto high-grade tape.

A high-grade tape also is a good investment if you're in the habit of recording at slow speeds to fit three or more movies on a single cassette. Often-times, a high-grade or super-high-grade tape recorded at the slowest speed will equal the performance of a standard tape recorded in the faster or normal mode. While the initial price may be higher, the actual cost works out to be lower on a viewing-per-hour basis. Standard tapes generally retail from \$5 to \$8, high-grades from \$8 to \$12 and the others as high as \$20.

High-grade tapes, it should be noted, offer little meaningful improvement to

black-and-white films. Standard tapes will do fine. They also are perfectly suited for time-shifting and most other recording needs at normal speeds, but if you intend to use the same tape each day as your workhorse time-shifting cassette, the investment in a higher grade will pay off in longer tape life.

Tape care tips

The tape grades best suited to your purposes will become apparent after a little experimentation. But the benefits of any tape can easily be lost by improper handling.

Static electricity and dust are the worst enemies of videotape. Static electricity picked up in dry environments or transmitted from carpets quickly attracts dust particles from the air. If dust finds its way onto the tape, the result is an increased drop-out rate, excessive noise and, in severe cases, fouling the video heads of the VCR. To avoid such calamities, always store the tape in its protective sleeve and never leave the cassette in the machine. Dust also adheres to the oils deposited by fingerprints, so never touch the tape itself.

Store on edge

Always store video cassettes on edge and never lying flat. Storing the tape flat puts the weight of the tape pack on the tape's edge, where the audio and control tracks are recorded. Edge damage can destroy a cherished recording. Additionally, storing cassettes on or near items that generate strong magnetic fields (TV sets, loudspeakers) can cause the recording to be erased. Three feet away is a safe distance. If you follow these precautions, your tape library should retain high-fidelity performance indefinitely. **PM**

Metal Tape For 8-mm Video Recorders

The latest videotape formulations on the street are metal-powder (MP) and metal-evaporated (ME) tapes, used in the new 8-mm camcorders marketed by Kodak, Polaroid and others soon to follow.

Because the 8-mm (1/3-inch) tape is narrower than the 1/2-inch variety used for Beta and VHS recorders, a more highly magnetic medium is needed to retain sound and images. "Pure," unoxidized metal formulas fill the bill, compared to the metal oxides used for the wider, half-inch Beta and VHS tapes. Because pure metal particles are more difficult to manufacture and coat, they're two to three times more expensive than the 1/2-inch oxide formulations.

MP particles are coated onto the polyester tape with conventional binders, but the more costly ME process deposits the particles directly to the tape as a vapor for a thinner tape with more recording time per cassette. Current MP and ME cassettes can record up to two hours.



Two-hour 8-mm tape (right) is about the same size as 20-minute mini VHS-C tape.

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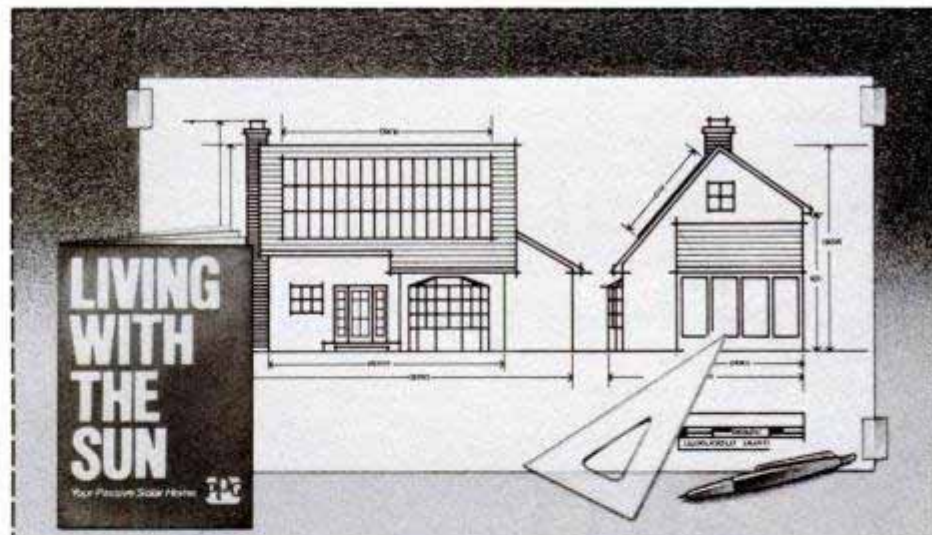
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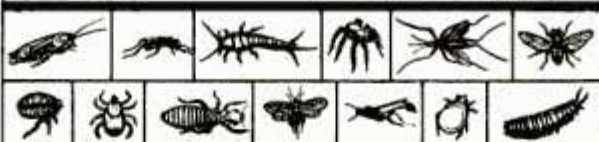
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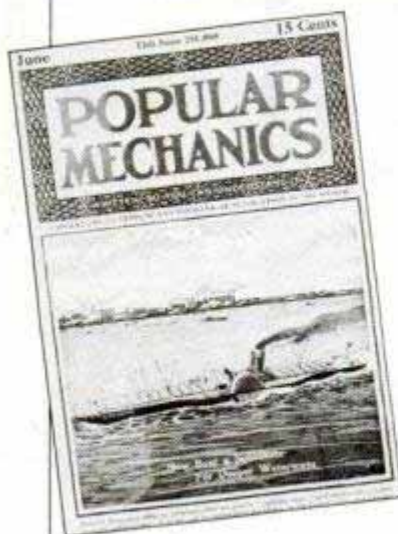
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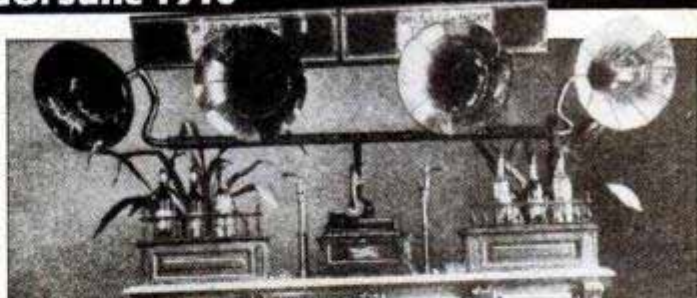
75 YEARS AGO: June 1910



Shallow-draft boat launched.

Deep waterways

At first glance the article, *New Boat A Substitute For Deeper Waterways* appeared to be a description of a new shallow-draft boat. But the article was largely devoted to the Lakes-to-the-Gulf movement. It was backed by the "boomers," who wanted a canal dug between the Great Lakes and the Mississippi River, thus providing a continuous waterway from the Lakes to the Gulf. President Taft opposed the plan. This summer the Tennessee-Tombigbe Waterway opens shipping from the Lakes to the Mississippi.



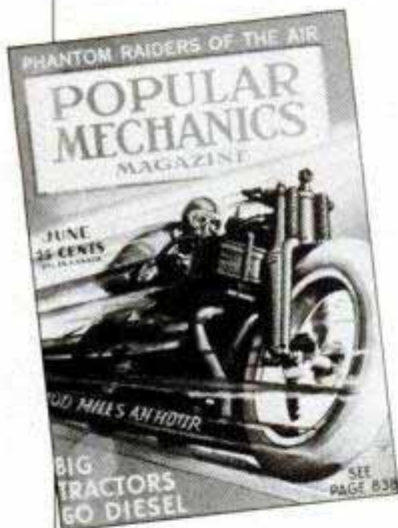
A sound search

In his search for accurate reproduction of music, man has employed many devices in the past. The four phono-graph funnels that are shown above were designed so that they would be able to produce "extraordinary sound intensity."

X-ray shielding

Once the dangers of Wilhelm Roentgen's discovery were recognized, X-ray rooms were outfitted with lead and iron-lined walls and Bohemian lead glass to protect technicians from harm. The first shielded X-ray rooms were installed in 1910.

50 YEARS AGO: June 1935



The 300-mph motorcycle roars.

Built for speed

The "Hybrid X" was a union of a six-cylinder Plymouth engine and a reinforced motorcycle frame. "Hybrid" could reach 300 mph, thus establishing a world's record. "Hybrid X" weighed 1,500 pounds. The wheelbase was 85 inches and its frame 115 inches. Two steel plates in front of the rear wheel served as brakes by actual contact with the ground. The fastest recorded speed for a motor-cycle was achieved by Donald Vesco on Aug. 28, 1978. He drove his 21-foot "Lightening Bolt" to 318.59 mph.



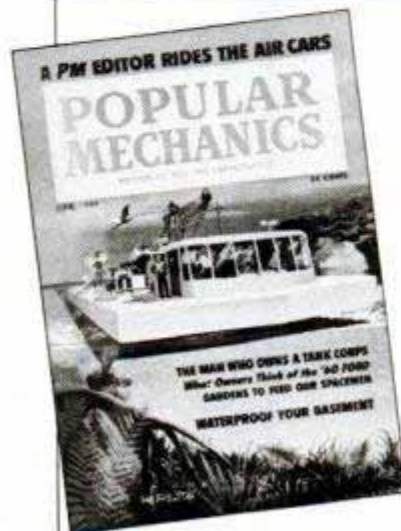
Promising gyroplane

The gyroplane shown above was still undergoing tests, but it held the hope of providing the average man with his own personal flight. James Bond used a similar, but smaller, model in "From Russia With Love."

Auto-home radio

The cellular telephone is the most advanced instrument in mobile communications. Unlike its predecessors, it can be dialed like a home phone without the use of mobile operator. A half-century ago, Don C. Wallace solved the auto-home mobile communications gap by installing two-way radio equipment in his car. By stepping on a button on the floor of his automobile and then speaking into a microphone strapped to his neck, Wallace was able to contact his son who was manning the home radio base.

25 YEARS AGO: June 1960



We sailed on a cushion of air.

Editor rides the air

Air-cushion or ground-effect crafts were still relatively new when a Daytona, Fla., manufacturer invited PM Editor John Linkletter to ride the Hydroair Vehicle, which was the largest of the air-suspension crafts. The Hydroair measured 32 by 24 feet and weighed 5,300 pounds. It skirted across water at better than 100 mph. Currently, air-cushion vehicles such as the Hovercraft and the Hovermarine are in service as high-speed ferries in Macao, Venezuela, and Rotterdam, and as a fireboat in Tacoma, Wash.

Tanks a lot

Steel company owner Walter Ising bought 500 surplus Sherman tanks for resale as scrap and parts. What seemed like an uncomplicated business venture turned into a logistical maze. Ising bought the tanks—originally worth \$47 million—for \$305,388.21. Ising then had to disarm the machines: He hired 14 men to remove the tanks' guns and firing mechanisms. It took about a month to move the surplus tanks by train from the arsenal to Ising's storage pasture. Happily, the tanks brought a welcome profit.



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