

**BONUS: COMPLETE IN THIS ISSUE:** Super troubleshooting manual for your car

MAY 1979 \$1.00

# Popular Mechanics

**INDY 500: How the world's best mechanics pass the toughest test**

**5 old-time toys you can make**

**TOP COMPUTER CHESS GAMES: PM picks the champ!**



1950 FORD CONVERTIBLE



**PM DRIVES GM's NEW FRONT-DRIVE COMPACTS PLUS: How to service 'em**

**A master craftsman's wood-turning secrets**

**3 cameras made of wood**

**29 years of car care paid off with this 1950 creampuff!**

**HOW TO KEEP YOUR CAR IN SHOWROOM SHAPE FOR YEARS AND YEARS**



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# For 1979 Ford creates an all-new LTD.



FORD LTD

FORD DIVISION



## A New American Road Car engineered for today's driving.

Ford technology and engineering combine to create the 1979 Ford LTD. New from the ground up, with a size and shape for today. Yet this re-engineered

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**V-8 standard, yet higher mileage than last year.** Even with V-8 power standard, the re-engineered LTD's EPA est. mpg is higher for 1979. EPA est. mpg is **16**. And this year's highway est. is still 22\*.



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\*Compare this estimate to the estimated mpg of other cars. Your mileage may differ depending on speed, weather, and distance. The actual highway mileage will probably be less than the estimated highway fuel economy. †Based on EPA Volume Index. авторским правом



Car have an ailment that's got you stumped?

# Ask the DuPont Car Doctor

He knows how to make a sick car well; keep a healthy car healthy. And the Du Pont Car Care Products he prescribes are good medicine for any car.

**Q. I can't seem to keep my V-8 in fan belts. Last one I put in lasted just 3 months. What's wrong?**

A. Chances are you installed it too tightly—a common mistake of shade-tree mechanics everywhere. Unlike most things on a car, tighter isn't better when it comes to fan belts. Install the next one with enough slack in it so light pressure from your thumb will push it in about 1/2" midway between pulleys.

**Q. The automatic transmission in my late-model wagon seems to be working fine. But lately I've noticed a little leakage of fluid on my garage floor. Any way to cure this without a teardown?**

A. One thing worth a try would be a can of Du Pont T-SEAL.<sup>®</sup> It's a fluid additive that swells shrunken transmission seals and prevents them from leaking. It's not a cure-all, but unless your transmission is on its last legs, it might just do the trick. (But don't use it in Citroens.)

**Q. Any way I can stop my engine from running after I turn the key off? Believe it or not, it does sometimes happen.**

A. A switch to higher-octane gas may help. If it doesn't, a complete tune-up, including adjustment of the ignition timing, is in order.

**Q. My 4-year-old compact's radiator needs a good flushing. But my engine has an aluminum block. Are chemical flushes safe?**

A. At least one is: Du Pont FAST FLUSH. Removes rust and grease, won't damage rubber or metal—including aluminum. And it works in only 10 minutes.

**Q. Is it okay to rotate my radial tires? And if so, how? One guy told me radials had to be rotated differently.**

A. By all means, rotate. But your friend is right. Unlike conventional tires, radials should be rotated only back to front or front to back, not side to side.

**Q. How can I get the grease out of my hands on nights when I want to go out? Saturday's the big problem, because during the day I work on my car. Saturday night, my hands are still greasy. Any suggestions?**

A. Try Du Pont PRO-TEK.<sup>®</sup> It's like an "invisible glove"—a cream you put on before you start work. Keeps grease and dirt from sticking to your hands and fingernails. Dirt and grease wash right off when you wash up.

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### On the cover:

Regular cleaning sessions, with all hands pitching in, keep this nifty '50 Ford looking as good at the curb as it does on the road. The car is owned by Lou Sasso of East Williston, N.Y. PM's Car Care Guide, beginning on page 151 in this issue, outlines an owner maintenance program that can make any car a perennial.

—PM photo by Jerry Abramowitz

# Popular Mechanics

MAY 1979

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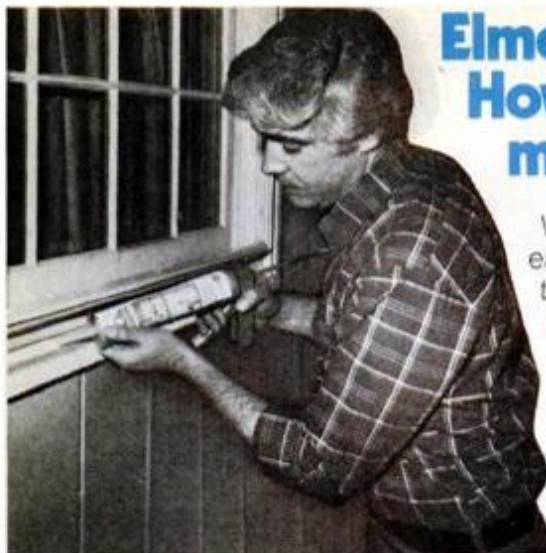
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to go motoring  
and pedaling too."**

*Auto Editor, Popular Mechanics*

The Auto Editor of *Popular Mechanics Magazine* evaluated the BikeBug as an alternative to mopeds ... and his choice was the BikeBug! His two-page Product Report, (Dec. '77), was based solely on quality, design and performance. Price was never a consideration, even though mopeds cost hundreds of dollars more (Complete reprints with our free brochures).

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#### The Complete Outdoorsman.

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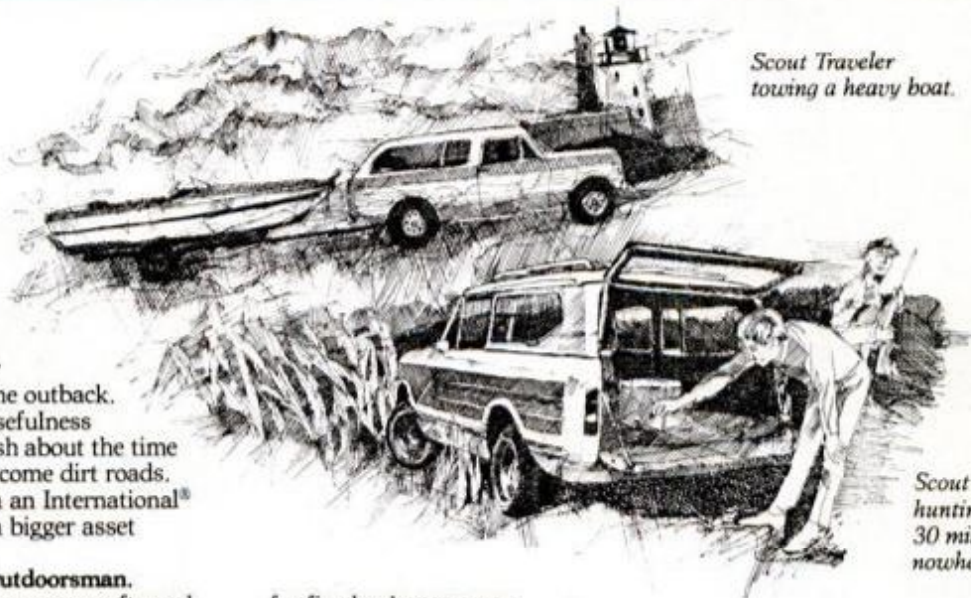
When towing something like a boat can give a car a backache, Scout provides an optional built-in, beefed-up towing package: 345 V-8 engine, leaf springs with a 6200-pound capacity, a truck-like rear axle, and one of the strongest frame hitches ever devised.

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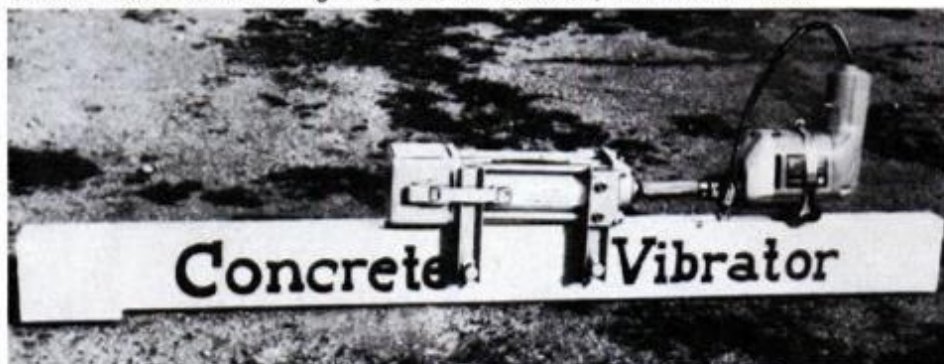


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# IT'S NEW NOW

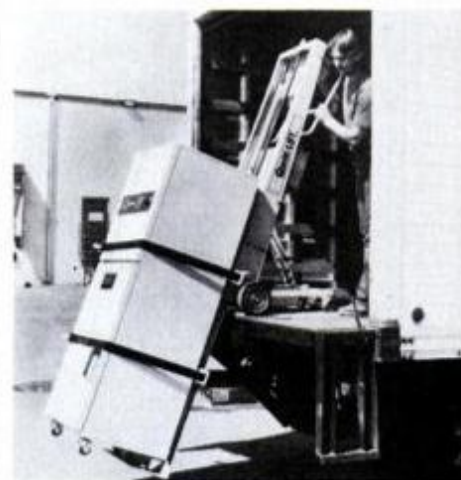
## Good vibrations

Connect a 1/4-inch drill to the Custom Vibe and concrete leveling becomes considerably easier, the maker claims. The unit clamps to any 2x4 up to 20 feet long and can be used on steps and side-wall forms as well as flat work. The vibrations are said to "walk" the board along the work and eliminate most of the physical effort involved. About \$150 without drill. Custom Trailers Manufacturing Inc., 233 South State St., Westville Ill. 61883.



## Going fiche-ing

Xerox developed this portable microfiche reader so their service technicians wouldn't have to carry a 15-pound service manual around. They liked it so much they decided to put it on the market. It's about \$50; optional light source is \$25 and a.c. charger is \$10. Xerox Corp., Xerox Square, Rochester, N.Y. 14644.



## Uplifting

The Qwik-Lift hand truck was also first designed to solve an internal problem: that of moving heavy equipment. With an electric motor powered by a rechargeable battery, the unit is said to be able to lift and lower itself and loads up to 1000 pounds. About \$1500 from Fox Industries, Inc., 6701 West 110 St., Minneapolis, Minn. 55438.

# Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

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# LETTERS TO THE EDITOR

### Of apes and men

I strongly protest your blatant endorsement of evolution as opposed to creation . . . Unless you publish a retraction of your false statements, I must insist that you cancel my subscription. Perhaps *your* ancestors are apes, but mine are not.

R. BRANNIGAN  
PITTSBURGH

*Reader Brannigan should be aware that a number of scientific-minded believers in Creation accept the process of evolution, so long as it is Divinely-directed (as opposed to the random selection Darwin postulated). PM's comment on evolution as a "useful way of modeling reality" (Letters, page 12, Feb. '79) was intended to consider that possibility.*

### Superbike

Bill Hampton, who recommends motorcycles ranging from 250-400 cc for carrying two people (*How to Carry a Passenger Safely*, page 74, Sept. '78) would be horrified to see a motorcycle cab, a popular public transport vehicle in the Philippines. It carries nine on a 100-cc motorcycle.

The cab is a two-wheel trailer slung from the motorcycle just behind the front wheel. The housing



A nine-passenger, 100-cc motorcycle-cab. for the rear wheel projects into the passenger compartment. Fully loaded, these vehicles are very slow and not really unsafe. When climbing a steep hill, if all nine passengers are heavy, sometimes one or two passengers get out and push. This doesn't contradict the contention that you can't expect a 100-cc machine to haul two people safely on a crowded highway, but it does show what a 100-cc machine can do.

(REV.) JOSEPH I. STOFFEL, S.J.  
MALAYBALAY, BUKIDNON  
PHILIPPINES

### Spotty dice

In your March issue there was a project entitled *Roll Your Own Electronic Dice* (page 14). I started the project and was stumped when I came to part C3, which is not in your parts list. Another conflict involved C1, which is listed as 10 mfd. in the parts list but as 10 pf. in the schematic. Could you please clarify this?

FRANCO PALOMBA  
SAN FRANCISCO

*The correct value of C3 is .1 mfd., as shown on the schematic. The value of C1 should be 10 mfd., as in the parts list.*

*We apologize for the inconvenience that this has caused and certainly hope your project is soon rolling along.*

### Not so dumb after all

In reference to *Menace in the Aisles* (*PM Briefs*, page 51, Dec. '78): While I agree that many government studies seem like "data churning," anyone who has heard the dull thud of a baby's head hit the concrete floor of a supermarket while the child was left unattended in a grocery cart will understand why safety standards on shopping carts should be considered—to save more than eggs from being cracked.

LAURA KOLENOVIC  
PHILADELPHIA

### Is the price right?

In the October '78 PM on page 124 (*Fireplaces and Stoves You Can Install in Your Home*) the Imperial Carousel firebox is listed as costing \$625. Yet the seller of the product nearest me is asking \$749 for one. While I know prices can be changed according to the way people feel, isn't this a bit much?

MRS. MERLE G. RIDGEWAY  
COCHRANTON, PA.

*We rechecked the price and found that the manufacturer's suggested retail price for the firebox with matte black finish is now \$629. With porcelain finish (available in 10 colors) it's \$739. If a dealer in your area has quoted you a price of \$749 for a matte black model, there is not much that can be done. According to the manufacturer their prices are only suggested and can be raised by dealers.*

# Burglar Alarm Breakthrough

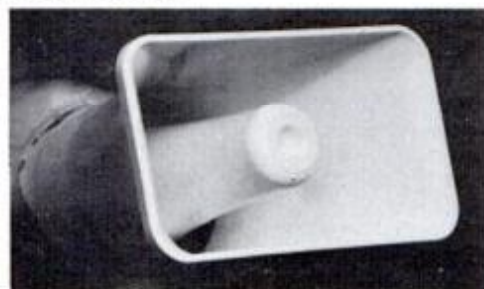


*A new computerized burglar alarm requires no installation and protects your home or business like a thousand dollar professional system.*

It's a security system computer. You can now protect everything—windows, doors, walls, ceilings and floors with a near fail-safe system so advanced that it doesn't require installation.

The Midex 55 is a new motion-sensing computer. Switch it on and you place a harmless invisible energy beam through more than 5,000 cubic feet in your home. Whenever this beam detects motion, it sends a signal to the computer which interprets the cause of the motion and triggers an extremely loud alarm.

The system's alarm is so loud that it can cause pain—loud enough to drive an intruder out of your home before anything is stolen or destroyed and loud enough to alert neighbors to call the police.



*The powerful optional blast horns can also be placed outside your home or office to warn your neighbors.*

Unlike the complex and expensive commercial alarms that require sensors wired into every door or window, the Midex requires no sensors nor any other additional equipment other than your stereo speakers or an optional pair of blast horns. Its beam actually penetrates walls to set up an electronic barrier against intrusion.

## NO MORE FALSE ALARMS

The Midex is not triggered by noise, sound, temperature or humidity—just motion—and since a computer interprets the nature of the motion, the chances of a false alarm are very remote.

An experienced burglar can disarm an expensive security system or break into a home or office through a wall. Using a Midex system there is no way a burglar can penetrate the protection beam without triggering the loud alarm. Even if the burglar cuts off your power, the four-hour rechargeable battery pack will keep your unit triggered, ready to sense motion and sound an alarm.

## ARRIVE HOME SAFE

There's personal danger in arriving home and finding a burglary in progress. And, if you surprise the burglar, you risk the chance of serious injury. With the Midex 55 protecting your home, you can open your front door with the confidence of knowing that no burglar lurks inside.

When the Midex senses an intruder, it remains silent for 20 seconds. It then sounds the alarm until the burglar leaves. One minute

after the burglar leaves, the alarm shuts off and resets, once again ready to do its job. This shut-off feature, not found on many expensive systems, means that your alarm won't go wailing all night long while you're away. When your neighbors hear it, they'll know positively that there's trouble.

## PROFESSIONAL SYSTEM

Midex is portable so it can be placed anywhere in your home. You simply connect it to your stereo speakers or attach the two optional blast horns.

Operating the Midex is as easy as its installation. To arm the unit, you remove a specially coded key. You now have 30 seconds to leave your premises. When you return, you enter and insert your key to disarm the unit. You have 20 seconds to do that. Each key is registered with Midex, and that number is kept in their vault should you ever need a duplicate. Three keys are supplied with each unit.

As an extra security measure, you can leave your unit on at night and place an optional panic button by your bed. But with all its optional features, the Midex system is complete, designed to protect you, your home and property just as it arrives in its well-protected carton.

The Midex 55 system is the latest electronic breakthrough by Solfan Systems, Inc.—a company that specializes in sophisticated professional security systems for banks and high security areas. JS&A first became acquainted with Midex after we were burglarized. At the time we owned an excellent security system, but the burglars went through a wall that could not have been protected by sensors. We then installed over \$5,000 worth of the Midex commercial equipment in our warehouse. When Solfan Systems announced their intentions to market their units to consumers, we immediately offered our services.

## COMPARED AGAINST OTHERS

**In a recent issue of a leading consumer publication, there was a complete article written on the tests given security devices which were purchased in New York. The Midex 55 is not available in New York stores, but had it been compared, it would have been rated tops in space protection and protection against false alarms—two of the top criteria used to evaluate these systems. Don't be confused. There is no system under \$1,000 that provides you with the same protection.**

## YOU JUDGE THE QUALITY

Will the Midex system ever fail? No product is perfect, but judge for yourself. All components used in the Midex system are of aerospace quality and of such high reliability that they pass the military standard 883 for thermal shock and burn-in. In short, they go through the same rugged tests and controls used on components in manned spaceships.

Each component is first tested at extreme

*The Midex security computer looks like a handsome stereo system component and measures only 4" x 10½" x 7."*

tolerances and then retested after assembly. The entire system is then put under full electrical loads at 150 degrees Fahrenheit for an entire week. If there is a defect, these tests will cause it to surface.

## PEOPLE LIKE THE SYSTEM

Wally Schirra, a scientist and former astronaut, says this about the Midex 55. "I know of no system that is as easy to use and provides such solid protection to the homeowner as the Midex. I would strongly recommend it to anyone. I am more than pleased with my unit."

Many more people can attest to the quality of this system, but the true test is how it performs in your home or office. That is why we provide a one month trial period. We give you the opportunity to see how fail-safe and easy to operate the Midex system is and how thoroughly it protects you and your loved ones.

Use the Midex for protection while you sleep and to protect your home while you're away or on vacation. Then after 30 days, if you're not convinced that the Midex is nearly fail-safe, easy to use, and can provide you with a security system that you can trust, return your unit and we'll be happy to send you a prompt and courteous refund. There is absolutely no obligation. JS&A has been serving the consumer for over a decade—further assurance that your investment is well protected.

To order your system, simply send your check in the amount of **\$199.95** (Illinois residents add 5% sales tax) to the address shown below. Credit card buyers may call our toll-free number below. There are no postage and handling charges. By return mail you will receive your system complete with all connections, easy to understand instructions and a one year limited warranty. If you do not have stereo speakers, you may order the optional blast horns at **\$39.95** each, and we recommend the purchase of two.

With the Midex 55, JS&A brings you: 1) A system built with such high quality that it complies with the same strict government standards used in the space program, 2) A system so advanced that it uses a computer to determine unauthorized entry, and 3) A way to buy the system, in complete confidence, without even being penalized for postage and handling charges if it's not exactly what you want. We couldn't provide you with a better opportunity to own a security system than right now.

Space-age technology has produced the ultimate personal security computer. Order your Midex 55 at no obligation, today.

**JS&A PRODUCTS**  
**THAT THINK®**

Dept. PM One JS&A Plaza  
Northbrook, Ill. 60062 (312) 564-7000  
Call TOLL-FREE ..... 800 323-6400  
In Illinois Call ..... (312) 564-7000

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# Driving the Saab 900

It's the best Saab yet.



## FIRSTHAND REPORT

by Gary Witzenburg  
DETROIT AUTO EDITOR

Five-door turbo, like complete range of 900-series Saabs, gets a longer, lower, sleeker nose from a stretch of overall length.

Last year I borrowed a Saab 99 car that I nicknamed "Olaf." A four-speed EMS coupe, Olaf was not too friendly at first. His steering wheel was mounted high and too horizontal for comfort. His steering was stiff, as though spring-loaded to the center position. His ignition switch was way down on the center console, and you couldn't pull his key until he was in reverse. His shifter was rubbery and made reverse (or any other gear) a chancy proposition to locate when at a stop in neutral. His seats were comfortable, but you needed a Swedish engineering degree to figure out how to adjust them.

In other words, Olaf was decidedly eccentric—not much like any other car built by any other manufacturer. But his two-liter, ohc four-cylinder engine was game and lively, his

handling sure-footed, his four-wheel discs stable and powerful, and his tranny ready, willing and able to grab any gear I wanted in spite of the sloppy linkage. Olaf was downright fun to drive. A week later I was sorry to see him go.

### Next came Super Olaf

Then I got hold of Super Olaf, a Turbo EMS. Same eccentricities, same complaints—but, boy, was he ever fun to drive! The Saab turbo-motor made the already spirited Saab two-liter feel twice its size and more. Away from a stop, before the boost had built up, it felt no different from the unturbocharged Four—but once underway, look out! Super Olaf was responsive, high-revving and surprisingly quick, yet nearly as economical as old Olaf the Ordinary. I really hated to give him up.

And now Saab 900 has superseded every Olaf ever built. Available in three-door and five-door "wagonback" body styles and in GL, EMS (sporty) or GLE (luxury) trim, the 900 has much of old Olaf's look and a lot of his better personality traits, but it's as distinct from the 99 as a collie is from a cocker spaniel.

It's longer by 7.6 inches, lower by 0.7 inches and sits on a 1.9-inch longer wheelbase (99.4 inches), yet weighs only 40 to 100 pounds more, model for model. Handling and stability are improved, thanks to wider tracks and redesigned suspension in front and rear. Its longer, lower, sleeker nose improves its aerodynamics and gives a more balanced appearance. Its interior is roomier, quieter, more comfortable and more luxurious—in keeping with the \$8000-to-\$12,000 price range.

One reason Saabs of the past have always been eccentric is that they were produced by a company more experienced at manufacturing aircraft than automobiles. The first Saab car, a prototype built in 1946, looked more like an airplane wing than a car because it was styled by a group of airplane-wing designers. It wasn't very pretty, but it had good aerodynamics.

When the first production Saab rolled off the assembly line, it was even uglier than the prototype. But it was functional, inexpensive to buy and run, and about as durable as a concrete bunker. Called the "92," it

(Please turn to page 16)



Driver and passengers in new 900s get royal treatment: In five-door models both front seats are heated; in the EMS and three-door turbo just the driver's seat is heated. Heating of the seat and backrest is thermostatically controlled. A new dashboard puts every control—even the glovebox—within reach of the driver.



*This \$20 pager can control 16 of either your appliances or your lights. There's no installation required and the complete story is explained below.*



# Space Pagers



*Control your entire home from your pocket with the world's first micro electronic remote Space Pager.*

You're in bed. It's late at night and you're watching TV. It's time to shut off your TV, so you reach for a remote control device, press a button, and off it goes.

That's not unusual. But what is about to invade the typical American home will be.

## ELECTRONIC PAGING

Scientists have developed the technology to individually page any light or electrical appliance in your home and command it to go on or off from a device that fits in your pocket.

Remote paging requires no special home installation since it utilizes your existing household wiring system and small, inexpensive modules that plug into your wall outlets.

The system is also very inexpensive. It costs less than \$14 per module to control any light or appliance, and less than \$100 for a complete paging system.

## HERE'S HOW IT WORKS

You press a number on a calculator-type keyboard that sends out a digital signal picked up by the electrical wiring system in your home.

The digital signal pages only those wall modules set to the number you keyed. If you page a light, for example, you can also page it to turn on, off, or you can even dim it (just like the dimmer switch you have on your wall). You can page an appliance such as your coffee maker or toaster to turn either on or off. There are up to 16 different electrical devices you can control with your pager.

## WHAT IT WILL DO

Remote space paging will perform many useful functions that will quickly pay for your modest investment.

**Security** From your bed, you can turn on all the interior lights, your exterior lights, and sound an alarm to warn your neighbors.

**Convenience** Wake up in the morning, turn on your coffee maker, the TV and all your lights from the convenience of your bed.

Because it is so easy to use and so inexpensive, you can start with just a few modules and

expand later. There are modules that plug into your outlets, and modules that replace your present wall switches.

To make space paging work, you need a device to generate the digital code and transfer the signal to your household wiring. There are two systems available to do this:

**Direct-Controlled** The direct system consists of a control unit at \$39.95. The control unit is plugged into the wall and placed by your bed or at any location you select. To open, close, or dim a light, you press the appropriate number and press the function you want to perform. You also have the option of using the system with a remote ultrasonic pager. You point the ultrasonic pager at the control unit and enter the command. The remote pager lets you move about a room or area and is an optional accessory of the direct system at only \$19.95.

**Timer-Controlled** The timer-controlled unit consists of a digital clock and a memory. You can program the exact time you want each light or appliance to turn on or off. You also have a "dynamic living pattern" switch which controls the lights randomly and automatically to make it look like you are home while you are away or on vacation. You can now have your TV wake you up, your coffee started, and even your car warmed up in a set sequence every morning. It's like having your own invisible robot.

Let's say you're in the living room and the lights are plugged into the modules and the control unit is in the bedroom. No problem. You can override the system by turning the lights on or off manually at your lamp switch.

You can inexpensively expand the system by adding more modules. If you want to control your lighting from two locations, order another control unit. You can always expand your system.

Once you've turned your bedroom into a paging command center, there is one more expansion possibility: the timer-controlled system which will be available for approximately \$50 in the fall of 1979. JS&A

customers will be advised first of its availability.

JS&A is America's largest single source of space-age products. We back the system with a prompt service-by-mail facility, a one year limited warranty and a 30-day trial period. If you're not completely satisfied, simply return the system within 30 days for a prompt and courteous refund.

Space paging will bring you freedom, security, convenience, and peace of mind. It will save you steps, time, and money. Finally, right from your bed, you can control your entire home's electronics—something that only a thousand dollar home computer could have done until the Space Pager was developed.

## TRY THE SYSTEM NOW

We recommend that you purchase a series of modules, wall switches, and the direct system. A good starter package consists of one plug-in module for a plug-in light at \$13.95, two modules for appliances at \$14.95 each, one wall switch for \$14.95, and the control unit for \$39.95. The total cost for the package is \$98.75 complete. If you wish to order the remote pager, it costs \$19.95. Postage and handling is only \$2.50 for each order no matter how many modules or receiving control units you purchase. (Illinois residents please add 5% sales tax.) Credit card buyers may call our toll-free number below.

Let space-age technology turn your house into a home of the future. Order your Space Pager system at no obligation, today.

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## DRIVING THE SAAB 900

(Continued from page 14)

was powered by a two-cylinder, two-stroke 746-cc engine and (like every Saab ever since) was driven by the front wheels.

### The evolution of Saab

As the 92 evolved into the less primitive 96, and the two-cylinder motor was replaced by a three-cylinder and later by the quieter and more powerful four-cylinder four-stroke, Saabs became viable alternatives to the little VWs, Renaults and Fiats that populated Western European countries and were carving a growing U.S.-market niche as well. They looked like inverted bathtubs on wheels, but they were tough as anvils and negotiated bad roads and rough weather about as well as anything built—as amply demonstrated by scores of wins in high-speed rallies in the skilled hands of factory driver Erik Carlsson and others.

A number of prototype sports cars and single-seat racers were followed by the first production Saab sports car, Sonett II, in 1966. A year later came the all-new 99 sedan series, much advanced and far more acceptably styled than the 96. The two-stroke engine was discontinued as an option in 1968, a V4 engine came and went in the Sonett and De Luxe 99, and in 1970 the new, more shapefully Sonett III appeared. That year, the 500,000th Saab car was built as the company was becoming a major European force in automobiles as well as trucks, buses, aircraft and industrial equipment. The last of more than 10,000 Sonetts were built in 1974. Designed primarily as a U.S.-market image booster, the Saab sports car had become a victim of our safety and damageability regulations. The same year also saw the first Combi-Coupe ("wagonback") 99 model.

### Test-driving the 900

Following the exciting turbo-charged engine by one year, Saab's excellent 900 series moves the Swedish manufacturer solidly into a prestigious and profitable mid-priced import sedan market. It will be sold side-by-side with existing 99 models in Europe and other markets, but will replace all but one base 99 in North America.

We met the 900 series via a cross-country trip through Sweden that included a cool, rainy afternoon at a challenging Swedish road-racing track and a two-hour jaunt through some really nasty rally-type dirt-and-gravel roads. Most of the driv-

ing was in a Turbo five-door with four-speed transmission, but we also tested nonturbo, automatic, three-door, EMS and luxury GLE versions. All performed flawlessly.

### Old steering wheel gone

If you've driven older Saabs, the first thing you'll notice about the 900 is that the traditional odd steering wheel angle has all but been eliminated. The comfortably padded wheel is still large but less buslike, and everything on the attractive instrument and control panel is easily readable. Adjustment of the orthopedic front bucket seats has been simplified, the passenger compartment seems roomier, and every control is accessible to the driver without leaning forward.

Saab still has the strangest front passenger restraint system we know of—continuous buckle-less belts latch into a set of jaws on the console—but it seems more practi-



Two-door turbo has aluminum wheels, rear-deck spoiler, sliding steel sunroof.

cal and comfortable every day you use it. Another unique feature is the industry's first and only ventilation air filter, which eliminates most of the dust, all of the pollen and some 50 percent of the bacteria from incoming air. The dashboard vents are large and well-placed, and fully integrated airconditioning is optionally available.

Steering effort on manually steered cars is still too high for our taste, but higher-cost models have a very precise power-assisted system that's delightful. The console ignition switch is still there (you get used to it in time), and the manual shifter is still a bit rubbery but better than before. The only shifting trouble I had was caused by the slightly raised left-side floor pan (over the wheel well) which would occasionally stop my size-12 clutch foot before the clutch was totally engaged—crunch! Also, like all Saabs before it, the 900's clutch pedal bounces up after each shift with a hollow "lub-a-dub" sound reminiscent of a '47 Nash.

### Front drive handles easily

The excellent front-drive system makes Saab's new 900 as good as about any car could be in rough-road

and bad-weather driving—certainly better than the already impressive 99. Try some really nasty back roads and the car will inspire so much confidence you'll soon think you're Erik Carlsson winning another Monte Carlo rally. Helped by the standard Michelin TRX radials (Pirelli P6s on the three-door), our Turbo five-door pulled us through the trickiest bends, uphill and down, with astounding precision and stability even at breakneck speeds. But don't try anything tricky with the hand brake to get you around a corner because it works on the front wheels, not on the rears as on most other front-drive cars.

Going fast on the wet, slippery paved racecourse was another matter. The car was always stable and controllable, but trying to accelerate out of a tight corner caused the front driving tires to hop and lose traction under power, wanting to "plow" straight ahead. This is a common problem with front-wheel drive in racing conditions, but not likely to be encountered in normal, sensible driving. Also, it's easily controlled by backing off on the power a bit and turning sharper into the corner—and it's far safer to lose a little traction in front than to have the rear wheels skid and threaten to spin you around halfway through a fast turn.

### Driving over a knife

The Saab people invited us to drive a 900 over a knife blade that cut its left front tire suddenly at 55 mph. Of course, it would pull a bit to the left—but there was no problem at all steering and braking the car to a safe stop. Another demonstration showed the 900's exceptional stability even with a heavy load—almost 900 pounds—in its cavernous cargo area. Weight distribution is about 60 percent front, 40 percent rear at light loads and no less than 52/48 even when heavily laden.

One final point: Saab is one of the few automotive mass-producers to have made the group-assembly technique work for engine, body and certain other production procedures. This is claimed to improve quality and even save money over the impersonal assembly-line method due to fewer necessary inspections and repairs after final assembly.

Based on our four-day, several-thousand-mile initial exposure, we're convinced that the 900 is Saab's best car yet and easily competitive with anything in its price range. If you like Saabs, you'll love it. If you don't, check it out anyway.



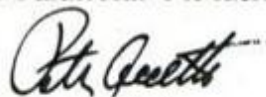
# 'I didn't sacrifice great flavor to get low tar.'

"The first thing I expect from a cigarette is flavor. And satisfaction. Finding that in a low-tar smoke wasn't easy.

"But then I tried Vantage. Frankly, I didn't even know Vantage was low in tar. Not until I looked at the numbers.

"That's because the taste was so remarkable it stood up to anything I'd ever smoked.

"For me, switching to Vantage was an easy move to make. I didn't have to sacrifice a thing."



Peter Accetta  
New York City, New York



# Vantage

Regular, Menthol and Vantage 100's.

FILTER 100's: 10 mg. "tar", 0.8 mg. nicotine, FILTER, MENTHOL.  
11 mg. "tar", 0.8 mg. nicotine, av. per cigarette, FTC Report MAY '78.

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

# ALL OUTDOORS

## Better than jogging?

Easier, too. Recently some medical researchers have reported that walking briskly may be as good an exercise for many people as marathon running, strenuous tennis or a number of other more active pursuits that can strain the system. So the National Sporting Goods Assn., always one to watch out for equipment trends, displayed shoes and clothes specially designed for walking and hiking at their latest show.

Additional predictions indicate that racquet ball, soccer and disco dancing on roller skates are also activities that are growing in popularity, though it seems too soon to tell if any of these will eventually rival Frisbees and Hula Hoops in overall appeal.

Talk of recession does not seem to worry the sporting-goods industry. During previous economic slumps, statistics show many unemployed people decided the enforced spare time would be a chance to catch up on fishing, hunting, camping and travel, and money saved up from overtime could be well spent on sports equipment. Fuel shortages meant more barbecues in the backyard and camping nearer home.

Previews of walking gear indicate that, so far, it is simple, serviceable and not expensive. Now we are watching for any reports that lying in a hammock is relaxing, good for the heart, and that spring fever is therapeutic. Sports trends seem to be moving more slowly, but in the right direction.

## Best fishing

In a continuing search for the world's greatest fishing hole, we recently headed south with some of the greatest of sportsmen. Group travel is becoming one of the best ways to look into outdoor action. Southern sports clubs head north for skiing and snowmobiling in the winter, boating and camping in the summer. Northerners steer south whenever they can.

Our new but fairly-near target was South America, where the seasons are reversed and there is always action. A thousand miles up in the jungles of Brazil at Manaus, where the Amazon begins, some of the most pugnacious of sportfish are spoiling for a fight. PM contributors Buck Rogers, Homer Circle and Mark Sosin were among investigators taking on peacock bass and oth-

er exotics. We learned early that red lures are out—they remind all Amazon fish of the scarlet stomach colors of the bloodthirsty piranhas.

Late fall, when the river is down 40 feet, is a favored time for fishermen, and Braniff International provides direct flights to Manaus from the States. Otherwise it can only be reached by steamer up the Amazon; the river and the jungle continually recapture the only road from the coast. *Outdoor Adventures* is a \$1 directory of other fishing, hunting and exploration trips from Alaska and Canada to Chile, Hawaii and Great Britain. Order it from Braniff Outdoor Council, Box 6147, Dallas-Fort Worth Airport, Tex. 75291.



A first for unlimited competition, next year's Pay 'N Pak will have turbine power.

## Hottest boats

Fastest racers on water, the unlimited hydroplanes may take a leap into jet-age performance and speeds next year when David Heerensperger returns to racing. His *Pay 'N Pak* was the winningest of thunderboats until he retired his team two years ago. Now his famous former crew chief, Jim Lucero, designer-builder of the league-leading *Atlas Van Lines*, is creating a new *Pay 'N Pak* for next year. Front spoiler and rear stabilizer wing are expected to improve handling and performance.

But the power may be the real breakthrough. Sue Spinnoble, of the Unlimited Racing Commission, reports that clearance has been granted for the use of turbine engines. Instead of the customary Rolls Royce aircraft mills that pushed rooster-tailers of the past, modified helicopter turbines should provide more thrust while making engine changes easier and reducing maintenance costs.

What speeds are possible? Fifty-year-old Bill Muncey, last year's champion driver again, tells us his Lucero *Atlas* can go well over the

200-mph official world record right now. Bernie Little's new *Miss Budweiser* might try turbine power, and Muncey reports he is considering ordering and driving a Lucero-turbine machine if his present winning steed slows down. A brand-new unlimited league with race-boat speeds up to 250 knots may be emerging.

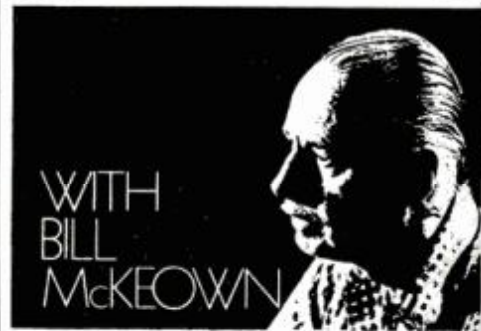
## New shooting notes

Confirming a prediction here two years ago, Remington has found such interest in their high-velocity .30-06 Accelerator cartridge with its small .224-inch-diameter bullet that they are now introducing a .30-30 model. The new .30-30 Win. Accelerator loaded with a 55-grain .224 soft-point bullet, fitted into a plastic sabot to bring it up to the rifle bore diameter, provides a long-range trajectory similar to that of a .222 Remington after the plastic drops off and the bullet speeds on its way with a muzzle velocity of 3400 feet per second. Accuracy is claimed to equal or surpass standard cartridges.

Remington is also improving the styling of its famous Model 1100 shotguns, and is offering to magnum owners extra barrels chambered for standard shells.

This year's Marlin catalog is worth study for the wild game recipes included, as well as announcements of new guns such as their Model 990 autoloading tubular magazine .22 and clip loading Model 995. Smith & Wesson has a new .44 magnum revolver in stainless steel, and a Model 1500 bolt action rifle in .243, .270, .30-06 and 7-mm calibers.

Newly popular metal silhouette target shooting can now be tried with a handgun using new 9-mm and .45 Winchester magnum cartridges. Weatherby has also introduced a handsome silhouette pistol. And for handgun hunters, Federal Cartridge now makes a .45 Colt with a 225-grain lead semiwadcuter hollow point bullet, the only one available. **PM**



# To fully appreciate a John Deere lawn mower, try it in tall grass.

One of the real tests of a lawn mower is how well it cuts and bags the long, thick grass you get in spring.

And the John Deere 21-inch, deluxe mower does the job. Even when grass gets extra long.

For one thing, it has an efficient rear-bagging attachment that blows all grass clippings to the top of the bag. There is no clogging. The bag fills completely, even in wet weather.

It also has a powerful engine that zips through tall grass.

Wheels with ball bearings for easier rolling and steel rims (instead of plastic) for durability.

And, like all John Deere mowers, it's quick-starting, smooth-running, and built to last a long time.

John Deere deluxe mowers come in 21-in. self-propelled or push type models. 18- and 20-inch models are also available.

So see your nearby John Deere dealer soon. Before that tall spring grass starts getting out of hand.



Nothing Runs Like A Deere!



For more information write John Deere, Dept. 62, Moline, Illinois 61255.



# YOU KNOW OUR PICTURES. NOW YOU KNOW OUR NAME.

They've grabbed you. They've gripped you. They've gotten to you. They're the photographs taken by Olympus cameras.

At this very moment, gutsy Olympus cameras are toughing it out on assignment around the world—with press photographers and photojournalists. Now nonprofessionals are realizing that plucky Olympus cameras are the ideal choice for themselves.

**We downsized the 35mm SLR.** Olympus was the first to cut the bulky, boxy SLR down to size.

The OM cameras are a full third smaller and lighter than their ancestors.

**The cameras that pass the stress tests.** Olympus cameras are built to take an incredible amount of punishment.

Random samples from the OM-1 and OM-2 production line are brutalized with a 100,000 life-cycle test at temperatures from -4F to 122F. That's equal to 100 years of use.

**You can't beat our system.** It's the largest compact SLR system in the world, with over 300 components. And it's still growing.

The system includes 14 focusing screens, Zuiko

lenses from 8mm to 1000mm, as well as equipment for photomicro and macro photography.

**A camera for every need. As simple as 1, 2, 10.** The OM-10 is the newest OM camera. It is fully automatic and it offers the features and ruggedness Olympus is famous for. For less.

The OM-1 has sold more than any other compact SLR, and for good reason. It was the first and is still the last word in providing full exposure control.

The OM-2 is the fully automatic camera that has the photographer's future in focus. It offers greater accuracy in light measurement because internal sensors measure the light that's reflected off the film during actual exposure of up to 2 minutes. By also incorporating the full exposure control of the OM-1, the OM-2 becomes the ultimate SLR.

For a detailed brochure, write to Olympus, Woodbury, NY 11797.

After all, since you're familiar with so many of our pictures, it's time you became a little more familiar with us.



# OLYMPUS

# 5

# new photo products

Precalibrated for many widely used photographic papers, the Beseler/Analite 300 is an inexpensive enlarging exposure meter. It allows preselection of enlarger lens aperture or exposure time and is said to be equally useful for color, as well as black-and-white printing. About \$40 from Beseler Photo Marketing Co. Inc., 8 Fernwood Rd., Florham Park, N.J. 07932.

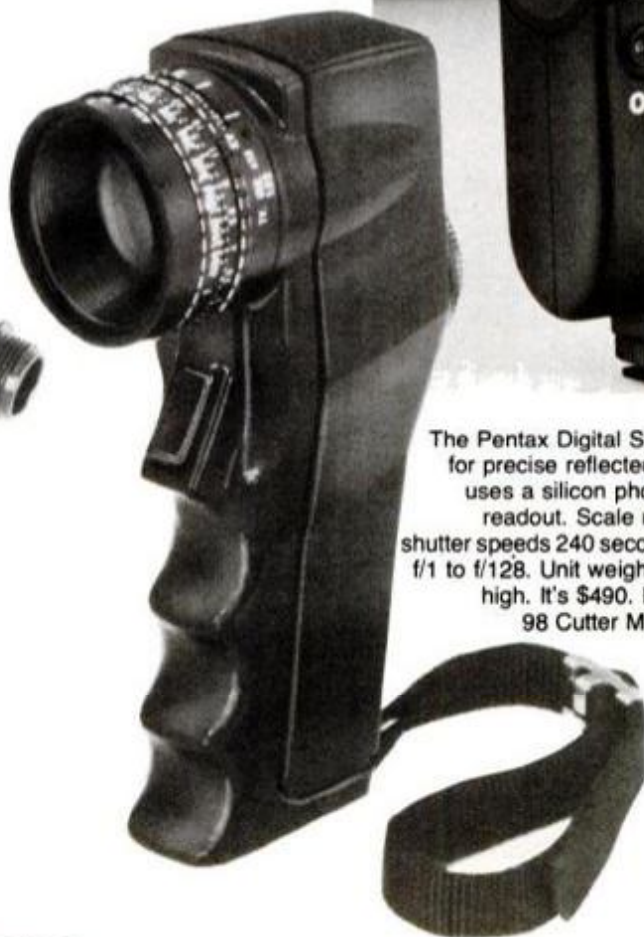


With most autofocus cameras, the picture subject must be centered in the frame. However, with a Chinon 35F-A 35-mm compact, you can focus on the subject, press a button to "hold" that focus and then frame the picture any way you want. It has a 38-mm f/2.8 lens, built-in flash and electronic shutter. It's about \$270. Chinon Corp. of America, 43 Fadem Rd., Springfield, N.J. 07081.

The BCS25 electronic flash by Osram is one of a line featuring simultaneous bounce and direct flash. It has two automatic settings and can also provide bounce or direct flash alone. Four AA cells power the unit; guide number is 46 for ASA 25 film. About \$90 from Hanimex U.S.A. Inc., 1801 Touhy Ave., Elk Grove Village, Ill. 60007.



The Unitron Universal Self-Cleaning Water Filter is said to remove particles as small as 20 microns. It comes with all fittings required for temporary setups with kitchen faucets or more permanent plumbing. A built-in valve permits filter flush-out. About \$18 from Ehrenreich Photo-Optical Industries Inc., 101 Crossways Park West, Woodbury, N.Y. 11797.



The Pentax Digital Spotmeter scans an area 1° wide for precise reflected light measurement. The meter uses a silicon photodiode and has an LED digital readout. Scale ranges are from ASA 6 to 6400, shutter speeds 240 seconds to 1/4000 second, apertures f/1 to f/128. Unit weighs nine ounces and is six inches high. It's \$490. From Pentax Corp., The Atrium, 98 Cutter Mill Rd., Great Neck, N.Y. 11021.

# WE DON'T BUY LIKE THEY

If you should compare a Gravely tractor and a car that had been around for a few years or more, you'd notice a difference right away.

The car would most likely have been put out to pasture.

And the Gravely would, more than likely, be out there mowing the pasture.

Because a Gravely tractor is the kind of machine that's built to keep on going. Job after job. Year after year.

And that means, of course that we have to build it just a little bit differently.

## **WHAT KEEPS A GRAVELY RUNNING AND RUNNING.**

Like all Gravelys, the riding tractor comes with exclusive all-gear direct drive.

That means better power transmission. And no belts to slip, break, wear out, or ever need adjusting.

It also has a tough eight-speed transmission that can deliver the power for every job you'll do. Including steady low speed peak power to handle the muscle jobs.

The transmission housing is cast iron. The power flow is through strong steel drive shafts.

Gears and bearings are precision made, to reduce friction and extend their life.

## **BUILT TOUGH, BUT EASY TO GET ALONG WITH.**

The rear-mounted engine is bolted to the transmission housing, for better traction and a low center of gravity.

The box frame is built out of welded, reinforced steel.



*A Gravely's still working for a living, when a car of about the same age has long since retired.*



# OLD TRACTORS BUILD CARS.



*The Gravelly 8183T  
18 hp riding tractor.  
Shown here with the  
center-mounted 50"  
blade rotary mower  
attachment.*

The heavy-duty, pivoting front axle is cast iron.

Yet, tough as it is, the Gravelly rider is also very agile. Which is one thing it does have in common with a well-engineered car.

Rack-and-pinion steering gives it precise handling and better maneuverability.

Instant forward and reverse helps it get in and out of tight spots with ease.

And it's a self-propelled power source for over 20 lawn and garden attachments.

So one engine can handle jobs from mowing to tilling, hauling to snowblowing.

Riders come in five models, ranging from the 10 hp 8102 to the big 18 hp 8183T.

If you'd prefer a two-wheeler, there's also a convertible Gravelly. In 8 to 12 hp models.

And, if you give it the right attachments, it can do almost everything the rider can do.

To get more information, or to find a nearby dealer, check the Yellow Pages.

Or write to:  
Gravelly, 0534  
Gravelly Lane,  
Clemmons, North  
Carolina 27012.

## **AN IDEA THAT'S WORTH IMITATING.**

We'll close by leaving you with a promise. Along with a bit of wishful thinking:

We'll never build tractors the way they build cars.

But one of these days they might just learn to build cars the way we build tractors.

**GRAVELLY**  
CLARKE-GRAVELLY CORPORATION  
A Studebaker-Worthington Company

# Ordering Delco-GM sound with your new GM car can offer you a lot of stereo options.

Great sounding AM-FM stereos with a selection of features. Like 8-track, Cassette, CB, Digital Display. And the remarkable Delco ETR (Electronically Tuned Receiver). A wide choice is yours.

And that sound!

Your new GM car and Delco-GM sound systems are made for each other. Made by Delco's experts in automotive sound. The result is that ear-pleasing "Delco-GM sound." You've got to experience it to believe it. So insist on Delco-GM when you order your new GM car.

Check your Chevrolet, Pontiac, Oldsmobile, Buick or Cadillac dealer for model availability. Whichever you choose, you'll like what you hear.



Electronically Tuned Receiver (ETR)  
AM/FM stereo with cassette



AM/FM stereo with Citizens Band  
and 8-track



AM/FM stereo with cassette



Delco Electronics Division  
General Motors Corporation

## PM LOOKS AT RENEW-A-TUB

The Renew-A-Tub process is a do-it-yourself, money-saving alternative to replacing an old chipped tub. It eliminates the mess of ripping out wall and floor tiles and the risk of disturbing and, possibly, damaging the plumbing. The process can also be used to resurface sinks, toilets and kitchen appliances.



Hard, sparkling finish cures for use in two days. Complete curing takes 30 days.



Kit contains material needed to refinish a tub or several sinks and a toilet. From left, back row: compressor, spray gun, hose, viscosity meter. Middle row: bicarbonate of soda, cleaner, finish, thinner, etcher, gloves, masking tape. Front row: scrubber, roller, patch filler, stir sticks, razor blades, face mask.

I tried it out on a chipped bathroom sink that had mineral stains. Results were quite satisfactory.

The system involves three basic steps: preparing the surface, patching chips and spraying a finish.

First you remove dirt and soap deposits with a special cleaning solution and scrubber. After cleaning, protect the adjacent areas with newspaper and masking tape. Remove the plumbing fixtures, if possible, or mask them. Next, remove the glaze by using a small foam roller to

apply an acid etching solution. Wear a face mask and rubber gloves for this step. Fill chipped areas with a special substance that hardens in two hours. Smooth out small areas with a razor blade; sand larger ones with 220-grit silicon carbide paper.

Mix the finish-coat materials together 30 minutes before you spray. Check the proper consistency with the viscosity meter. Several finish coats produce a hard, glossy surface. To keep the finish in top condition, clean the tub weekly (don't use abrasives), keep the faucet from dripping, don't apply decals or use mats and don't rest soap or other objects on the tub's surface.

Kits come in white, black, red and major plumbing colors. It's from Spectrodyne Industries Inc., 2005 North Keystone Ave., Chicago, Ill. 60641. Complete kit covering a conventional tub costs \$110; materials only (no spray equipment) are \$70.—*Rosario Capotosto*



An acid etch removes all of the original glaze to give "tooth" for the finish coat.



A patch filler builds up chipped areas. It is sanded flush to the adjacent areas.



Finish chemicals are combined and sprayed in coats every 20 minutes.



# ANNOUNCING 1980 PONTIAC PHOENIX!



When Pontiac introduces front-wheel drive, we do it right. With the kind of traction and pulling power through corners that you expect. And the kind of five-passenger roominess that may surprise you.

**NEW FLAIR!** You get Pontiac's kind of styling flair.

Distinctive new Phoenix Coupe and 5-door Phoenix Hatchback. And this exclusive new instrument panel design.

**NEW FUN!** You get Pontiac's kind of driving fun. New rack and pinion steering. 4-cylinder acceleration as peppy as last year's

model with V-6.\* And available V-6 response as good as last year's model with 5.0 litre V-8.\* Phoenix is equipped with GM-built engines produced by various divisions. See your dealer for details.

**NEW FUNCTION!** You get Pontiac's kind of lasting quality. New MacPherson strut front suspension with long-life shocks. And some of the most extensive corrosion protection in Phoenix history.

The all new Phoenix.  
That's starting the '80s.

Pontiac style!



\*All with automatic transmissions.

## ADVANCED ENGINEERING FOR BETTER GAS MILEAGE.

Numerous efficiency features include: new design for low aerodynamic drag. Standard engine cross-flow cylinder heads. Low drag brake calipers. And much more, contributing to better gas mileage than last year. EPA estimated at 24 MPG and a highway estimate of 37 with 2.5 litre 4-cyl. engine with manual trans.

Remember: Compare the *estimated* MPG with that of other cars. Your mileage may vary depending on speed, trip length and weather. And your actual highway mileage will probably be less than the highway estimate. Your mileage will be slightly lower in California.



# A NEW FRONT-WHEEL-DRIVE CAR, PONTIAC STYLE.



## One of a kind.

The man. The cigarette. They speak for themselves.

Ordinary cigarettes just don't have what Camel Filters has.

Its blend of Turkish and Domestic tobaccos gives him what he smokes for.

Pleasure. Satisfaction.

A Camel Filters Man understands why the best times are often the simplest.

Do you?

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

# Make a custom super sheath

Form-fit molding, wax-treating and baking are tricks from a master knife-and-sheath maker.

by Sid Latham

**J**ack Barnett feels a fine knife deserves the best sheath possible. He should know. This Littleton, Colo., craftsman is considered one of the top knifemakers, scrimshanders and leatherworkers in the country.

Unlike many knife artisans who have no interest in leather work, Barnett finds it a creative challenge, as well. "I like taking a piece of leather and doing something completely different with it," he notes, and his precise construction, artful tooling, plus special wet-forming and hot waxing techniques result in knife-and-sheath sets that are considered collectors' items. We asked him to show us how.

Choose a good piece of  $\frac{7}{8}$ -ounce vegetable-tanned leather, Jack Barnett advises. It can be formed to the contours of your knife, is excellent for tooling, and provides a better fit than chrome-tanned or other leathers. Because it can absorb water well, it is good to work with, but must be handled with great care; while wet it can pick up marks from tools, or even fingers, that are impossible to remove.

## Pattern first

Proper fit is the result of making a careful pattern. Lay the knife on a piece of paper and draw its outline, plus the outline of the sheath. Next, with dividers, a stitch line is marked around the edge of the pattern. Stitch holes are then marked along the stitch line, about  $\frac{1}{8}$  inch apart. A fork can be used for this. With the pattern as a guide, the sheath is cut out with a sharp knife, X-acto blade, heavy shears or special leather worker's head knife. Stitch holes are indented into the leather with an awl, but don't have to go through at this point.

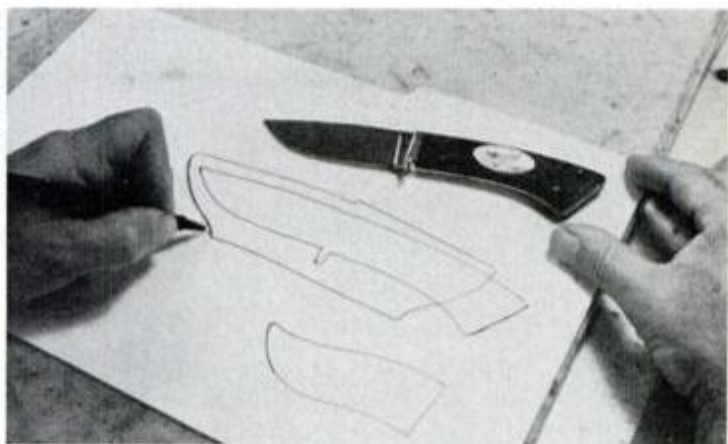
Barnett prefers hand stitching, and holes for the stitches drilled with a Dremel tool or drill press. An awl can be used, but Barnett advises against trying to force an awl or needle through the three layers of

*(Please turn to page 31)*



Art and craftsmanship combine in knives and sheaths made to order by Jack Barnett (above). Sheath (left) has hand-tooled decorations, molded front for snug fit for the knife, grommet at bottom of back for a rain drain and hole in belt loop for hanging it in display case.

Pattern for sheath is developed by making outline sketch around the knife. Outer edge of sheath is drawn around it. Shape of belt loop must be worked out and drawn in, too, before cutting.



Stitch line is first scribed inside outer edge of sheath pattern with dividers. Stitch-hole placements may be marked with fork, then poked through leather with an awl.



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"Most spray paints chip and flake when scratched. Ours doesn't. It's that simple."

Adhesion test authenticated by Nationwide Consumer Testing Institute. Untouched photos magnified to show detail.



## MAKE A CUSTOM SUPER SHEATH

(Continued from page 29)

leather around the edge. Instead, a small bit slightly larger than the needle makes a neat row of stitch holes, and final stitching will be considerably easier.

Edges are now rounded, beveled and trimmed. Fine sandpaper, of 400 to 600 grit, can be used to burnish the edges down and smooth them off. Now is also the time to do any decorative tooling, stamping or carving. For these steps, the leather is dampened, then left until it feels almost dry.

### Stitching

Barnett prefers a saddle stitch, using nylon thread and a needle on each side. First the top of the belt loop is sewn to the back of the sheath, then a hole is punched and lined with a brass grommet. This hole allows for hanging for display in a gun-and-knife cabinet. Another grommeted hole also goes in the back bottom of the sheath. This is a drain hole, in case a hunter or fisherman wearing it should be caught in a downpour or fall in a stream. The belt loop is grooved slightly at the fold, shaved down a bit with a skiving knife, and stitched down at the bottom to make a firm, tight loop.

Once the welt is cut (it keeps the top and bottom of the sheath apart and prevents the blade from cutting threads), the parts are assembled without stitching to test the fit. With holes drilled for stitches and all parts stained, they are now laced together with tight saddle stitches, as well as a few back stitches to secure them in place. Then a flame should be held to the trimmed end of each nylon thread to further lock it in.

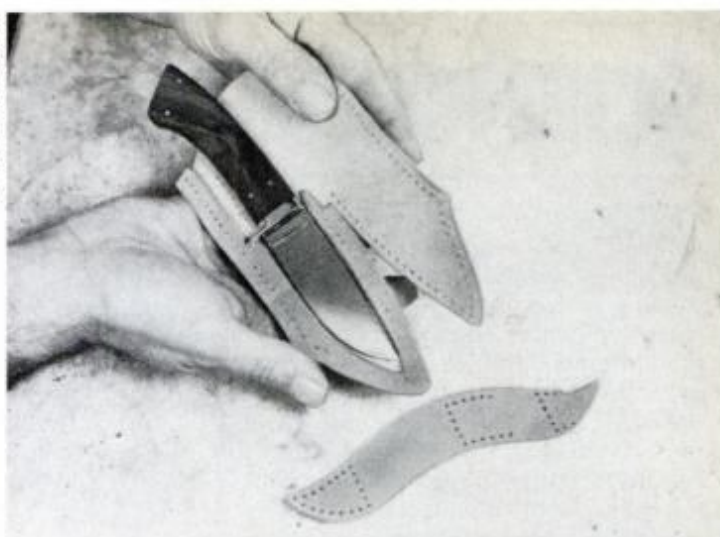
### Forming and baking

Next come more Barnett customizing steps that can give your sheath a professional appearance. Rough edges are trimmed with a very sharp knife, slightly dampened, and rubbed with fine sandpaper. Final polishing is done with a piece of bone, ivory, Micarta or hardwood.

Wet-forming for a tight fit is accomplished by dampening the leather enough so that, with your fingers, you can form the sheath to the contour of the knife. Again, be especially careful to make no fingernail scratches. Then allow the sheath to dry overnight.

A final wax process gives the leather a handsome appearance and makes it waterproof. To about four

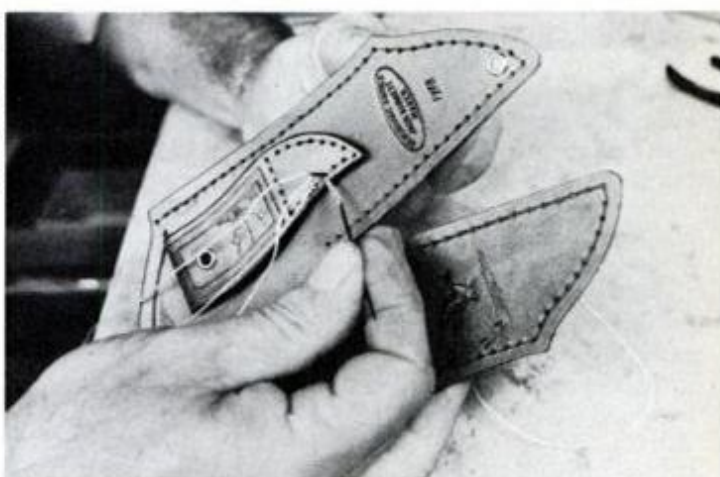
Spacer welt is then cut and fitted into the sheath. It will hold knife in place, keep blade away from threads. For clean stitch holes, a small drill has been used.



Decorative sketches and tooling, typical of Barnett's craftsmanship, are added next. Paint, even fingernail scratches, cannot be removed from leather, so care is necessary.



Saddle stitching, with needles pushed in from opposite sides, secures the decorated belt loop to sheath. Top and bottom, with welt, are then also stitched together.



liquid ounces of molten paraffin, add ¼-ounce of saddle oil (a blend of lanolin and silicon). Heat this mixture carefully, preferably over an electric hot plate, since it catches fire easily. Once it is hot and well mixed, brush it on the inside and outside of the sheath. Never dip the sheath in the solution; it will absorb too much. (And never coat the mixture on leather boots; it will seal the pores and you might get frozen feet.)

### Concluding the job

After the sheath has been brush-coated, place a stick or rod in it and

rotate it over a low flame on the stove to help melt and draw the wax into the fibers of the leather. Then, with the oven set at about 170°, place the sheath on a piece of foil and leave it in the oven for 15 minutes. When you take it out, it's a good idea to smooth off any remaining blobs of wax with a toothpick.

Your result may not include the noted embossing and art work that have made Jack Barnett's creations famous, but there is no doubt you'll take pride in your own customized sheath.

FM

# SCIENCE WORLDWIDE

## Radio control of pain

Charles Niethold, a California salesman, was crippled after he fell while pulling a flower wagon in 1975. Because of excruciating pain in his back, he was unable to walk without crutches.

Today, Niethold no longer needs his crutches. Three times a day, he passes a ring-shaped radio transmitter over his chest, where Dr. Yoshio Hosobuchi implanted a tiny receiver. From there, direct current travels to hair-thin electrodes in Niethold's brain. These stimulate production of a recently discovered hormone, beta endorphin, which appears to be a natural narcotic. Pain disappears.

Niethold told PM that during the self-treatment, he turns up the transmitter until he feels a slight flickering sensation in his eyes. Then he turns the power down, and leaves the transmitter in place for 15 minutes. The sessions, which produce no "high" or euphoria, enable him to work normally. Once, he used the transmitter before going to a dentist, but he said he's reluctant to call on the system for mild discomfort—from headaches, for instance—for fear that he will develop a tolerance for the hormone and require longer radio sessions.

Hosobuchi and colleagues at the University of California at San Francisco report that after implant operations on three patients, they found a two to seven-fold increase of beta endorphin in the clear fluid surrounding the spinal cord. There, the hormone acts on nerves to block incoming pain signals. Hosobuchi said the naturally produced pain reliever is nonaddictive.

## Space shuttle snag

Engine problems during tests have snagged plans to orbit the first in a series of four reusable space shuttles later this year. Now, a spokesman for the National Aeronautics and Space Administration said, the launch of Shuttle 102—recently named *Columbia*—"could slip into next year."

Original plans were to send the first winged shuttle into orbit two months ago. The current target date is Nov. 9, but meeting that deadline would require perfect tests from now on.

In a setback last December, one of the liquid-fuel engines caught fire



Hosobuchi, right, displays pain-control system that enables Niethold to work normally.

during a test. The space agency later traced the problem to friction in a valve controlling the flow of oxygen through a 2½-inch-diameter pipe.

## Lucy's family

An ape-human creature, nicknamed Lucy by anthropologists who discovered her skeleton in Africa, has challenged some long-standing theories about mankind's ancestors.

Conventional theory holds that



The Cleveland Museum of Natural History

Johanson's Lucy: She "felt less fatigue."

human and ape species went their separate ways between 15 and 20 million years ago. Lucy and other recently discovered 3-million-year-old fossils have punched holes in that theory, many scientists think, because the fossils show both human and ape characteristics. Lucy's skull resembles a modern chimpanzee skull. But exhaustive studies of her knee joints and other bones indicate that she walked and ran on two legs, like humans.

The work, by Dr. Donald C. Johanson of the Cleveland Museum of Natural History, and others, pushes back the frontier of knowledge about human roots by about a million years.

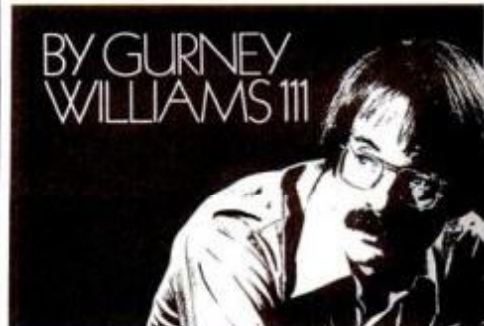
"The possibility that the split between man and ape was as old as some people thought is no longer viable," anthropologist C. Owen Lovejoy of Kent State University told PM. In some ways, Lucy held an advantage over us. "The muscles about the hips could act with better leverage," Lovejoy said. "So she probably suffered less fatigue."

In other ways, Lucy was like many of us. Lovejoy said she probably had several offspring and a single mate, who went off periodically to bring home food for his family.

## Pumping uranium

A professor from McGill University is in Cornwall, England, to find out whether some ancient tin mines can become a source of modern fuel: Uranium 235.

Professor Philip Distin's theory is that seawater could be piped into 3000-year-old mines where it would wash the uranium out of granite. Uranium-rich water would then be pumped to the surface where the fuel would be extracted. Distin's research, backed by a British government grant, parallels "pump mining" projects by some U.S. companies, including Mobil Oil Corp. **PM**

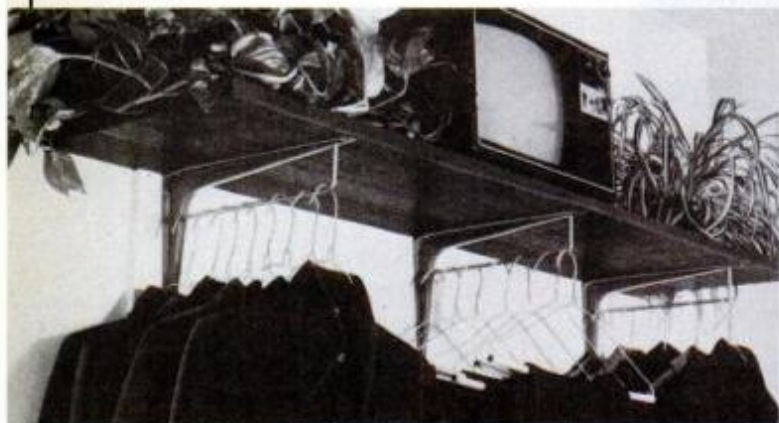


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**Next time you serve Chivas at a party, do something really impressive.  
Serve enough.**

# NEW NOW for home and shop



**A** The shelf brackets of the Closetmaker incorporate a metal rung for hanging clothes. Resulting "closet" is said to be half as wide as a conventional one, and does not require side walls for support. Price, including mounting screws, for three brackets, is about \$12; five brackets are \$19. NAB Manufacturing Co., Box 68160, Seattle, Wash. 98168.

**B** Microscopic Teflon "ball-bearings" are said to be the secret of Tri-Flon spray lubricant. As a lubricant, it has a wide variety of applications, from door locks and hinges to appliances, tools, ski bindings and carburetor linkages. Maker says it displaces moisture, protects against corrosion, frees frozen parts and reduces reapplication by 90 percent. The 450- and 90-gram cans are \$6 and \$3, respectively; 28-gram bottle is \$1. Tri-Flon Co., 3180 Pullman St., Costa Mesa, Calif. 92626.

**C** The 4-Way Workmaster screwdriver has two sets of quick-change bits stored in its barrel. One set has 1/4-in. slotted and 2-pt. Phillips bits; the other, 3/16-in. slotted and 1-pt. Phillips. The bits lock into barrel and barrel locks into the handle. Bits are black oxide finish; handle is triangular shape for better grip. The 66-401 is \$5. Stanley Tools, Box 1800, New Britain, Conn. 06037.

**D** If a lack of counter space has been your prime reason for not buying a microwave oven, General Electric claims you no longer have an excuse. The Spacemaker is designed to fit in the space occupied by vent hood over your stove and combines venting and lighting with the microwave oven. Unit fits 30-in. space over most electric ranges (unit for gas models is coming). The JVM45 lists for \$530.





# It took Honda to build a rotary lawn mower this advanced.

You're looking at the world's most advanced rotary lawn mower.

It's the new Honda HR-21, with the advanced safety feature no other major manufacturer currently offers: Honda Roto-Stop,<sup>™</sup> which stops the rotor blade within seconds after the handle lever is released, while the engine is still running.

Of course, this mower comes with a Honda engine. The rugged GV-150 3½-hp four-stroke. It has a cast-iron cylinder for long life. And it's not only a tough power plant, it's also a quiet one.

For quick, sure starts the Honda rotary lawn mower features Honda's Automatic Decompression easy-start system. And the operating controls are on the handle, within easy reach.

The HR-21 is a dynamic performer on the lawn. It has powerful suction, aided by a one-piece cast-aluminum deck and carbon-steel blade.

Cutting height is adjustable from 1" to 3," in half-inch increments.

And its slim rear-bag design makes it maneuverable when you get to walls and shrubs. The bag is easy to attach and remove.

On selected models, low-maintenance Capacitor Discharge ignition is available. Self-propelling models are also available.

Along with all its advanced engineering, this Honda offers something else to discerning consumers: Honda quality of manufacturing.

Come see how beautifully this lawn mower is made at your nearest Honda lawn mower dealer—you'll find him listed in the Yellow Pages. If not, call toll-free: (800) 648-5311 and ask for Operator 99.

Honda also makes tillers that are ideal for home garden jobs.

For safety and optimum performance, read the owner's manual before operating the unit. © 1979 American Honda Motor Co., Inc.



# HONDA MOWERS

# DETROIT LISTENING POST

## Preview of 1980 models

Since General Motors introduced—with its corporate breath held and executive brows furrowed—its shorter, narrower, lighter big cars for the '77 model year, we have witnessed a total turnaround in design and character of the American automobile.

Downsized intermediates and front-drive luxury cars have followed from GM, while Ford has unveiled space-efficient, lightweight compacts, downsized big cars and all-new sporty coupes. Chrysler has countered with the nation's first front-drive small cars, sporty coupe versions of the same, and a new generation of Chrysler and Dodge full-size models. American Motors has given us luxury compacts and prettier, more efficient subcompacts, and Volkswagen has become the fifth major U.S. manufacturer by installing a Pennsylvania plant to turn out its popular subcompact Rabbits.

Further on in this issue you'll find our report on the first of the 1980 models, GM's all-new front-drive X-body compacts. And there's plenty more in store for the fall. Here's what to expect in September:

### General Motors

The General's got a lot of new stuff up its corporate sleeve for '80, even after his new compacts hit the street.

First off is an all-new, front-drive Cadillac Seville based on the downsized Eldorado platform. The four-door '80 Seville's most distinguishing styling feature is a fast-sloping rear deck and "bustle-like" trunk, a throwback to 1930s design. Power will come from a choice of a fuel-injected 350 V8 gas engine or GM's 350 V8 diesel, with turbocharging a possibility.

The full-size B- and C-body cars of all five divisions, which led the downsizing parade in '77, will get mild face lifts and shed 200 to 300 more pounds for 1980. Their noses will be lower and their rooflines altered slightly, as GM designers milk all the aerodynamic efficiency they can out of these basically squared-off shapes. Front and rear styling will remain similar to '79, except that Buick's Electra picks up the very handsome Riviera's frontal look with a sloped, vertical-bar



Seville, all-new for '80, shares front styling, front-drive chassis with Eldorado.



Olds 98 has lower, more aerodynamic hoodline but keeps traditional grille.



Buick Century four-door notchback model has '79 Seville-style squared-off roof.



Cadillac deVille gets subtle face lift and new roof style for 1980.

grille. With Oldsmobile planning to triple its diesel engine production for '80, most models from all divisions will offer optional diesel power.

As predicted a year ago, both Olds and Buick will have Seville-like notchback luxury versions of their intermediate A-body Cutlass and Century sedans, although the controversial Aero fastback sedans and coupes will stay for now.

Pontiac's very popular Firebird Trans Am will offer an optional turbocharged 301 V8 as 400-plus-cu.-in. engines fall out of sight, while Chevy's Corvette gets a substantial face lift and sheds 250 pounds of excess weight for '80.

The aging H-body subcompact—Monza, Sunbird, Starfire and Skyhawk—will hang around little changed until replaced for '81 with a new front-drive design, but Chevy's Chevette receives another minor restyle in the face of increasing competition in the mini class.

On the technical side, there will be a new small-displacement V8 from



Olds 88 four-door retains '79 look, but rear styling is cleaner and simpler.



'80 Buick Electra inherits handsome Riviera front, restyled coupe roofline.



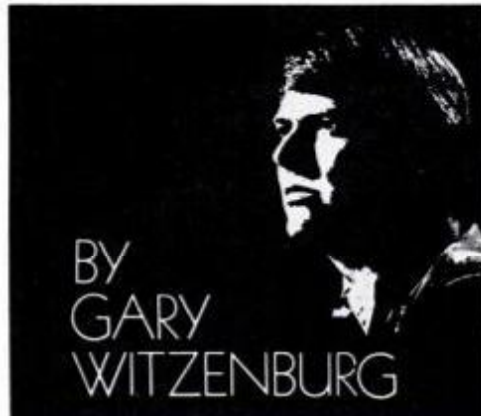
Chevy Caprice has rectangular taillamps, altered roofline, quarter-window shapes.

Chevrolet (around 267 c.i.d.), low-drag disc brakes and lock-up torque converters for most of the larger cars.

### Ford Motor Co.

Ford was two years behind in downsizing its family-size cars, but will waste little time in giving the same treatment to its luxury cars and intermediates. Topping the '80 Lincoln-Mercury line will be an all-new, smaller, lighter, 114-inch-wheelbase

*(Please turn to page 38)*



# So cool, you can feel it.



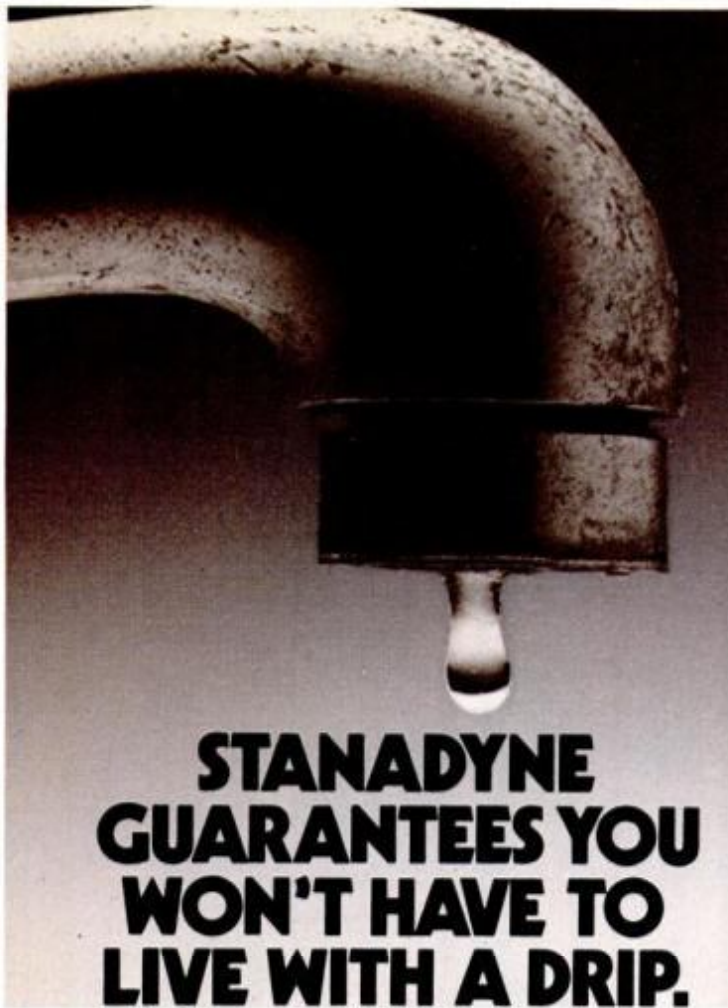
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Nothing satisfies like America's most  
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1.3 mg. nicotine av. per cigarette, FTC Report May '78.

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**STANADYNE  
GUARANTEES YOU  
WON'T HAVE TO  
LIVE WITH A DRIP.**

**DETROIT LISTENING POST** *(Continued from page 36)*

Mark VI and 117-inch-wheelbase Lincoln two and four-door sedans. They will retain much of the basic Lincoln look, except for refinements in roofline and window shapes.

A new four-speed automatic transmission with overdrive top gear and lock-up torque converter will be standard equipment, as will electronic fuel injection. Also standard on the Mark VI (optional on other Lincolns) will be a space-age electronic instrument panel.

The 1000-pound weight decrease, lock-up overdrive transmission and fuel injection will combine to give these cars a substantial fuel economy increase. Yet they will retain Lincoln comfort. The Mark VI will have more interior room than the Mark V it replaces.

Ford's regular intermediates, Ford LTD II and Mercury Cougar, will disappear for '80, but the intermediate specialty Thunderbird and Cougar XR-7 will get an all-new, smaller and more efficient unitized body/frame on a 108-inch wheelbase—nearly identical in size and weight to the original '67 Cougar. Much-improved aerodynamics and a new 255-cubic-inch V8 will help give these small luxury coupes better fuel economy with equivalent or better performance compared to the overweight '79s they supersede.

Also new for '80 will be turbo versions of Fairmont and Zephyr (with automatic transmission optional for the first time with the Ford turbo four-cylinder), special multi-adjustable Recaro bucket seats (like those in the '79 Mustang Indy pace car) available for Mustang/Capri and T-Bird/XR-7, and electronic fuel management (EFM) on some models. Ford trucks also will get a 250-pound weight reduction, the 255 V8 engine and lockup overdrive automatic transmission.

**Chrysler Corp.**

Chrysler's downsized, front-drive Volare/Aspen replacements won't be ready until 1981, but there are some interesting things on tap for '80, nevertheless. For one, the handsome but heavy Chrysler Cordoba and Dodge Magnum personal luxury coupes will be redone on the 113-inch-wheelbase LeBaron/Diplomat chassis (with a new name for Magnum), while the two-door L/D gets a 109-inch wheelbase and restyling.

By mid-year, there will be an all-new car to wear the distinguished Imperial nameplate, certainly a European-style four-door sedan and probably LeBaron-based. Also, Chrysler has been craving a turbomotor, but couldn't get one due to supply problems. However, Garrett AiResearch is increasing its turbocharger capacity and Borg-Warner is importing a Japanese-built unit, so watch for a turbo Omni/Horizon by mid-'80.

**American Motors**

Biggest news is four-wheel drive available for all Concord models, and the agreement with Renault of France, which is bringing fine Renault Le Car minis, Gordini sportsters and (by early 1980) R-18 sedans into more and more AMC showrooms. Also, the workhorse 258 six-cylinder engine will be lightened for '80, and Pontiac's fine 2.5-liter Four will replace the costlier VW-designed unit as the base Spirit engine.

**Volkswagen**

Rabbit-based, front-drive mini-pickups will begin hopping out of the U.S. plant by late summer or early fall, and Karmann-built Rabbit targa-top convertibles will replace the ancient Bug convertible, most likely by early summer. Look for more refinements and options, as well.

PM

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1. THE BROTHERS OF MOOSE LODGE #1628 IN MERIDIAN, MISSISSIPPI, HAD ALWAYS STORED THEIR ICE IN IGLOO ICE CHESTS BEHIND THE BAR.



3. AS THEY RUSHED TO THE SCENE, FIRE TRUCKS PUMPED THE BLAZE. TOO LATE - THE LODGE BURNED TO THE GROUND.



2. 'TIL ONE NIGHT... THE LODGE WAS ON FIRE!



4. NEXT DAY, THE LODGE BROTHERS WERE BACK ON THE SCENE, PICKING THROUGH THE RUBBLE OF THE BUILDING...NOT MUCH WAS LEFT.



5. THEN THEY SPIED THE IGLOOS.

6. THEY WERE PARTIALLY MELTED, BUT... THERE WAS STILL ICE INSIDE!



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BUILT TO SURVIVE THE REAL WORLD.

# Add this end vise to your workbench

**A**lthough this end vise costs under \$6 to make, it serves the same purpose as the traditional end vise found on fine woodworking benches. Mount it on your bench end and combine it with stops, and you can work on pieces of wood longer than your bench.

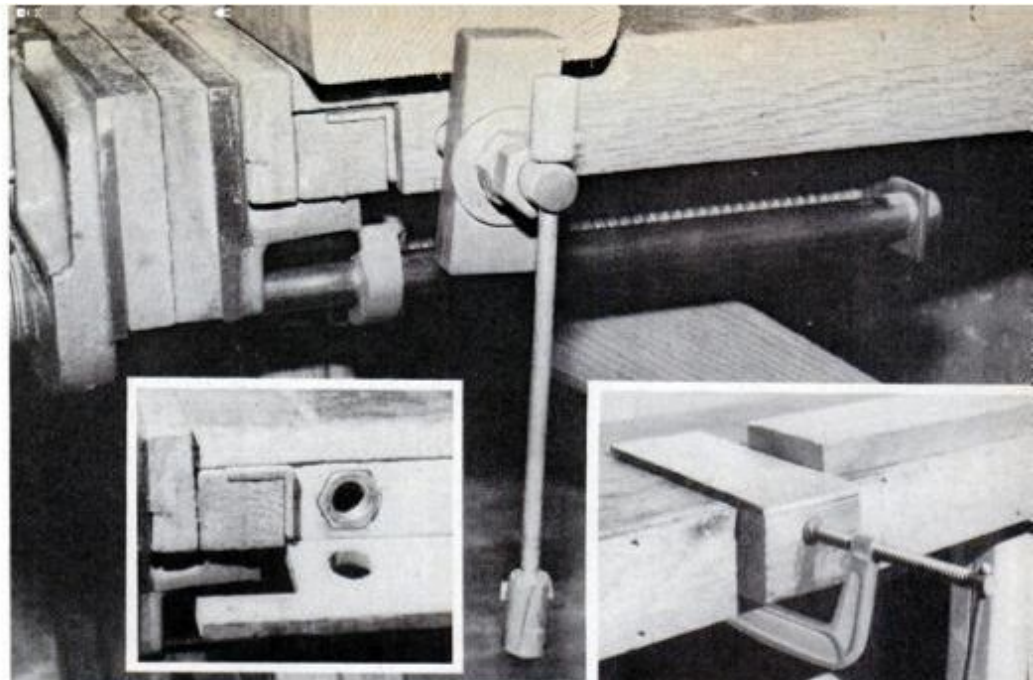
## Installing the vise

Determine where on the bench you want to locate the vise. Then bore a  $\frac{3}{4}$ -in.-dia. hole in the mounting surface. If the benchtop is solid 2-in. hardwood, bore the hole deep enough to accommodate the full length of the threaded rod. If the benchtop is plywood or particleboard and its edge lines up with the end rail, bore the hole through the end rail. If the benchtop is particleboard or plywood that overhangs the end rail, attach a 2x4 filler beneath the overhanging top. Cut the 2x4 the full bench width and clamp it to the overhang. Next, bore pilot holes through the benchtop into the 2x4, countersink holes and secure the 2x4 with screws. Finally, bore a  $\frac{3}{4}$ -in.-dia. mounting hole for the vise through the 2x4.

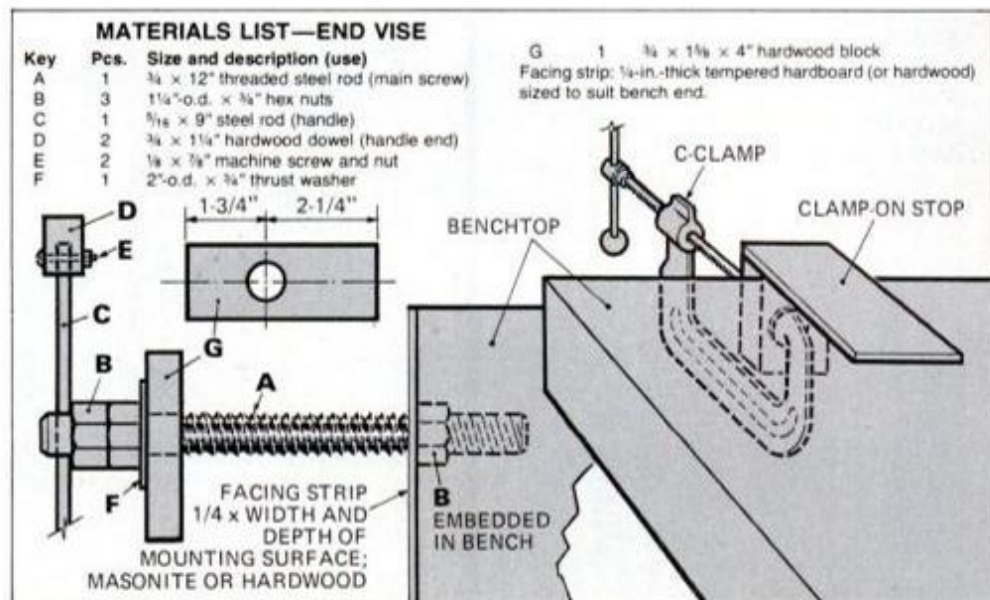
Center one of the nuts (B on plan) and trace its outline. Chisel out a mortise so the nut force-fits with its face flush with the mounting surface. Drive in the nut. From  $\frac{1}{4}$ -in. tempered hardboard, cut a facing strip the same size as the end rail. Locate and bore a  $\frac{3}{4}$ -in. hole in it to coincide with the hole in the mounting surface. Fasten the facing strip in place with screws so it retains the nut.

## Assembling the vise

Begin work on the vise by cutting dowel handle ends (D). Bore a hole in the end of each to hold the rod handle (C) and position one of the dowel-handle ends on the rod. Bore a hole through both the rod and dowel and insert a machine screw and securing nut (E). Bore a hole through the threaded main screw (A), slip the handle through it and fasten the other handle end. Run a nut (B) down the main screw until it hits the handle; run the other nut tightly against the first one and slip on the washer (F).



End vise is handy for securing long workpieces. Hex nut that receives vise is let into end rail and retained by a facing strip shown flopped down (left inset). If bench has a front rail, a clamp-on stop is handy for securing the workpiece end (inset, right).



The hardwood block (G) is for a vise mounted  $1\frac{1}{2}$  in. below the surface of the bench. Notice that the hole is off center so the block will hold work of different thicknesses. Cut the block and bore a  $\frac{3}{4}$ -in. hole through it. Slip the block over the main screw. Then thread the assembly into the bench.

## Bench stops

If you have a solid benchtop, simply bore a series of  $\frac{3}{4}$ -in. holes about  $1\frac{1}{2}$  in. deep in line with the vise end and as far apart as the end vise opens—8 to 10 in. A length of  $\frac{3}{4}$ -in. dowel sliced vertically in half along the portion of the dowel that will protrude above the table, then positioned in one of these holes, makes an excellent stop. It won't nick a finely-honed cutter if you accidentally strike it with a plane.

If your bench has a particleboard

top and no front rail, using counter-bored holes first screw a 2x4 to the underside of the top the full length of the bench and in line with the vise. Fill the screw holes with wood putty. Bore  $1\frac{1}{2}$ -in.-dia. holes for stops through the top *only* and fit hardwood plugs in these holes flush with the top surface of the bench. Then bore  $\frac{3}{4}$ -in. holes centered in each plug and use the dowel stops described above.

## Stop for flush-rail bench

If your bench has a rail flush with its front edge, the clamp-on stop shown is quite effective. It's made of a 2x4 block and  $\frac{1}{4}$ -in. plywood  $3\frac{1}{2}$ -in. wide and extending several inches across the centerline of the end vise. Plywood is attached with screws at right angles to the 2x4. Clamp as needed along the bench.—  
*Gerald David*



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# PM WORKBENCH

## PM EXAMINES PRODUCTS & SERVICES

### Solar water heating book

Whether you're an engineer or a solar buff looking for some specific design guidelines on putting together a solar water heating system, consider adding the *Design Manual for Solar Water Heaters* to your library. It provides a step-by-step design procedure to help select collector, storage tank, pumps (when required) and a control system. It also includes complete insulation tables, plus methods for computing the anticipated fuel savings and the payback rate of the system you design. Plumbing and wiring diagrams are also included, but no photos.

The 40-page publication is available for \$5 from Horizon Industries, 12606 Burton St., North Hollywood, Calif. 91605.—J.P.

### Ax handles stay tight

The heads and handles on these axes from Plumb, Ames, Box 1774, Parkersburg, W. Va. 26101, are fastened by a compression bonding process that the maker says eliminates loose handles. I tried No. 11-725 sport ax and No. 11-720 Utility axes recently and found both tools easy to use and superefficient choppers. The utility ax is \$10.99, sport ax, \$9.49.—H.W.

Sport ax (inset) comes with a leather belt sheath to protect edge. User found both axes easy to use.



### Device for airless spray gun

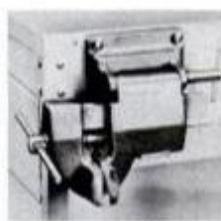
Twist Tip kit from Binks Mfg. Co., 9203 West Belmont Ave., Franklin Park, Ill. 60131, eliminates time consuming, messy airless tip cleanup. With this device, operator simply (1) releases trigger to stop flow, (2) reverses the nozzle by rotating a lever, (3) triggers gun to flush out obstruction, (4) releases trigger and returns nozzle to original position. All this can be done in under 30 seconds, says the maker. About \$66.—H.W.



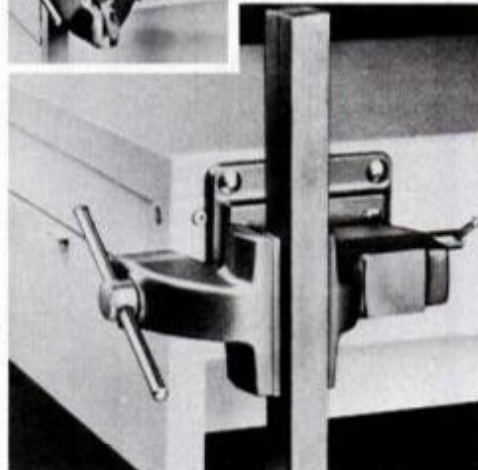
Self-cleaning tip is a boon for sprayers.

### You'll flip over this vise

Unique home workshop vise called Flip-Grip II is a cleverly built three-in-one unit. It is a multipurpose vise



Versatile vise fastens to bench end, can be flipped down (left) when it is not being used.

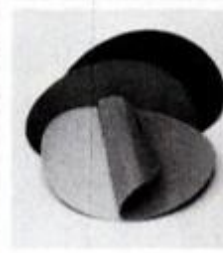


that can be mounted either vertically or horizontally on your workbench. The feature I like is that it

can be "flipped" to any working position in seconds and securely locked at any angle or stowed out of the way when the project is finished. For woodworking it holds projects with its 2 x 4-in. smooth jaws; the vise converts quickly for metal working by simply inserting 4-in. hardened, serrated steel jaws. The price is \$25.—H.W.

### Better power sanding

The claim that this was the first industrial-grade abrasive offered to consumers made this product worth investigating. Called Super-Sander, it consists of industrial-quality aluminum oxide abrasive bonded with



Abrasive comes in discs, belts and sheets. For discs, peel off backing and press abrasive onto rubber disc.

high-strength resin to tough cloth backing. In the shop, I found it superior for power sanding; it cuts wood fast and holds up well. It comes in fine, medium and coarse grades in 5-in. discs, 3 3/4 x 9-in. sheets and, for belt sanders, in 3 x 21, 3 x 24 and 4 x 21 1/4-in. belts. For a free pamphlet write The Carborundum Co., Consumer Products Div., PM-578, Box 337, Niagara Falls, N.Y. 14302—H.W.

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





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# PHOTO HINTS

## Double-duty light



An "under shelf" fluorescent light makes an effective and inexpensive slide sorter. Its translucent plastic housing is flat and provides bright, even illumination. Such lights can usually be mounted so they can provide light for an area and easily dismount for use as a sorter.—*Jan S. Paul*

## Ladder to good photos

Keep a small step stool or ladder in your car trunk. It'll come in handy if you need extra height to take a picture above a crowd or with a tripod at full extension, for example.—*Stanley Clark*

## Trays protect chemicals



Foam trays from prepackaged items like meats or bakery goods can be used to make bottle caps more airtight for photo chemical jugs. Press the cap into the foam to mark size, trim with scissors, and then replace the old insert.—*Rudy and Marcia Schulze*

## Can it

A rectangular metal can like the kind adhesive bandages come in fits nicely into a corner of your camera bag. It can be used to hold batteries, small tools and other odds and ends that are tough to find when they are just dumped into the bag.—*Margaret Shauers*

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CHAFITZ, INC., Department 747, 1055 First Street, Rockville, Maryland 20850.

Richard Petty says,

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**You learn in your spare time and they give you the training and equipment you need to get you started in a hurry.**

My Dad made auto mechanics out of us long before he'd let us enter a race... so I learned the importance of a good mechanic early... and the opportunities that are out there for well-trained men. That's why I'm sure glad to see training like the two NRI courses come along. With NRI, you learn at home in your spare time, at your own pace. And get solid, "hands on" training for practical experience. It's a lot of training for the money.

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NRI's basic Professional Repair Course covers the basics of auto repair in 30 "bite size" lessons. From headlight to taillight, you'll learn all you need to know, quickly. Your training includes important service equipment like an inductive pickup DC timing light, ignition analysis and tune-up instrument, tune-up tool kit, and more.

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NRI's 70-lesson Master Automotive Technician Course includes what you need to be a real pro. In addition to carefully planned lessons, you receive all the equipment in the

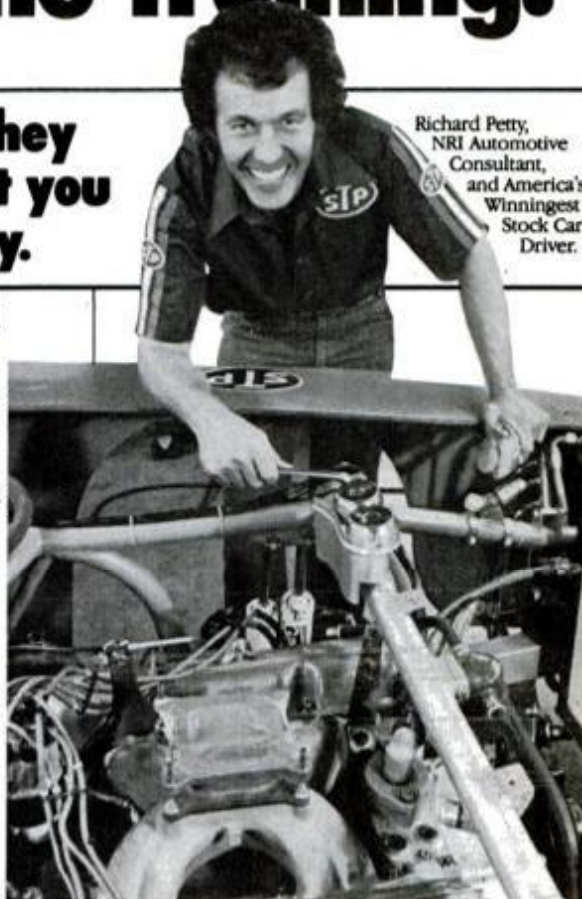


NRI training includes professional instruments and tools.

Basic Course plus a carburetor air-fuel tester, silent vacuum test pump, and the latest advance in diagnostic tools, a digital read-out tune-up analyzer. It performs over 70 tests and gives you the answers in precise, LCD numbers... no need to approximate or interpret scope displays. You'll learn to service electronic ignition systems, vacuum controls, pollution control systems, fuel injection systems, auto air conditioning, brakes, and much more.

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

17mg "tar," 1.0mg nicotine av. per cigarette, FTC Report May '78

# CAR CLINIC

## SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



### Roman's holler day

*I'm fit to be tied. The owner's manual for my 1978 Oldsmobile diesel calls for SE-CD SAE 30 oil in summer and SE-CD SAE 15W-40 oil in winter. I can't find this stuff in gas stations, and dealers haven't been helpful. My friend has a 1979 Olds diesel, and his owner's manual says to use SE-CC oil, which is plentiful. Should I switch to SE-CC?—Roman Berry, Brooklyn, N. Y.*

Not if your owner's manual calls for SE-CD. You bought your diesel before an engineering change modified the engine for SE-CC. This change took place late in the '78 production run. The only way an owner can tell whether a car uses SE-CC or SE-CD is to look in the owner's manual.

If your dealer doesn't carry SE-CD, try truck stops. Some brand names are Shell Rotella T, Chevron Delo 400, Gulf Super Duty and Amoco 300 MV. As long as the initials SE and CD appear *anywhere* on the can, the oil is safe to use. These initials may be mixed in with a lot of other designations, so check the can carefully.

### Fanning the fires

*My problem concerns a 1977 Jeep Cherokee (360-4bbl. engine) equipped with a trailer package which includes a heavy-duty cooling system. Despite this, and although the air conditioner wasn't operating at the time, my first attempt at pulling my 20-foot Wilderness trailer was a disaster. The Jeep's temperature gauge went into the red and the vehicle lost all its coolant. A Jeep garage told me to add an overflow tank for the radiator, but it hasn't made a difference. Next time out, the temperature gauge went into the red again, and the overflow tank overflowed. Now, I've been advised to replace the automatic fan with one that runs constantly. Is this going to be a never-ending problem?—Don Mattley, Matamoras, Pa.*

Shouldn't be. First off, do you

have an accessory mounted on the front of the vehicle, such as a snow plow, bike rack or spare tire? It could be altering the airflow to the fan, preventing automatic engagement at the necessary time. Remove the accessory or disconnect the automatic fan as I describe below.

Perhaps the fan itself is malfunctioning. You can override the automatic feature which, incidentally, allows you to turn the fan into a constant-running fan. There is no need to pay for another fan, as you have been advised to do. With the engine off, find the end of the bimetal spring on the viscous (automatic) drive. Disconnect the spring from its stop and turn it counterclockwise (in the direction it tends to move). The spring should turn about 90° before coming to a stop. Let it hang. Now, try towing the trailer. If this modification fails to stop overheating, look for trouble in some other part of the cooling system. The Jeep people have troubleshooting charts in the service manual which should help.

### My month for Jeeps

*Advise your readers to buy stock in tire companies. It's a good investment the way Jeep owners are wearing rubber. Take my '76 Wagoneer with constant four-wheel drive. It wears the outer edge of the right front tire almost to the cords after only 5000 miles. An independent shop told me alignment was set to spec and that no adjustment could be made. What do I do now?—Niel Turrini, Merrick, N.Y.*

Find a competent frame shop (in my Yellow Pages, frame shops are listed under "Wheel Alignment, Frame and Axle Servicing—Automotive"). Ask the man to bend the axle tube on the right side of the vehicle to give a 0° camber. He should *not* bend the axle housing—just the tube, which is a 2-foot-long welded steel part.

Don't let the man talk you into installing tapered shims between the wheel bearing spindle and steering knuckle. This, too, will give 0° camber, but it will also load the universal joint when the vehicle corners and put unnecessary stress on spindle bolts.

### My month for alignment

*I own a 1976 Ford F-150 pickup that was wearing front tires on the outside tread. An alignment shop told me the truck was toeing in. He aligned the wheels, which got rid of the outside tire wear okay. Now the blasted things are wearing on the inside. The truck also wanders all over the road. What will stop this?—Leonhart Deibert, Herreid, S. D.*

Two shims (part No. 385795-S2)

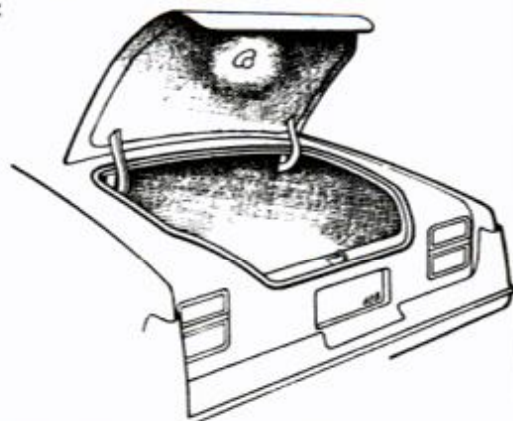
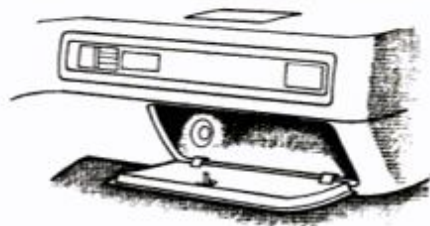
(Please turn to page 50)

### Out of sight, out of mind



Two good reasons for a good battery going dead and needing recharging are improperly adjusted or defective switches in the glove compartment and trunk. A bad switch allows the light to remain on, draining the battery. You can confirm this by performing a current-draw test, or by simply opening the trunk and glove compartment and feeling the bulbs. A warm bulb indicates one that has been staying on. Adjust or replace the switch. If you can't do the job right away, remove the bulb to stop the drain on the battery.

CHECK TRUNK AND GLOVE-BOX LIGHT SWITCHES



## CAR CLINIC

(Continued from page 49)

under the coil spring on each side of the truck, and a toe setting of  $\frac{1}{8}$  inch in.

### Mutual admiration society

*I found some rust under the top lip of the bed of my 1978 Dodge P/W step-side pickup, although I had the vehicle treated with Ziebart when I took delivery. I wire-brushed the spot clean and rubbed on Permatex Undercoating. So far, so good. Hope this tip helps some of your other trucker readers. Love your PM magazine.—F.F. Grant Jr., Fairbank, Pa.*

Threes and eights to you, too, F.F.—for both the tip and the nice words.

### To hounds

*I have a 1978 Buick Skylark that keeps stalling. The dealer has failed to correct the trouble. A service station operator told me this problem has been common to GM models for several years. Why can't a company the size of General Motors do something about this?—Jan Lowe, Columbus, Ohio*

They've tried. There have been numerous service bulletins issued to

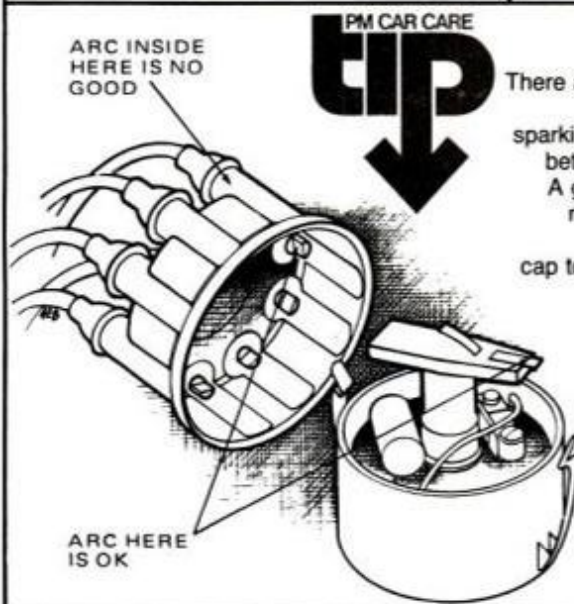
dealers for setting the choke, resetting the carburetor and modifying the EGR system. Some that may apply to your car are 78-T-1, V6 Cold Driveability; 78-T-54, Resetting the Carburetor; and 78-T-75A, Vacuum Break Setting.

Owners of GM cars who are experiencing stalling should hound their dealers until they go through the service bulletin index and apply every applicable bulletin.

### Batting .667

*I have had a problem with the tension of the accelerator since the day I bought my 1976 Capri II with a 2800 V6 engine. The force needed to depress the pedal is such that when the pedal does give way, the car lurches and throws everyone against the seat backs. There is no way to get smooth acceleration.*

*Some of the local mechanics have told me the problem is caused by the*



### Arc enemy

There are only two places in an ignition system where a gap is needed to produce high sparking voltage—at sparkplug electrodes and between rotor and distributor-cap terminals.

A gap elsewhere brings trouble. One of the most common places where a gap is left, resulting in sparks, is inside distributor cap towers.

Sparking—arcing, as it's called—can destroy terminals in the towers, making the cap useless, and can also cause high-tension cable terminals to burn. A loose cable in the tower is frequently responsible for arcing.

The gap left between cable terminal and distributor-cap terminal forces current to jump the space, and this is what causes the arc and subsequent burning of terminals. Make sure connections are tight whenever you reconnect these high-tension cables.

Selection shown priced from \$20 to \$60

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Available in pump or aerosol.

*geometric angle of the linkage, that it is inherent to the Capri V6 and that nothing can be done. Are they right?—Robert E. Ansley, Jr., Pensacola, Fla.*

On two points only: geometric angle and the Capri V6. They strike out on the third. Tell them that article No. 2073 of service bulletin 148 outlines the fix.

If your mechanic tells you that he doesn't have this information, have him order and install the following parts: bracket, D6RY9728A; accelerator shaft, D6RY9919A; connecting rod, D5RY9746B; kickdown lever (cars with automatic transmission), D5RY9P721A; and shaft bushings (two), D3RY9873A. These parts change the angle of the linkage, stopping the hangup.

### Hesitant Datsun

*Can you tell me why my Datsun 810 is hesitating and backfiring? The dealer can't.—John Linkletter, Old Greenwich, Conn.*

An improperly adjusted airflow meter is the most likely reason. To adjust the airflow meter correctly, remove the throttle switch plug. This reveals three contacts. Join the front and middle contacts with a jumper wire. Start the engine and

adjust the airflow meter to give a 3.3 percent CO reading on an exhaust system analyzer.

This reading will be richer than specification, but CO output will fall to normal when the jumper wire is removed.

Adjusting the airflow meter any other way causes the engine to run on an overly lean fuel mixture. This may well lead to hesitation and backfiring.

You should be using premium fuel in this car. Furthermore, timing is different than originally specified. An 810 Datsun that has manual transmission should have its timing advanced from 2° to 4° from the specification given. A car equipped with automatic transmission should have its timing stepped up to 14° BTDC.

Another problem that may result in hesitation, although it is probably a remote one, is an air leak that may exist in the boost control deceleration device.

### GOT A PROBLEM WITH YOUR CAR?

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

### SERVICE AND SAFETY TIPS

■ Chrysler has announced a way of fixing a low-speed vibration in 1978 cars with automatic transmission and lock-up torque converter. The procedure involves installing a new lock-up valve spring and valve body end cover. Ask your dealer to see if the provisions of service bulletin 21-02-78 apply to your vehicle.

■ A detailed repair has been issued by Ford to eliminate rough idling and surge in cars and trucks with 6.6-liter (400-cu.-in.) engines. The repair, which involves installing new main jets, connecting vacuum hoses and installing an EGR restrictor, is contained in service bulletin 158, page 27.

■ Owners of 1970-1974 Fiat 124 and 850 models should stay tuned in. Your vehicles will probably be recalled soon to repair underbody rust and corrosion. According to the National Highway Traffic and Safety Administration, "premature rusting and corrosion causes bending or separation of such structural components as suspension systems, rocker panels, floor pans and steering components. Such failures may result in loss of vehicular control." Over 180,000 cars are involved.

■ The Rubber Manufacturers Assn., 1901 Pennsylvania Ave. N.W., Washington, D. C. 20006, has a handy 18x24-inch wall chart available that you can hang up in your garage. It contains information about acceptable substitute sizes for replacement of alpha-numeric, P-metric and European metric passenger-car tires; a tire application guide that shows tire mixing combination "dos" and "don'ts"; and important service and maintenance recommendations on radial-tire inflation and temporary spare tires. The chart costs \$1. **PM**

# THE PM GARAGE

## CAPSULE REPORTS ON NEW AUTO PRODUCTS

### Roll your own

The latest offering from Merit Abrasive Products Inc., 201 West Manville St., Box 5447, Compton, Calif. 90224, makes life easier for home engine rebuilders, as I found out doing a rebuild with my son. Grind-O-Flex rolls are used on an extension man-



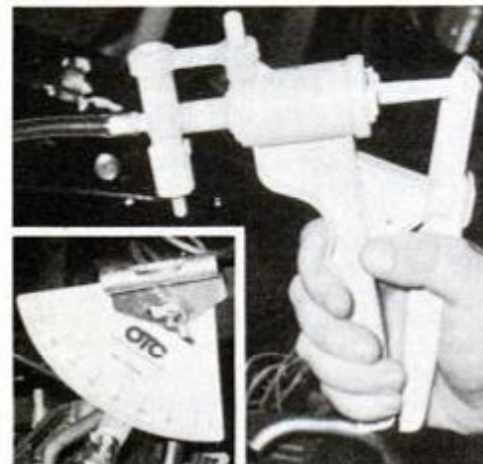
Engine rebuild is eased with porting kit.

drel to get into hard-to-reach spots, and stones are used for the first cut to remove hardened surfaces. The full 36-piece kit of stones and rolls is available at automotive sections in department stores (and through the Sears mail-order catalog after June '79). Price is \$19.95.—H.W.

### Setting vacuum break

Automatic choke vacuum break is an extremely important adjustment, particularly on late-model cars. If the choke cracks open too much after a cold start, the engine will stall out. If it doesn't open enough, the engine will gasp for air and stall out for this reason, too.

The traditional way of setting the choke break has been with a drill bit. You start with a cold engine, apply vacuum to the choke break diaphragm and use the specified size drill bit, between choke butterfly and carburetor barrel, as a feeler



Protractor sets proper vacuum-break angle while vacuum is applied with hand pump.

gauge. Now there's a new, more accurate way, and it involves measuring the angle of the choke butterfly when the vacuum diaphragm has cracked it open.

The tool is a protractor with a bubble level and a magnetic base to hold it to the choke plate. You attach the tool, turn the protractor scale until the zero lines up with a line on the tool's shank, then level the bubble (which is on a wingnut pivot) with the choke fully closed. Next you turn the protractor dial to the degree number specified for the carburetor, apply vacuum to the diaphragm unit with a hand pump such as the Mity-Vac, and if the choke break is correct, the bubble level will again be centered. If it isn't, you adjust the diaphragm linkage until it is.

At present, choke angles are specified only for GM two- and four-barrel carburetors, but carmakers will soon be providing specifications for all conventional carburetors.—Paul Weissler

### 'Car Wars' timing light

This Timing Diagnostic Computer (a catchy "TDC" for short) contains two computers and also serves as a universal gasoline engine tachometer and dwell meter. Its hookup is extremely simple: two cables go to the battery terminals and another clamps onto No. 1 sparkplug wire. There's a fourth wire, to the ignition coil negative terminal, but that's for dwell only, not an essential on cars with electronic ignition. Once you're hooked up, all you do is press buttons and look at the timing marks and a digital readout on the back of the instrument. You could buy a dwell-tach-timing light combination in a simpler design for a lot less money, so you should know that TDC offers a lot more than pushbutton convenience and digital readouts.

The most useful feature is a timing delay. What it means is you can press buttons to put any amount of timing advance into the computer and its digital readout, and the timing light will delay flashing that number of degrees. If you put 10° into the readout and the actual timing is 10° before top dead center, the light will flash and show the marks aligned at zero (top dead center). Inasmuch as the zero mark is invariably the easiest to see, you can really check timing accurately. The instrument also permits you to check



Mopar's Timing Diagnostic Computer.

vacuum and mechanical spark advance at higher speeds, at which the crank damper mark would be completely off the scale if you didn't punch in the delay.

You can push the buttons to increase or decrease the readout while you're operating the light, so it's also useful for spark-advance computers such as Chrysler's Lean Burn, for which there is an extensive spark-advance analysis in the shop manual. By following the shop manual schedule, you can pinpoint problems in a sensor.

While in the timing delay mode, the timing light does a lot of calculating and so is programmed to turn on only at every-other firing of the sparkplug. The tachometer develops its rpm numbers solely from the connection to the No. 1 sparkplug wire. It times the plug firing intervals and the computer deduces the number of cylinders, so you can use the instrument as a universal gasoline-engine tachometer. It will work on any number of cylinders without the need to turn dials.

If you've got a car with breaker points, the instrument also measures dwell (just connect the fourth wire). And you don't get just an averaged reading, as with an ordinary dwell meter; you get a separate one for each cylinder (and the readout tells you which cylinder the computer is checking). As a result, a bad distributor cam lobe shows up as a noticeably different reading.

This light will serve the Saturday mechanic well for many years to come, particularly as on-board computers become standard equipment on all cars in the early 1980s. List price is \$210 (discounts are reportedly available) and you can get it from auto-parts stores that carry the Mopar line.—Paul Weissler



# ANNOUNCING 4-WHEEL-DRIVE CHEVY LUV.

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**23** EPA  
ESTIMATED  
MPG  
32 ESTIMATED HIGHWAY

Remember: compare this estimated MPG to the "estimated MPG" of other vehicles. Your mileage may differ, depending on your speed, trip length, weather and 4-wheel-drive usage. Your actual highway mileage will probably be less than the estimated highway fuel economy. Lower in California.



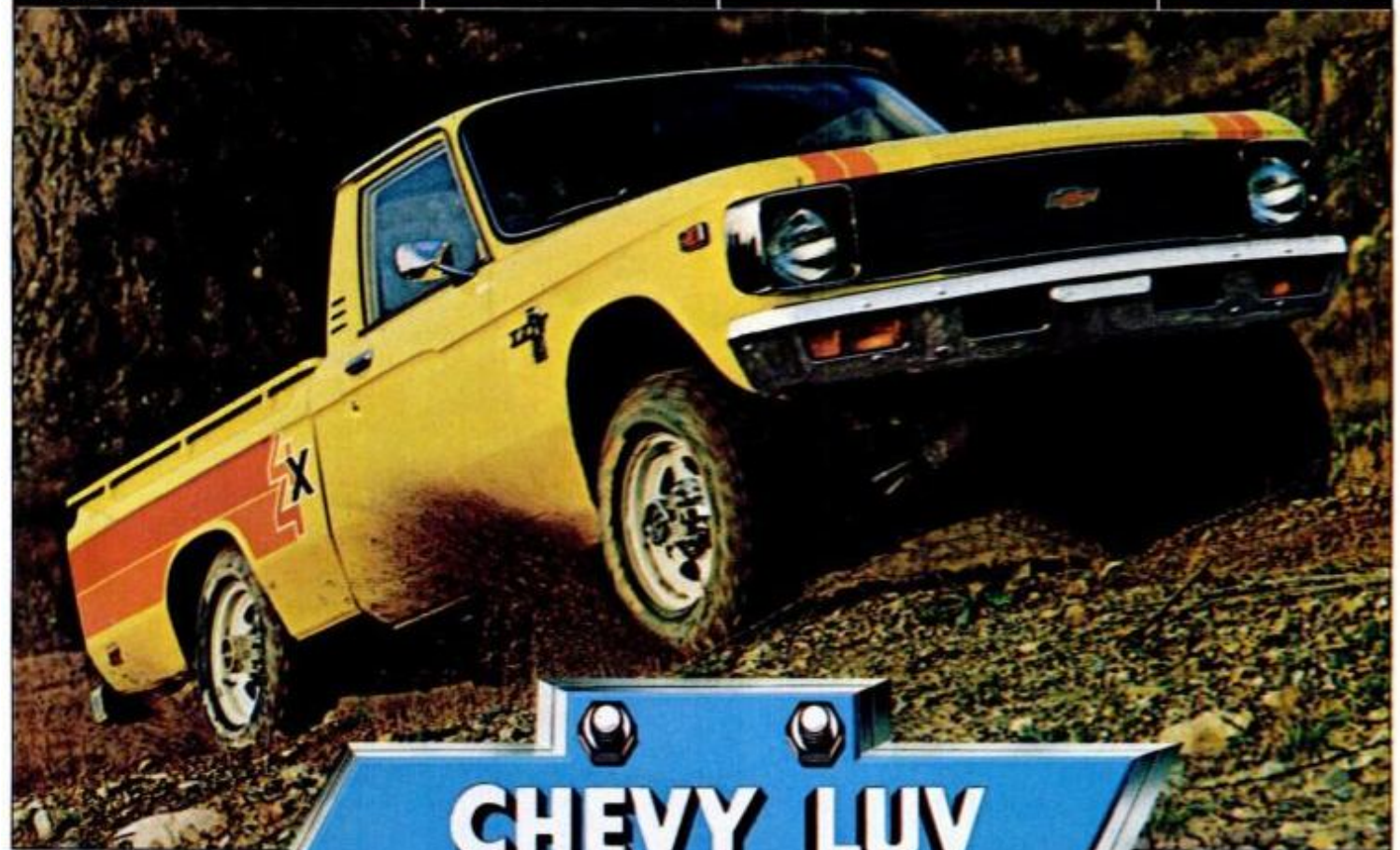
Tough independent front suspension with front stabilizer bar helps absorb bumps.



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Tighter turning circle than any full-size 4-wheel-drive pickup.



**BUILT TO STAY TOUGH**

# Wilderness.

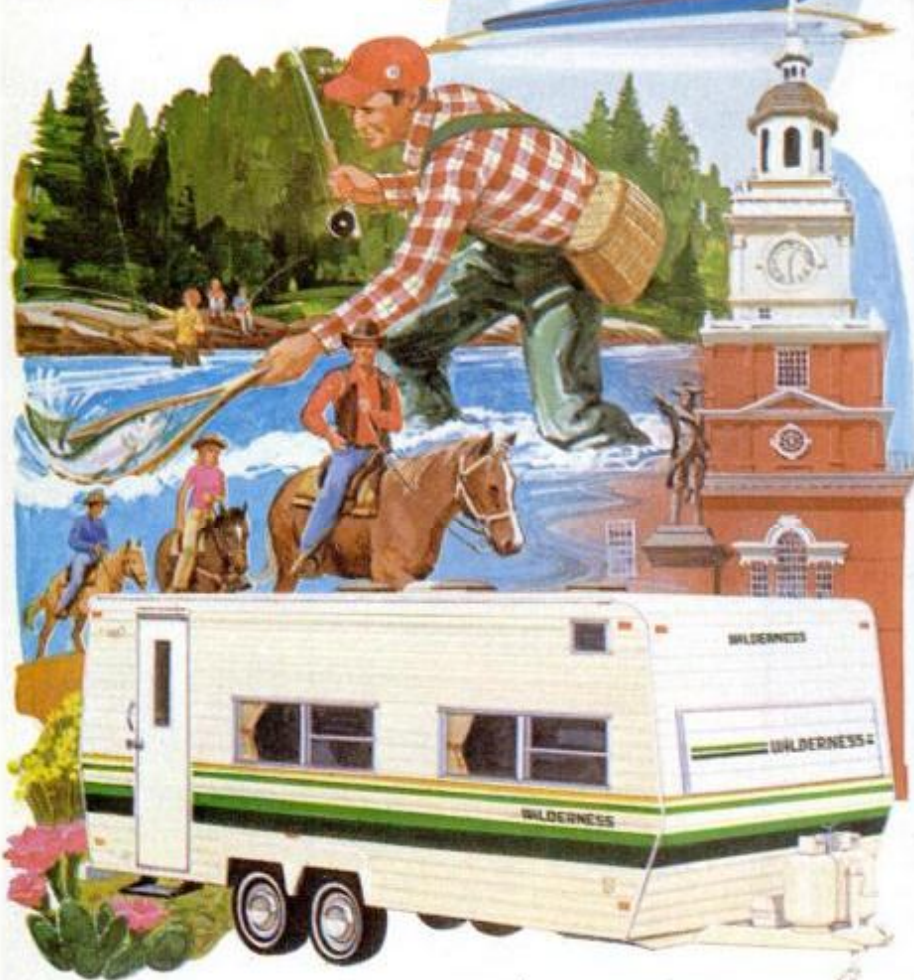
Families are discovering a lot about the Wilderness.

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## HINTS FROM READERS

### Sander converts to buffer



Substitute carpet scraps for sandpaper and your electric pad sander can double as a buffer-polisher for tabletops and floors. It works great when used with paste wax applied to wood surfaces in conventional fashion.  
—Marshall W. Harnes

### Use for refrigerator frost

If you defrost your refrigerator manually, collect the ice chunks. When melted, it's almost as good as distilled water for salt-sensitive plants. If you wish, strain the water to catch food particles.  
—Grace B. Weinstein

### Cover for oil cans

The plastic lid of a 1-lb. coffee can fits on a quart-size oil can to protect its contents after it has been opened. The lid snaps off easily when you need oil.  
—Lane Olinghouse

### Pencil pointer



A shallow 3-in.-dia. jar lid lined with fine-grit sandpaper is an excellent aid for sharpening pencil points. The lid rim keeps the lead waste from spilling onto your desk or drawing board.  
—Walter E. Burton

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**THE TEAR DROP 'Little Gem' CLOCK**



**Lippinzaner Horse Clock**  
SOURCE: Gustav Becker Co.  
YEAR: 1880

**STYLE:** Classic Vennia Regulator  
**SIZE:** 36"L x 14 1/2"W x 6"D  
**CASE:** Solid Cherry, with hand-rubbed Walnut finish. Features Horse on top, large Glass Door on front and Glass Panels on each side. Has 2 turned columns and 5 finials.  
**MOVEMENT:** Solid Brass with hardened Steel Pinions. Chimes the hours and half-hour. 8-day key wind.  
**PENDULUM:** Solid Brass. Deluxe design with classic RA on Bob.  
**FACE:** Classic white with raised Brass Rim. Black Numerals and Maltese Hands.

**Black Forest Cottage Clock**

**SOURCE:** Junghans Co.  
**YEAR:** 1880  
**STYLE:** Barvarian Regulator  
**SIZE:** 35"L x 15"W x 7"D  
**CASE:** Solid Oak with hand-rubbed Walnut finish. Features a pediment with a Head in a Circle, and 3 Finials. Door has Floral Corners, Round Glass, and 2 turned Columns. Bottom is shield design with Rosette and 2 Finials. Glass Panels on each side.  
**MOVEMENT:** Solid Brass with hardened Steel Pinions. Chimes the hour. 8-day Key Wind.  
**PENDULUM:** Solid Brass with Snow Flake and Floral Motif.  
**FACE:** Classic White with raised Brass Rim. Black Roman Numerals and Spade Hands.

**American Schoolhouse Clock**

**SOURCE:** Waterbury Clock Co.  
**YEAR:** 1896  
**STYLE:** American Regulator  
**SIZE:** 24"L x 11"W x 5"D  
**CASE:** Solid Oak with hand-rubbed Walnut finish. Features a pediment with a Fluted Arch that ends in Tear Drop Finials-accented on top with a deeply carved Sea Shell. Door is also a Fluted Arch with a gold Floral motif on the Glass. Has carved Floral bottom.  
**MOVEMENT:** Solid Brass with hardened Steel Pinions. Chimes the hours. 8-day Key Wind.  
**PENDULUM:** Solid Brass Bob.  
**FACE:** Classic White with raised Brass Rim. Black Roman Numerals and Spade Hands.

**SOURCE:** Ansonia Clock Co.  
**YEAR:** 1880  
**STYLE:** Octagon Regulator  
**SIZE:** 22"L x 12"W x 4 1/2"D  
**CASE:** Solid Oak, with hand-rubbed Walnut finish. Features 2 Glass Doors, upper door with solid Brass Bezel, lower door with gold lettering.  
**MOVEMENT:** Solid Brass with hardened Steel Pinions. Chimes the hours and runs 8 days. Key wind.  
**PENDULUM:** Solid Brass. Deluxe Bulls Eye and Leaf design.  
**FACE:** Classic white with raised Brass Rim. Black Roman Numerals and Spade Hands.

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## FIRSTHAND REPORT

by Michael Lamm  
WEST COAST EDITOR



# Driving the Fiat Strada



Fiat Strada gets a 32-mpg rating from EPA. A sport coupe's coming in late '79 or '80.

As small cars become ever more similar, their subtle differences take on greater and greater importance. The Rabbit, Civic, Accord, Fiesta, Datsun 310, Horizon, Omni, Champ, Colt hatchback, last year's Fiat 128, and now the new Fiat Strada all use basically similar engineering. They're all sidewinders, with cross-mounted ohc four-cylinder engines, front-wheel-drive, unitized bodies, MacPherson-strut front suspensions, and rack-and-pinion steering.

The serious shopper is thus forced to study the minor variations in these cars. He tends to weigh price against such subtleties as space efficiency, rated fuel economy, styling

and the manufacturer's reputation for quality and service.

There's no doubt that the sidewinder/fwd formula provides more cargo and passenger space than traditional rear-drive layouts. The cross-wise engine keeps the hood short, while the lack of a rear differential allows a deep, flat, unobstructed

cargo floor. Passengers gain leg-room on a shorter wheelbase, plus more hip and foot space, thanks to the lack of a bulky driveshaft tunnel.

### Costs less than Rabbit

Despite their similarities, sidewinders offer too many advantages to ignore. Question is, though, what separates the Strada from its rivals? And how should the buyer view Fiat's place in the U.S. market?

First, you have to realize that the basic three-door standard Strada costs about \$200 less than the lowest-priced Volkswagen Rabbit. There's also a Strada Custom series in three- and five-door body styles that retail for \$4690 and \$4840, respectively. Just as most VW buyers don't opt for the stripped Rabbit, Fiat expects most of its customers to go for the Custom series, with its reclining seats, tinted glass, a higher trim level and more color choices.

Then above the Custom, there's a \$385 luxury package that includes

*(Please turn to page 58)*

### SPECIFICATIONS—FIAT STRADA

#### Vehicle types

Unitized, 3 and 5-door hatchbacks.

#### Engine

Type: In-line sohc Four; cast-iron block; aluminum head; five mains; transverse positioning. Bore and stroke, inches/mm: 3.40 x 2.52 or 86.4 x 63.9.

Compression ratio: 8.5:1

Net bhp @ rpm (49 states): 69 @ 5100.

Net torque @ rpm (49 states): 77.4 @ 2500.

Carburetion: 2-barrel Weber downdraft.

Fuel capacity: 12.2 gal. U.S.

#### Drivetrain

Transmission: 5-speed manual transaxle with overdrive high or 3-speed automatic.

Final drive ratio: 3.59:1

#### Suspension and steering

Front suspension: Independent, MacPherson struts, coil springs (antisway bar with automatic transmission).

Rear suspension: Independent, MacPherson struts, transverse leaf spring that acts as anti-sway bar.

Steering: Rack and pinion, 3.4 turns, 33.8-ft. turn circle.



Masterful styling touches are evident inside and outside (door handle is inset).



Dash layout includes temperature and fuel gauges set vertically between speedo and tach, both easy to read through wheel. Unique rocker switches for lights are under clock.

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## DRIVING THE FIAT STRADA

(Continued from page 56)

digital clock, split rear fold-down seats, rear wiper, tach, roof rack, and woven cloth upholstery. A five-speed overdrive manual transmission is standard, with a three-speed automatic optional. Other major accessories include airconditioning and five different sound systems.

Mechanically, all Stradas use the same engine. It's derived from the Fiat 128 and shared with the X-1/9 sportster.

In driving the Strada, I found the seating most comfortable, with good support and ample legroom for my 5-foot-8 frame. My 6-foot codriver, however, complained that there wasn't enough seat travel—a situation he has experienced in nearly all modern cars, domestic as well as imported.

The Strada's acceleration compares favorably with that of its peers. Like several other sidewinders, if you push this car hard enough in low gear on slippery surfaces, you can feel it torque-steer slightly to the left. Steering itself is quick, light and positive, with only 3.4 turns lock to lock.

And the Strada handles well on the highway, with a good ride that's smooth, solid and silent. It's an admirably quiet car at cruising speeds, thanks to good body insulation and suspension isolation. There's a bit of whine from the transmission in its lower gears, but very little engine buzzy-ness on the road. Fifth gear helps here, yet it's really a ratio for the flatlands only. The Strada demands downshifting from fifth on any sort of long or steep grade. And, gearshift action can be rubbery.

The car under-steers when cornered hard, but the standard steel-belted radials stick well. All Stradas have a transverse rear leaf spring that doubles as an antisway bar. When you order the automatic transmission, the car comes with a front antisway bar as well. Both bolster the all-independent suspension to limit body roll in hard turns, and if you keep your foot clamped tight on the gas pedal, you can make it around the kind of hairpin turns that shove other cars off the road. Before you try this, though, be sure to practice on a deserted parking lot.

I found the use of plastic inside the Strada on a par with other cars in its class—or, in a word, excessive. Here's a friendly suggestion to the



Strada's cargo carrying capacity is biggest in its class; rear seat is split-type.

auto manufacturer who wants to make both a good first impression and then a good lasting impression: Two interior items *have* to be made of metal, not plastic—the glovebox door and the ashtray.

Anyone who test-drives the Strada and who either smokes or happens to open the glove compartment will get a false reading on the overall quality and workmanship. It's actually very well put together—first-rate inside and out.

Fiat's reputation for quality and service hasn't been the strongest in recent years, but company spokesmen assured me that extensive rust-proofing and improved quality control put the Strada several leagues ahead of its predecessors. The body uses Zinchrometal in all rust-prone areas, as well as PVC undercoating and plastic inner fender liners. The fit and finish impressed me as top-quality throughout (except for the above-mentioned plastic components).

Interior spaciousness, comfort and versatility—especially with the optional split rear bench—make this one of the most livable cars in its class. It's now up to Fiat dealers to back the Strada with service. **FM**

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### Sidewinders from \$4000 to \$6000

Car make	Engine in cc/ net hp	Wheelbase/ overall length, inches	Curb wt., lbs.	Max. cargo cap., cu. ft.
Datsun 310	1400/65	94.3/162.2	1995	19.1
Dodge Colt hatchback	1400/70	90.5/156.8	1950	22.9
Fiat Strada	1498/69	96.4/161.0	2025	39.3
Ford Fiesta	1598/66	90.0/147.1	1775	29.0
Honda Accord	1597/68	93.7/162.8	2018	27.2
Honda Civic	1238/55	86.6/147.8	1665	16.2
Omni/ Horizon	1715/75	99.2/164.8	2116	34.4
Plymouth Champ	1400/70	90.6/156.9	1940	22.9
Volkswagen Rabbit	1457/71	94.4/155.3	1837	38.9



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When you weigh down your car's rear end, you're risking more than a flattened tailpipe. An overloaded car won't handle as it should on curves. It won't respond as fast to rapid turns. Or brake as quickly.

Air-adjustable Hi Jackers help solve the problem. They help your car's suspension when you're carrying heavy loads. They keep your car stable and in control—even when you're towing a trailer or a boat. And because they are adjustable, they help keep your car riding level, whether you're traveling heavy or light.

Hi Jackers are America's best selling air-adjustable shocks. Here's why:

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A pair of Gabriel Hi Jackers adds up to 1,000 pounds to your car's carrying capacity. Which means that you can load a lot of extra weight and still maintain control.

### Rotating mounts



Gabriel Hi Jackers are the only air-adjustables with a "floating" can that allows the upper end mounts to rotate. That makes Hi Jackers easier to in-

stall. More important, it means a poorly aligned or damaged mounting bracket on your car isn't likely to damage your Hi Jackers. The floating can also means an accidental loss of air pressure will not ruin the shock.

### Extra protection

Hi Jackers don't look like most other air-adjustables. They have no exposed—and vulnerable—rubber diaphragms. Instead, the diaphragms on Gabriel Hi Jackers are enclosed, protected from road debris and gravel.

### A better shock inside

A Gabriel Hi Jacker is basically a shock inside an air-jack. The quality of the ride you get depends mainly on the shock inside. Gabriel Hi Jackers use a heavy-duty 1 $\frac{3}{16}$ "-inch bore for more control with



The rubber diaphragm on the shock at right can be damaged by road debris and gravel. The Hi Jackers' diaphragm is protected.

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Too much weight can make a safe car dangerous. Gabriel's Hi Jackers—America's best-selling air-adjustable shocks—can help your car control that extra weight.

\*Gabriel's "slim-line" models use a 1" bore—they're smaller in diameter so they will fit on cars that don't have room for larger air-adjustables.

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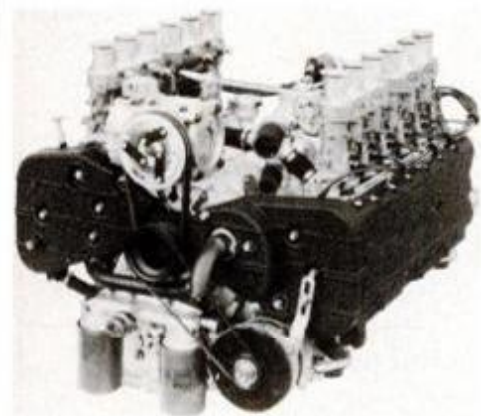


# IMPORTS & MOTORSPORTS

## Forbidden Ferraris

Have you ever seen a Ferrari Boxer in your neighborhood? How about a Lancia Stratos? A DeTomaso Longchamps? Monteverdi Sierra? If you have, it was one that flew over the hornet's nest of federal rules and regulations without getting shot down. Its owner endured the nightmare of having the car certified clean and safe by the Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA).

There are a number of exotic Eu-



Pancake powerplant stacked with Weber carbs is Ferrari's 12-cylinder from Boxer.

ropean cars not for sale here, because their manufacturers have elected not to go through the trouble and expense of certifying them. Bumper-height-and-strength rules, for example, may be difficult to meet on a lean and low design, and that's just the most visible requirement. The rules cover roof crush resistance, side door strength, fabric flammability, crash protection (padded dash and the like), windshield defrosting, rear-view mirrors, brake hoses, wheel nuts and so many more things that a *Commendatore* may just say nuts to the U.S. market. Furthermore, the powerplant must meet emissions levels for HC, CO and NOx, and now there is the corporate average fuel economy (CAFE) to be reckoned with. A manufacturer with an enthusiastic home market just won't bother reckoning.



Ferrari Boxer has to be modified to be legal on U.S. roads.

So, if you're a wealthy enthusiast and want to own a Boxer, you'll have to bring in the car on your own. It need only conform to the emissions level that was in effect the year of its manufacture. But, whatever, the year, you've got your work cut out. Do-it-yourself importing, you'll find, involves expensive freight charges, insurance, bond posting and other complications. That's before the car even gets here. When it does, it has to be documented for NHTSA and readied for the EPA's laboratory emissions tests.

It seems that there are enough Ferrari fans—and Lancia, Lamborghini, and others—with the penchant and pesos for importing a dream car so that a whole new business enterprise has sprung up here. These compliance or qualifying shops, as they're called, specialize in making exotics road ready. For a price—\$2000 to \$20,000, depending on make, model and year—you can buy the skill and patience that will rehabilitate your outlaw Lancia and turn it into a good citizen eligible for legal registration and... *driving!* Of course, now that you can take that 188-mph Ferrari out on the road, your troubles may be just beginning!

If you're game, however, some of the shops specializing in the Americanization of brutes from abroad include: Automotive Compliance, Harbor City, Calif.; Trend Imports, Hermosa Beach, Calif.; Amerispec, Danbury, Conn.; ACC, Spring Valley, N.Y., and Chinetti International Motors, Greenwich, Conn.

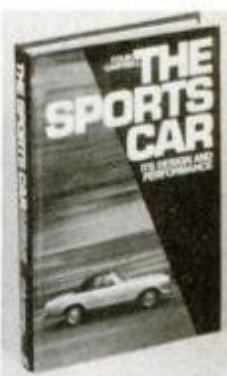
## Designing the sports car

The effect of governmental legislation on sports-car design is one of the considerations that updates Colin Campbell's *The Sports Car—Its Design and Performance*. The drive to reduce pollution, Campbell points out, may actually make it illegal for you to tune your own car (carburetor mixture screws are already plugged at the factory). This is indeed a revolting development for

the enthusiast. Campbell doesn't dwell on it, however, preferring matters of a more optimistic nature: exciting developments in engine design, advances in aerodynamics, tires, suspension, brakes. Chapter headings indicate the ground he covers in the

306-page text: Development of the Sports Car; The Engine: Combustion, Induction and Exhaust, Valve Gear; Fuel Metering; Road Holding; Suspension; Chassis, Frame and Body; Transmission; Brakes; Performance; The Sports Car in the Future and, finally, Design Studies, Jaguar, Lotus, Mercedes and Porsche specifically. First published in 1954, this fourth edition is now available from Robert Bentley Inc., 872 Massachusetts Ave., Cambridge, Mass. 02139 for \$14.95.

In the Lotus section of Campbell's

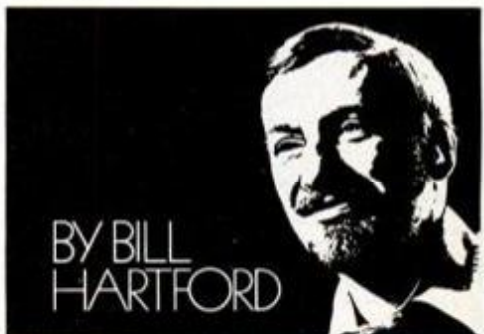


New car-buff book has lots of detail.



Luxurious grand tourer, the front-engine Eclat, just joined the Lotus lineup here.

Design Studies the Eclat is mentioned. This is the Lotus that's new to us, just having been introduced at the New York Auto Show. Colin Campbell may be better known to some motorsports fans as Mario's Grand Prix team manager, but those who have followed his Lotus marque from the kit-car days of the Fifties are even more dazzled by his success as a carmaker. **PM**



BY BILL HARTFORD

## NEW GRUMMANS



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Grumman introduces a new generation of aluminums. Three models—12, 14 and 15 feet—offer best overall performance in their price range.

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**NOW**

### Portable shower

Carry pressurized water anywhere with the Water Caddy. It fills from any faucet and holds up to four gallons of water. Different snap-in heads at the end of its seven-foot hose provide alternate spray patterns. The unit has no motor or springs; an expandable bladder maintains pressure. Weight is less than four pounds when empty. It can be used while camping, sailing, at the beach or at home. The Water Caddy costs about \$30 and is available from Sturges Marketing Corp., 49 Riverside Ave., Westport, Conn. 06880.



### Three-way light

The Security Lite plugs into a wall socket to recharge continuously; in a power failure, it lights automatically. Unit can also function as a nightlight or flashlight. About \$17 from Rival Manufacturing Co., 36th and Bennington, Kansas City, Mo. 64129.

### Frayed not

Fray Check, a colorless liquid, is said to reinforce and lock fabric threads so they can't shift and become frayed. It can be used in crafts or the shop as well as in sewing applications. A ¾-ounce bottle is \$1.50 from Scovill Manufacturing Co., Box 5028, Spartanburg, S.C. 29301.



### Pickup dumper

The E-Z Dumper transforms a pickup truck into a dump truck. Made of 14-gauge steel, it's said to carry more than 4000 pounds. Installation often requires no alterations, maker claims. Unit with 12-v.d.c. motor, hydraulic hoist, two-way tailgate, hold-down clamps and controls is about \$965. Side extensions and granular material spreader are also available. Jerr-Dan Corp., R.D. 3, Box 120, Greencastle, Pa. 17225, sells the dumper.

# Ferrothane® Plastic Finish. Nobody's ever seen plastic rust.



Now you can seal outdoor metal things—like this wrought-iron table—in plastic with the wrist-and-brushwork of an ordinary paint job.

It's a cinch with Ferrothane Plastic Finish—the new outdoor metal coating from Flecto, the makers of Varathane® Liquid Plastic. You don't even need a primer.

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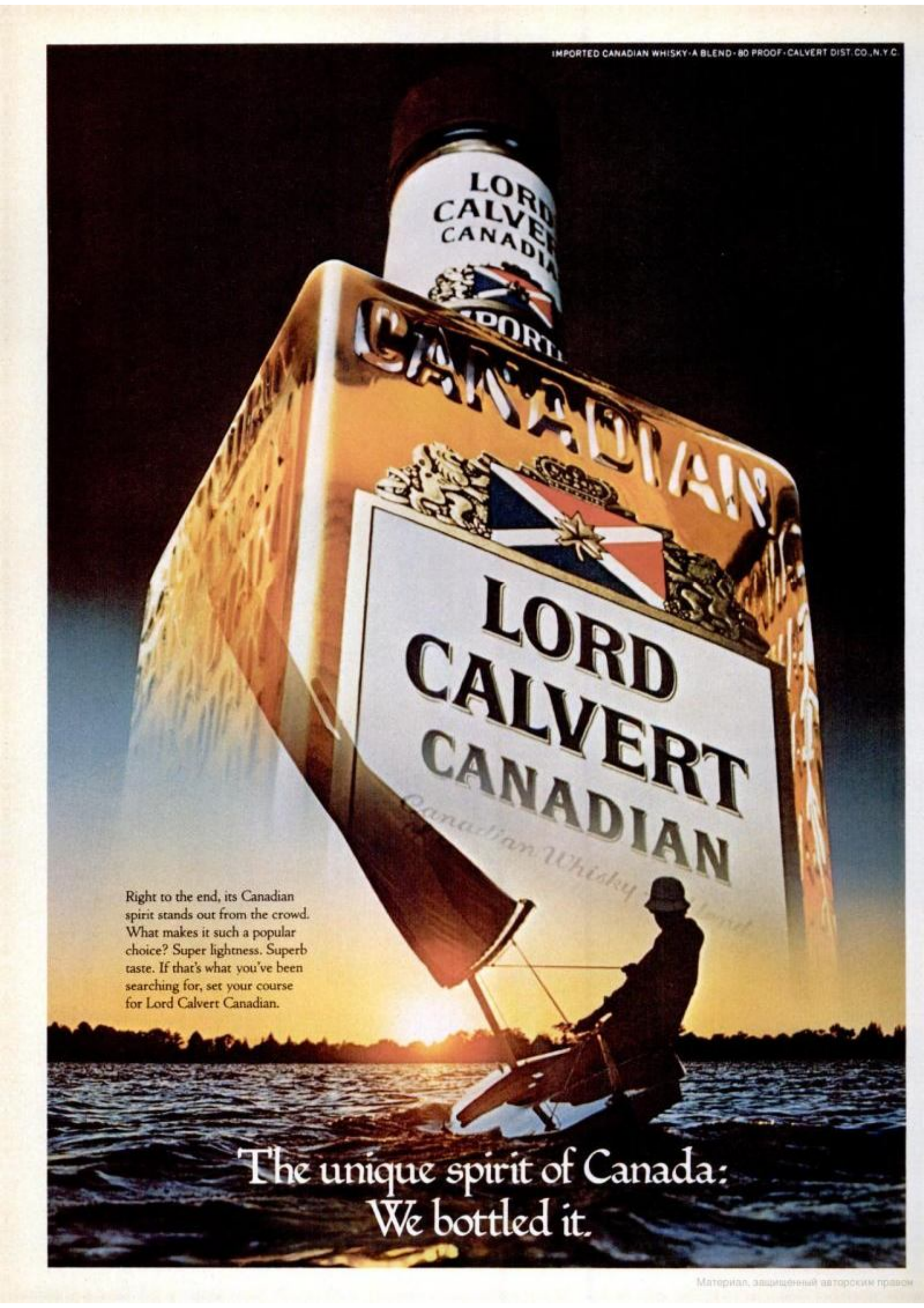
chemically formulated protection against rust and corrosion.

You'll also get a terrific-looking finish in a choice of 12 Ferrothane colors. Plus a coating that levels itself, spreads evenly, and dries in 4 to 6 hours. And gives outdoor metal things tough, long-lasting protection against rust, corrosion, mars, nicks and chipping.

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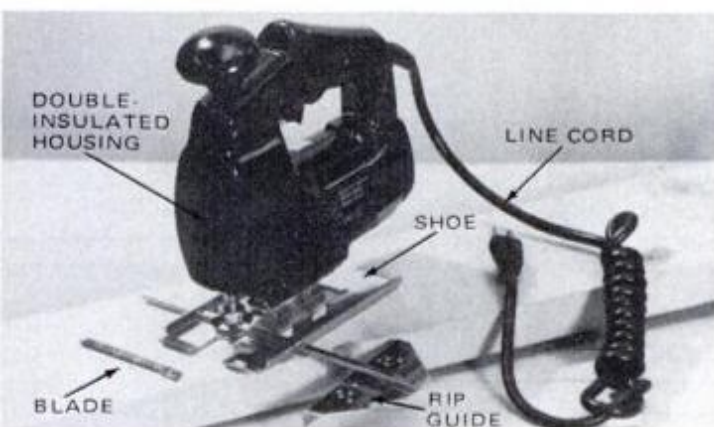


Right to the end, its Canadian spirit stands out from the crowd. What makes it such a popular choice? Super lightness. Superb taste. If that's what you've been searching for, set your course for Lord Calvert Canadian.

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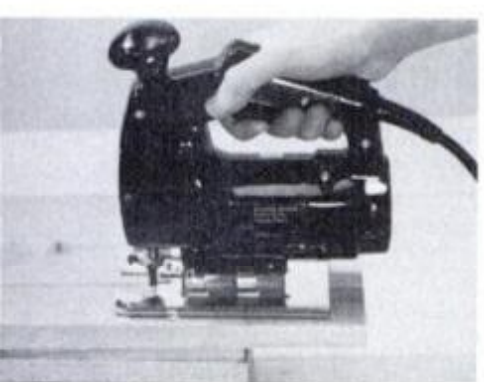
# WORKSHOP MINICOURSE

## SABRE SAW BASICS



**F**or my money, the sabre saw is the second power tool (right after the drill) to buy. With a good one, you can do some pretty rugged cutting—and some fancy cutting as well. Don't make the mistake of thinking that a sabre saw replaces a circular saw. It doesn't. However, a properly used sabre saw does give you the capacity to make scroll cuts and the like with professional accuracy. But keep in mind that you must use the right blade for the job and learn to master the tool. Before using your sabre saw for the first time, read the manufacturer's instructions for tool use and care. Use sharp blades only—toss out dull ones, which put undue strain on the saw's electric motor. **PM**

Most sabre saws come with blade and rip guide, as this J. C. Penney model does.



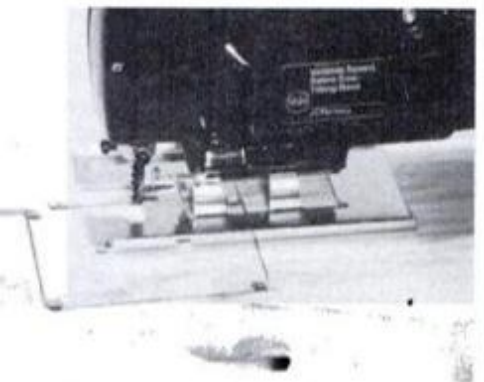
To cut freehand, simply follow line with a steady hand. For maximum control, pick the right blade and use a slow feed rate.



When accuracy is a must on a long rip, use the guide that comes with the kit. Make certain it is securely fixed to the shoe.



For a reasonably accurate crosscut, simply hold (or clamp) a square as shown. Keep saw shoe pressed against square's blade.



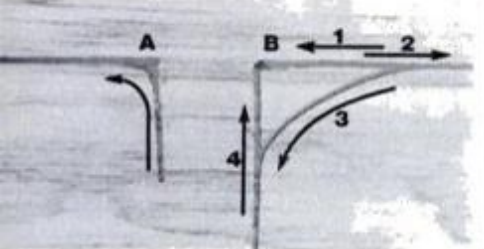
To make an internal cut, first bore entry holes for the blade at critical corners.



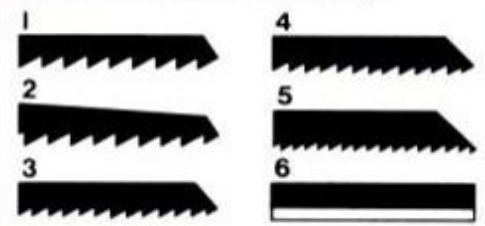
A faster—but not as neat—way is to make a plunge cut as shown. Start plunge around middle of line. Hold saw securely.



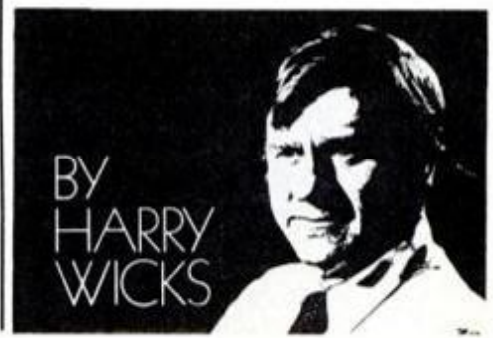
Slowly lower blade until shoe rests flat on work. If saw has variable speed, as here, use a slow blade speed, too.



Two ways to cut a corner with a sabre saw: (A) Push blade to corner, back up and nibble your way around turn. Or (B), push blade along line right up to the corner (1), back up (2), and make an arcing cut in waste area into the perpendicular line (3). Then turn saw to make neat corner cut (4).



Sabre saw blades to know about (and have in your toolbox): (1) 7-tooth for fast, rough cuts in wood; (2) extra-long rough-cut for thick boards; (3) 10-tooth for hardwood, plastics, etc.; (4) 10-tooth taper ground for smooth cuts in plywood, veneers; (5) 24-tooth hacksaw for metal; (6) knife blade for rubber, leather, paper, and cardboard.



# HOMEOWNERS' CLINIC

## QUESTIONS ANSWERED

### Roll screen repair

Reader Norma Wilson wrote asking us to pass on information to owners about a repair service for Weather-Seal storm windows. These units have screens which are on rollers fastened to the bottoms of the storm windows. When a storm window is raised, the screen appears. The product was made between 1953 and 1974, but has since been phased out. Don't throw away your damaged screens. They can be repaired. Write to Pratico Supply Co., 830 Liberty St., Trenton, N.J. 08611, for information.

### Siding on asbestos shingle

How do I re-side over asbestos shingles, as suggested in the December '78 Homeowners' Clinic (page 12)? My sheathing is the "soft" type and the fasteners are almost like a cotter pin, open or spread behind the sheathing. I can't nail into the shingles because they break. Even if I could, the sheathing wouldn't hold nails.—A. Taylor, Ambler, Pa.

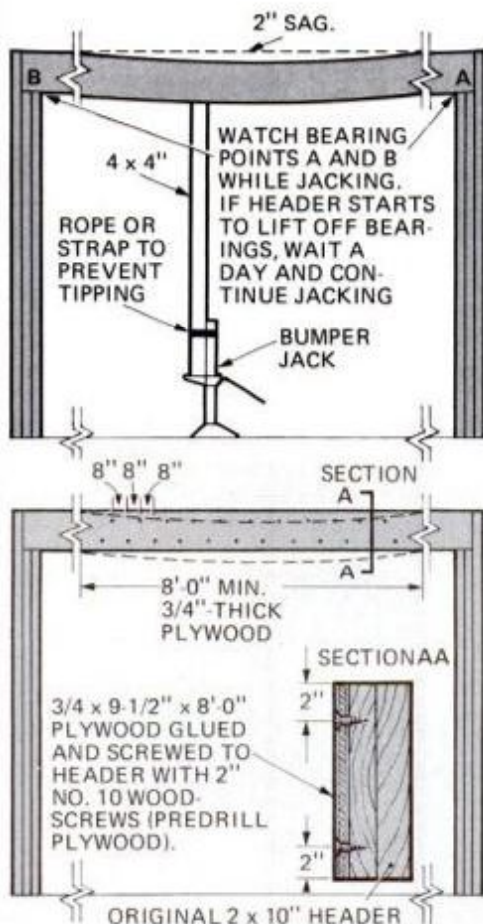
Many homes built after World War II were sided in the manner you describe. This makes re-siding just a bit difficult. First, get used to the word "hanging," not nailing, when you're talking about aluminum or vinyl siding. It's not nailed tightly to the existing siding. That's why the slots on aluminum siding are provided. The pro will first locate and mark the studs under the sheathing. A 2-in. galvanized-steel nail is used to penetrate the asbestos shingle. Personally, I would put 15-lb. felt over the shingles before re-siding. Don't worry about shingles cracking underneath, as long as you're fastening them to a stud. The cracked shingle will act as a shim. From here on, follow installation instructions for the siding you choose, but don't drive the nails all the way home. The siding must expand and contract in the fastening slots.

### Sagging header

My garage door opening is 16 ft. wide; there is a 2-in. sag in the middle of the double 2x10 header. How do I get the sag out and keep it straight and level?—Harry A. Bobco, Warren, Ohio.

Normally a double 2x10 header can safely span 16 ft. However, if you have living space above the garage framed into the header, it may

be overstressed. If the sag isn't too permanently "set," it can be jacked up in the center and reinforced as shown. A car bumper jack and 4x4 can be used, but take care to loop a rope or strap around the top of the jack and the 4x4 to prevent the jack from popping out as pressure is applied. Apply pressure slowly, making certain that the header isn't lifted off the end supports (posts); this may mean jacking only about 1/2



Reinforce header with a plywood flitch.

in. per day, until the sag is out. When you feel you've corrected the sag as much as possible, glue and screw the plywood "flitch" to the inside of the header, centered with 4 ft. on either side of the center. If the sag cannot be removed without lifting the header off the end supports, the header may simply be

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

reinforced to prevent further sagging. If it is supporting living space above, and you're not certain of its structural adequacy, have a professional engineer check it out.

### Reglazing bathroom fixtures

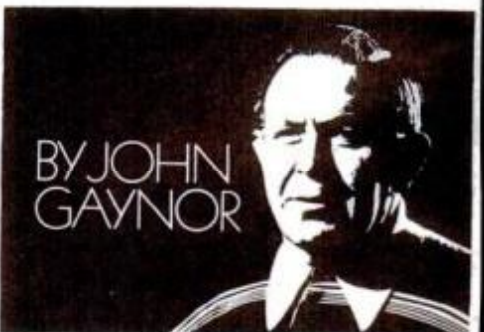
How can I re-enamele sinks, bathtubs and wash basins so they can be cleaned and scrubbed properly? It is inconvenient, costly and sometimes impossible (because of odd sizes no longer available) to replace existing tubs and sinks.—E.C. Carson, San Rafael, Calif.

Many professionals won't repair a nick without reglazing the entire fixture, to be assured that water won't penetrate beneath the patch. Basically, the pro does the following: etches the tub with a mild acid to cut the existing glaze; patches and sands all nicks with an auto body-type filler and thoroughly washes and dries the fixture; and sprays on several coats of a special porcelain glaze. (This may be the time to change the color of your fixture.) After three days, you can use the tub, although the finish continues to set and harden for several months. The job will take five hours and cost less than \$200 for a tub.

To find a professional, look in the Yellow Pages under "Bathtubs, Refinishing," or write: Kott Koatings, Paralta Drive, Suite K-12, Laguna Hills, Calif. 92653, for free brochure and name of refinisher in your area.

Another alternative is to use a kit to refinish the tub yourself. One manufacturer of these kits is: Spectrodyne Industries Inc., 2005 North Keystone Ave., Chicago, Ill. 60641. The price for a complete kit, including spray gun and compressor, is about \$110.

When weighing the economics of refinishing or replacing, remember the hidden costs in replacement—plumber, tile setter and, of course, mess.



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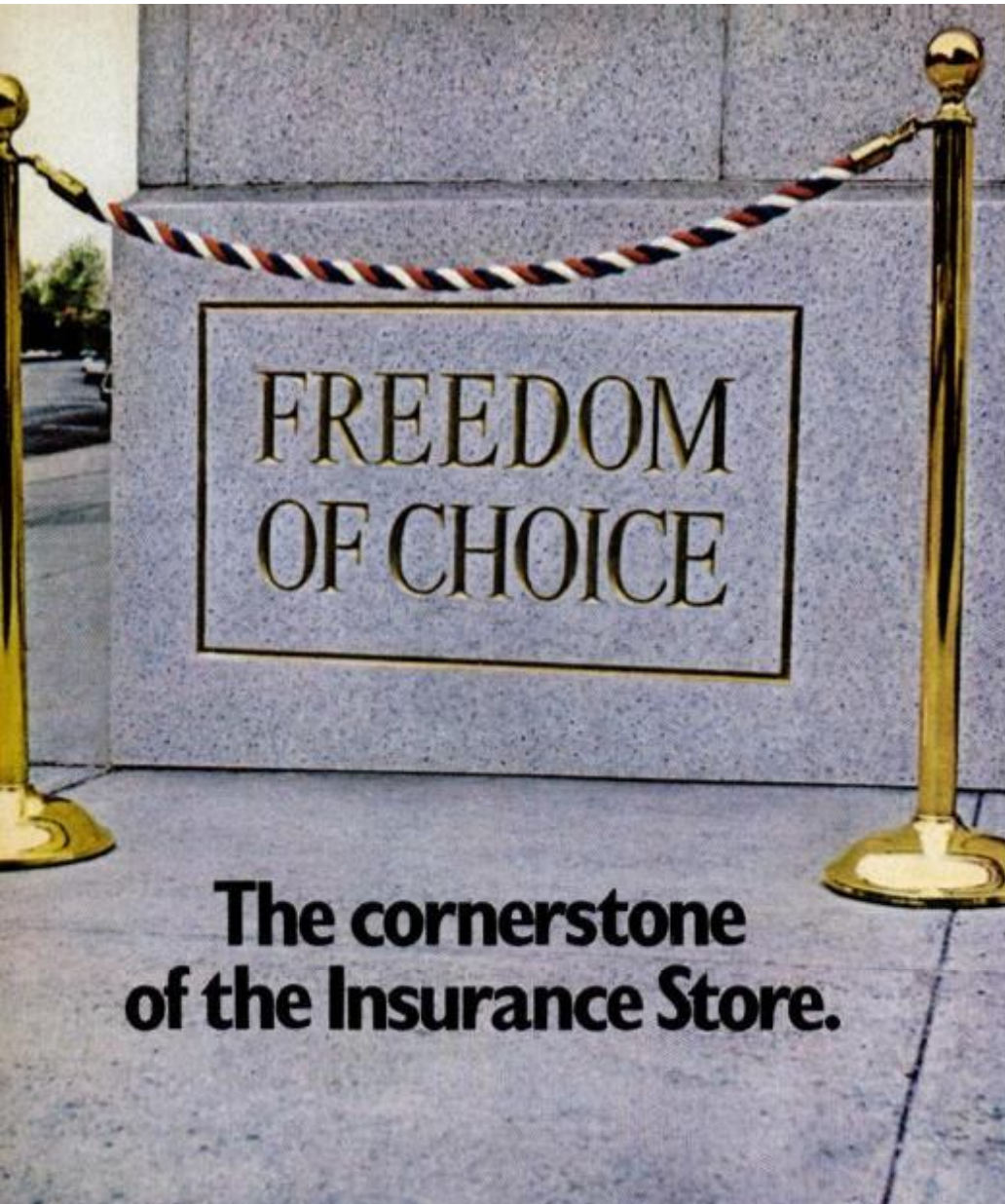
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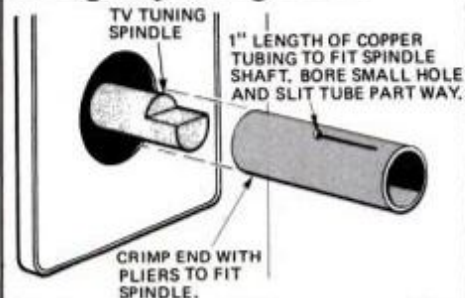
## HINTS FROM READERS

### Flame site



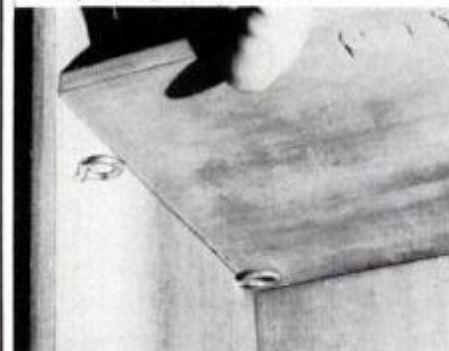
Keep both hands free to position work pieces when you use a propane torch. Use aluminum foil crumpled into a ball to form a cradle for the torch. You can shape foil as needed to point flame in any direction.—*Harry Wheeler*

### Emergency tuning handle



If the tuning dial on your TV doesn't work because of a crack or break in its collar, you can make an emergency one as shown, using a piece of copper tubing and crimping it around the tuning spindle. Apply the same idea to other appliances with similar dials.—*Norbert Engels*

### Temporary shelf holders



Use large screw eyes to temporarily install a shelf. Insert the screw eyes and rest the ends of the shelf on them as shown.—*William Swallow*

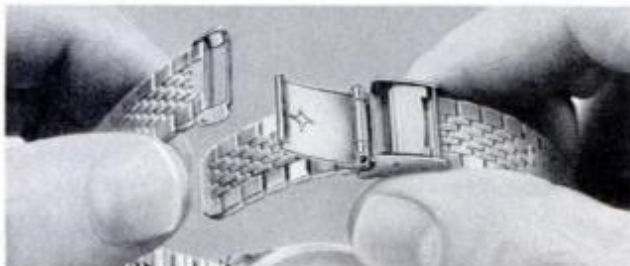


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**WATER RESISTANT \***



Both watches feature "Memory-Fit" clasp. Slide it to your most comfortable wrist position, lock in place and you never have to adjust it again.

The purpose of a watch is to help you relate to time. Now, here are two technological beauties from Sensor, that will do that job for you in a number of ways.

First, they give you a continuous 6-digit readout of hour, minutes and seconds accurate to 15 seconds per month. The exact time is visible in large numbers day and night, without the bother of pressing a button.

#### They Glow In The Dark

Second, both the Chrono and Alarm feature TriLite™, a space-age illuminating technique. Two tiny glass tubes lined with phosphor are injected with tritium, sealed permanently by laser beam and mounted behind the digital display.



With TriLite, there's no battery drain. No button to push. TriLite is self-contained. Self-powered. It illuminates the digital display for continuous readout, day and night, year after year.

Third, with the touch of a button, both watches provide a numeric-alpha readout of the month, date and day. An automatic calendar adjusts the date for

the correct number of days each month.

#### \*Water Resistant

Fourth, both the Chrono and Alarm are water resistant. To carry the water resistant label, these watches have to meet strict requirements set by the FTC. They have been tested in water under pressure up to 50 pounds per square inch. You can wear them in all types of normal water situations—from showers to swimming—with complete confidence.

#### Chrono Features

The Chrono (pictured above left) is offered in an attractive gold and silvertone combination. The stainless steel case and band are offset by a striking 24-K 5 microns gold ring circling the face and a 2½ microns gold inset in the band. This unique chronograph and stop watch will time any event from  $\frac{1}{100}$ th second to 12 hours, 59 minutes and repeats indefinitely.

It records both elapsed time and lap time so you can easily keep track of a single event such as a phone call, speech, jogging or a race involving many such as a track event or car race.

#### Alarm Features

The Alarm (pictured above right) is the only water resistant digital alarm available. Instead of an irritating electronic beep that you may or may not hear, the Sensor Alarm "chirps", much like to the sound of a cricket. This new



sound feature is audible in noisy environments and especially effective in waking you.

The 24-hour alarm will signal you at the precise moment you wish day or night and when it shuts off, it is automatically set for the same time the next day.

Available in two attractive styles—silvertone (nickle plated case with stainless steel band) and goldtone (5 microns 24-K gold case and 2 microns gold bracelet).

Try the Sensor Chrono and Alarm on a 10-day free trial. If not satisfied, return for courteous refund. Both watches carry a two year limited warranty. Only \$75.00 for the silvertone Chrono; \$80.00 for the goldtone Alarm; \$70.00 for the silvertone Alarm. Add \$3.00 per watch for shipping and insurance.

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# Contemporary Marketing, Inc.

790 Maple Lane, Bensenville, Illinois 60106

## FIRSTHAND REPORT

by Gary Witzenburg  
DETROIT AUTO EDITOR



# Driving the Mazda 626



The 626 coupe speeds through "corkscrew" at Laguna Seca road course in California. Suspension of coupe makes it quicker through such twists and turns than sedan.

Virtually no one had heard of Mazda cars, built by Toyo Kogyo in Japan, when they entered the U.S. market with barely 2000 sales in 1970. But 10 times that many were sold the following year, 63,000 in 1972, and by 1973 Mazda had climbed, almost incredibly, to fourth place (behind VW, Toyota and Datsun) among U.S. importers, with sales of nearly 120,000 cars.

But this success was built largely around Mazda's unique rotary Wankel engine, which was smooth, quick and responsive but far less fuel-efficient than the four-cylinder conventional engines powering competitive imports. Already smarting from dealer and service problems, Mazda was dealt a crippling blow when the Environmental Protection Agency published extra-low fuel economy

numbers for the rotary engine following the 1973-74 fuel crisis. Sales fell to 75,000 in 1974, 69,000 in '75 and 41,000 in '76.

Then the comeback began. Reorganization and a dealer improvement program were followed by introduction of the very conventional but very competent and reasonably priced GLC minicompact two years ago. The quick, sexy, rotary-powered RX-7 sports car came a year after that, and now Mazda has introduced

its answer to the midsize, mid-priced import family sedan and sport coupe—the 626.

While everyone else has been falling all over one another trying to build a better VW Rabbit, Mazda has scored a coup by building a better Toyota Corona and Celica in one fell swoop. The two-liter, piston-powered, rear-wheel-drive 626, suspended by MacPherson struts in front and a live axle with coil springs in back, is as conventional as a gray-flannel salesman. But conventional does not mean dull or boring.

Besides going head-on against No. 1 importer Toyota in the growing mid-price battlefield (\$5500 to \$7500), Mazda sees its 626 as competition for everything else from Honda's Accord to Audi's Fox. Clever and sophisticated engineering bits and pieces, innovative and practical conveniences and large touches of class and comfort have been skillfully interwoven.

The 1970-cc, in-line, overhead-cam Four sports an aluminum cross-flow cylinder head (intake on one side, exhaust on the other), hemispherical combustion chambers that have "masked" valve seats to create efficiency-producing swirl in conjunction with high-swirl intake ports, two-stage exhaust gas recirculation (EGR) and twin reed valves (instead of a power-robbing pump) for secondary air to the catalyst. Result: a 25-mpg EPA city economy, emissions are well below even the tough state standards of California, 0-to-60

(Please turn to page 72)



Nose of the 626 has family resemblance to GLC model, as evident from views of the coupe (top left) and the four-door sedan (top right). Coupe cockpit (above, left) shows tachometer, which sedan does not have. Rear seat of both models folds down (split 60/40), as shown (above, right), to accommodate cargo that's too big for the trunk alone.



## THE SPARKOMATIC SOUND. CAR STEREO FOR THE TRAVELIN' MAN WITH EARS OF EXPERIENCE.

Until now, comparing car stereo to home stereo was like night to day. Auto sound equipment was completely in the dark. Powerless to produce serious audio reproduction. Hopelessly lacking in high fidelity specs. For a travelin' man with *ears of experience*, this was the pure "pits".

But that's all over now. Now that Sparkomatic has introduced its radically new High Power Car Stereo series. With exacting high performance high fidelity credentials. Tuners with exceptional FM sensitivity; credible multipath signal rejection; superb separation; integrated cassette or 8-track with virtually inaudible distortion and unnoticeable wow and flutter.

The power: a bone shaking 45 watts.

Sparkomatic's SR 3300 High Power AM/FM Stereo with Auto Reverse Cassette has some other impressive high fidelity touches as well. Like *feather touch* electronic controls and sophisticated tape handling capabilities. All told, a component-looking package that delivers faithful high fidelity pleasure in its *purist* form.

And Sparkomatic High Fidelity Speakers complete a car sound system that produces the highest form of *erotic* experience.

Visit a Sparkomatic dealer and get a Sparkomatic high power car stereo demonstration soon.

**SPARKOMATIC**  
For the Travelin' Man™

For our free catalogs on Car High Fidelity write: "For The Travelin' Man", Dept. PM, Sparkomatic Corporation, Milford, PA 18337

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

BE YOUR OWN BOSS!

Make \$8<sup>00</sup> an hour...

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No layoffs. No strikes. Provides a steady source of year round income.



**This can be one of the most important decisions you ever make**  
Going into business for yourself can be the most exciting and rewarding decision you're likely to make in your lifetime.

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

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

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

**More sharpening businesses are needed every year**

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

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- A sharpening business provides excellent retirement income
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STATE \_\_\_\_\_ ZIP \_\_\_\_\_



**DRIVING THE MAZDA 626**

(Continued from page 70)

mph time is 13 seconds and outstanding driveability is achieved.

The front suspension struts are canted rearward for directional stability and road-shock absorption, rear springs are variable-rate tapered coils with gas-filled shocks, suspension travel front and rear is a generous 7.7 inches, and weight distribution is nearly 50 percent in front and 50 percent in rear with a four-passenger load. The result is true sports-car-style handling combined with one of the softest rides ever produced in Japan.

**Good drag coefficients**

A bit more sports car than sedan are the 626's aerodynamics. The low, sloping grille and hood, front spoiler, smoothly integrated bumpers and lights, flush windshield pillars, partial engine undertray and other features produce impressive wind-tunnel drag coefficients of 0.39 for the coupe and 0.42 for the four-door sedan (as tested by Mazda). This overall slipperiness aids high-speed performance and road-holding, saves fuel and helps to quiet down interior wind noise.

Inside, roominess front and rear is generous by Japanese standards, comfort and support from the cloth-covered, fully reclining front buckets are excellent by any standards (there's even cushion-height and lumbar-support adjustment for the driver), and the color-coordinated instrument panel is as attractive as it is functional. Convenient shelves, pockets and compartments are everywhere you look, the asymmetrically split rear seat folds down to combine the rear passenger area with the trunk, and a dash-mounted deck-lid release is standard.

The four-door 626 is a bit of an ugly duck with its high, squared-off greenhouse, but the coupe is very svelte and well proportioned. Both come standard with five-speed manual trans, steel radial tires, stereo radio and much more. And the coupe throws in a tachometer, rear sway bar, remote-control outside mirror and electronic check panel. About the only options are larger tires and styled aluminum wheels for the coupe, plus airconditioning and automatic trans for either model.

In Mazda's own words, the 626 was designed to achieve "the perfect combining of European styling, comfort and handling with Japanese quality, value and economy." And it comes as close to this lofty goal as anything at the price that is on the road today.

FM



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# "My Wheel Horse makes things a whole lawn easier. You can depend on it."

**And that's important** when keeping up your yard is a labor of love. The last thing you want is downtime. You need a tractor you can trust.

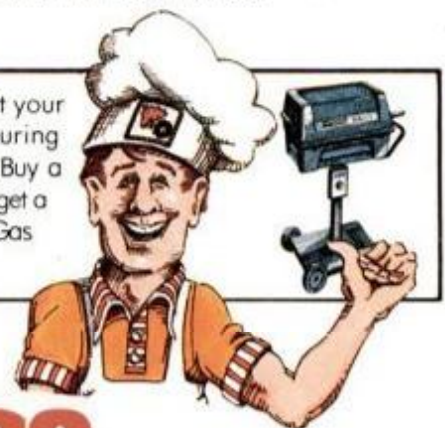
For me it's my Wheel Horse. Around the house, in the garden or on the lawn, my Wheel Horse is a real work horse. Because it does so many different jobs, I get more done in less time. Talk about a smart investment...!"

And talk about choice. Wheel Horse has a full line of quality products. From our snappy new riding mower to a tough 19.9 HP estate tractor.

Whatever the job, there's a Wheel Horse made to take on your job.

Visit your nearest dealer and find out why you can do it all on a Wheel Horse.

See what's cooking at your Wheel Horse dealer during his Spring Sizzle Sale. Buy a new Wheel Horse and get a genuine Charmglow Gas Grill free!



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**Wheel Horse**

515 W. Ireland Road, South Bend, Indiana 46614



Caprice Classic Wagon

# America's Bandwagon.

## The New Chevrolet.

A popular success in its first two years. And now, in its third year, with a bandwagon following that makes it America's best-selling wagon by far.

Trim and beautifully in tune with the times outside, yet full-size inside, The New Chevrolet remains one of the newest wagons around. The wide spacious seats are designed for six adults. The rear seat folds down at the touch of a button, opening up 87 cubic feet of cargo space. The door-gate opens like a door for people, or like a gate for cargo. There's a large lockable storage

compartment under the rear cargo floor. There's a side lockable storage compartment. There's the convenience of built-in utility trays.

Yet, on the road, The New Chevrolet is pure enjoyment. Satisfyingly solid, with a sense of handling ease you'll appreciate when you maneuver and park in cramped quarters.

See your Chevy dealer about buying or leasing The New Chevrolet.

Get on America's Bandwagon. You'll love it.



**87 Cubic Feet.** Takes loads up to 4 feet wide through the rear opening.



**Three-Way Door-Gate.** Opens like a door for people, like a gate for cargo.



**Underfloor Storage.** 8 cubic feet of lockable storage on 2-seat models (less on 3-seat models).



**Extra Storage.** 2 cubic feet of convenient lockable side-compartment storage, plus built-in utility trays.



**Push-Button Seat Conversion.** Release the second seat with a touch of a button as you glide it down.



# The New Chevrolet.

America's best-selling wagon.

## PM follow-up: Rail disaster

In PM's January '79 lead article on railroad accidents involving hazardous materials (*Rolling Bombs That Ride Our Rails*, page 57), reference was made to a derailment that occurred in Waverly, Tenn., on Feb. 22, 1978, resulting in an explosion during cleanup operations that ultimately took 16 lives. The National Transportation Safety Board has since concluded its investigation of the accident and has produced some chilling findings.

While most derailments are assumed to be caused by poor roadbeds or damaged rails, this apparently was not the case in the Waverly disaster. The NTSB concludes a handbrake was improperly left set on one gondola railcar

of the train, and went undetected by crew members. The set brake caused a wheel to overheat, and ultimately break, according to the NTSB, leading to the derailment of the affected car *some seven miles outside* of the Tennessee city. Dragged along in a derailed condition, the car eventually contacted a main-line switch in the city, causing 22 other cars to derail at that point — where danger to human life from the liquid petroleum gas that finally exploded was most intensified.

It was also determined in the Board's study that the LPG tank car that exploded cracked on a welded seam before rupturing.



## Out of right field...

It always comes as a shock to Americans to be reminded that we don't have an exclusive franchise on the game of baseball. It came as even more of a shock to us to learn that as the major league teams took to the field this year, about 150 players — almost 20 percent of big-leaguers — were wearing gloves bearing the trademark of a Japanese company, Mizuno.

It's no secret that a pro player can have any glove, bat, shoe, wristband, sunglasses, etc., he wants without an outlay of personal funds, so the inroads made by Mizuno are impressive. One of the ways they accomplished this little invasion, PM found out, was to send their "ichiban" (number one) glove-maker, Yoshi Tsubota, to training camp last year. Yoshi was back again in Florida this pre-season (see photo) in his mobile home outfitted as glove studio, patiently custom-stitching gloves for individual big-league stars. Among "name" players using Mizuno leather to snare hot ones off the AstroTurf is Brian Doyle, New York Yankee super-sub infielder who became a World Series hero last year. Dodgers Dusty Baker and Bob Welch also put Mizunos on the horsehide — when the Yankees weren't tanning it — in last year's Series.

Yoshi Tsubota has been making baseball gloves for 30 years. If you pressed him, he'd probably admit that the shifting of almost all their baseball glove manufacturing to Asia over the years by big American names like Wilson and Rawlings has gone a long way toward helping him, and Mizuno, enjoy the winters in Florida.

## Biological engineering gallops onward

The horse is a well-known British thoroughbred named Sidney Carton, whose brilliant record on the turf may eventually be eclipsed by his role as a medical pioneer. When Sidney finished fourth in a field of 10 recently, he did so on forelegs that shouldn't have even been able to take him to the water trough. The out-of-the-money race was his first following 10 months of recuperation from an operation in which plaited strands of carbon fiber were implanted in both front legs to act as "scaffolding" in helping torn tendon fibers — injured on two separate occasions — grow back correctly.

The surgical technique involved was developed by a team under orthopedist David Jenkins at Cardiff Royal Infirmary in South Wales. A number of British surgeons have since implanted carbon fibers in human patients with encouraging results.



# IPM BRIEFS



## The sensuous robot

You can build a robot to pick up paperweights — it's easy. You can build a robot to pick up eggs, too — maybe not quite as easily. But to build a robot that can pick up eggs and paperweights — a robot with a sense of touch — aye, there's the rub. But at the University of Warwick in Coventry, British computer scientists have put together one "Mr. Bill," the creature at the left in the photo, who is equipped with carbon fiber

touch sensors in his manipulator claw. He has the strength to lift very heavy objects, but with his ability to measure pressure patterns through the fiber touch system, he can also pick up light objects without crushing them.

In the photo, Mr. Bill is kidding around with "Horace," a small wheeled robot who is primarily designed to find his way to a "goal object" (which emits sound or light) while avoiding obstacles and playing a series of musical notes. *Marvelous, Horace. Bang-on, Mr. Bill.*

## Long-haul Samaritans

When it comes to international relations usually only dire threats and outright hostilities make page one. But here's another kind of story that comes to us via Lockheed-Georgia Co., which keeps close touch with the uses transport aircraft are put to by its clients: Recently in the Antarctic, a Russian Ilyushin-14 aircraft attempting a takeoff from a Soviet research station crashed. Five injured survivors were in desperate need of medical attention. Help came from the only possible quarter, the U.S. installation at McMurdo Sound, where a ski-equipped Navy C-130 Hercules transport took off on the good-neighborly rescue mission.

The incident not only underscores the fact that errands of mercy have no politics, but also points out the immensity of the Antarctic continent. To pick up the survivors, the Hercules had to fly about 1000 miles; to get them to a New Zealand hospital, another 5500.

## PM's Whatsit



If you gazed at our photo and wrote down "Blonde, 18-20, cute" as your answer, go to the foot of the class. We're interested in seeing if you can guess what the instrument... er, device... umm, gizmo is that she's... ah, manipulating.

Time's up. It's a tongue-scraper. Now that we brush regularly and have good check-ups, now that our gums are firm and pink and the orthodontists have corrected all of nature's mistakes — now that we've taken care of all that—we're going to be asked to worry about our tongues. According to the proponents of tongue-scraping, the practice not only reduces dental plaque and prevents bad breath, but can even improve your general health. Actually, the idea of cleaning the tongue was well established in ancient cultures — what's new is the stainless steel scraper, which is \$4.49 from Foster's World, Box 64, San Miguel, Calif. 93451.



## For the birds

One of the big current trends in the pet world is toward exotic birds, accounted for in part by the growing number of apartments and condominium dwellers who are restricted from owning larger pets. The rage, unfortunately, has led to an influx of smuggled, black-market birds which have not passed government quarantine and inspection procedures and this has the Department of Agriculture worried sick. The prime fear is something called exotic Newcastle disease, which affects most feathered species and can wipe out an entire poultry flock. An outbreak in California several years ago cost an estimated \$56 million. If it hits again, poultry and egg prices could go through the roof.



National Smoker Study:



# Merit Science Works!



**Low tar MERIT with 'Enriched Flavor' tobacco delivers taste equal to—or better than—leading high tar brands.**

The 'Enriched Flavor' science of low tar MERIT, 12 years in the making, isolates and fortifies flavor components of smoke for a taste way out of proportion to tar. Can that taste satisfy the toughest critics of low tar smoking—current smokers of high tar cigarettes?

Read the results from a detailed, nationwide research effort involving smokers who taste-tested MERIT against leading high tar brands.

**Confirmed:** Majority of high tar smokers rate MERIT taste equal to—or better than—leading high tar cigarettes tested! *Cigarettes having up to twice the tar.*

**Confirmed:** Majority of high tar smokers confirm taste satisfaction of low tar MERIT.

And in interviews conducted among current

© Philip Morris Inc. 1979

Kings: 8 mg "tar," 0.6 mg nicotine—  
100's: 11 mg "tar," 0.7 mg nicotine av. per cigarette, FTC Report May '78

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

MERIT smokers:

**Confirmed:** 85% of MERIT smokers say it was an "easy switch" from high tar brands.

**Confirmed:** 9 out of 10 MERIT smokers not considering other brands.

**Confirmed:** Overwhelming majority of MERIT smokers say their former high tar brands weren't missed!

MERIT has proven conclusively that it not only delivers the flavor of high tar brands—but *continues* to satisfy!

This ability to satisfy over long periods of time could be the most important evidence to date that MERIT science has produced what it claims: The first real taste alternative for high tar smokers.

**MERIT**  
Kings & 100's

# SOME RULES OF THUMB ON HOW TO GET THE UPPER HAND



Are you tired of routine situations that turn into battles? Battles that you seem to always lose?

Well, help is on the way. Now Ralph Charell, America's top consumer activist has written a new book. **HOW TO GET THE UPPER HAND.**

In it, he tells you how to deal with the doctor who keeps you waiting—and waiting and waiting....

How to shut up those neighbors who prevent you from getting any shut-eye.



How to put a stop to computer errors on your bills. How to get the V.I.P. treatment wherever you go—posh hotels, restaurants, big corporations. And much, much more.

If you're tired of getting the short end of the stick, read **HOW TO GET THE UPPER HAND.**



"Good advice...for the disaffected, the scorned, the consumers who are mad as hell and aren't going to take it anymore."

—The Washington Post Book World

"A freshly entertaining new run-through of techniques for becoming a tough customer."

—Publishers Weekly



AVON PAPERBACK. \$2.25

## HINTS FROM READERS

### Credit cards are ID tags



Make durable identification tags for your personal property from expired credit cards. Bore or punch attachment holes on the tags and reinforce the holes with grommets.—David W. Roberts

### Emptying tube dispensers

When you can no longer get the contents out of a tube by squeezing it, punch a small hole directly behind the nozzle. Remove the cap and use a small-diameter object such as the eraser end of a pencil to push contents backward from the nozzle through the hole.—Helen LeMunyon

### Used parts are helpful

Dismantle old appliances and keep the remains such as screws, nuts, washers, electrical parts, rods and sheet-metal scraps. They could come in handy and will save you shopping time and money.—Walter E. Burton



An old electric can opener that was discarded because of a damaged pulley mount provides many useful odds and ends: a button-shaped magnet, fan-cooled electric motor, large gear wheel, round-section rubber belt, electric cord and plug, strips of insulating material, pair of switch points and miscellaneous bolts, nuts and washers.

# Pocket Power tool Breakthrough

The amazing Mini-Tron Tool System  
...miniaturized, featherweight power tools  
1/4 the size and weight of conventional equipment.



The world is shrinking! During the past few years we've seen startling advances in miniaturization. Products such as calculators, watches, cameras, even automobiles



The Mini-Tron Workshop. Everything you need in a fitted carrying case the size of a small attache

are getting smaller and better. And now this new technology has finally been applied in the design of an entire new family of power tools.

## POWER TOOLS FOR THE YEAR 2000

Developed in West Germany and available in the United States from Beacon Scientific under the name Mini-Tron, these tools are less than 1/4 the size and weight of comparable units made with conventional technology. Mini-Trons have been made possible through the development of a new power module, which offers startling advances in miniaturization. These motors apply the latest advances in solid-state techniques and are completely encapsulated and self-lubricating. Imagine a 1/4 inch drill weighing only 10 oz. and roughly equivalent in size to the palm of your hand. And that's just for starters...the 8 oz. sabre saw is small enough to fit neatly in your shirt pocket. In addition, there is a circular saw and vibrating sander, all incorporating the same advanced miniaturized technology.

### A UNIQUE EXPERIENCE

For anyone who has worked with conventional power tools, Mini-Tron represents a unique experience. Aside from their light weight, the first thing one notices is the almost complete lack of vibration. Women and even children are able to handle Mini-Tron tools with ease and in complete safety.

### FREEDOM OF OPERATION

Mini-Trons are the answer to many of those impossible jobs, where big heavy, bulky tools are simply too difficult to use. And, since they can operate in both AC and DC (battery) modes, Mini-Trons are ideal for working on your boat, motor-home, out in the field...any place where an AC line cord can't reach or just plain gets in the way. Because Mini-

Trons are substantially smaller in size and lighter in weight than conventional tools, they are ideal for transporting. Just think, it's possible to carry and store an entire set of Mini-Trons in the space previously required for one or two ordinary size tools!

#### THE MINI-TRON DRILL

**WEIGHS ONLY 10 OZ.—ONLY 5 1/2" LONG**  
A 1/4" drill designed to accept all standard bits from 1/64" to 1/4". Transistorized, super quiet, vibration-free motor runs at 7,000 r.p.m. This motor has up to 4 times the life span of conventional drills. Trigger control plus lock position. Shock-proof. AC/DC\*

#### THE MINI-TRON SABRE/JIGSAW—

**WEIGHS ONLY 8 OZ.—ONLY 4" LONG**  
Uses special six-edge safety blade with safety points. Includes "C" clamp for bench operation. Transistorized, super quiet, vibration-free motor operates at 4,500 r.p.m. Cuts the most intricate patterns without splintering, even in paneling. Use with wood, plastic, and soft and medium-soft metals. Shock-proof. AC/DC\*

#### THE MINI-TRON CIRCULAR SAW—

**WEIGHS ONLY 11 OZ.—ONLY 6" LONG**  
Powered by a 4,500 r.p.m. transistorized motor. Blade retracts inside housing until ready for use. Revolutionary patented swinging pendulum blade motion, not rotating as in conventional saws. Motor automatically turns off when not held in hand. Shock-proof. AC/DC\*

#### THE MINI-TRON VIBRATING SANDER—

**WEIGHS ONLY 6 OZ.—ONLY 4 1/2" LONG**  
Rugged transistorized motor operates at 4,500 r.p.m. Uses self-adhesive paper in all grades from very coarse to very fine. Sanding surface is 3 1/2" x 2 1/2". Will sand any type of wood. Shock-proof. AC/DC\*

#### THE MINI-TRON AC ADAPTER

Required for use with all Mini-Tron Tools when using 110-120V. Uses standard 3-prong plug.

#### THE MINI-TRON BATTERY CASE

Accepts 2 standard 6 volt dry-cell lantern batteries (batteries not included.) Set of batteries provide approximately 25 hours of

operational use. Simply plug in and start working anywhere!

### BUY IN CONFIDENCE

Your purchase is only as good as the people who stand behind it. We're Beacon Scientific, an operating unit of Beacon Photo Service, Inc., a public company in business for over 20 years. We pride ourselves on the quality and integrity of the products we bring to market. Our Mini-Tron tools not only represent a major advance in technology, but also create new standards for durability and quality of manufacture. They are designed to take years of punishing use under conditions that are unthinkable for conventional tools. Frankly, it is unlikely that service should be required. If anything should go wrong, however, a special by-mail service facility has been established, designed to have it repaired and back to you in a matter of days.

### DON'T TAKE OUR WORD— SEE FOR YOURSELF!

As a measure of our confidence in the Mini-Tron Tool System, we invite you to try them yourself for 15 days at our risk. Use them at home, or travel with them in your boat, truck or motor home. If for any reason you are not satisfied, return them for a prompt refund of purchase price.

### OWN THE ENTIRE MINI-TRON SYSTEM

Mini-Tron tools may be ordered individually or as a complete workshop with the entire set shipped in its own fitted carrying case. Each set consists of: 1/4" Drill, Sabre/Jigsaw, Circular Saw, Vibrating Sander, AC Adapter, carrying case plus battery case. The complete Mini-Tron Tool Set is priced at \$149.95. You save \$15.00 over the purchase price of individual tools.

Mini-Tron tools represent a major advance in technology. See for yourself. Order at no obligation today.

\*NOTE: Both the AC Adapter and Battery Case are supplied with the purchase of a complete Mini-Tron Workshop. However, they are not included in the cost of individual tools and must be purchased as separate items.

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<input type="checkbox"/> Sabre Jigsaw	\$39.99
<input type="checkbox"/> Circular Saw	\$39.99
<input type="checkbox"/> Vibrating Sander	\$29.99
<input type="checkbox"/> AC Adapter	\$9.99
<input type="checkbox"/> Battery Case	\$4.99
Add \$1.00 per unit for postage and handling.	
<input type="checkbox"/> Better yet, I want to save \$15.00. Send me the complete Mini-Tron Tool Set in its own fitted carrying case plus the battery case at \$149.95 plus \$3.00 postage and handling. N.Y. Residents. Add Sales Tax	
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# New RVs for summer



Small and light enough for mini-compact to tow, the Sunline Sunspot 10½-foot hardtop travel trailer from Denver, Pa., has a hitch weight of 95 pounds.

**T**his year's trend to lighter, smaller rigs that take less gas to drive or tow continues with new developments. Multipurpose rigs have more conveniences arranged into less space inside. Outside wind resistance is being cut down by reducing frontal area of trailers and van conversions. Curved corners of plastic, roofs that lower, sides that fold all help reduce the push against oncoming air and consequently lower fuel consumption. Aerodynamic streamlining is becoming a necessity, not just a styling stunt.

Mini motor homes, available on Chevy, Ford, Dodge and GMC chopped van chassis, are squeezing in more bunks and adding that camping luxury—a bathtub. A 23-footer can manage six sleepers if two are berthed in an over-the-cab compartment, two in a convertible dinette, and two (or more) in a stacked “bunkhouse” arrangement in the rear, a layout that is becoming more popular.

How small can trailers get? The Time Out Camper, from the TOC Co., Box 2028, Elkhart, Ind. 46514 is a three-foot by five-foot unit that can be towed behind a motorcycle. Opened up, a four-sleeper model has over six feet of headroom and becomes a 5¼ × 13¼-foot tent. A 20-cubic-foot cargo carrier is another option. Accessories include a hitch for



Diamond GT, from the Diamond Division of Coons, Oswego, Kans., uses streamlined styling to raise the roof of this new mini motor home with an optional solar heater.



Some panel decorations of standard vans are being added to Carefree and Woodland van conversions that can sleep four from El Dorado Industries, Minneapolis, Kans.



Matched pairs of travel trailers and tow vans are available from some builders. Shasta's 23-foot trailer towed by a Shasta van has

bathtub, double sink, four-burner stove. The travel trailers from Shasta come in 15 lengths and 28 floor-plan options.

bike or car, air mattresses and picnic table. Prices run from over \$1000 for the four-sleeper to under \$300 for the cargo trailer.

One way to take your car camping with near-100-percent fuel economy is to tow it behind your truck or motor home. In the past, that was difficult if your car had automatic transmission, rather than stick shift. However, Remco, 4404 South 89th St., Omaha, Neb. 68127, is offering a Drive Shaft Coupling Kit. American cars with open driveshafts can usually be adapted, and the result is a push-pull knob at the driver's seat that disengages the driveshaft as soon as the car is hitched for towing.



Bronco truck camper, at light 970 pounds, mounts on half-ton pickups and sleeps four with roof cranked up. It's new from Vanguard Industries, Colon, Mich.



Two from Hop'Cap of Bremen, Ind.: The van conversion at top mounts on a maxi-bed chassis; 23-foot mini motor home with picture window has rear door, sleeps four.

The driveshaft must be cut and the coupling welded locally, or a new shaft can be supplied by Remco for \$69. The coupling kit is an additional \$329, and installation time is two to four hours for a good mechanic, it's claimed. For under \$500, you can now tow your passenger car along without endangering its automatic transmission. Remco reports a similar adaptation for foreign compacts and sports cars is also under development and may be available to the public later this year.—  
*Bill McKeown*

# Beautiful, but Beasts at heart.



These beautiful, handcrafted Old Timer® knives are beasts at heart. The Beast within these beauties stands up to any test—on the trail or on the job. Each is made with over 100 hand operations, each carefully inspected. That makes the beast tough. Sharp Finger and Little Finger: tough knives that do tough jobs, beautifully. To find out more send for your free Old Timer Almanac.

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## Telephone Listening Device

Record telephone conversations in your office or home. Connects between any cassette or tape recorder and your telephone or telephone LINE. Starts automatically when phone is answered. Records both sides of phone conversation. Stops recorder when phone is hung up. This device is not an answering service.



Each  
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# THERE'S ENOUGH FR TO SAVE UP TO 60%



**THE WEATHERTRON® HEAT PUMP SAVES 30-60% ON HEATING COMPARED TO DUCTED ELECTRIC HEAT, DEPENDING ON WHERE YOU LIVE.**

What might seem to be bitter cold to you, is heat for the taking to the Weathertron heat pump from General Electric.

How does it work? By actually getting heat from cold air.

That's right, even on most freezing winter days, the Weathertron heat pump extracts heat from the outdoors and transfers it indoors.

And in more moderate climates, there's more heat available in the air. That's where a heat pump can really work for you.

Because that's where it can use energy most efficiently.

Depending on where you live, only one unit of electrical energy gets you 1.4 to 2.5 units of heat energy during the heating season. That's where the 30-60% savings comes in. And that's why only the heat pump can deliver ducted electric heat to your home in the most cost-efficient and energy-efficient way.

**IN REVERSE,  
IT'S AN AIR CONDITIONER.**

In warm weather, the thermostat reverses the whole process, and the Weathertron heat pump cools using the same principle. It takes

warm air from inside the house and transfers it outside. A system for all seasons.

**GENERAL ELECTRIC HAS SPENT OVER 40 YEARS DEVELOPING THE WEATHERTRON HEAT PUMP.**

Since 1932, when GE was one of the few heat pump pioneers, we've been developing and improving it. Years of research, engineering and manufacturing expertise go into every single Weathertron heat pump system.

We put parts and assemblies through grueling quality-control tests and inspections. Every 230-volt motor must run at 170 volts. And that's only the low-voltage test

# KEEP THE HEAT OUT HERE ALL YEAR ON HEATING.



...n there are leakage tests. And surge test, when 3,500 volts are through the motor windings. Plus the torture test our engineers use to simulate the worst possible operating conditions. It's no wonder that the General Electric Climatuff™ compressor, a device that helps extract heat from the air, has been operating in over two million cooling as well as heating installations.

**THE WEATHERTRON HEAT PUMP  
CAN MAKE YOUR ENERGY CRISIS LESS  
OF A CRISIS.**

...difficult for anyone to safely predict the availability of energy in the future. And unfortunately,

everyone can predict that the fuel available will get more and more expensive.

That's why it's very important for all of us to make good use of the oil, gas and electricity we pay for.

The Weathertron heat pump uses electricity and nature's heat to save you money. That's how close we've come to solving the energy crisis.

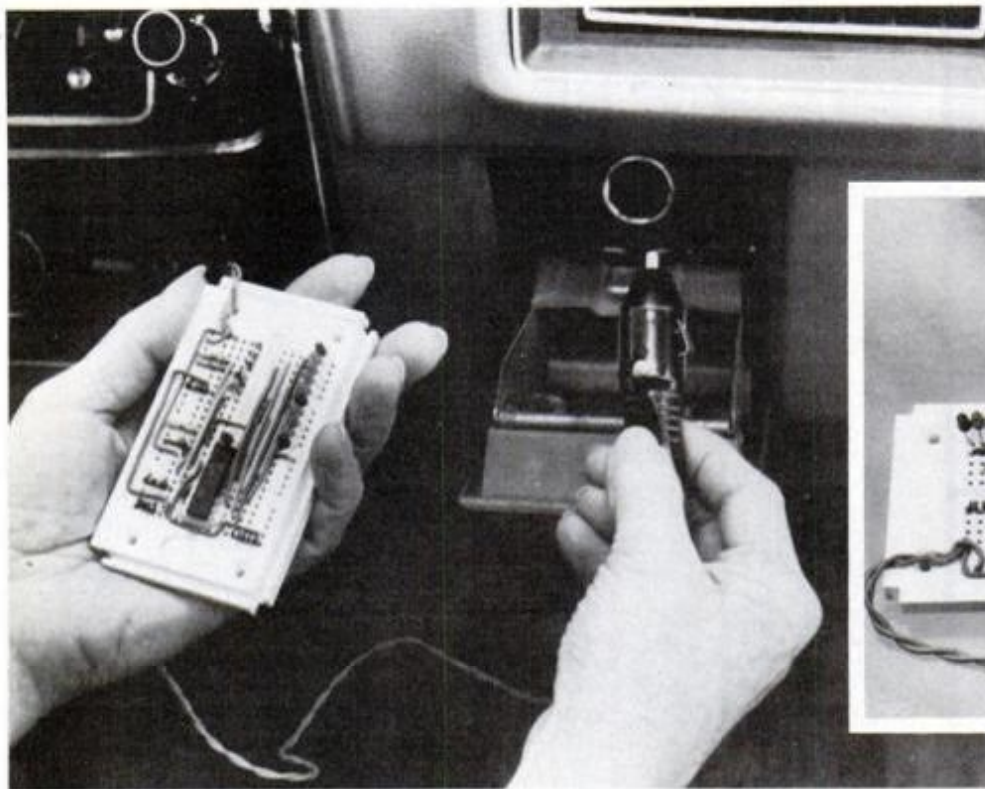
That's why the Weathertron heat pump from General Electric could be one of the most important things you put in your home.

**THE WEATHERTRON® HEAT PUMP.  
AMERICA'S #1 SELLING HEAT PUMP.**

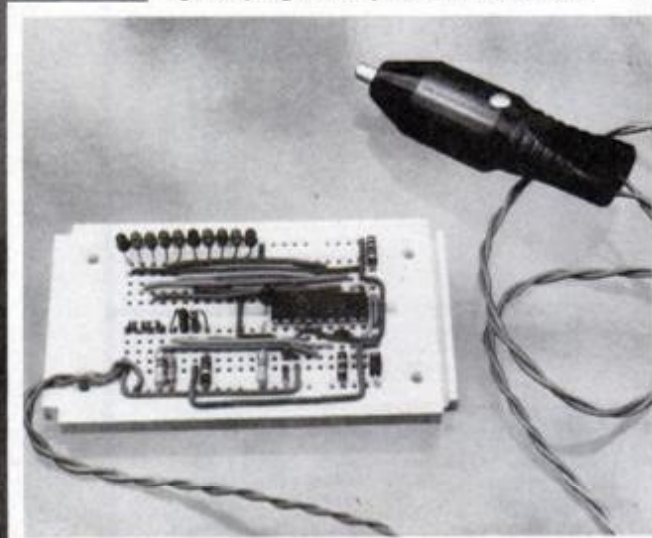


**GENERAL  ELECTRIC**

# Guard your battery with PM's Charge Checker



Hooking up the Charge Checker to monitor your car's electrical system couldn't be easier. All you do is plug it into the cigaret-lighter socket of any 12-volt vehicle. You can buy cigaret-lighter plugs at any electronics store.



Our project uses plastic "breadboard" construction, but could be in a cabinet.

Shed light on your car's charging problems with this unique construction project.

by Martin Bradley Weinstein and Joseph Gartman

**P**M's Charge Checker is no idiot light—but a blinking genius. Hook it up to your car's battery, via the cigaret lighter, and it not only tells you if there are any battery problems, but can give you clues on how to make the necessary repairs or adjustments to the car's electrical system. Charge Checker, as we have named this construction project, uses 10 red, yellow and green LEDs to inform you as to what's going on.

This project makes a good introduction to constructing electronic circuits, as it uses an easy new technique—plastic breadboarding—to eliminate any need for soldering.

The key to the Charge Checker is a new integrated circuit from National Semiconductor, the LM3914, which takes a voltage at its input and translates it into either a variable-length bar-graph display (using a row of LEDs) or a moving-dot display.

We've arranged the circuit to display a moving dot (one of the 10

LEDs will be lighted at any one time, with just a slight overlap, called hysteresis, between levels) for voltages between 12 and 15 v.d.c. Our table defines the "on" voltages for each LED, suggests which color of LED to use at that point in the display, and tells what the display means.

## What the voltages say

Two voltages are critical to your battery and charging system. One is the *open-circuit voltage* of the battery itself—the voltage read across the battery terminals when nothing is connected to them. This means with the engine off and no accessories on. The open-circuit voltage of a good car battery should be between 12.6 and 12.9 v.d.c. at full charge.

A good or bad battery can read more than 12.9 v.d.c. if measured just after the engine has been running. This is referred to as "top charge" or *gassing* and is potentially very misleading. Fortunately, the effects of gassing can be neutralized

simply by turning the car's headlights on for 30 to 60 seconds before taking a reading. Be sure to turn the lights off when you take the reading.

The second critical voltage is the charging voltage produced by the car's alternator or generator, controlled by the voltage regulator. The standard nominal voltage setting for the regulators of most cars is 14.4 v.d.c., which can be between 14.0 and 14.4 v.d.c. in real life.

A higher voltage means a poorly set or malfunctioning voltage regulator, which can overcharge the battery, cooking out its water and causing it to destroy itself.

A lower voltage could mean many things, including a poorly set or malfunctioning voltage regulator, a poor connection at the battery post, a bad alternator, deteriorating battery cable or car wiring, or a short circuit or heavy load somewhere in the car's wiring. A very low reading with the engine running—something in the range you might expect with the engine off—usually means a broken fan belt or bad alternator, but the entire charging system is suspect. This is a *critical* situation and demands immediate attention.

The LM3914 is very complex, but it is also very repetitive in its con-

*(Please turn to page 86)*



Decisions...decisions...Make your decision

# PALL MALL LIGHT 100's

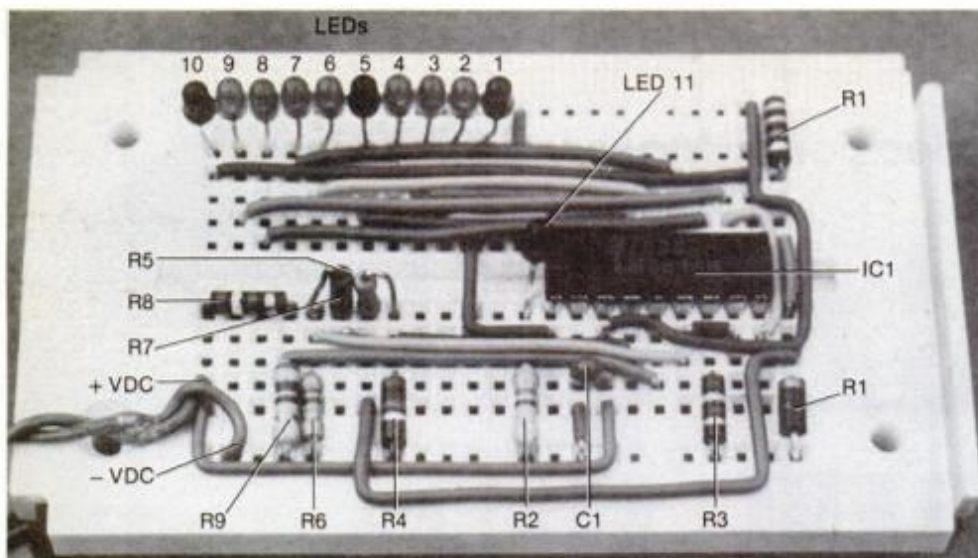


**The most flavor you can get in a low tar cigarette!**

**Only 12 mg. tar  
1.0 mg. nic.**

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

12 mg. "tar", 1.0 mg. nicotine av. per cigarette by FTC method.



## PARTS LIST—CHARGE CHECKER

- C1—1- $\mu$ F tantalum capacitor, 25 v.d.c.  
 IC1—LM3914N display driver (National Semiconductor or equiv.)  
 LED1, 5, 10, 11—red light-emitting diode  
 LED2, 4, 6, 9—yellow light-emitting diode  
 LED3, 7, 8—green light-emitting diode  
 All resistors are 1/2-watt, 10-percent tolerance  
 R1, R2—470-ohm resistor  
 R3—1800-ohm resistor  
 R4—12K resistor  
 R5—33K resistor  
 R6—15K resistor  
 R7—24K resistor  
 R8—39K resistor  
 R9—6800-ohm resistor  
 D1—zener diode, 6-volt at 1/2-watt or more  
 PL1—cigaret-lighter plug  
 Misc.—solderless breadboard, Continental Specialties Corp.'s CSC EXP-350 or equiv.  
**Note:** A kit to build the Charge Checker is available for \$19.95 postpaid from Jameco Electronics, 1021 Howard St., San Carlos, Calif. 94070.

When you build your Charge Checker, pay particularly close attention to where the jumpers go. Follow both the photo above and the schematic to the right. The rest of the parts placement is not critical.

### Interpreting the Charge Checker

LED	V.D.C.	MEANING
Red	12.0-12.3	Battery not up to charge, probably bad. Battery under a heavy load, as in starting.
Yellow	12.3-12.6	Not full charge. If battery good, check cable, posts, connectors, regulator.
Green	12.6-12.9	Normal (engine off). Battery okay. If engine is on, serious charging problem; check.
Yellow	12.9-13.2	Gassing voltage. Turn on headlights 30-60 seconds, read again. If engine is on, a charging-system problem is indicated.
Red	13.2-13.5	Charging-system problem; severe undercharge. Check alternator, regulator, cables, connectors.
Yellow	13.5-13.8	Low charging voltage, may mean regulator set wrong; okay if battery, regulator hot after hard driving.
Green	13.8-14.1	Charging system okay; regulator set a bit on low side of its range (usually 14.0-14.4 v.d.c.).
Green	14.1-14.4	Charging system okay; regulator set to factory specifications; cables and connections good.
Yellow	14.4-14.7	Overcharging. Reset regulator at once. Check battery water often; battery will cook it out.
Red	14.7 and up	Dangerous overcharging condition. Immediate service required. Use extra caution in handling battery.

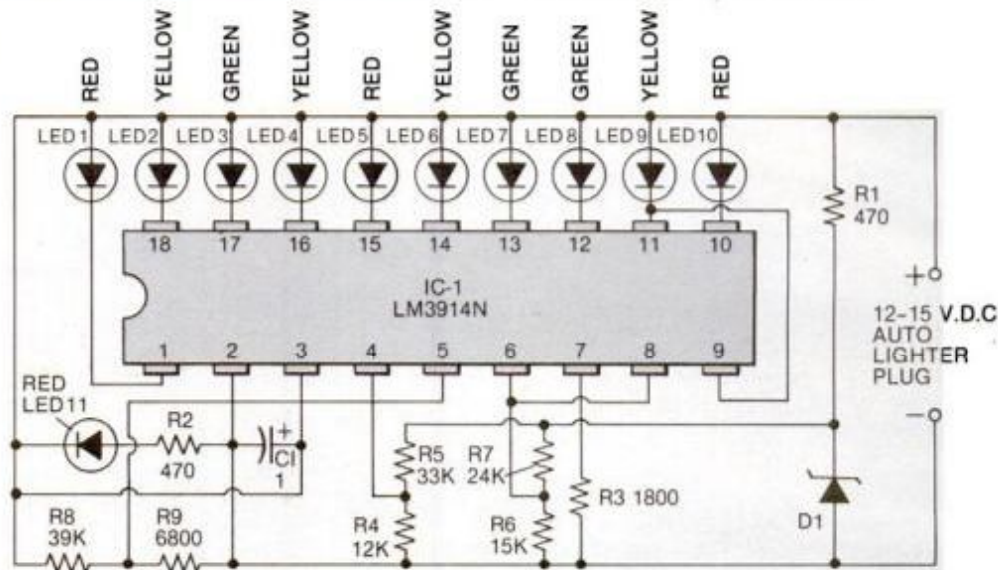
### GUARD YOUR BATTERY

(Continued from page 84)

struction. Simplified, it might be seen as a string of comparators—electronic circuits that act like seesaws, balancing and comparing two inputs and turning an output either on or off, depending on which of the inputs is greater.

### How the Charge Checker works

Inside the LM3914, the input signal at pin 5 (in this case, a sample of



the actual battery voltage as provided by the R8-R9 voltage divider) is provided to all 10 comparators through its buffer amplifier. This amplifier helps keep the IC's operation from influencing the input signal itself. The signal is balanced against the voltage level present at each tap of a long voltage-divider string of resistors. The resistors at pin 4, pin 6, pin 7 and pin 8, working in conjunction with a reference voltage, set these levels between 12 and 15 v.d.c. The resistor at pin 7, R3, sets the brightness of the LEDs and keeps the IC from overdriving itself and overheating.

Connecting pin 11 to pin 9 establishes the format of the display's output as a moving dot, so only one LED is lighted at any one time. The result is that the 10 LEDs connected to the 10 LM3914 outputs turn on, one at a time, at well-defined 0.3-v.d.c. intervals over a 12.0- to 15.0-v.d.c. range.

An 11th LED is connected to the power leads and is on whenever power is applied to the Charge Checker. This confirms that voltage is present at the lighter; it also shows, in the event all other LEDs are un-

lighted, that the battery voltage is below 12.0 v.d.c., which means either a nearly dead battery or a severe short or load somewhere on the electrical system.

### Building a Charge Checker

We built our Charge Checker on a small, solderless breadboard, the EXP-350 Experimentor Socket from Continental Specialties Corp. Identical breadboards are available from Radio Shack and GC Calectro (which calls it a Wiz-Board).

Following our circuit layout, you don't even have to know how to read a schematic to know what plugs in where. Just follow the pictures.

Polarity is only important for a few parts. For the LM3914, make sure the end with the circle is pointed as shown. The zener diode, D-1, must be connected so the end with the bar is pointed inward, toward the end pin (pin 9) of the IC. The small capacitor, C1, will either have a bar or a plus sign marked on it. The bar should go toward pin 2 (closer to the end) of the IC; the plus sign should go toward pin 3. And it's important, when connecting the

(Please turn to page 264)

# Why in the world would you want a Kero-Sun heater in the summertime?

Because there are quite a few occasions when having inexpensive, portable, non-electric heat will be the best thing that ever happened to you!

**M**ost people turn off their furnaces in the summer and houses tend to get damp and dank (if you've ever fought the mildew problem, you'll know just what we mean!) The solution is a little heat to dry things out and it seems a shame to turn on an enormous furnace just for some musty corners. Wouldn't a Kero-Sun Heater come in handy?

**A**n unheated vacation house can be shivered for seven straight days (Cheer up, that's vacation!) Wouldn't a Kero-Sun heater come in



ery when it's only half your handy?

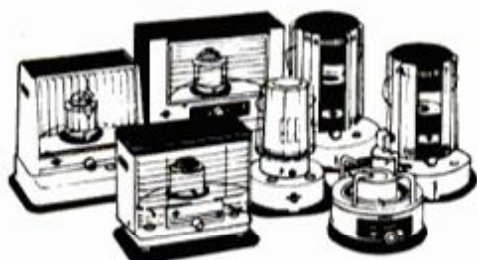
**A** workshop Wouldn't a



camper, a tent, a screened-in porch, a boat or a basement — all tend to get a little chilly when the summer sun sets. Kero-Sun heater come in handy?

**K**ero-Sun heaters have no smoke, no odor, need no chimney venting, and you can use them in places where electricity is only a fond memory. Push the automatic igniter and enjoy up to 30 hours of warmth on less than 2 gallons of fuel.

**L**isten, you wouldn't go on a vacation without packing a sweater along, would you? Take along a portable Kero-Sun heater — it's like a sweater for your whole family!



Puts the WARM where you want it!

**KERO-SUN**

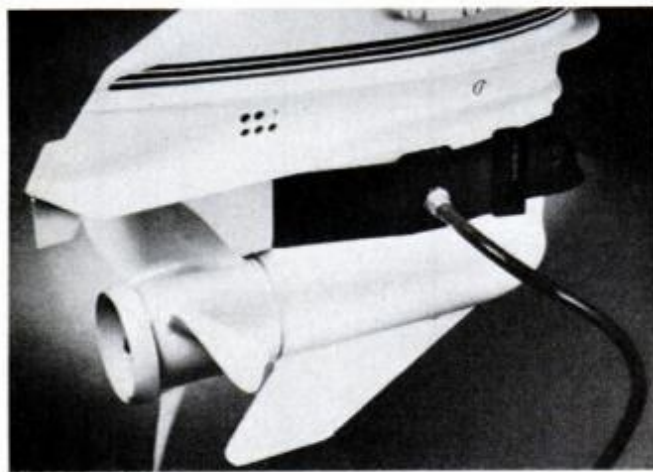
PORTABLE HEATERS

Please send me full facts about Kero-Sun portable heaters and the name of my nearest dealer.

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City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

KERO-SUN, INC., BOX 340, KENT, CONN. 06757

# IT'S NEW NOW



## Outboard flush

Potential corrosion-causing materials in the coolant passages of an outboard motor can be flushed out on dry land with a garden hose, say the makers of Flush-Rite. A stretchy rubber belt fits most engines that have a side water inlet vent, and an O-ring seal provides a watertight connection for the hose. About \$9 from Moeller Manufacturing Co. Inc., Box 1318, Greenville, Miss. 38701.



## Touch me not

ToneLock is said to prevent unauthorized use of pushbutton-type phones. It mounts permanently; model 201 fits standard phones and model 206 fits business phones with line buttons. Both come in five colors and are about \$10. Liberty Enterprises, Box 7384, Newport Beach, Calif. 92660.



## Shouldering the load

Travelers who could use another free hand might want to investigate the Sholda Holda, a fulcrum-and-hanger assembly that sits on the shoulder and allows hands-off carrying of garment bags. The polypropylene unit has a wide range of adjustment for shoulder fit and folds away for bag hangup. It's about \$8 from Heritage Products Corp., Box 449, Reading, Mass. 01867.

## Grill thrill

The Campecue II carries compactly for camping. In operation, a propane cylinder is inserted into a plastic base and the regulator and grill are attached on top. A stainless steel radiant screen and special noncombustible coals spread the heat evenly. It's approximately \$60 from Century Tool and Manufacturing Co., Box 188, Cherry Valley, Ill. 61016.



## Roll, roll, roll your boat . . .

RollaBoat wheels mount permanently to the transoms of most cartop-type boats. They flip down for boat launching and flip up when not needed. Wheels can be locked in either position and are said not to obstruct an outboard or reduce boat performance. About \$43 from LoadaBoat Products, Box 6726, Bellevue, Wash. 98007.



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KING CAB®

STRRETCH BED

# DATSUN TRUCKS: THEIR JOB IS TO LAST.

'79 DATSUN KING CAB.® Meet a half ton of tough! Like big rigs, the King Cab boasts a ladder-type frame and all-steel bed that helps it haul a bigger payload than some larger pickups. Yet inside, the King Cab treats you royally. You ride in car-like comfort, with more leg room than any other small pickup, relax in the only reclining bucket seats in any pickup, and enjoy the security of lockable inside storage space.

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**30** EPA ESTIMATED HIGHWAY  
\*Excludes California where mileage will be lower. Standard 4-speed. Use these numbers for comparisons. Actual mpg may differ depending on speed, trip length, and weather. Actual highway mpg will probably be lower than EPA highway estimate.  
**ON REGULAR GAS**



\*\*Source: R. L. Polk, Truck Registrations

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  - Torsion-bar ball-joint front suspension
  - Semi-elliptical leaf springs with overload springs
  - Fully transistorized ignition system
  - Low-maintenance battery
  - 5J-14" steel wheels
  - 11 tie down hooks on bed (13 on Strretch)
  - Datsun Load-Sensing Valve (proportions more power to rear brakes as cargo increases)
  - Hidden support chains in tailgate
  - Radial tires (King Cab)

**NOBODY DEMANDS MORE DATSUN WE ARE DRIVEN**

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# How to pick



## **B5100**

2- or 4-wheel drive.  
12 hp. 2 cyl.

Designed for grass cutting, vegetable gardens, and general estate maintenance. For home owners, this tractor is a step up from riding mowers. Can use mid-mount or rear-mount mower, rotary tiller, plow, disc harrow, rear blade.

## **B6100**

2- or 4-wheel drive.  
14 hp. 3 cyl.

Similar to B5100, but bigger engine offers more pulling power. Can handle all the same implements as the B7100DT. Good tractor for landscapers, nurserymen, and other commercial users requiring a tractor to handle variety of materials.

## **B7100DT**

4-wheel drive.  
16 hp. 3 cyl.

Our biggest selling tractor. Small enough for grass cutting and general work around private homes. Strong enough for a wide variety of commercial applications, especially park maintenance, nurseries, landscape contractors. Implements include post hole digger, front blade, trencher, front-end loader, backhoe, snow-blower, as well as all those listed under B5100.

## **L185**

2- or 4-wheel drive.  
17 hp. 2 cyl.

Works as mowing tractor with turf tires. With 2-wheel drive it is versatile chore tractor on large farms. For farm or industrial use where ground is soggy, we recommend 4-wheel drive for maximum traction. Category 1 3-point hitch can handle plow, cultivator, disc harrow, rotary tiller. Also a wide range of earth moving and excavating implements. Rental operators will find this model in great demand.

## **L245**

2- or 4-wheel drive.  
25 hp. 3 cyl.

This model has many crop applications, especially vegetable growing and orchard work. A wide range of implements is available, including backhoe, front-end loader, post hole digger, front blade, box scraper.

**L245HC** (not shown)  
2-wheel drive.  
25 hp. 3 cyl.

New high-clearance tractor, ideal for special crops such as vegetable and tobacco. Provides ample 22" ground clearance plus an uncluttered off-set operator's platform for excellent visibility.

Have you noticed the color of our Kubota tractors? Orange. Every one of them. It's our way of making it easy for you to choose a good tractor. Now all you have to do is pick an orange. That way you won't get a lemon.

In the 12 to 55.5 hp range, no one offers as many models as Kubota. And all our mid-size Kubotas give you the qualities that separate real tractors from the lightweight garden variety.

All Kubotas have water-cooled diesel engines, which are designed with more cylinders than many competitive models. Standard equipment on all models includes rear PTO and a 3-point hydraulic hitch that accommodates a variety of implements.

For more information, write or call us. Better yet, see your Kubota dealer. He knows more about how to

# an orange.



## **L285**

4-wheel drive.  
30 hp. 4 cyl.  
Cylinder diesel engine provides lots of smooth power. Built to accommodate a long list of implements, including rear-mount mowers, tillers, disc harrows, box scraper, front loader, backhoe, plow. Good tractor on small farm. Also wide application for institutional or government grounds maintenance. With front loader, it is excellent machine for dairy farmer.

## **L295DT**

4-wheel drive.  
30 hp. 3 cyl.  
Will outpull many larger farm tractors that only have 2-wheel drive. Can handle most medium-sized Category 1 farm implements. Also, earth moving capability makes it suitable for general building contractors. Outstanding fuel economy for its size. Draft and position control is standard.

## **L345**

2-wheel drive. 34 hp. 4 cyl.  
Brand-new model designed to fit into popular horsepower range. 4 cylinders let it run more smoothly than many competing models. Fine all-round performer as chore tractor on large farm. Handy for general contractor because it doesn't require a heavy-duty trailer to haul it to construction site. Live rear PTO, draft and position control, power steering are standard on this model and all larger tractors.

## **M4500DT**

4-wheel drive. 55.5 hp. 6 cyl.  
Our big brute. Tremendous pulling power for its size and weight. Works beautifully as primary tractor on smaller farms. Fine for land where traction is critical. Ideal for building contractors who start work in the North as soon as frost is out of the ground.

## **M4000** (not shown)

2-wheel drive. 47.5 hp. 6 cyl.  
Good number one tractor for small farms, especially vegetable crops. Also excellent for many types of small to medium excavating work. 6 cylinders provide smooth torque. Quiet running. Economical to operate. 16 forward gears supply wide range of ground speeds to match many different implement uses.

pick an orange than anybody.

For specific information about any Kubota tractor, call 1-800-241-8444. (In Georgia 1-800-282-1333.) Ask for Operator 63.

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 **KUBOTA®**

**HELP!** To help me pick an orange, please send free spec sheets on the following Kubota models:

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2. (Model No.) \_\_\_\_\_

3. (Model No.) \_\_\_\_\_

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# New electronic gear for better boating



Modern anglers, like these salmon fishermen on the newly stocked Detroit River, fit out with VHF and CB Radios, recording depth finders, fish finders and electric downriggers.

Today's weekend sailors now fit out with gadgets that would have dazzled professional skippers only 10 years ago.

by Bill McKeown  
BOATING EDITOR

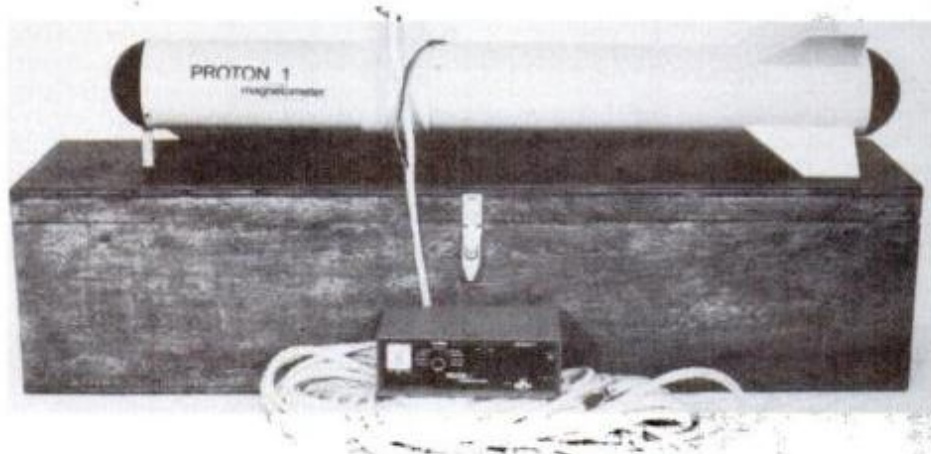
It's a pleasant moonlit night as you finish fishing and steer back for home port. Suddenly wisps of fog move in and within minutes you are wrapped in a chilling dark gray blanket, shut off from everything except the sound of the water moving past the hull. You have a compass that points the general direction you want to go, but tells nothing about how fast you're going or currents that might be drifting you, how to round the point ahead or where any big craft are that may be heading your way.

Smart old-timers used to anchor until visibility got better, or ease in toward shore while checking soundings with a lead line. But that's no

*(Please turn to page 95)*



Power from only 19 pounds, the \$275 AQB 300 generator, from AquaBug International, Rockville Centre, N.Y., puts out 300 watts at 115 volts a.c. or 10 amps of 12 volts d.c.



Underwater treasure finder for distances up to 800 feet, the Proton I, \$2850 from J.W. Fishers Mfg., Taunton, Mass., has control box and four-foot-long towed "fish."



Like a radar view of the action underwater, Wesmar's SS165 Scanning Sonar shows commercial fishermen obstructions and fish in any direction. A smaller SS116 for sport fishermen is \$3800.



Dual-performance flasher recorders are becoming popular, with the option of dial light or printout record of depth and fish. Ray Jefferson's \$390 Model 5300 ranges down to 300 feet.



# Quick-Change Artist.

When it comes to all-around performance, nobody out-performs Suzuki.

Case in point:

The TS Dual-Purpose Bikes.

These well-built machines are ideal for families who enjoy riding around town or the toolies. Because all four (TS-100, 125, 185, 250) are easy to ride, easy to service and all are easy on the family budget.

And, of course, all are equipped to handle open roads or open spaces with ease.

For instance, each is powered by Suzuki's proven Power Reed™ engine. Which delivers smooth power for street cruising and low-end power for mountain climbing.

Other neat features include adjustable laid-down rear shocks, tucked-in exhaust pipe, primary kick starting and street-legal lights and instrumentation. Also, the TS-185 and 250 now come with leading-axle longer-travel front forks for better control.

So you see, these bikes are built to go beyond the call of double-duty.

Now you know why the TS Dual-Purpose Bikes are among the world's great performers.



**Suzuki. The performer.**



Ride with care: wear protective apparel and help protect the environment. Member Motorcycle Safety Foundation.

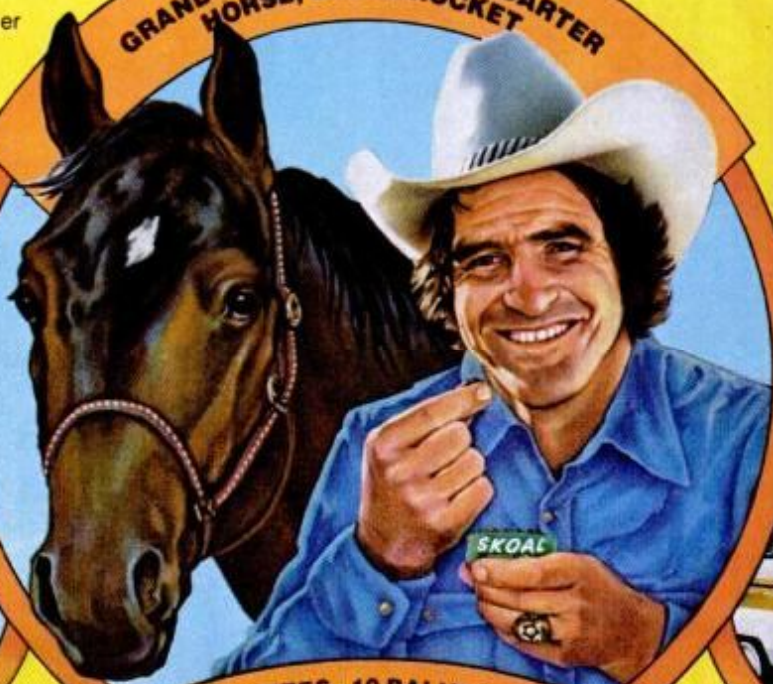


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# Enter SKOAL DASH Sweepstakes

"Hi, I'm Walt Garrison. And I want you to get in on the Skoal 'Dash for Cash' Sweepstakes. Skoal, one of the fastest growing smokeless tobaccos in America, is giving away over \$160,000 worth of prizes. And all you have to do to win one of these great prizes is fill out the coupon and send it in. You don't have to buy a thing. The Grand Prize is Skoal Rocket, a beautiful two-year-old racing-bred American Quarter Horse. The colt will be awarded along with all entry fees, training and room and board paid in full up to and during the Futurity trials for the Skoal Dash for Cash Futurity Race. The race will be held at Los Alamitos Race Course in Los Alamitos, California on July 28, 1979. More than that, the Grand Prize winner will get an all-expense paid trip for two to Los Alamitos to watch the race. I'll be there too. If you're the Grand Prize winner and you'd rather have cash instead of the colt, we'll give you \$20,000.

**GRAND PRIZE - AMERICAN QUARTER HORSE, SKOAL ROCKET**

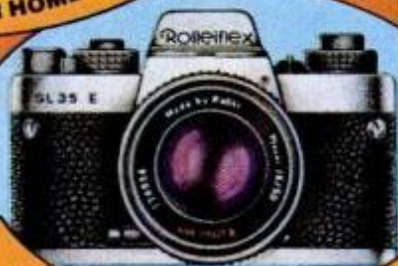


**ONE 1ST PRIZE - A COACHMEN MINI MOTOR HOME**

**10 4TH PRIZES - 10 BALLY STRIKES AND SPARES PINBALL MACHINES**



"The first, second and third prizes are pretty darn grand too. Three Coachmen recreational vehicles: a \$16,000 Leprechaun Mini Motor Home, a \$13,500 Modelcee Van Camper and a \$10,500 TRV-1 Travel Van. The next 10 winners will get a Bally Strikes and Spares pinball machine worth \$1600. Other prizes include a Rolleiflex SL35E camera outfit from Rolleiflex including lens, flash and case worth about \$450, a quartz electronic chronograph watch from National Semiconductor valued at \$80, and 5 album collections of Country Western artists from ABC Records worth \$35 each.



**50 5TH PRIZES - FIFTY ROLLEIFLEX CAMERA OUTFITS**



**300 6TH PRIZES - 300 NATIONAL SEMICONDUCTOR CHRONOGRAPH**

"Don't wait. Get going now and mail your entry in the Skoal 'Dash for Cash' Sweepstakes. Then sit back and relax, like me, with a little Skoal smokeless tobacco pleasure, until June 15th, the day the winners will be selected."



**715 SEVENTH PRIZES - 715 ABC RECORDS' ALBUM COLLECTION**  
Freddy Fender • Barbara Mandrell • Oak Ridge Boys • Red Steagall • Don V.



# For DASH

## OFFICIAL SWEEPSTAKES RULES AND REGULATIONS

Complete the official entry form. Your entry form must be completed in full to be valid. If you are an official entry form, print your name, address and telephone number on a sheet of paper no larger than 3" x 5". Mail your entry to: "Skoal Dash For Cash Quarter Horse Sweepstakes," Box 1979, Garnerville, N.Y. 10923. Entries must be postmarked by May 15, 1979 and received by May 31, 1979. Enter as often as you like. However, each entry must be mailed separately. No refund may be made for more than one prize. 3. NO PURCHASE NECESSARY. ALL PRIZES WILL BE DRAWN. Prizes are non-transferable and non-refundable for cash except where specified. No substitutions are permitted. **One Grand Prize:** Racing bred AMERICAN QUARTER HORSE two-year-old gelding "Skoal Rocket," plus all entry fees, training fees, room and board for the horse paid in full during the Skoal Dash For Cash Futurity trials. Winner of horse also receives a free trip for 2 to Ashtabula, California for the running of the Skoal Dash For Cash Futurity on July 25, 1979. **One Second Prize:** A 1979 Dodge Van Camper (approximate retail value \$15,000). **One Third Prize:** A 1979 Dodge Van Camper (approximate retail value \$15,000). **One Fourth Prize:** A Billy Straker portable machine (approximate retail value \$1,500). **10 Fifth Prizes:** A Raytheon SL 252 including lens, case and flash (approximate retail value \$450 each). **300 Sixth Prizes:** A one chronograph watch from National Semiconductor (approximate retail value \$80 each). **Prizes:** A live album collection of country western artists from ARC Records (approximate retail value \$10.00 each). 4. Winners will be randomly selected from all entries received by TRG Communications, Inc., an independent organization, whose decision will be final. Winners will be selected by 1979 and will be notified by mail. 5. The Sweepstakes is open to all residents of the United States and its possessions and their immediate families, its affiliated companies, its officers, directors and TRG Communications, Inc. The Sweepstakes is void in Utah and in all other jurisdictions where prohibited by law. 6. ALL FEDERAL, STATE, AND LOCAL TAXES ON PRIZES ARE THE RESPONSIBILITY OF THE WINNER. On the Grand Prize of Skoal Rocket, if for some reason the prize prior to the awarding of this prize, the winner will automatically receive \$20,000 in cash. Coachmen vehicles are also responsible for the appropriate sales and use tax, dealer registration and any other taxes or fees applicable on the prize. If the winner is not a licensed driver he must sign a release and transfer title to a designated licensed driver. If the winner is a minor, a parent or guardian must sign this release. 7. The odds of winning will be determined by the number of entries received. A list of winners can be obtained by sending a stamped, self-addressed envelope to: "Skoal Dash For Cash Sweepstakes," Winners List, c/o TRG Communications, Inc., 1142 Avenue of the Americas, New York, N.Y. 10036.



- A COACHMEN VAN CAMPER  
- A COACHMEN TRAVEL VAN



### OFFICIAL SKOAL "DASH FOR CASH" SWEEPSTAKES ENTRY BLANK

No purchase required. All prizes will be awarded. For complete details see Sweepstakes rules.

Mail your entry to:  
"Skoal Dash For Cash Sweepstakes,"  
P.O. Box 1979, Garnerville, New York 10923.

Name \_\_\_\_\_ (please print)  
Street Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_  
Telephone Number \_\_\_\_\_

Entry blank must be completed in full to be valid.



## ELECTRONIC GEAR FOR BOATING (Continued from page 92)

longer necessary. There are now waterproof depth finders you can even mount on an inner tube or carry in the smallest dinghy. The lighted dial or digital readout, used with a coastal chart, will shoot down sonar signals to track the bottom and tell where you are.

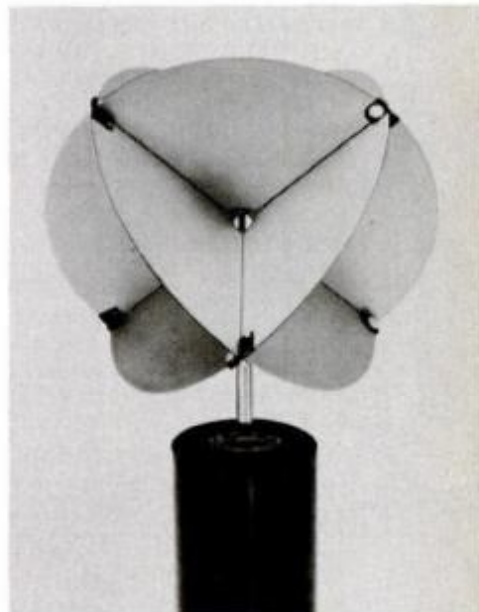
But that's the simple \$100-to-\$200 unit. Spend more and it can be set to sound off a warning if the water gets to be less than a depth you select.



Gasoline or diesel-oil use is measured by three new Airguide Fuel Flow Monitors. Meters at left, \$130, and center, \$120, show total used; \$90 unit has warning light.



Useful hand-held VHF transceiver for boatmen is Apelco's \$300 six-channel AF-6. Its five-mile range and two-pound weight makes it handy for small-craft harbor use.



Next best to a radar set to see traffic coming is a radar reflector, like Davis Instrument's \$40 Echowaster that casts a warning blip on approaching radar scopes.

Crank up the sensitivity, and beeps as well as flashing lights tell you if fish are swimming below and just how deep they are. For a printed picture, recording graph depth finders will trace a curved or straight-line outline of the bottom and also show where the fish are schooling. Newest, most sophisticated (and expensive) fish finders are remarkable models like Vexilar's Video-Sonar 990 CRT (cathode ray tube), which tunes in a picture of the bottom and fish above it down to 1440 feet, and can be adjusted to zoom in for a closeup of an area that looks like a fishing hot-spot—all for up to \$2071 for the top unit. Wesmar has Scanning Sonars, at prices approaching \$4000, that sweep a circular area beneath the boat, like an underwater radar, or can be aimed to monitor one special sector. They even have built-in stabilization to compensate for the pitch and roll of the boat. Or for \$40 Lowrance, pioneer in compact portable Fish Lo-K-Tors, provides a gravity switch and two

transducers for sailboats so that the depthfinder automatically reads from the transducer pointing down on different tacks.

Radio direction finders that can home on several stations ashore to show where you are on a chart are nothing new. Now, however, automatic models will give a prompt reading of direction, correct for reciprocals so you don't get a bearing off by 180°, and can even work with a transmitter. Regency Electronics has a Polaris 7200 that can transmit on 55 VHF channels, receive on 75, scan 15 while continuing to monitor emergency calls on Channel 16, and will give the compass heading of any call received. A built-in computer memory maintains often-called frequencies, all for about \$1300.

Radio telephones now come in a variety of types and prices. Useful for the small boat skipper is the new little hand-held VHF that can communicate with the big boat, bridge and lock tenders, other craft in the

*(Please turn to page 96)*



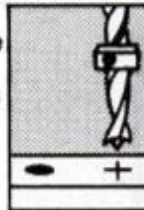
# NOW, For The First Time- Use The WOODBITS The PRO's Use!

Professional woodbits are not available in hardware stores. Stores only carry spade bits which clog and bind, or metal cutting twist bits that also bind and tend to "walk", or move off course.

## Why is a WOODBIT Best ?

A professional woodbit has four features designed specifically for wood:

- A CENTER SPUR that locks your bit on course and so prevents "walking".
- TWO CUTTING SPURS that begin and dimension a perfectly round hole.
- EXTREMELY SHARP FLUTES extend from the two cutting spurs and continue the cutting action all the way through the wood... shaving the sides smooth. Most important, the two spurs will not splinter the wood as the bit cuts through... as spade or metal cutting bits do.
- THE CUTTING FLUTES ARE ENGINEERED for maximum chip ejection so that your drilling machine won't bind and burn out.



LEICHTUNG'S PROFESSIONAL WOODBITS can be used in portable drills or drill presses with chucks of 3/8" or more.

7 piece Chrome-Vanadium alloy set includes 1/8, 3/16, 1/4, 5/16, 3/8, 7/16 and 1/2" sizes. Made by German professionals for pro's or "wood-be" pros.

7 PIECE WOODBIT SET..... ONLY \$14.95



## Matching Depth Adjusting Collars

Get the precision of a costly drill press for less than \$10.00. Here's how it works: Figure the desired depth of the hole; Slip the collar over the bit to that depth; fix the collar

position with the set screw - and drill. This set has a collar to fit each bit in the 7 piece woodbit set. Tool steel. .... ONLY \$8.95

BUY BOTH BITS AND COLLARS AND SAVE \$2.00 ..... \$21.90

You Can Order  
Tools By Phone:

Call TOLL-FREE 800-321-6840

Ohio Residents

Call: 216-461-4677

Yes Ric Leichtung, please send me:

7 pc. Woodbit Set(s) @ \$14.95.....

7 Collars To Match @ \$8.95.....

Woodbit and Collar Set(s) @ \$21.90 (save \$2).....

Shipping, Handling and Insurance \$1.75

Ohio Residents add 5 1/2% Tax

TOTAL COST

### Method of Payment

Check Enclosed  VISA  MASTERCHARGE

Card # \_\_\_\_\_ Good thru \_\_\_\_\_



Enclosed is \$1.00. Please send me your 1979 Catalog of Fine Tools PLUS all catalogs and new tool brochures FOR THE NEXT TWO YEARS!

Enclosed is my order for Woodworking Tools. As my BONUS, please send your 68 page 1979 Catalog of Fine Tools, etc., for the next two years FREE!

Name \_\_\_\_\_ Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**LEICHTUNG**  
"THE Workbench People"

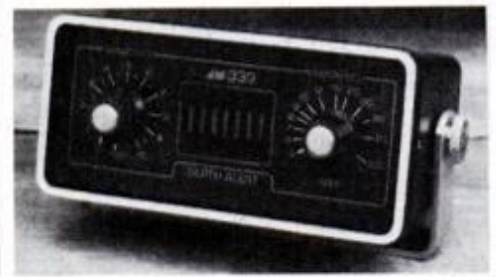
701 Beta Drive #579PM  
Cleveland, Ohio 44143  
Phone 216-461-4677

## ELECTRONIC GEAR FOR BOATING

(Continued from page 95)

harbor and marine telephone operators ashore.

For the pleasure boat with a power supply aboard, you can now nearly duplicate the navigation equipment of ocean liners. Tiny solid-state circuits have brought down the sizes, though not yet the several-thousand-dollar costs, of radar sets and Loran C units that now read out both latitude and longitude simultaneously and may shortly



New Depth Alert from Aqua Meter can be used with almost any flasher, digital or chart-depth recorder to emit beeps that signal a channel, shoaling or fish below.



A commercial-style echosounder that reads to below 6000 feet, the Simrad 802 has a straight-line graph recorder or reads digitally in feet, fathoms or meters.

lock into your autopilot to provide hands-off steering.

Commercial fishermen may want to use the Magnavox Satellite/Omega unit that derives continuous position from a satellite fix, and lobster fishermen can call up hidden pot buoys or anything else electronically with Poseidon International's Sub-Surface System.

EPIRB stands for "emergency position radio beacon," and the handheld units can send an automatic SOS to the Coast Guard and planes overhead. Want to see at night when there's practically no light at all? Goggles from Impossible Electronic Techniques do the trick, and they're only \$15,500. **PM**

## Build a picnic table you can store indoors



Parking a bulky picnic table indoors when summer is over is practically impossible. So it sits in the yard or on the patio 12 months of the year. Not so with this unique design.

Both table and benches fold scissor-fashion into an incredibly small unit which means the whole thing can be stored in your garage or basement with room to spare. And if made of redwood, the table will last for years.

To obtain plans and instructions for building this stowaway table send \$3.95 to

Popular Mechanics Plans Service, Box 1014, New York, N.Y. 10019.

Popular Mechanics is a publication of Hearst Magazines, a Division of The Hearst Corporation

# Maybe you thought catching smugglers, stopping poachers and saving lives only happens in the movies.

Wrong.

Life in the Coast Guard is a lot better than a movie. It's the real thing.

You probably already know that the Coast Guard has the unique mission of saving lives and property.

We do a lot of other unique things, too.

We're law enforcement officers, patrolling thousands of miles of America's coastlines, on the lookout for narcotics smugglers.



provide an allowance for housing and meals. So most of your pay is yours to keep—or save towards a new car, stereo equipment, even college.

And because we're smaller than the other military services, your chances of being recognized are greater. Good performance earns re-

wards. Which

means a bigger paycheck, a bigger job and a brighter future.

It all adds up to something pretty ex-

ceptional. A meaningful job, with an exciting lifestyle.

If you would like to be involved, see your local recruiter or call us toll free (800) 424-8883, (except Wash. D.C., Hawaii, Alaska).

Or send us the coupon below for more information.

vent pollution of our waterways and coasts. Maintaining the lights and markers that guide ships. Promoting safety in recreational boating.

## Helping others is helping yourself.

It's not all hard work, though there's plenty of that.

In the Coast Guard, when your job is done and you're off duty, your time is your own. You can get out of your uniform and into your own thing.

The paycheck you get (over \$400 a month after basic training) goes a lot further. We pay for your uniforms, medical and dental care, and when quarters aren't available, we



We protect our national resources, keeping our new 200-mile fishery conservation zone safe from "poachers" who illegally fish our waters.

These are big jobs, important jobs to our country and to the men and women who perform them. So are the other things we do. Working to pre-

## HELP OTHERS. HELP YOURSELF. THE COAST GUARD

Coast Guard Opportunities,  
P.O. Box 1452, Scranton, Pa. 18501

56059

Please send me more information about the following Coast Guard Programs:

- Regular enlisted     Coast Guard Reserve  
 Coast Guard O.C.S. (College graduates only)  
 Coast Guard Academy

Mr./Ms. \_\_\_\_\_ Age \_\_\_\_\_

Street \_\_\_\_\_ Apt. # \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone number \_\_\_\_\_

**PUBLIC NOTICE!  
BANKRUPTCY**

**and Financially  
Distressed Merchandise!**

We are authorized liquidators of large inventories that must be quickly sold at sacrifice prices because of:

- Bankruptcy
- Sheriff's sale
- Bank loan foreclosure
- Insurance claim salvage
- Manufacturer's overproduction
- Last year's models

If your company finds itself in any of the situations listed above and is forced to sell large inventories for immediate cash, call us. Only products in perfect operating condition (or slight blemishes that do not affect operating efficiency) will be considered.

All inventories we liquidate must be priced to sell **BELOW DEALER COST** or **BELOW MANUFACTURED COST**.

**MUST LIQUIDATE**

**AT FAR BELOW DEALER COST!**

**12-Speed, Heavy-Duty  
3/4 hp. DRILL PRESS.**

**FACTORY NEW! PERFECT CONDITION**

**Rockwood drill press by Cummins  
Machinery with ball-bearing 5/8" chuck!**

Great for industrial use or home workshop!

Here's that heavy-duty, 14" drill press you've always wanted! Now you can have it at a fantastically low liquidation price that's even less than those little "sissy" models!

This big, man-sized "brute" has all the power, all the "guts" you need for fast, smooth drilling into steel, cast iron, aluminum, brass, wood, plastic. Head and base are made of strong, fine-grained cast iron. Heavy walled machined column increases rigidity, cuts vibration for smoother operation. Standard NEMA 56 frame.

Oil table swings 360° and tilts 0° to 45°. Precise up and down movement of table with rack and pinion. Recessed light in head gives bright illumination of work.

We dropped the price way down low to liquidate them FAST! Better order your right away! One year parts warranty included.

- Height . . . . . 40 1/2"
- Width . . . . . 12 1/2"
- Depth . . . . . 18 1/2"
- Column diameter . . . . . 2-7/8"
- Spindle to table (max.) . . . . . 15 1/4"
- Spindle to base (max.) . . . . . 23-5/8"
- Chuck . . . . . 5/8" No. 3 J.T. Arbor
- Speeds . . . . . 12, from 230 to 3890 rpm.



**Vise Attachment . . . \$25.00**  
For maximum clamping, holding power. Steel jaw faces; 4" jaw width, 1 1/4" jaw depth, 3/4" jaw opening. Cold rolled steel screw.

**Reg. Retail: \$695.00**

**NOW . . . while they last:**

**\$198**

Plus \$10.00 shipping and handling



To order, or to ask questions,  
**Phone Toll-Free: 1-800-328-5082**  
Minnesota residents call Collect.

**C.O.M.B. Co. / Authorized Liquidators**  
3258 Minnehaha Ave. S., Minneapolis, Minn. 55406

Enclosed is my check or money order. Please send the Rockwood 12-speed Drill Press for only \$198.00 plus \$10.00 shipping and handling.

Also send the Vise Attachment for only \$25.00  
(Delivery time: approximately 2-3 weeks)

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Name \_\_\_\_\_  
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City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

**TOP QUALITY!  
ONE YEAR  
PARTS WARRANTY!**

**C.O.M.B. Co.**

AUTHORIZED LIQUIDATORS  
of Manufacturers' Overproduction  
3258 MINNEHAHA AVE. / MINNEAPOLIS, MN 55406  
PHONE: (612) 729-2345

# MUST LIQUIDATE!

## POWERFUL 4.2 cu. in. COMMERCIAL LOGGING CHAIN SAWS

**BRAND NEW, PERFECT CONDITION**

Powerful 69 c.c. with 16" cutting bar for the brute force you need to turn big trees into firewood, **FAST!**

Fully jeweled and balanced engine!

Easy to handle! Barely 14 lbs. in weight. Made in U.S.A. by American Power Equipment Company.

Reg. Retail: **\$309.95**

NOW... while they last:

**\$179<sup>99</sup>**

Plus \$5.00 shipping and handling

QUANTITY DISCOUNT to municipalities, utilities, logging firms, govt. agencies.



Needle bearings on all key moving parts!

- Aircraft quality hard chromed steel cylinder wall!
- 4-reed pyramid intake valving for greater power!
- Automatic lubrication increases with acceleration!



Bumper spikes for easier cutting.

### A commercial logging saw at the low price of backyard models!

Sure, you've seen lots of sale prices on "sissy" little chain saws. And they're O.K. for trimming twigs and small branches. But when you want to tackle big trees in the forest for a winter supply of firewood, little "toys" can't take it. You need a chain saw with plenty of guts and big, strong teeth to make short work of large trees. You need this powerful 4.2 cu. in. QUIKUT!

This is the same great saw used by commercial loggers, day after day after day! Compare the features of this QUIKUT with the BEST models of any competing models. You'll quickly realize what a sensational value this top quality chain saw really is.

The manufacturer, American Power Equipment, has designed newer models and is discontinuing this one. Now we are authorized to liquidate this

entire inventory at an amazingly low closeout price. It means a HUGE SAVINGS for you. But don't delay. Our supply is limited. Order yours right away, before they're all sold out.

#### TOP QUALITY FEATURES THROUGHOUT:

- Aircraft quality, chromed steel cylinder wall.
- Fully jeweled engine with needle bearings on all key moving parts in upper and lower crankcase.
- 4-reed pyramid intake valving for greater power.
- Anti-vibe, cushioned front handle bar.
- Adjustable, automatic oiler; the more acceleration, the more lubrication.
- Low tone, spark arrest muffler.
- All position carburetor.
- Carburetor adjustment for high and low jets.
- 16" speed tip bar with 3/8" pitch chrome chain.
- Control cut bumper spikes for easier cutting.

### ONE YEAR PARTS REPLACEMENT WARRANTY ON ALL 3 MODELS!

If any part should prove to be defective within one year from date of purchase, call our toll-free number (1-800-328-5082) and we will replace it FREE of charge. For normal servicing, there are over 340 authorized service centers in the U.S.A. A listing of them comes with each saw.

For MASTERCHARGE and VISA members only:

Phone in your order on our toll-free number (1-800-328-5082) and charge it. In Minn., call collect.



## C.O.M.B. Co.

AUTHORIZED LIQUIDATORS of Bankruptcy Merchandise and Manufacturers' Overproduction

3258 MINNEHAHA AVE. S., MINNEAPOLIS, MINN.

Phone: (612) 729-2345

### 2.4 cu. in. CHAIN SAW

WITH 14" CUTTING BAR

More rugged, more powerful, more quality than the "cheapie" promotional models of similar size that you find in discount stores! Less than 8 lbs., but the 36 c.c. engine packs plenty of power for trimming big limbs or felling medium size trees. An excellent quality saw with fully jeweled engine and caged roller bearings. Spark arresting, low noise muffler. Hard chromed, steel cylinder wall. A tremendous value for you!

Reg. Retail: **\$199.95**

Now... for only:

**\$99**

Plus \$5.00 shipping & handling.

### 2.2 cu. in. CHAIN SAW

Same features and appearance as 2.4 cu. in. model above, but with 12" cutting bar. Excellent quality and highly dependable! Priced far below dealer's cost. A great value for you!

Reg. Retail **\$169.95**

Now... for only:

**\$79.00**

Plus \$5.00 shipping & handling.

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Enclosed is my check or money order. Please send the following chain saw:

- 4.2 cu. in. @ \$179.00 plus \$5.00 shipping and handling
- 2.4 cu. in. @ \$99.00 plus \$5.00 shipping and handling
- 2.2 cu. in. @ \$79.00 plus \$5.00 shipping and handling

Allow 2-3 weeks for delivery.

PLEASE PRINT CLEARLY

Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

# APPLIANCE CLINIC

## QUESTIONS ANSWERED

### Tough nut

I have the nuttiest problem. It concerns our Kenmore electric clothes dryer Model 110.7208630, which worked like a charm for seven years. Suddenly, we can't get it to finish a drying cycle because the door insists on popping open. As you know, when the door is open, the door switch releases automatically, shutting off the machine. I've replaced the parts. What do I do now?—Ed Wohlmuth, Buffalo Grove, Ill.

Okay, we'll buy the fact that you've replaced the striker and catch. We hope you have good parts, because a dryer-door problem is normally caused by a defective striker and catch. If the parts aren't defective, check their alignment. You can replace the striker and catch until the cows come home, but they won't hold the door closed if they aren't properly aligned.

Which brings us to what the trouble might be. Maybe someone leaned or pushed down on the door, knocking it out of alignment. This would cause a mismatch between the striker and catch. If so, you can pull up on the door and tighten the bolt-on hinges.

There is also a possibility that excessive vibration is knocking the striker and catch apart. A worn idler pulley could set up a good enough shake to do this. So could a flat spot on one of the drum support wheels. These wheels are under and at the rear of the drum.

### No time for cooking

The timer of the Tappan wall oven in our mobile home isn't working. We followed the operating instructions outlined in the manual and had a serviceman look at the gadget. Still, the timer won't turn the oven on automatically. Why not?—Steve Olson, Dunnellon, Fla.

Let's find out. To begin, make sure you're operating the timer correctly by following these steps:

- Push in the Start-Time control and set the timer to the time you want the oven to turn on.
- Set the Stop-Time control to the time you want the oven to turn off.
- Set the selector switch to Time-Bake and the thermostat to the desired temperature.

Each of these steps must be done. To test timer functioning, set the Start-Time for 10 minutes later than the time on the clock and set the

Stop-Time for 10 minutes beyond that. Now, if the timer fails to turn on the oven, one of these conditions exists:

1. The timer is miswired. The timer has its own circuit through a set of contacts in the selector switch. The circuit is activated when the Stop-Time control is set.

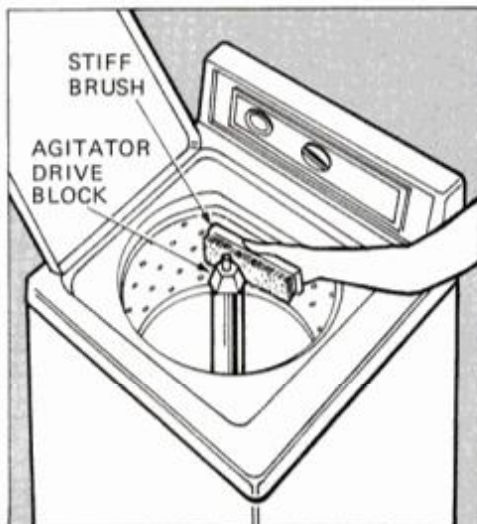
2. The clock stems or hands are binding against the crystal. If this is

### SERVICE TIP

When the agitator drive block of a washing machine becomes coated with hardened detergent and mineral residue, the agitator begins to rub against it. Result: moans and groans during the wash cycle. To eliminate this annoying noise, remove the agitator. If it sticks, pull upward on it as you strike it along its sides with a hammer. Clean the agitator drive block with hot water as you scrub it down with a stiff bristle brush. Then coat the drive block with a thin film of petroleum jelly. Reinstall the agitator.



Hammer, pull up on agitator to remove it.



Clean the drive block with a stiff brush.

the case, remove the clock and shift it on its backing plate.

3. The timer is defective and should be replaced.

### Discordant melody

A year after I bought a 19-cu.-ft. Amana chest freezer (Model C-19F) it developed an annoying hum. The dealer replaced the motor/compressor rubber shock mounts, but this failed to lessen the noise. Is there a solution to my problem?—John Fred Breitschwerdt, Elberta, Ala.

If the noise is a result of tubing coming in contact with the freezer cabinet, adjust or insulate the tubing. If the noise is being caused by compressor harmonics, repair the compressor, but check the cost first. You may find it isn't worth it.

A third reason for the noise may be the floor. Was the freezer heavily loaded with food prior to the onset of noise? If so, heavy weight could have caused the floor to settle, resulting in a vibration through the joists. In this case, the solution to your problem lies in finding another location for the freezer.

### Snow bird

My dehumidifier works properly, except when the cellar temperature gets lower than 50° F. Then the coils become frosted. An appliance serviceman told me the unit wasn't getting enough airflow, so I cleaned the coils. This didn't help. What is the solution to my problem?—Thomas Clarke, Mt. Holly, N.J.

There is no solution because there is no problem. Here's what Whirlpool tells its service people:

"In a cool, dry environment, the evaporator may become completely coated with frost, perhaps even to the extent that no moisture is collected. This condition will exist when the weather approaches a temperature of 65° F. with a relative humidity of 60 percent or lower. Dehumidifiers aren't designed to operate at these conditions, as dehumidification is not needed."

Tom, you should unplug or turn off the dehumidifier, or readjust the humidistat to a higher setting. **PM**

If you have a question about any appliance, send it 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.



# TURTLE WAX INTRODUCES THE SEA TURTLES.



**Metal Polish.**  
Cleans and protects stainless steel, chrome, brass and copper. Removes and retards rust and corrosion.



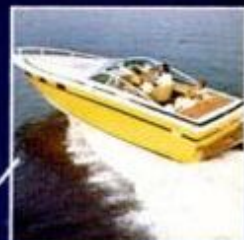
**Vinyl Cleaner.**  
Restores luster, revitalizes ravaged tops, seats and trim.



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# Modern search and rescue: Call out the computers!

Advanced radar systems, automatic Mayday transmitters and photos from space are steadily improving the odds for air-crash victims.

by Gurney Williams III  
SCIENCE EDITOR

**D**owndrafts had buffeted Paul McLatchy Jr.'s plane, and when he had recovered, he was off course. Then a cumulus cloud loomed in front of the single-engine Piper Cherokee. The cloud was too high to fly over, so McLatchy, 25, began descending at a steady 500 feet per minute to duck below the ceiling.

Gray mist whipped over the maroon top of the little plane, purchased by McLatchy only two weeks before. He was concentrating on his artificial horizon and other instruments when his passenger, Tom Richardson, yelled a warning: "Trees!" Instantly, McLatchy yanked back on the controls and hit full power. He heard the noise of impact. Then: blackness.

McLatchy's watch stopped at about 7:30 on the morning of Dec. 27 last year when he hit a remote New England mountain. No one saw him go down.

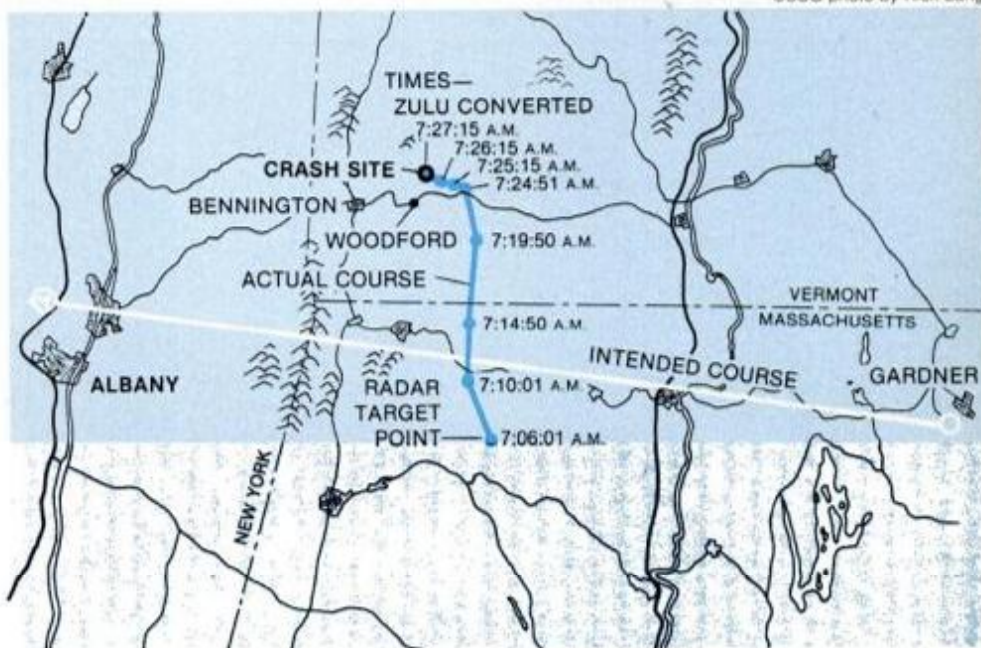
Eventually, the efforts to locate Paul McLatchy's plane would involve dozens of people in four states. The search would depend on electronic wizardry and techniques that weren't even on the drawing board a decade ago.

## Computers start the job

Gone are the days when search and rescue depended on seat-of-the-pants posses dragged by bloodhounds with their noses vacuuming the ground for scents. Today, computers miles from the scene of a crash often do the tracking before a small, well-trained search team is sent out. Sometimes weather satel-



USCG photo by Rick Langill



The end of the line, for pilot Paul McLatchy, was a snow-capped New England mountain. Hours after the crash, a computer memory spewed out enough data for an analyst to reconstruct the actual course during the final minutes of the flight. The analysis led rescuers (above) directly to the downed Piper.



In view (above) from helicopter, rescue workers prepare stretcher to lift Paul McLatchy to safety. Minutes later, the chopper (left) arrived at Bennington, Vt. airport. Without the use of a computer system, the initial search would not have been able to locate the plane. More than 700 persons were saved in missions last year alone.



Inland search and rescue missions are coordinated from this windowless room at Scott Air Force Base in Illinois. On call: an army of local rescue agencies.

lites peering down from space provide additional clues. Pictures of clouds help analysts to suggest where pilots might have hit rough air. Infrared satellite photos can pinpoint thunderstorms that might have snagged a plane.

Small aircraft themselves have become easier to find in the five years since most have been required to carry emergency locator transmitters. These onboard radios automatically begin squawking a distinctive warbling signal if the plane is badly jolted. In 1981, satellites will be used during a year's test program to listen for the warbling, and to beam the location of the automated Mayday back to Earth.

The hub of much of this search-and-rescue activity today is a windowless room at Scott Air Force Base in the pancake-flat countryside of Illinois, east of St. Louis. Controllers here at the Air Force Rescue Control Center face a huge multicolored map of the United States covering one wall. On a typical day, the map displays half a dozen black arrows pointing to sites where missions to save someone are underway.

Although the Air Force runs the center—24 hours a day—it depends on help from an army of search-and-rescue workers, from local sheriffs and civilian pilots to paramedics and computer programmers all over the country. In 1978, missions coordinated from this room saved 724 lives—about two a day—up from 698 lives saved in 1977. Most of those saved were civilians: lost children, hikers who had wandered from the trail, and victims of plane disasters.

Often, achievements are spectacular. In one mission coordinated by the center last December, Civil Air Patrol volunteers tracked an emergency locator transmitter signal through a blizzard to find the wreckage of a Rocky Mountain Airways plane that had crashed in Colorado. Their efforts—with an assist from the radio—saved 21 of 22 persons aboard. The center has also rescued hundreds of private-plane pilots.

### Survival odds frightening

For every person pulled alive from a downed private plane, however, there are two who don't survive the crash. Long experience with small-plane accidents has taught Air Force rescue workers a grim lesson. Only about 35 of every 100 persons who crash in a small plane live through the initial impact. Some 21 of those survivors will be injured, most of them critically. Even those 14 who are unscathed in the crash

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face tough survival odds: Half of them will die if not rescued within three days. So the odds were heavily against McLatchy and his passenger that day last winter when they belled into a 2500-foot-high mountain.

Word came late in the morning to the Rescue Control Center from Buffalo Flight Service, a Federal Aviation Agency facility, that Paul McLatchy had failed to close his flight plan. He was overdue in Rochester, N.Y. And checks of other local airports—to see if he had diverted and landed elsewhere—had so far failed to find him.

### Missions are risky

The call didn't necessarily mean that McLatchy had crashed. Private pilots constantly forget to terminate their flight plans, or find themselves putting down where they can't immediately reach a phone. About 80 percent of 1550 general aviation incidents investigated by the center last year were closed when missing pilots turned up healthy, if shaken or embarrassed. Mounting a mission itself entails some risk: sending ground teams into remote country, planes into unsettled weather. "We tend not to throw people in the air until we've verified that the pilot's in trouble," said Capt. Ed Frye at the center.

Instead, for the next several hours, the case of Paul McLatchy rested in the hands of Capt. Ken Pribyla, working his last shift on a telephone console at Scott before the New Year.

"When I took over the mission, it looked like it was going to be kind of routine," Pribyla said. "It looked like the kind of case where a guy forgot to close out his flight plan. We didn't know for sure that he had



After electronic and other aids have narrowed the search, trained dogs sometimes help to close in. This German shepherd can pick up scents carried on breezes.

made the trip. Route checks were still underway."

### Concern mounts

But as he made call after call, Pribyla became more concerned. He learned from talks with McLatchy's family in Massachusetts that the pilot had been up around 4:30 a.m., checking weather and preparing for the trip. He discovered that the flight had been planned partly for business reasons—and that raised his alarm.

"If a guy's out for a pleasure trip, he might decide to go somewhere else on a whim," Pribyla said. "It's much less likely if he's got business appointments to keep."

Pribyla also got a picture of McLatchy as a pilot: a conscientious flier with perhaps 200 hours of flying time, a man likely to remember

to close his flight plan. Late that afternoon of the 27th, Pribyla decided to step up the mission.

At around 4 p.m., he placed a call to the Boston Flight Center, a Federal Aviation Agency facility in Nashua, N.H., and asked for help from a computer.

At that moment, McLatchy and his passenger were preparing to face darkness high on the snow-covered mountain. Both were badly shaken and numb with cold.

McLatchy had regained consciousness about half an hour after the crash. The two dazed survivors stared at each other in the cockpit.

"How do I look?" Richardson had asked.

"You look fine. How do I look?"

"Fine." Both were lying. McLatchy had broken eye sockets, cheekbones, skull, jaw and nose. Richardson's visible injuries included a long jagged laceration on his forehead.

Throughout the day, McLatchy had occasionally heard planes overhead. He had flipped on switches, and tried to make contact. "This is 6476 Juliet 180. Mayday. Mayday. Mayday." He didn't know that one of his antennas had been bent in the crash. No one had heard his calls.

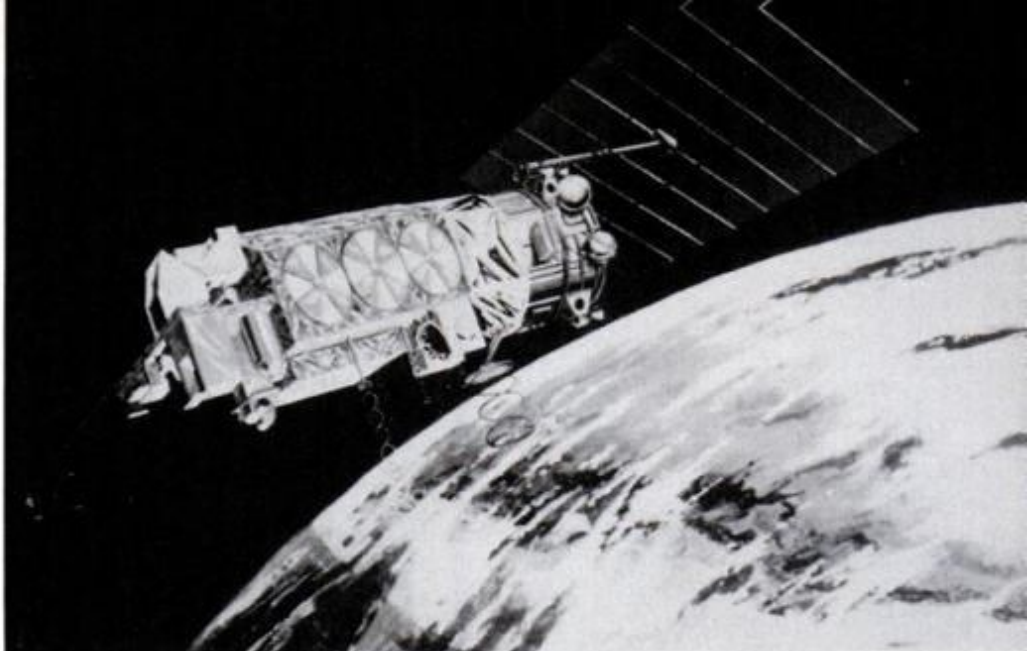
### Facing the darkness

At dusk, he pulled open a plaid sleeping bag he carried in the back of the plane. The heating system in the Piper had never worked properly. It was always too hot up front and frigid in the back seat, so McLatchy had thrown the bag in the plane for the sake of his passengers. Now the bag, and the battered fuselage, were the only protection against high winds, snow and ad-



Several high-traffic areas (shaded) are not protected by ITAP—rescue aid based on computer memory. But the proven system is to expand over shaded areas shortly.

Weather satellites sometimes aid search and rescue work by pinpointing storms along flight path. Infrared photos from space locate thunderstorms in cloud blanket.



vancing darkness on the mountain.

Meanwhile, in nearby New Hampshire, Pribyla's request for computer assistance had been passed to Malcolm Dodge. The assignment probably couldn't have gone to a better man: Dodge is a veteran data specialist who has worked with computers for 20 years.

The system Dodge prepared to call into play is only a couple of years old. It's called the Interim Track Analysis Program (ITAP). And—like McLatchy's sleeping bag—the program had originally been put in place for reasons unrelated to emergencies.

Basically, ITAP records computer conversation. It was designed several years ago to monitor signals between IBM and Raytheon computers used in air traffic control. The idea was that if foul-ups occurred in the electronic chattering between the two different systems, analysts could decide which computer was at fault by going over the tapes.

Some time after ITAP began as computer watchdog, officials at several of the 15 air-traffic centers equipped with the system made an important discovery. The tape recordings contained data on every bit of air traffic picked up by every antenna in the center's control area. Punch in a time and place, and the computer would print out a chart of everything in the air, even if no one had been watching a screen at the time. The discovery presented analysts with a virtual time machine, enabling them to get a picture of any airspace as it was just before a plane went down.

### System aids searches

Since the discovery, the system has done very little cross-computer refereeing. On the other hand, it's helped in dozens of search operations. In one case, it allowed analysts to follow the path of a jet engine which ripped off and spun away from an aircraft in flight. As a result of the analysis, the engine was found on the ground near where the system said it had fallen. In another set of cases, computer printouts have often shown the characteristic tracks of small aircraft—appearing on computer paper as a chicken-track series of letters or slashes—entering a final spiral before crashing.

Paradoxically, the system cannot be used in several parts of the coun-

try where air traffic is heavy. The reason is that in five of the nation's busiest traffic-control stations, only IBM computers were used when radar systems were automated. So designers saw no need for the recording system to keep track of signals between computers. The program has been so successful in 15 centers, however, that it is scheduled to be expanded to the five remaining centers. Then, perhaps as early as this summer, the Interim Track Analysis Program will become the National Track Analysis Program, covering the whole country.

McLatchy's intended course passed right through the radar net covering the northeast part of the country, an interlacing of radar signals from antennas near Boston and Hartford. After he had grabbed some computer time, Dodge had no trouble finding what he guessed was McLatchy's plane in the computer's memory. He picked up the path from Bedford, Mass., at 6 a.m. when the plane took off. Then, in one computer printout after another, each revealing a different time and place, he had followed the plane on its way. The printouts had begun to stack up—at the end of the analysis there would be close to 30 sheets of paper—when Dodge spotted trouble.

"It was a bit west of Gardner, Mass.," he said. "He went down to the south. Then a swing to the west again. Then up north." How did Dodge feel, watching the swinging line? "You always wonder," he said. "Did the aircraft malfunction? Did the pilot have a lapse? You continue to track him."

Over Vermont, the plot suddenly curved to the west, and stopped. There was no further record of the flight in the computer memory. Dodge called Pribyla and read him the coordinates at line's end.

Abruptly, the mission came to a sharp focus. Now, Pribyla began making calls to search-and-rescue agencies near Bennington, Vt., where Dodge's analysis suggested the plane had gone down. The site was miles off McLatchy's planned course. And Air Force officials said that without the computer information, it would have taken at least a



Civil Air Patrol volunteers followed signals from an emergency locator transmitter to find wreckage of commercial plane in Colorado last December. As a result, 21 of 22 survived Rocky Mountain Airways flight.

day for searchers to check out the area. Initially, at least, spotter planes would have scoured countryside within 10 nautical miles on either side of his intended flight path—missing McLatchy's plane.

Thanks to Dodge's printouts, Pribyla was able to tell an officer in the Vermont Civil Air Patrol almost exactly where to begin. Vermont C.A.P. Commander David A. Dawson, who retired from the Air Force about 10 years ago, called together 11 other volunteers. Early on the morning of Dec. 28, he drove 130 miles from his home to Bennington

(Please turn to page 258)

# IT'S NEW NOW



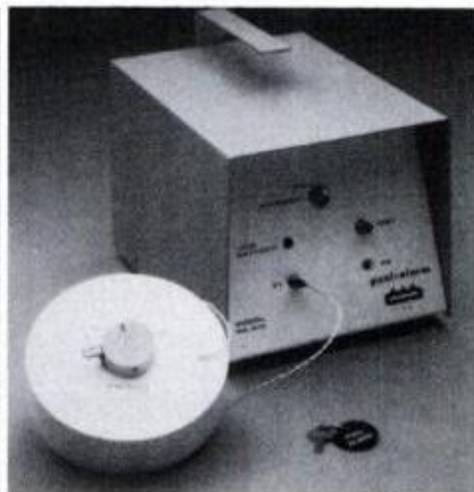
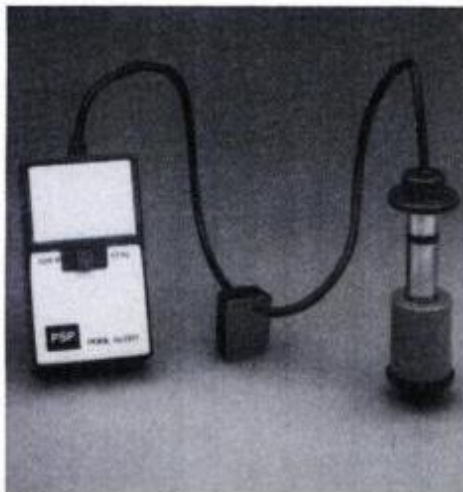
## Can you top this?

Bumpers on new cars make cartopping boats more difficult than ever. The CanoeTopper Combo has webbed tie-downs with S-hooks that fit into bumper jack holes. Four vinyl pads snap onto the canoe's gunwales to protect the car roof, and two straps secure the canoe. About \$23 from Grumman Boats, Marathon, N.Y. 13803.



## Brush up

The Brush Gripper can be used to hook up a boat while fishing. Its galvanized-steel jaws firmly grab brush to keep your boat from moving too far; one at each end of the boat further limits movement. Unit is said to release with one squeeze. About \$5 from Championship Fishing Club, Inc., Virgil Ward, Box 119, Amsterdam, Mo. 64723.

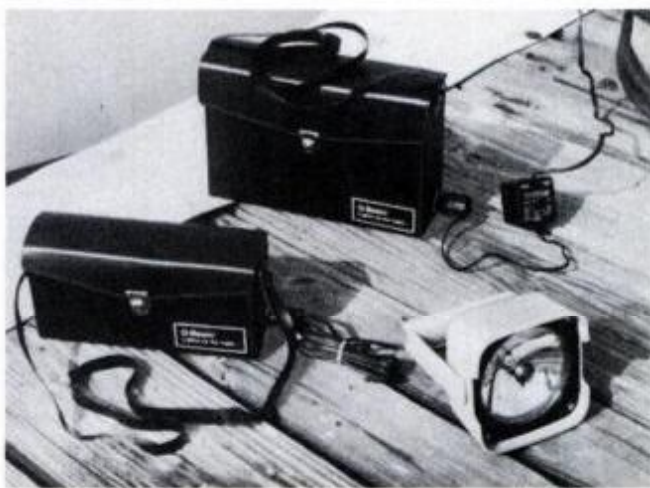


## Splash guards

Guard against drownings or vandalism in your pool or large tub with one of these alarms. Both wail loudly when the water surface is disturbed and have adjustable sensitivity. Battery-powered Pool-Alert (left) is about \$40; Pool-Alarm starts at \$200. Pool Security Products, 2924 Scott Blvd., Santa Clara, Calif. 95050.

## Portable power for 12-volt appliances

Q-Beam Power Packs provide 12-volt power for lights, tools and other appliances that have cigarette-lighter plugs. Unit includes rechargeable battery, voltage-regulated charging device with current limiter (to prevent overcharging), plug receptacle and case. Model 1720 (left) is about \$60; model 1721, \$80. Available from Brinkmann Corp., 4215 McEwen Rd., Dallas, Tex. 75240.



## Take a dive

This quartz-movement diver's watch has been pressure-tested to 3300 feet, the maker says. It features a two-way ratchet bezel to avoid accidental movement of the dial while diving and a stainless steel band with infinite adjustment for wearing on a bare wrist or over a wet suit. The UMW1 is \$300 from Dacor, 161 Northfield Rd., Northfield, Ill. 60093.

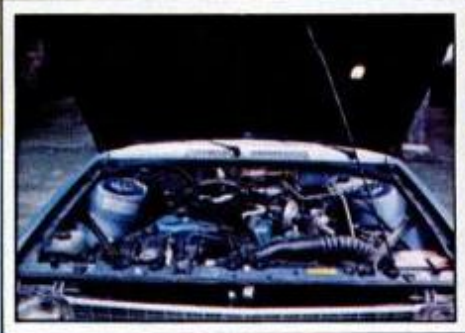
# Driving GM's 1980



1980 Chevrolet Citation four-door hatchback is shown at speed above. Three-door hatchback in X11 trim appears at right, and hatch arrangement is shown in photo below.



Iron Duke Four, an in-line, cross-flow design, displacing 151 cu. in. and placed transversely, is standard engine.



A couple of days evaluating these new compacts convinced us that their foreign and domestic rivals are in for big trouble.

by Gary Witzenburg  
DETROIT AUTO EDITOR

**T**here's nothing revolutionary any more about front-wheel drive. Many imports have it, General Motors' top-line, personal luxury coupes have it, and Chrysler pioneered it in U.S.-built, high-volume small cars fully two years ago.

But when GM, the world's largest automaker (and one of its most con-

servative), banks the largest new-car investment in its long and successful history (some \$2.5 billion) in a totally new series of front-drive small cars for four of its five car divisions, it's something of a revolution. Others have long since applied and further developed the system. Now mighty GM has endorsed and em-

braced front-wheel drive and intends to popularize it as never before in this country.

The new GM compacts, known as "X-cars" in industry jargon, actually began life as a small family car (SFC) project in the gloomy, fuel crisis days of April 1974. Five years later they have emerged as Detroit's



# front-wheel-drive compacts



Citation X11 two-door slantback sport coupe is unique to Chevrolet. Other GM Divisions—Pontiac, Buick and Olds—have notchback models with familiar, formal roof lines. For the fwd 1980 model, Chevy drops Nova name in favor of Citation. Pontiac, Buick and Olds, however, retain Phoenix, Skylark and Omega on their respective versions.



V6 powerplant, displacing 171 cu. in., is optional. The 60° V6 is also set transversely in the engine compartment.

ance and appointments—instead of the other way around.

### Lighter, shorter than '79s

By way of comparison, these '80 "compacts" average 20 inches shorter and nearly 800 pounds lighter than the '79s they replace. Yet they have significantly better interior and luggage room, more standard and optional equipment, better ride and handling, better performance and some 30 percent better fuel economy! All models ride on a 104.9-inch wheelbase and measure about 68 inches wide by 52 inches high.

Base curb weights are in the 2500-pound range, while overall lengths range from 176 to 182 inches.

"We started with five people," says Chevy X-car chief engineer Norm Sholler. "The object was to shape a car around them—the interior as well as the exterior. . . . This is not a four-passenger car in which you can shoehorn five if you must. This is a full five-passenger car." Fully 7.5 inches of front-seat travel make the '80 "X" one of the most comfortable cars of any size for long-legged drivers and front passengers. Yet rear-seat leg-room is increased

first truly *small big* cars, as opposed to *big small* cars like Ford's Granada/Monarch, Chrysler's Volare/Aspen and the old Nova-series GM X-cars. A small big car, you see, is sufficiently small in size, weight and fuel economy but very "big" in roominess, quietness, ride, option availability and richness of appear-

more than two inches over that of the '79 X-car two-door. Front-wheel drive allows a center tunnel just large enough to accommodate the exhaust system, and a flat (instead of contoured) rear seat back gives habitable comfort for a trio of full-size rear passengers.

Other interior features include a removable package shelf and fold-down rear seat back in hatchback models, "high-low" ventilation, even without airconditioning, and front-serviceable instrument panels. Front bench seats are standard (with separate seat backs in two-doors), and buckets are optional.

### Chassis and power train

Standard engine is the Pontiac-built, 2.5-liter, cross-flow four-cylinder rated at 90 hp, while a brand-new 115-hp, 2.8-liter, 60° V6 (designed and built by Chevrolet) is optional. Both are mounted transversely to save space and drive the front wheels through a choice of four-speed overdrive manual (with long-life, self-adjusting clutch) or three-speed automatic transmission. Assisted by such fuel-saving features as standard radial tires, low-drag front disc brakes and a part-time electric cooling fan, the cars have EPA composite fuel economy ranges from 23 mpg for the V6 automatic to 30 mpg for the manual-shift four-cylinder. And thanks to more than 600 hours of wind-tunnel tests, X-car bodies are the most aerodynamic GM now builds.

Steering is rack-and-pinion, and the front suspension is MacPherson struts with large-diameter coil springs. The Pontiac-designed rear suspension is a unique variable-rate "trailing arm twist axle" with coil springs, tube shocks and a transverse track bar. Wheel bearings are sealed and lubed for life.

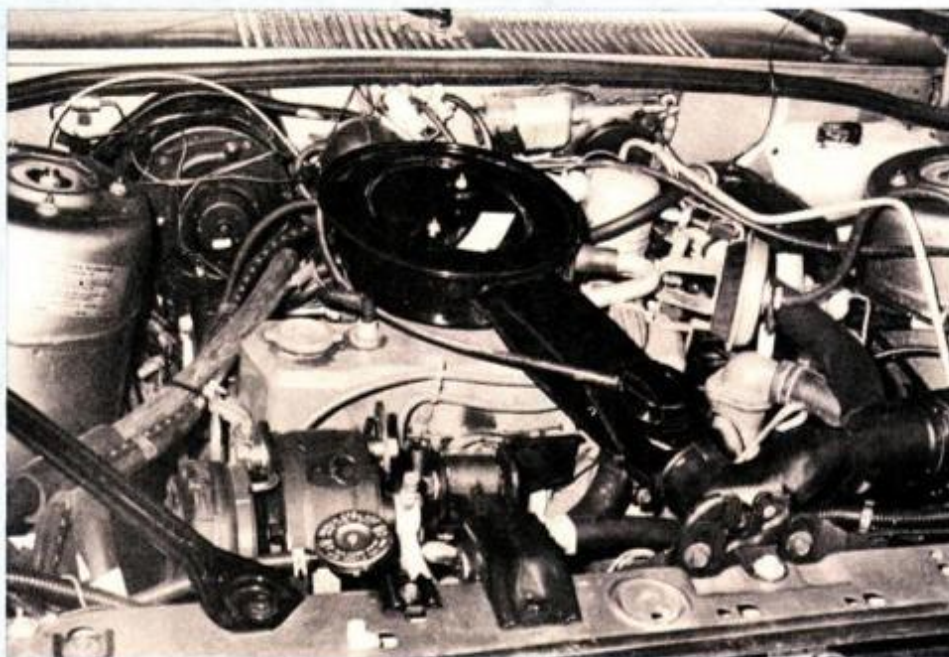
The engine/transmission and the front suspension lower arms are carried by a clever "split cradle" mini-frame that provides vibration isolation as well as structural rigidity, and one side even pivots away for serviceability. Both front and rear sway bars are standard equipment, the latter incorporated as part of the rear axle assembly. And the dual braking systems are split diagonally to provide at least one front and the opposite rear brake if either system fails.

### Chevrolet Citation

"Such a new car deserved a new name," replied Chevy general sales manager Bob Cook, when asked why the division chose to scrap the reliable Nova nameplate. "When you get

(Please turn to page 252)

# Servicing GM's



Transverse installation of Four required moving water pump to side of engine.

**L**ike a traditional bride, GM's new line of transverse-engine fwd cars have under the hood something borrowed and something new. On loan is the Pontiac Iron Duke crossflow four-cylinder, and fresh off the drawing boards are a 60° Chevrolet V6 and manual and automatic transaxles. Since they're installed across the engine compartment, both power-train combinations call for some new approaches to service.

The Four and V6 both have been laid out for passable-at-least access to routine service items, but the V6 is clearly the easier to work on.

### The V6

You must reach over the V6 engine, or work from the side, to get at the rear bank's three sparkplugs, but there's a good half-foot of clearance between the plugs and the firewall, so it's really not a problem. The plug-wire nipples have built-in grips, so you can



Sparkplug boots' built-in grips make it easy to remove ignition cables.



Dipstick for engine-oil level is right up front on V6 and has convenient handle.

disconnect the wires without a special tool.

The ignition distributor is conveniently mounted between the banks, so there's no sweat making timing adjustments or hooking up a tachometer. Timing marks are at the pulley end of the engine and reasonably easy to read. Both the oil filter and the fuel pump are on the front side of the engine, and although you get at them from underneath, they present no service problems.

If there is any difficulty in routine service, it would be in the drive belts. You can reach all the adjustment points, but it's tight going. Alternator service on airconditioned models is strictly from underneath, because the compressor is mounted just above it on the front side.

Underhood room in this type of car is invariably at a premium, and a significant amount was saved by the installation of a redesigned, higher-output Pulsair system in-

# 1980 front-wheel-drive compacts

stead of an air pump. Pulsair, that diaphragm device triggered by exhaust gas vacuum pulsations, eliminates a lot of hardware and plumbing, but until the new design, it was limited to engines that do not require a lot of air in the exhaust. There's a Pulsair canister for each bank of the V6.

The new V6 engine is metric (as are the body and most other parts of the car), so have the right wrenches handy. It's a very conventional push-rod powerplant, however, although the 60° bank inclination is new for GM, which has been making V6s by chopping cylinders off 90° V8s. The 60° inclination for a V6 permits an even-firing, inherently balanced engine. So when you get this one tuned right, it should be smooth.

## Emphasis on simplicity

Because the emphasis was more on reliability and simplicity than technical novelty, the V6 should pose no problems even for the advanced Saturday mechanic doing major work. There is a subtle difference for which you should be prepared, however: Aside from the cylinder-head and intake-manifold joints, there are no gaskets. Sheet-metal pans such as rocker cover and oil pan use a room-temperature-vulcanizing silicone paste instead of a gasket, and machined-surface joints have a coat of an anaerobic sealant, which cures in the absence of air. Neither material takes a compression set, so routine retightening should rarely be necessary. If you have to take apart a joint, make sure you have the right paste for repair. You can't use them interchangeably.

If it seems strange that a V6 is easier to service than a straight Four, it shouldn't be. The V6 was designed specifically for the transverse installation, so everything could be positioned after lots of thought. Additionally, putting the carburetor and distributor between the banks is a natural arrangement that happens to work very well for service on a transverse installation.

## The in-line Four

The Iron Duke isn't a service disaster—you can get to what you must—but it's well short of a Saturday mechanic's dream. Both the oil filter and fuel pump are on the back of the engine, and you'll have to work in tight quarters—between the engine block and the steering assembly—to get to them and make any repairs.

The sparkplugs are all on the front side, so they're no problem, but the distributor is on the back side, and getting to the lock bolt for a timing adjustment or distributor removal is strictly a feel-your-way Braille operation. The timing marks, however, are among the easiest to see on any car.

Although the distributor location is tough, it isn't exactly a joy on a fore-aft installation, either, and there's actually one aspect that's easier with the transverse installation: hooking up a tach to the distributor-cap flange. On the fore-aft, it's practically a blind job in tight quarters. With the engine mounted transversely, the side of the cap flange virtually faces you.



Timing marks on Four are easy to read; distributor-lock bolt is hard to reach.

As it was made for the fore-aft installation, the Iron Duke is a bit too long for transverse mounting, so Pontiac shortened it by moving the water pump to the side. Pontiac wanted to keep all other accessories in the same locations, so the belt arrangement is a bit unusual. Two belts wrap around the alternator, crankshaft, power-steering pump and water pump. The water-pump pulley, however, has a third groove for a belt to run the airconditioning compressor. The alternator is at the top of the engine and very accessible, and overall, belt service is probably a bit easier on the Four.

## Transaxles

The transaxle installation for both manual and automatic transmission models is con-

ventional, but each has a design feature you'll like.

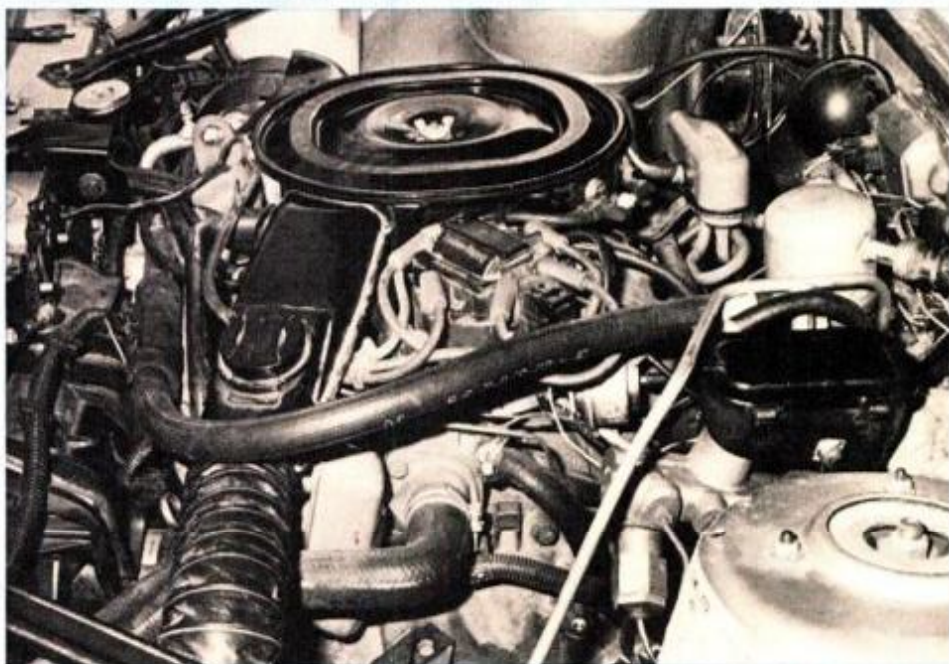
The manual comes with a self-adjusting clutch, and this one is for real. The British used to call their clutches self-adjusting because they had a carbon throwout bearing, and in theory, the carbon wore at the same rate as the friction disc so that free play was always maintained. Unfortunately, the theory was better than the practice, because the carbon wore out while the friction disc remained usable.

The GM arrangement resembles a ratchet: The clutch is cable-operated, and the cable is attached to a spring-loaded quadrant with teeth at the pedal assembly. Just above is a tiny, toothed, spring-loaded pawl that rests against the quadrant. As the friction disc wears, the cable must become effectively longer to permit the throwout bearing to come back farther and maintain the desired free play.

The cable does this by pulling on the quadrant as much as necessary, and the quadrant  
*(Please turn to page 257)*



Fuel pump on V6 is next to oil filter; both are reached from front underside of car.




V6, seen from the driver's side of the engine, gives easy access to distributor.

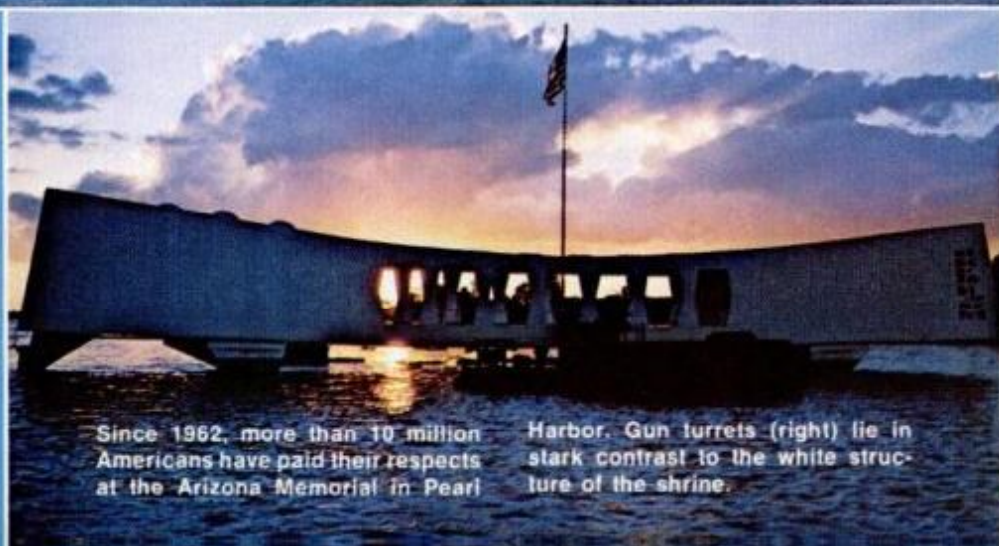
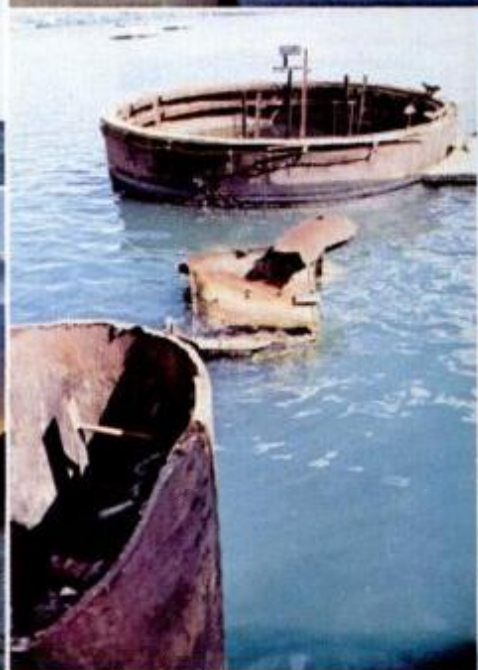
# THE ETERNAL FLEET

There's something about a ship that millions of Americans find hard to resist. Our memorial flotilla is bigger than ever.

by Charles N. Barnard



She's still an official Navy ship, and could be reactivated should the need arise, but part of the battleship *USS Missouri*, moored in Bremerton, Wash., is open to the public. The destroyer *USS The Sullivans* (below), now a memorial in Buffalo, N.Y., honors five brothers killed in WW II.



Since 1962, more than 10 million Americans have paid their respects at the Arizona Memorial in Pearl

Harbor. Gun turrets (right) lie in stark contrast to the white structure of the shrine.

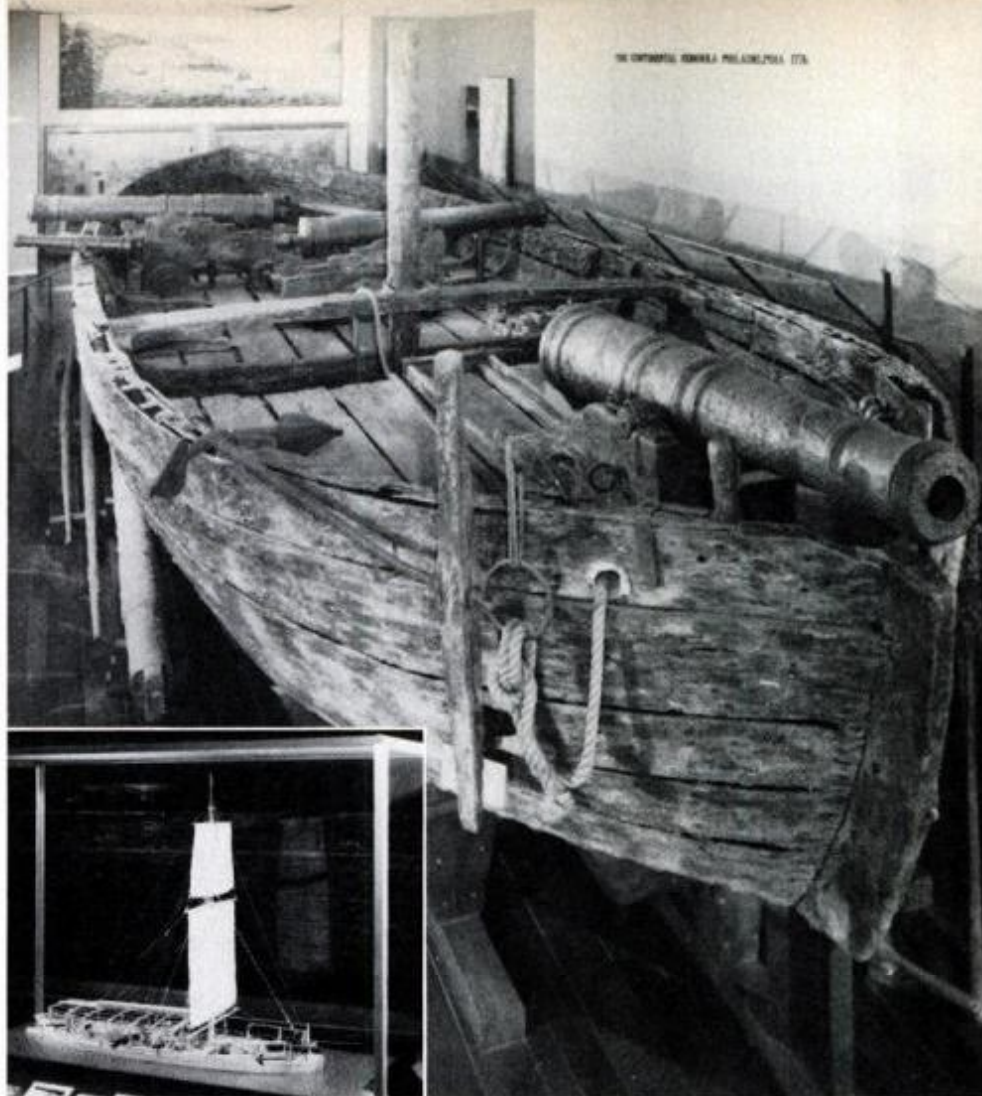
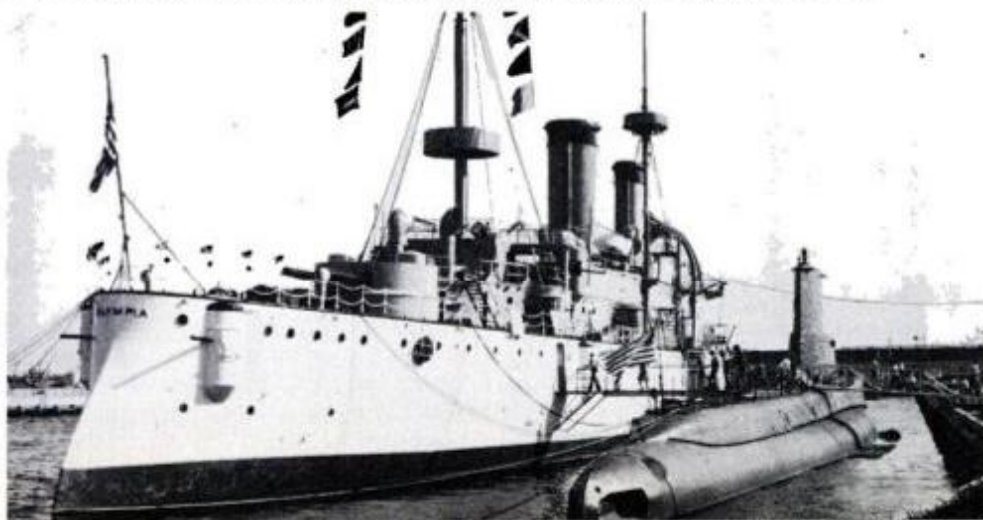
It was once a United States Navy Ship, BB39; now it is a sunken sarcophagus, 608 feet long. Its guns have been taken away, also its anchors, its great bronze bell and 43 pieces of silver service, which was all divers could find in the shambles of a pantry near the officers' mess. But the flag is still raised and lowered each day over the battleship *Arizona* and in her dark and flooded compartments, the bodies of 1102 of her crewmen have slept now for nearly 38 years.

More than 10 million Americans have made the pilgrimage over Pearl Harbor's blue waters to pay their respects at the Arizona Memorial since 1962. Some of them come expecting to see a shattered battleship, some anticipate a monument or a movie or a cemetery with crosses row on row. What they find is a graceful white bridge, which seems to float just over the water—and below, the barnacle-encrusted outlines of a warship, with schools of fish hovering and darting over its decks. It is a moment of history preserved, like a specimen in a bottle. One great circular gun turret (opposite) protrudes above the tides like a rusty manhole without a cover. Oil still seeps from the sunken hull and spreads in rainbow patterns on the water.

### A diverse armada

The *Arizona* casts a spell. Like a national skeleton, a relic, a shrine, she generates a special emotion. Yet this is only one of dozens of former U.S. Navy ships which have, in one fashion or another, been preserved as memorials. (The former battleship *Utah*, converted to a target ship, was also sunk by the Japanese on Dec. 7, 1941. It, too, can be seen at Pearl Harbor.) Located in 39 states, they comprise a unique armada, everything from mighty aircraft carriers to the 57-foot oaken gunboat *Philadelphia*, on display at the

Now berthed in Philadelphia with the WW II sub *Becuna* alongside, the cruiser *Olympia* was Admiral Dewey's flagship at Manila Bay. Her captain? Gridley, of course.



Oldest intact American warship is the gunboat *Philadelphia*, on exhibit in the Smithsonian. Sunk by the British on Lake Champlain in 1776, she was both designed by and under the command of Benedict Arnold, a patriot and hero on that particular day.

Smithsonian in Washington. The *Philadelphia*, both built and sunk on Lake Champlain in 1776, is the oldest intact military vessel presently on exhibit in North America.

In a class by itself is perhaps the best loved old warship of them all, the USS *Constitution*, better known as *Old Ironsides* and visited by more than a half-million people a year at her berth in Boston. Despite this constant flow of tourists (nearly a million during the Bicentennial),

*Constitution* is not officially a memorial, but a "USS," a United States Navy ship still in commission and serving as the flagship of the commandant of the First Naval District.

### The Navy's oldest ship

Another famous ship of the Revolutionary period is the frigate *Constellation*, a sister ship to the *Constitution*, one of three warships ordered constructed by George Washington in 1794. *Constellation*, which is now berthed in the inner harbor of Baltimore, was the first of these to be launched, making it the oldest ship of the U.S. Navy, although no longer on commission.

Two notable old ships from other wars are the reconstructed brig *Niagara* and the ironclad gunboat *Cairo*. It was in the *Niagara*, while flying his famed battle flag, "Don't Give Up The Ship," that Commodore Oliver Hazard Perry defeated the British on Lake Erie in the summer of 1813. After the battle he reported to the Secretary of the Navy, "We have met the enemy and they are ours . . ."

*Niagara* eventually went to the

bottom through neglect and decay, but was raised in 1913 and completely rebuilt. The ship is on dry land today at Erie, Pa.

The river gunboat *Cairo* is in the

early stages of restoration at Pascagoula, Miss. When the five-year project is complete, she will be returned to Vicksburg as part of a National Park Service museum which will tell

the story the ironclads played on inland waterways during the Civil War. Finding the *Cairo* was a historical puzzle which took years to solve; raising her from the gluey

## The Lexington—one memorial still at sea



**T**he USS *Lexington*, oldest operational aircraft carrier in the world, is destined to become a memorial at Pensacola, Fla., one of these years. It was supposed to have happened this year, but *Lexington* just refuses to end her usefulness to the U.S. Navy.

Stripped of her armament, she continues in service as a training carrier and is not now scheduled to be decommissioned until 1981. Meantime, the folks in Pensacola can watch the lively *Lex* move in and out from the Gulf on a frequent schedule.

Few ships have such a varied and distinguished history. Commissioned in February 1943 as CV16, the *Lex*, fifth Navy ship (and second WW II carrier) to bear her name, was in the thick of the Pacific war almost at once. She was the flagship of Vice Admiral Marc A. Mitscher and his swift Task Force 38. She survived a major *kamikaze* attack and became known as the ship that couldn't be sunk. Because of her topsides paint job, they also called her "the Blue Ghost." Her planes destroyed more than 850 enemy aircraft and sank or damaged almost a million tons of enemy shipping. She was decommissioned for the first time in October 1946.

At the time of the Korean War, the Navy decided it needed *Lexington* again. She was completely refurbished, fitted with an angled flight deck, then recommissioned in August 1955 as CVA16. She remained in the Pacific until 1962, serving in part as a qualification ship for fleet pilots.

In October 1962, *Lexington* came to her present base at Pensacola for the first time and was given a new designation—CVS16, an antisubmarine car-

rier with patrol duties in the Gulf of Mexico and Caribbean.

*Lex* entered the final stage of her naval career in July 1969, when she was once again refitted and redesignated, this time as CVT16, naval training carrier. As such, she qualifies over 2000 U.S. Navy pilots a year, providing them their first experience of landing jet aircraft on a ship's deck—also their first taste of being catapulted from a carrier into the wild blue with a mighty steam-powered shove.

So many planes have landed and



been launched from the *Lexington's* decks that the Navy has almost lost count. The total may exceed a half-million before final decommissioning.

*Lexington* today is far from a ghost ship. Her top speed of 27 knots is only about three knots slower than it was when she was new 35 years ago. Her flight deck still swarms with aircrewmembers in their many-colored uniforms, as fledgling Navy tailhookers screech to arrested landings where their fathers might once have been "waved off."

If there is a nostalgic corner on *Lexington*, it may be the now unused flag bridge with its two great swivel chairs, where the likes of Nimitz and Halsey once sat and determined the course of history. Not to mention Glenn Ford, who perched there and deliberated like a real admiral in the epic film, *The Battle of Midway*.

The old admirals may be gone, but on *Lexington's* bridge a new generation of naval officers carries on the tradition.—C.B.



Periscope photo of a Japanese cruiser sinking was taken by *USS Croaker*, is on display at Groton, Conn. Though Groton-built, *USS Cobia* (right) is a memorial at Manitowoc, Wis., where 28 WW II submarines were built—and none remain intact.

mud of the Yazoo River in 1964 was an engineering task which required four derricks with a total lifting capacity of 1000 tons. The *Cairo's* museum will be finished this fall; the ship itself can be viewed only from a distance until the restoration is complete.

Such is the affection of Americans for their Navy and the part it has played in the nation's history that even bits and pieces from famous ships are preserved in almost every state of the Union: an anchor here, a bell there; conning towers, guns, figureheads, propellers, mainmasts, turrets, flags, wheels—even bilge pumps and mess tables.

### Retired fleet impressive

The greatest attractions of all, however, are the many warships of World War II which have become memorials, notably in the last decade. These are the ships which people can recall from a war many still remember; actors in a great drama, heroes of a global contest.

Counting only ships which saw service in World War II and which, unlike *Arizona*, are still afloat or intact, this retired fleet consists of five battleships, one carrier (soon to be three), two cruisers, two destroyers, 16 submarines, one destroyer escort, countless smaller craft such as motor torpedo boats, mine sweepers, —even one captured German sub.

Despite its age, dispersion and decommissioned status, this adds up to a naval force of awesome potential, a "navy" worthy of several world powers. Norman Polmar, former U.S. editor of *Janes Fighting Ships*, calculates that among ocean-going navies, the U.S. memorial fleet would rank fifth in the world, right behind the U.S., U.S.S.R., Britain and France. Britain and France, for example, have only two aircraft carriers each and the Soviet Union but one. No other nation has even one battleship in commission. It is easy to speculate that in the hands of a South American dictator or a Middle East oildom, a naval force the size of America's memorial fleet could up-

set any regional balance of power.

It was in 1956 that Congress passed legislation which authorized the Navy to transfer obsolete or condemned vessels to states, territories, municipal corporations or non-profit private associations. The recipient of a Navy ship must agree to provide an acceptable towing and berthing plan (tows are almost always necessary; in some cases propulsion machinery has been removed from the ship) and must also maintain the vessel in a condition satisfactory to the Navy. Most important, any group taking over a Navy ship must show evidence of having sufficient funds to do the job right. This can mean having as much as \$3 million in the bank. It's an approval not easy to earn.

The purpose of the program, after

*(Please turn to page 280)*



Under attack by Japanese aircraft (top), the carrier *Intrepid* survived, was back in the Pacific off Korea, even later off Vietnam (center). Funds are being raised to convert the ship, now in Philadelphia, into a New York City aviation museum.



### 'Torpedos . . . los!'

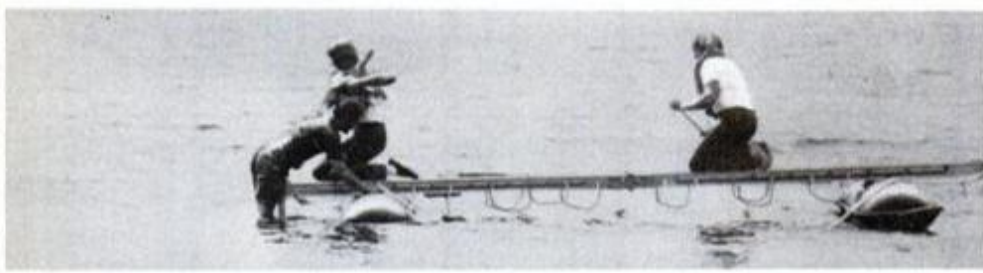
It's not one of ours, but the German World War II submarine U-505 is still one of the prime attractions at Chicago's Museum of Science and Industry. Its capture intact off the African coast in 1944 by a task group, led by the carrier *Guadalcanal*, was the first U.S. Navy

seizure of an enemy ship on the high seas since the War of 1812. Damaged and forced to the surface, the sub was towed to Bermuda, hidden there until war's end. Visitors are often impressed by the quality of wood joinery and cabinetwork inside the vessel.

## To the rescue

There are times when thin ice or surging waters pose as great a threat to rescuers as to the rescued. The Res Q Dek is said to eliminate this danger because of its two large, inflatable pontoons. The flotation bags are inflated by gas canisters in sev-

en seconds, and the whole unit can be deployed by two people in less than a minute from a paramedic van. According to the manufacturer, New Products Safety Corp. of Alsip, Ill., the unit has enough buoyancy to keep 20 people afloat.



## New uses for fiber optics



The fiber optic "dipstick" held above is one of several digital measuring devices that have been converted from analog operation through the use of fiber optics. Designed to measure temperature, pressure, flow rate, rpm and the like, the instruments are particularly suited to the development of all-digital aircraft. The use of fiber optics has several advantages. The dipstick, for example, can measure jet fuel level safely because there is no electricity to cause a spark.

## Recycling tired tires

Just before water started to trickle into the reservoir of the recently completed New Melones Dam near Sonora, Calif., the tires of the earthmoving equipment used to build the dam were recycled. Neatly stacked (right, top), the 400 tires will serve as a spawning and feeding area for schools of fish. Holes were drilled in the tire carcasses to let air out when the reservoir fills to its 30-foot depth.

Servicing quite a different sort of school, the playground at right is also made from old tires. An organization known as Tire Playgrounds Inc., of South Orange, N.J., claims to have developed a way to build safe, inexpensive playgrounds, using old rubber and volunteer labor. The system has been used in over 100 playgrounds, and with the volunteer labor, it's said to allow construction in one weekend at a cost of \$1500 to \$2500.





## Personal transportation for the handicapped



Why is the handicapped boy above wearing such a big smile? Because, thanks to some simple modifications of his tricycle, he can now ride around like other kids. Free plans for the modifications are available by writing to: Tricycles, Corporate



Public Relations, R.J. Reynolds Tobacco Co., Winston-Salem, N.C. 27102.

Meanwhile, a New York inventor has built a quick-detach, gasoline-engine power unit for wheelchairs. Top speed is about 10 mph, and range is about 40



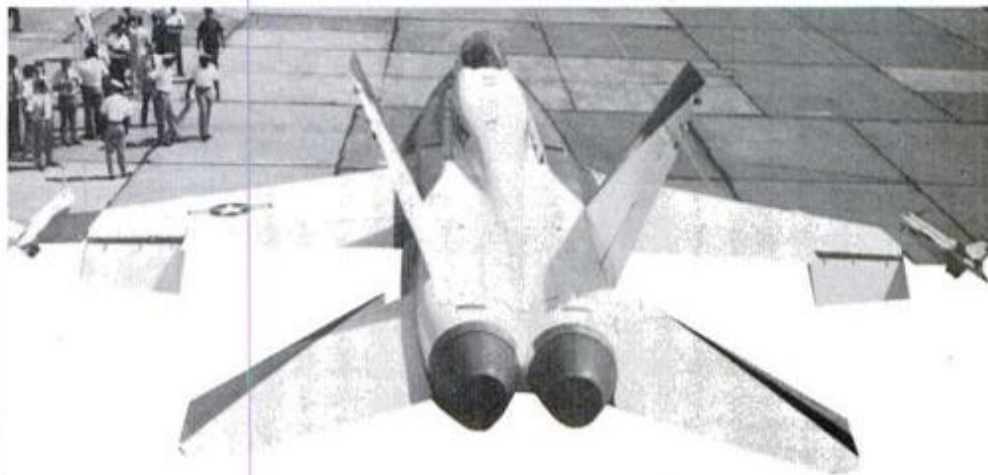
miles, according to inventor Robert Brewster (above). Speed and clutch controls are a bit crude on this first model, but could probably be mounted on a swing-away handle. Driver steers by applying friction to chair wheels with gloved hands.

## Air-powered cartridges

These recyclable cartridges use compressed air and air-gun pellets instead of powder and bullets. Made in Britain, they're used to reduce police training costs and lower lead pollution at heavily used firing ranges. After use, the rounds can be recharged with compressed air; properly maintained, they are said to have almost unlimited life. They fit a wide variety of standard law-enforcement weapons via the insertion of a barrel liner to reduce the bore.



## New Hornet will have a dual role



The McDonnell Douglas F/A-18 Hornet is shown at its recent rollout. As a dual-role fighter escort/attack aircraft, it is part of a trend towards multipurpose planes. Ten

percent of the fighter's weight is composed of graphite epoxy composite construction. It also features 360° pilot visibility and digital flight controls.

# PM CROWNS



Chess master Shelby Lyman moderates a game between computers Chess Challenger 10 and Boris in New York's famed Marshall Chess Club. The computers both put up furious fights and proved—like humans—a good computer never says die!



# THE COMPUTER



Electronic grandmasters go at it in 75-plus hours of grueling tournament play.

by Shelby Lyman



# CHESS CHAMP

Chess-playing computers fill department store showcases throughout the country, their arrays of buttons and glowing red readouts an intimidating sight. Just the thought of a computer that can play chess—that can “think”—seems almost unbelievable.

But play chess they do, and they can play a good game! Will you answer the challenge of man against computer? And, if so, which of the machines is for you? Each of them, in their advertisements, claims to be better than the others. What's the real story?

To find out, we took the four most widely available of these chess-playing think tanks—Boris (\$300 from Chafitz Inc.), Chess Challenger 10 (\$300 from Fidelity Electronics), CompuChess (\$180 from DataCash)

and Chess Champion (\$100 from JS&A)—and pitted them against each other in a real donnybrook of a round-robin chess tournament. We were looking not only for a winner, but for an insight into how these machines really are to play with.

Computers, like humans, think better when given more time. It was possible to have games that would go on literally for days. Instead, we chose to simulate a home environment and allow each machine no more than an average of one minute per move. It seems that our results justified our choice. After the tournament, we handicapped the stronger machines with shorter “think” times. They still defeated their weaker foes.

As shown at right, Boris and Chess

(Please turn to page 284)

	Chess Challenger 10	CompuChess Boris II	Chess Champion
Chess Challenger 10		1,1	1,1
Boris	0,0		1,1
CompuChess II	0,0	0,0	
Chess Champion	0,0	0,0	

Final Standings: Chess Challenger 6, Boris 4, CompuChess II 2, Chess Champion 0.

This round-robin scorecard is used by cross-referencing the computer players. Note that Boris, for example, won both as White and Black against Chess Champion (1,1) and that Chess Champion lost both of the games it played against CompuChess (0,0). This type of scorecard is standard in many of the actual chess tournaments that are sponsored by the United States Chess Federation (USCF).

Материал, защищенный авторским правом



Chess Challenger 10 from Fidelity Electronics was declared the winner of the tourney.

Boris (below), from Chafitz, is most personable machine—besides playing a quite respectable game. He delivers some 80 programmed comments, from pleas to outrageous insults.



JS&A's Chess Champion retails at \$100, lowest price of units tested. Though it finished low, it's a fun computer for playing or learning chess.



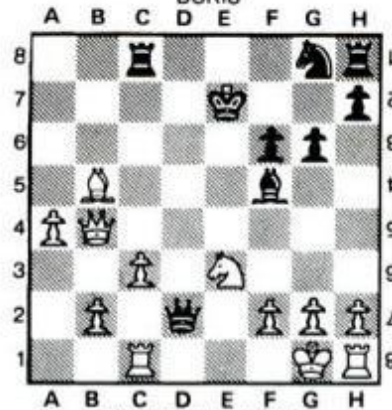
CompuChess, made by Data Cash Systems, can play different variations of chess as well as random middle-game situations.



## DANGER LURKS!

AFTER 24. a5-b4 ch

BORIS



CHES CHALLENGER

WHAT IS BORIS'S ONLY PLAYABLE MOVE?

The following game is a sample of our tournament chess-computer games. The notational system we use is simple—in fact, much simpler than systems used in most chess books.

Each move is described by giving the initial and final square of the piece moved. And each square is described by obvious letter-and-number coordinates. For example, the first move in the game is given as E2-E4. The pawn on the second square, on the E file, moves two squares forward to the fourth square on that same file. Black's answer, D7-D5, similarly means that black's pawn, on the seventh square on the D file, moves two squares to the fifth square on that file.

The next move, E4-D5, represents a capture. The white pawn on the E4 square has gone to the D5 square where it has captured the black pawn. And so on . . .

You will find that the play is energetic and highly tactical. The machines go at each other in a virtual slugfest. But Chess Challenger wins a substantial advantage when it slyly traps Boris's queen. Then, with admirable aggressiveness, it switches to the kingside and mates black's king. Even on the fifth or sixth time around, I found the game fun to play over.

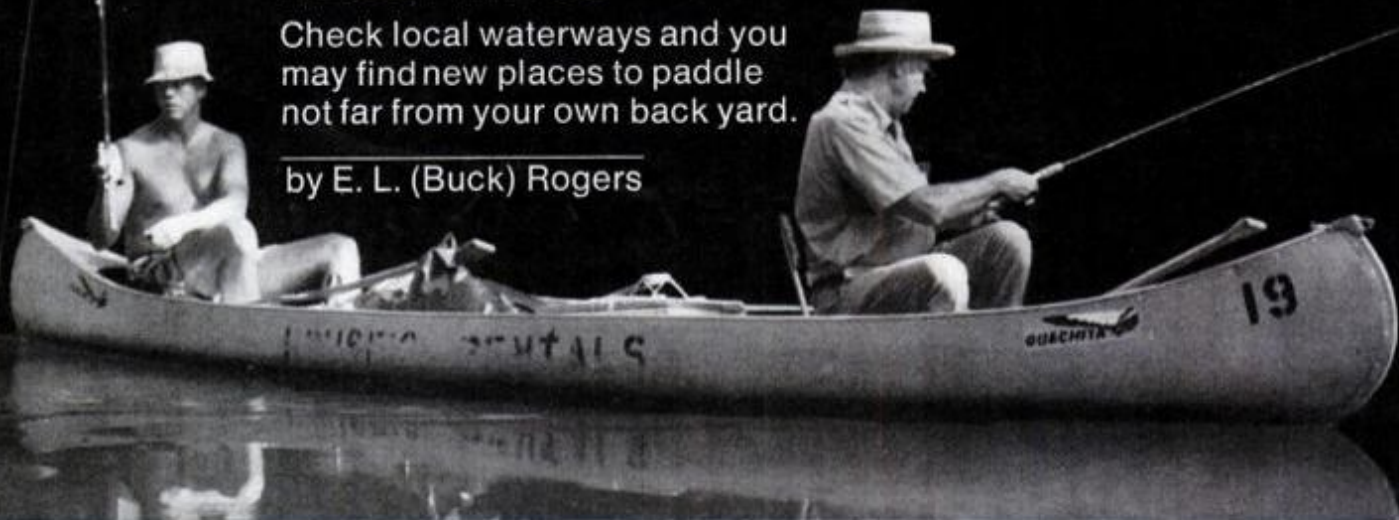
CHALLENGER	BORIS	CHALLENGER	BORIS
1. E2-E4	D7-D5	20. A7-A5ch	D8-E7
2. E4-D5	C7-C6??!	21. F1-G1?	F8-H6
3. D5-C6	B8-C6	22. D2-F1	H6-C1
4. G1-F3	C6-D4?	23. A1-C1	B8-C8*
5. F3-D4	D8-D4	24. F1-E3	D6-D2*
6. F1-E2	E7-E5	25. A5-B4ch <sup>10</sup>	E7-F7??
7. C2-C3	D4-E4	26. C1-D1!	D2-D1ch <sup>11</sup>
8. E1-F1??	E4-C6*	27. E3-D1	F5-C2
9. D2-D4	E5-D4	28. D1-E3	C2-F5
10. D1-D4	C8-E6	29. E3-F5	G6-F5
11. B1-D2	F7-F6	30. B5-D7	C8-C7
12. E2-H5ch	G7-G6	31. D7-F5	G8-E7
13. H5-F3	C6-A6ch	32. B4-B3ch	F7-G7
14. F3-E2	B7-B5	33. F5-C2	C7-C6 <sup>12</sup>
15. D4-D3!	A8-B8	34. B3-B4	H8-E8
16. A2-A4!	E6-F5	35. B4-G4ch	G7-H8
17. D3-E3ch	A6-E6	36. G4-H5!	E8-B8?? <sup>13</sup>
18. E2-B5ch	E8-D8	37. H5-H7	
19. E3-A7?	E6-D6*		mate!

1. Boris's characteristic opening gambit.
2. Moving piece again prematurely and thus wasting time.
3. Why not simply castle?
4. Wasting time. Why?
5. The right decision. White can safely take pieces.
6. To protect the threatened rook.
7. Why?
8. Why? A computer move that drives you bananas.
9. Poor Boris doesn't see what's coming.
10. Closing the net by protecting the pawn at B2.
11. What else? The queen is trapped.
12. Why?
13. Boris inexplicably saves the threatened rook, but overlooks the mate.

# Bargain float trips near home

Check local waterways and you may find new places to paddle not far from your own back yard.

by E. L. (Buck) Rogers



**Y**our boat drifts lazily around the bend of the river and you stop fishing to watch a startled doe leap from the water's edge into the thicket. Ahead you may hear the muffled roar of another stretch of whitewater rapids to navigate. Behind are memories of big fish that got away, steaks sizzling over a bed of hot coals, mist-shrouded dawns, and evenings spent around a campfire listening to the whisper of the river.

Such is the appeal of a wilderness float trip, and it's an outdoor experience which is growing more popular each year. It also costs a bundle of money. In the Ozarks, and on many of our western rivers, the price tag of a three-day float excursion for two persons can approach \$500.

But what if you could do the same thing in your own back yard for just a few dollars? You can. Here's how.

As an example, the Niangua River in central Missouri is considered anything but "wilderness." In its upper reaches, it flows through a state park jammed with trout fishermen, sunburned swimmers, camping rigs and yapping dogs. The lower portion forms one of the arms of the Lake of the Ozarks, which attracts hordes of locals and midwest vacationers. At first glance, the Niangua would not seem a likely place to escape honking horns and the press of people.

But it is. For 20 miles, between

the two concentrations of civilization, the Niangua is an unspoiled scenic stream which is ideal for a three-day wilderness float. It's not unlike thousands of other streams, some of which flow near your own back yard.

## Proving the point

To prove the point, four of us floated this stream recently. We took two cars, loaded a canoe on top of each, and filled the trunks with grub box, coolers, sleeping bags, tarps and plenty of beer. Then we drove to our upstream access point and unloaded everything on the river bank. Two of us stowed gear in the canoes while the other two in our party drove the cars to the downstream landing where we planned to end our float two days later. Leaving one car there, they returned with the other just as we completed loading.

We embarked at 3:00 p.m. Knowing from experience that good campsites are difficult to find, we'd decided that in two hours we would start looking. Meanwhile, we tied on spinners and caught 10 trout as we drifted, keeping six for our evening skillet.

Two hours of daylight were left when we found a broad gravel bar three miles downstream at the foot of a riffle, overlooking a deep hole, with a rock bluff on the other side of the stream. It was scenic, offered an escape route in case of a flash flood, and probably would be rela-

tively free of mosquitoes. In our party was Lloyd, an old friend; Doc Holsman, now known as the "gravel bar gourmet;" and his friend Charlie—all congenial and relatively knowledgeable outdoorsmen who made short work of pitching camp and sharing the chores. In 30 minutes everything was in order, with sleeping bags spread and equipment laid out where it could be easily reached during the night.

Evenings are among the highlights of a float trip. First comes cocktail hour while the fire burns down to a heaping bed of red coals. Then the rack of ribs goes on the grill to cook slowly at the edge of the fire. Salad is prepared and the spinach soufflé, frozen in a plastic bag, goes in a pan of water to thaw. With everything almost ready, the trout are arranged in a big frying pan to brown over the fire.

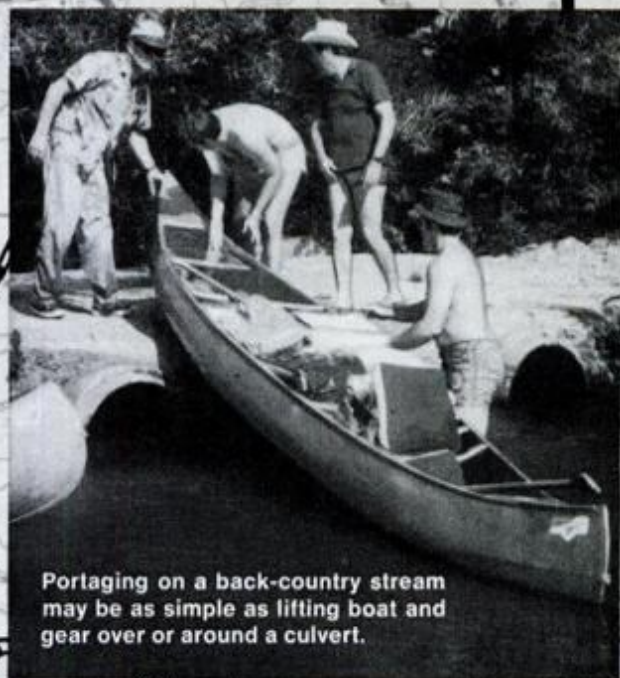
Then, in a few minutes we grab plastic plates and heap them full while Doc uncorks a bottle of wine. After dinner, chatting around the fire, we plan the next day. Often sleep does not come quickly on the

*(Please turn to page 250)*

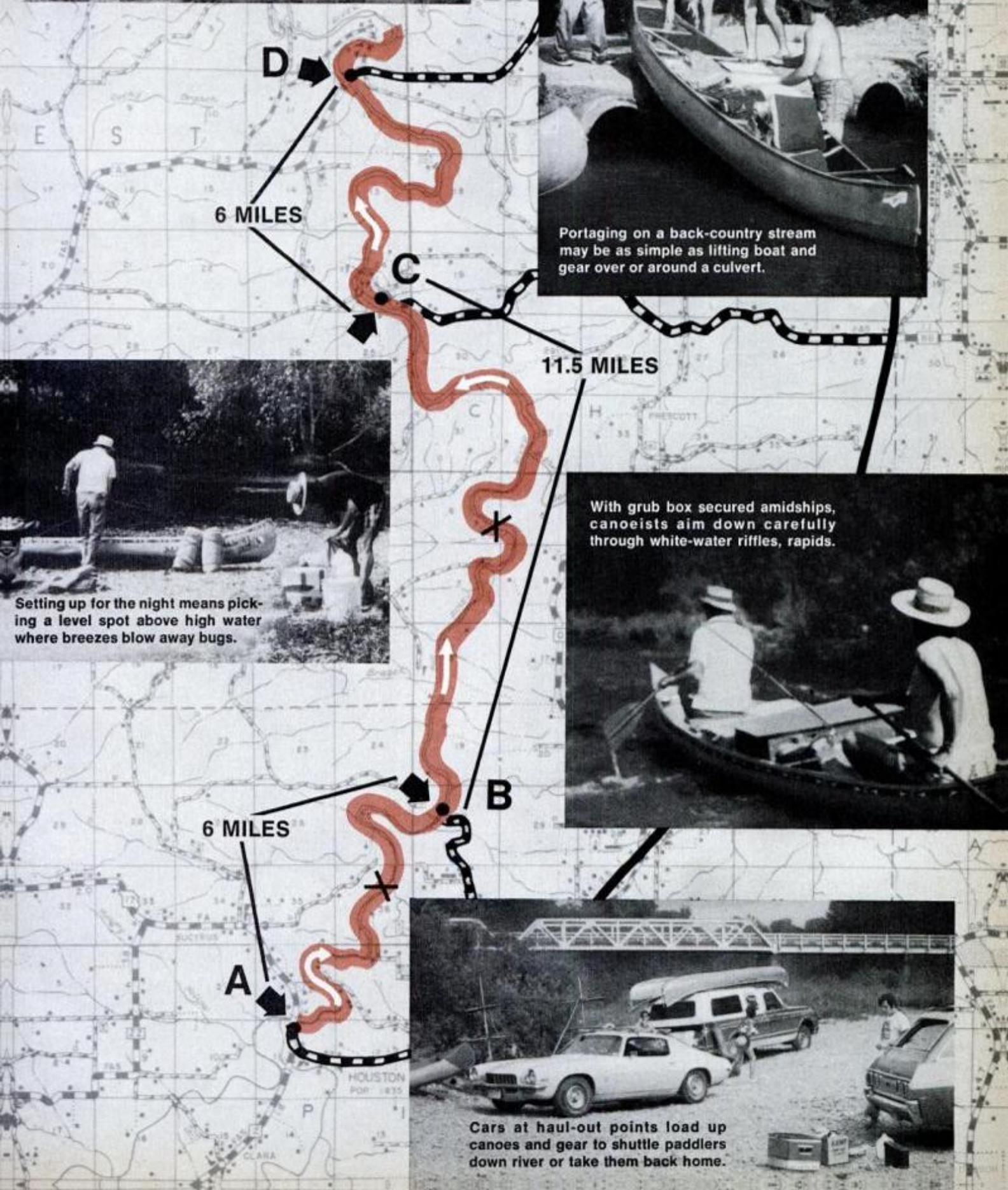
**On a 25-cent county map, like one from the Missouri Highway Dept. (right), mark likely launch and haul-out points (A, B, C, D). Easy weekend float would be halfway from A to B (3 miles) on a Friday late afternoon, 8 miles Saturday toward C and haul-out Sunday at C. The C-to-D stretch adds a day.**



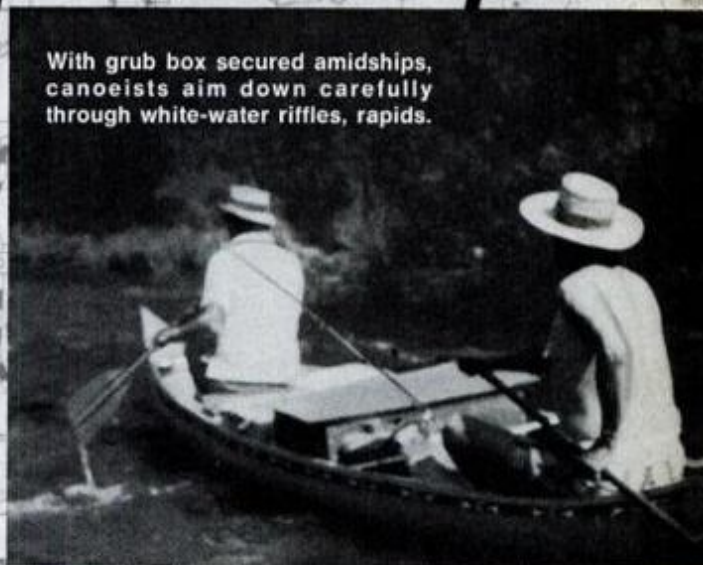
A sandbar only a few miles from home, plus simple equipment, can make a comfortable camping spot.



Portaging on a back-country stream may be as simple as lifting boat and gear over or around a culvert.



Setting up for the night means picking a level spot above high water where breezes blow away bugs.



With grub box secured amidships, canoeists aim down carefully through white-water riffles, rapids.



Cars at haul-out points load up canoes and gear to shuttle paddlers down river or take them back home.



# INDY 500

## The men behind

by Pack Bryan

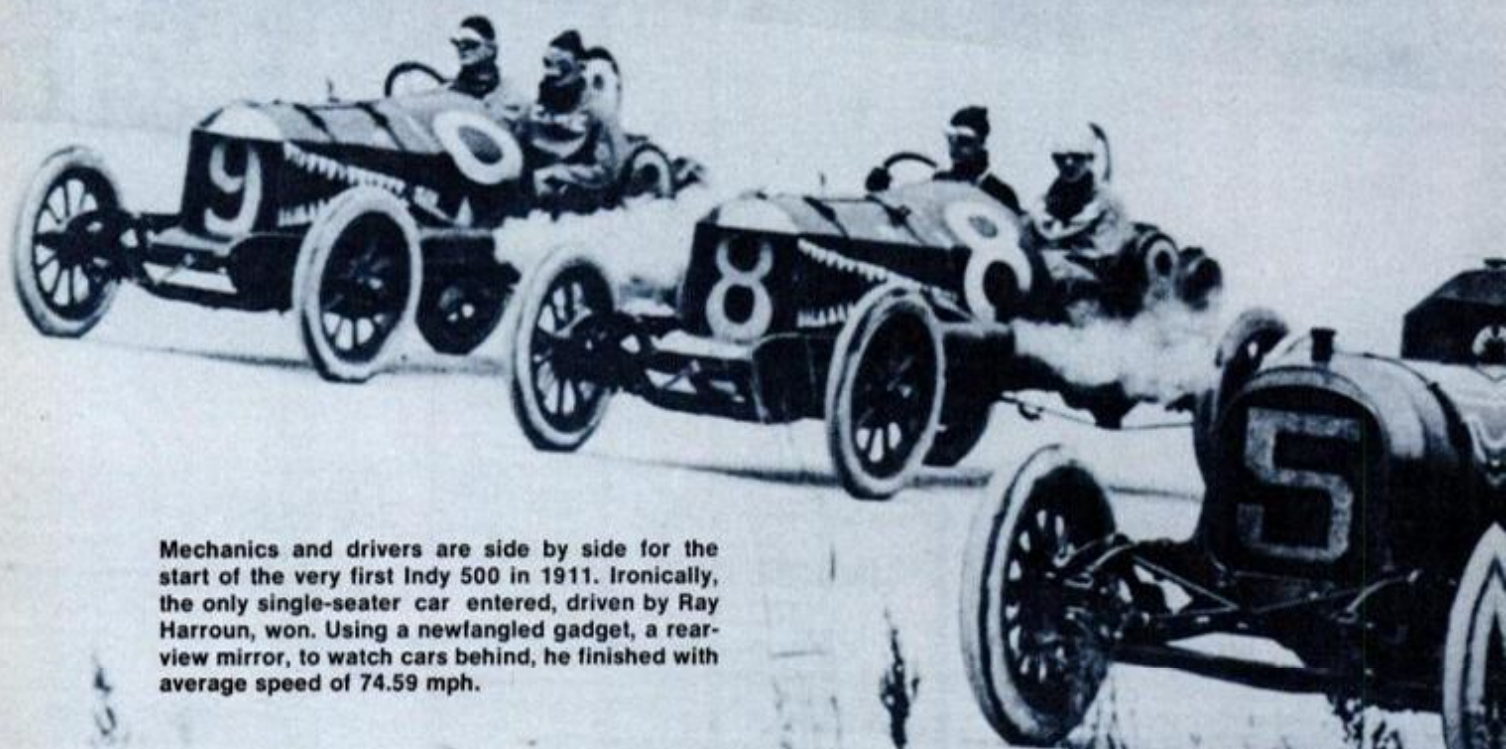
**R**emember the days of the two-man cars at Indy? They ran from 1911 through 1922, and then again from 1930 through 1937. A riding mechanic sat alongside the driver throughout the race and it wasn't a job for the faint-hearted! Cleon Tchan, veteran rider of the second era, once described his experiences as "afternoons of stark terror."

Picture the Speedway in the '20s and '30s: Two and a half miles of rough-riding brick pavement, often slippery with spilled oil; rock-hard tires carrying 60 to 80 pounds of pressure; open-cockpit cars without safety belts; two men wedged behind the wheel, not quite side-by-side, the driver on the left, a shoulder in front of the

In winner's circle (above) is riding mechanic "Jigger" Johnson, left, who rode with Wilbur Shaw for his 1937 win. Shaw-Gilmore Special (below) set a new record of 113.580 mph.



They used to



Mechanics and drivers are side by side for the start of the very first Indy 500 in 1911. Ironically, the only single-seater car entered, driven by Ray Harroun, won. Using a newfangled gadget, a rear-view mirror, to watch cars behind, he finished with average speed of 74.59 mph.

# MECHANICS

## the machines

mechanic; cars running often within a foot of the outside "retaining" wall.

"It wasn't the drivers whose heads and arms were barely scraping the wall, it was ours," exclaimed Tchan. "No wonder they were so brave; they had us as cushions!"

Ernie Olson, on the other hand, one of the great mechanics of the 1920s, knew that's where he wanted to be during a race, despite the dangers and kidney-pounding ride. And it was a *hard* ride, too. Shock absorbers, if they were used at all, were crude affairs that usually didn't last past the first 100 miles. So, to keep the car from reacting to spring rebound after every bump, they just used harder springs. In that little nugget, by the way, lies

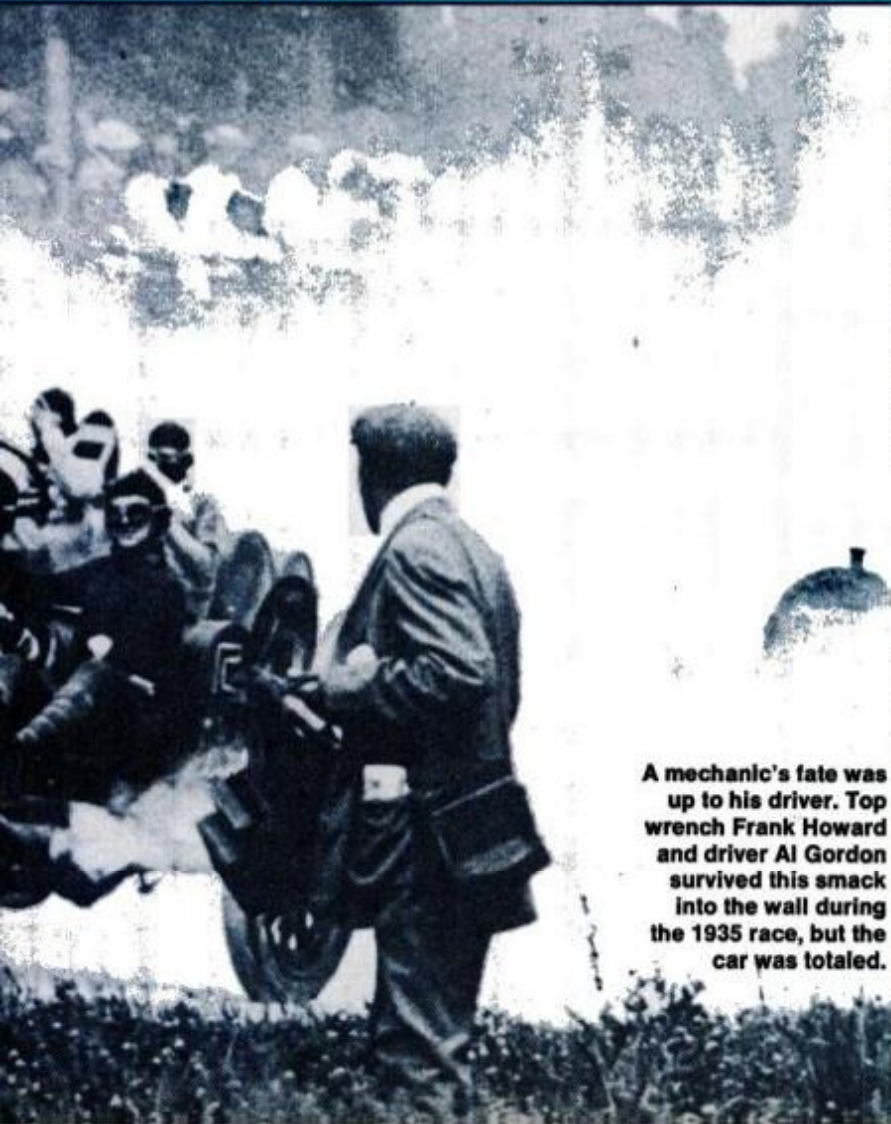
Louis Meyer, Indy's first three-time winner, is at the wheel in these photos with brother Harry on 1937 ride. Pushing is Lawson Harris, riding mechanic in two of Meyer's Indy wins.



## go along for the ride...



Cheek by jowl in their cars, mechanics and drivers start the 1934 race. Stacked in tiers in the famous pagoda at Speedway are race officials, timers and press.



A mechanic's fate was up to his driver. Top wrench Frank Howard and driver Al Gordon survived this smack into the wall during the 1935 race, but the car was totaled.



## ... But look at the Indy mechanics' job now!



Colorful fleets of mobile machine shops pull into the infield during the mad month of May. The huge, 40-foot trailers are decked out with lathes, milling machines, drill presses, electric welding equipment and tons of tools. Dan Gurney's Eagles are borne to the Speedway in this big rig where his mechanics spend hundreds of hours in pursuit of the Indy 500 win. All photos are of Dan's rig except for the Parnelli Jones "pit wagon" (middle left) which has translucent roof for good light inside.

the genesis of the common assumption that a car must be heavy to ride well.

Riding with Jimmy Murphy in the last race of two-man cars in 1922, Olson knew he'd be in for a beating and bound his whole torso in heavy surgical gauze. Within 5 hours, 17 minutes and 31 seconds, according to racing historian Griffith Borgeson—their winning time—mechanic Ernie Olson

was lighter by *eleven pounds*.

Ray Harroun had proved, while riding alone to victory in the very first 500, that the riding mechanic really wasn't necessary for a closed-course race. But every one of the other 39 cars in the 1911 race had two occupants—and it wasn't until Tommy Milton won his second 500 in 1923 that another driver crossed the finish line

without a mechanic riding with him.

In the early days of racing, when most races took place on the open road, an extra man *was* necessary—to help the driver find his way, change a tire, fix a sputtering engine and, if things were going well, look back to check the competition. When public pressure moved racing off the roads and onto the many dirt-surfaced horse tracks



# GASOLINE ALLEY



Gasoline Alley—a few rows of wooden garages—is where mechanics work wonders, often in the wee hours of the morning before the race. In addition to the equipment that racing teams bring to Indy, the Speedway maintains a tool crib; other outfits set up shop for specialized services like tire/wheel balancing and front-end alignment.



around the country, the riding mechanic went along.

There really wasn't much for him to do in closed-course racing, however. He wasn't needed as a navigator, and there were pit crews available for help in refueling, changing tires, and making necessary repairs during a race. True, he could work the side-mounted bicycle pump that pressurized the fuel

system, and he could listen for telltale knocks, clunks and thumps. He'd keep an eye on the gauges, another out back; mostly he hung on and prayed.

Peter DePaolo, winner of the 500 in 1925 and the first man to average more than 100 mph, attributed much of his success to all that he'd learned "riding" with Uncle Ralph. His uncle had determined that he could save a

second per shift if he'd keep both hands on the wheel and have his riding mechanic do the shifting on signal. "Uncle Ralph," incidentally, was the immortal Ralph DePalma, whose 1915 win at the Speedway was one of more than 2000 victories in about 2800 events he entered.

For every Peter DePaolo or Ernie [\(Please turn to page 271\)](#)

# Handbuilt cameras: the



These elegant beauties may pave the way for a return of the view camera.

by Bob Berger

Photos by the author

**F**or the past few weeks, I've been using three 4×5 view cameras that are among the most beautiful cameras I've ever seen. They are handbuilt, with the sort of painstaking craftsmanship that we nostalgically link with days gone by. But the cameras are not relics; they are brand new. The names Ikeda, Tachihara and Nagaoka may not be familiar to Americans, but in Japan, their cameras are standard tools for the serious photographer.

It's hard to imagine a Japanese camera that isn't made in an ultramodern automated factory. But these cameras were crafted one at a time in small workrooms on Tokyo side streets. In Mr. Ikeda's shop, for example, no automation can be found, not even the few power tools common to a basic home workshop. There are instead surgically sharp chisels, planes, saws and a few other hand tools. With this simple equipment and sinewy hands guided by 40

years' experience, Mr. Ikeda builds his cameras. Not far away, in similar shops, Masao Tachihara and Nagaoka-san proudly make the cameras that bear their names.

Building one camera at a time may not be efficient, but it is conducive to perfection. Joints fit with hairline precision. Adjacent screws are turned so that their slots run in the same direction. And the brass corner plates, also handmade of course, are inlaid so meticulously that a fingertip can't detect where wood and metal meet. The cherry wood, patiently aged and air-dried, is carefully selected from Japan's choicest. The sheepskin bellows are lined with silk. And the crowning touch, a finish as smooth and deep as that on a fine musical instrument, is achieved by applying coat after coat of hand-rubbed lacquer.

## Classic design

The result of all this incredible effort is an appealingly old-fashioned-looking camera. Its design is that of the classic flatbed view camera—deceptively bulky when opened and perched atop a tripod, but instantly transformed when folded into a flat, compact, easily portable package.

So small is the package that it can be stowed away neatly in a shoulder

bag—or even in an oversized pocket of a safari jacket. The Nagaoka and Ikeda fold to 2½×7×8 inches. The Tachihara is ⅝-inch thicker.

The light weight is remarkable. The Ikeda and Nagaoka each weigh a mere 2.6 pounds—lighter than some 35-mm single-lens reflexes. And even the Tachihara, at 3.3 pounds, isn't much of a burden.

Not only in size and weight are the Ikeda and Nagaoka virtual twins, but also throughout their technical specs. Both have a 13-inch bellows draw and an impressively short 2⅝-inch minimum bellows extension—permitting the use of a lens as short as 65 mm without the recessed lensboard required by some cameras.

As its weight and size indicate, the Tachihara is a bit sturdier than the Ikeda and Nagaoka. Two unusual accessories are available for the Tachihara: a 5×7-inch back, and a bellows ring for use with extremely long focal length lenses or ultra-close-up photography.

Any of these cameras would make a fine choice for a photographer needing an easy-to-tote 4×5. True, the lensboard adjustments are limited compared to those on a full-fledged studio view camera, but the Ikeda, Nagaoka and Tachihara are designed as field cameras. For that

# craftsman's art



Three stunning examples of hand-crafted quality (left to right): Ikeda, Tachihara and Nagaoka view cameras. Their light weight makes them perfect for field work.

say, the top of a tall building without tipping the camera upward, or for reducing a vast sweep of foreground. Swings and tilts are also provided at the camera back, to control image shape and focus.

The combination of large film size and complete control over composition, focus and image shape is the prime reason for the resurgence of interest in the view camera. Another factor, I suppose, is that with a 35-mm camera, particularly a motor-driven, electronic one, a photographer is sometimes inclined to be careless and becomes a snaphooter. But the view camera photographer is forced to work slowly and compose each shot with care.

The Ikeda and Tachihara can be purchased directly from Lee Beeder Cameras, 1728 North Vermont Ave., Hollywood, Calif. 90027. The Ikeda, without lens, costs \$289, or \$314 with gear-drive adjustment of back swings. An unusual option package, gold-plated hardware and red bellows, costs \$35 extra. Tachihara price is \$395 without lens.

The Nagaoka is sold at some professionally oriented shops for a suggested retail price of \$359—also without lens. For more information, write Graphic Imports, 677 Ala Moana Blvd., No. 213, Honolulu, Hawaii 96813. **FM**

purpose, they are very hard to beat. Movements on the cameras are similar. Lensboards can be tilted forward or back to modify or help control focus. The lensboards can

also swing (twist on a vertical axis), also to help control focus. Completing the lensboard movements are a rising and falling front—a frequently used adjustment for taking in,

## A low-cost alternative

If you lust for a view camera, but your budget won't budge, how about building your own? An ingenious kit, designed and sold by architect and college professor Lester Fader, makes it possible for anyone to build a 4x5 view camera, without special tools or tricky workshop techniques.

The camera is not fancy, but it works. The kit sells for \$85, and putting it together is an interesting way to spend a few evenings—from 15 to 20 hours in all, depending upon how adept you are.

Finnish plywood (with hardwood layers) is used for the major structural parts—the platform and the front and rear standards. The pieces come pre-cut, leaving little to be done except careful fitting, sanding, and assembling. Also included in the kit are bellows, lensboard, assembled ground-glass back, hardware, and excellent illustrated instructions. Lens and shutter are not furnished; a good unit costs about \$225 and up.

Because Les Fader has done most of the work, you need only a few tools—some C-clamps, screwdrivers, a square, scissors and knife. You'll also need wood glue, contact cement, epoxy and sandpaper.

The kit may seem easy to assemble, but it's important to resist the temptation to work hurriedly. Extra time devoted to fitting and smoothing each part will pay big dividends in operating ease and appearance of the camera.

Fader inspires variation of the basic design

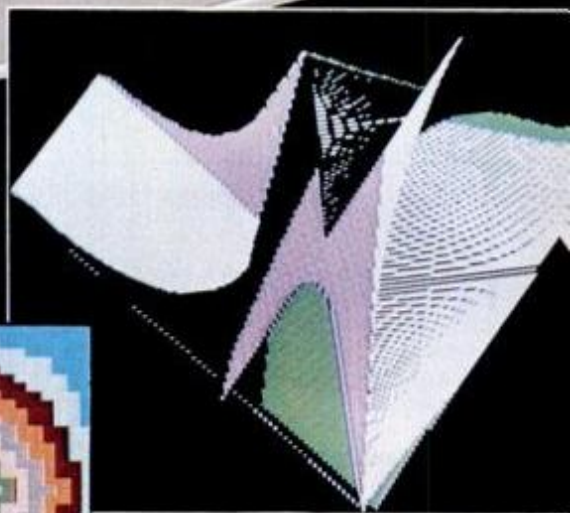
by offering, at extra cost, construction details for two items vital for wide-angle work—bag bellows and a recessed lensboard.

Fader also offers complete plans for a roll-film back. For information, write to Lester Fader at 1402 Bardstown, Ann Arbor, Mich. 48105.—Bob Berger

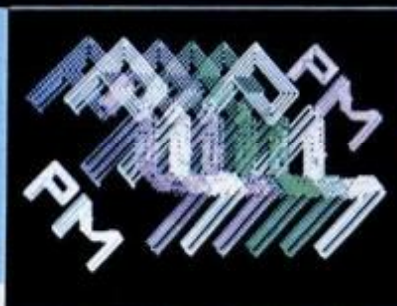




The drawing at right and the large one above were produced by one computer program that creates the basic image, then shifts colors and designs.



Computer drawings do not have to be abstract. They can be as familiar as the letters of the alphabet—or you can even draw common, everyday scenes.





# Art by computer

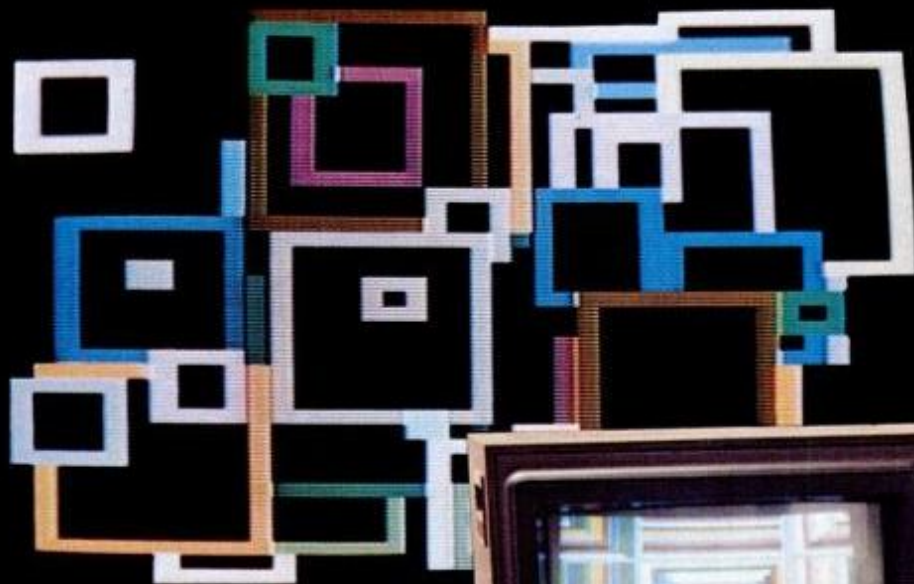
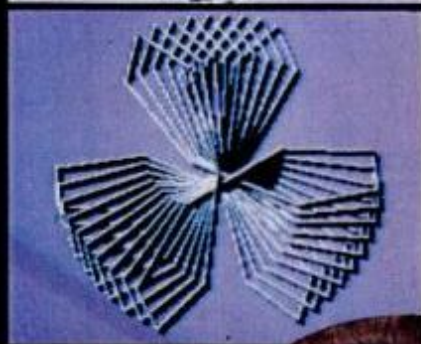
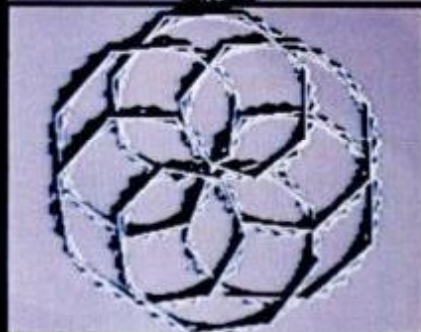
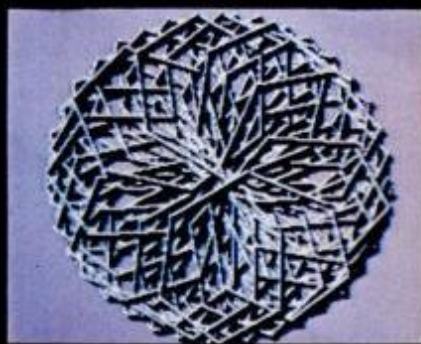
You don't need a million-dollar studio to become an electronic Rembrandt—just a color TV and a home computer.

by Neil Shapiro ELECTRONICS EDITOR

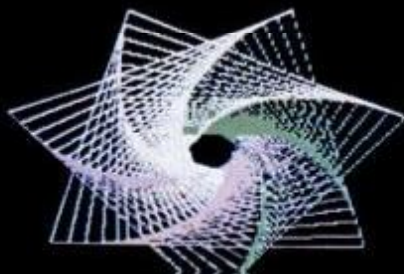
**N**ow anyone can draw complex and colorful patterns right on the screen of a color TV. You can draw everything from stars and intricate geometric shapes to truly mind-boggling kaleidoscopic designs that shift color and change form faster than a bedazzled viewer's eyes can follow. All you need is a home computer that has color graphics capability, a little practice in computer programming, and

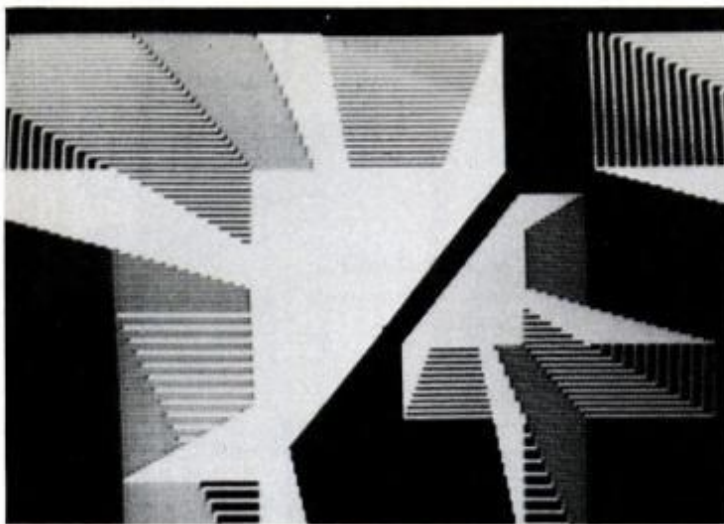
enough aesthetic judgment to know when you've achieved something worthwhile.

Computer graphics have been widely used by television in the past few years, as well as in movies like *Star Wars*. Using the Basic language, home computers can be programmed to simulate colors that seem to flow right out of the screen in a false perspective that literally grabs one's gaze; to bend,

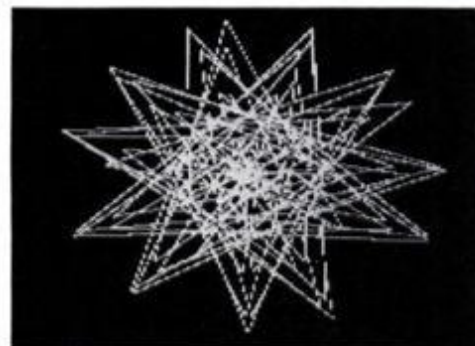
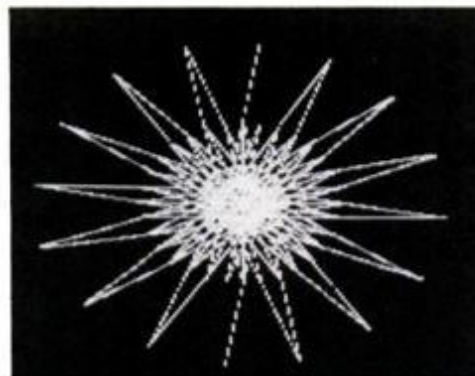
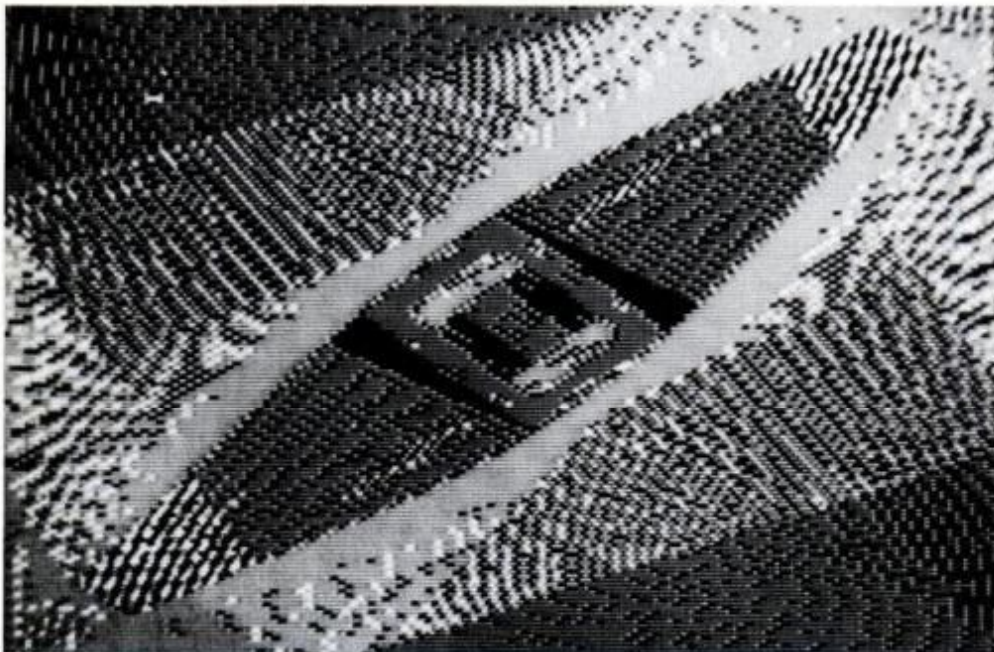


The Apple II computer was used to display all these designs on the screen of a Sony TV set. PM's Electronics Editor, while no artist, was able to produce these effects with computer help.





The Apple II computer can draw in either low or high resolution. The high resolution turns on much smaller points on the TV screen than the low resolution. So, if you want to show shapes of intricate complexity—as pictured here—you will have to use the high-resolution capability. The only drawback to high resolution is that there are only four colors available instead of 15 in low resolution.



warp or scroll images such as company trademarks across the screen; to draw bright, eye-catching designs in endless variety—and many other artistic applications.

It used to cost millions of dollars for the equipment needed to do even the simplest computer graphic. And the programming ability needed was more than average nonprogrammers could achieve.

All of that has changed. Computer graphics have come home, right into the living room with the advent of the personal computer. The Apple II computer (which PM used), the Videobrain computer, the Compucolor computer—and probably others by the time you read this—all offer color graphic capability for well under \$1000. For display they can use home color TV sets (the photos we show were taken using a Sony Trinitron). Of course, like all personal computers, they can do many other things besides draw pictures; but it is their color graphics that set them apart from other systems.

Programming is no longer the esoteric realm it once was. These home computers speak the Basic computer language, which can be learned by almost anyone in less than a week.

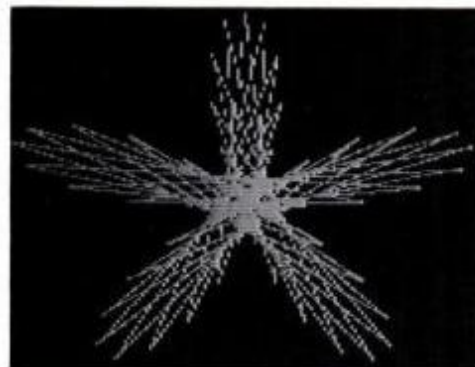
Suppose you want to program your

computer to draw a straight line. Computers divide the TV screen into a grid along an X-Y axis (the Apple II's grid is 40 by 40 units). Points are then plotted on that grid in much the same way you might have plotted points on graph paper back in high school geometry. It is your job to tell the computer—to program it—to "turn on" a series of points all in a row in order to form that straight line. Some computers require that each point be separately programmed. Others, such as the Apple, do a bit of the work for you.

### Are artists threatened?

What makes computer art different from ordinary drawing? For one thing, it is a dynamic process that is more like making a movie than taking a still photograph. One minute a program may be displaying a bright red, many-pointed star and then it will overdraw it with a green square of color—all at a speed that seems designed to keep your attention riveted to the screen. (Remember the last part of *2001—A Space Odyssey*? The effect can be much the same.)

Does this mean that computers will replace humans in art? Will the next Rembrandt be a conglomeration of integrated circuits and memory chips?



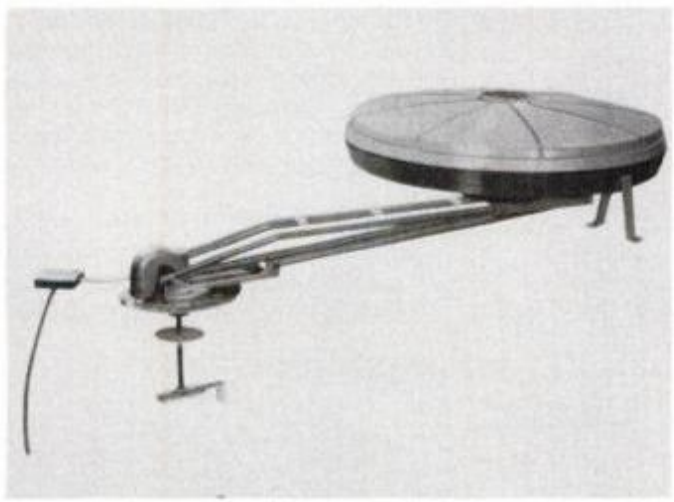
Many authorities have tried to answer that question—in both ways. We tend to feel that it will never happen—that asking if computers will replace artists is like asking if paintbrushes will replace them.

The computer is a tool. If an artist buys one and takes the time to learn how to program it, he will certainly produce better graphics than a nonartist as he will develop better ideas on how to use the computer. However, people who have not been able to draw a straight line will now be able to do so—as well as make designs such as we present here.

The computer is not the artist of the future—but it may very well turn out to be the paintbrush of the future.



# IT'S NEW NOW



## Rotating TV antenna

This 21-inch-diameter rotating TV antenna is designed for vans, RVs and boats and for home use. The unit is said to provide sharp signals within 35 miles of TV stations. It plugs into 12-v.d.c. or 120-v.a.c. and comes with remote control, power supply, matching transformer, coax cable, mounting mast and hardware. Stock No. 80,277 is about \$130 from Edmund Scientific Co., 7782 Edscorp Bldg., Barrington, N.J. 08007.



## Iron support

The Idle-Rest can hold most soldering irons in its cradle, the maker says, while the exterior of the holder stays relatively cool. Unit comes with desoldering wick, solder, parts tray and self-wetting tip-cleaning sponge. Model TL194 is about \$20. Edsyn Inc., 15958 Arminta St., Van Nuys, Calif. 91406.

## Voltmeter reads temperature

The TP-28 temperature probe converts an analog or digital voltmeter into an electronic thermometer. Plug-in unit measures from  $-50^{\circ}$  to  $+150^{\circ}\text{C}$ . ( $-58^{\circ}$  to  $+302^{\circ}\text{F}$ .) to within  $\pm 1.7^{\circ}\text{C}$ . Switch converts readings to Fahrenheit or Celsius. Price is \$75; 9-volt battery is not included. B & K Precision, 6460 West Cortland St., Chicago, Ill. 60635.

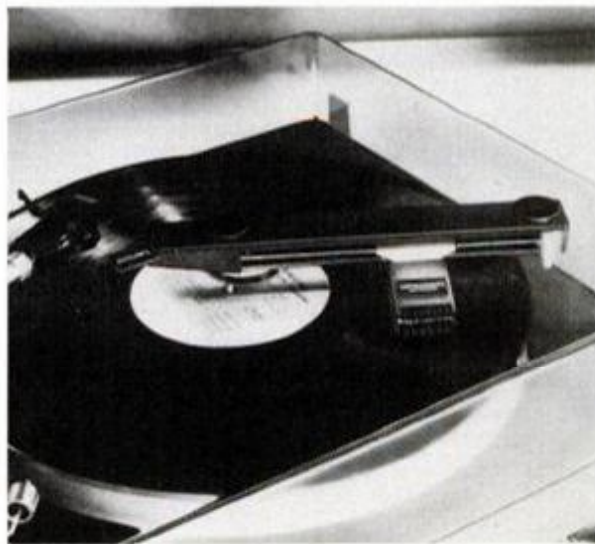


## Upstanding bike gadget

Many owners of lightweight bicycles don't like the added weight of a kickstand, but they would like to keep the bike stable when it's parked. The Flickstand, mounted on the frame's down tube, flips down to steady the front wheel. The 26-gram unit installs with a screwdriver. About \$4 from Rhode Gear USA, 111 Empire St., Box 1087, Providence, R.I. 02901.

## Plug performance at a glance

An erratically pulsating neon light on the System 80 Monitor can help pinpoint ignition trouble in your car. The dashboard-mounted unit is available for four- and six-cylinder engines. Raven Accessories Ltd., Apta House, Mesnes Green, Cherry Orchard, Lichfield, Staffordshire, England.



## Reduce static

The Lencomatic record-cleaning system removes electrostatic charge, dust and dirt, the maker says. A traveling brush assembly mounts inside the turntable dust cover, and a conductive foil pad rests beneath record. Electric charge is conducted from brush through a spring contact to turntable spindle. Charge underneath is conducted to the foil. When dust cover is raised, brush returns to starting position. About \$20 from Neosonic Corp. of America, 180 Miller Pl., Hicksville, N.Y. 11801.

**O**ldsmobile pioneered General Motors' entry into front-wheel drive (fwd) back in 1966, when the first Toronado bowed.

The Toronado marked a distinct break with the past—it became America's first *successful* application of fwd in a large, heavy, luxurious car. Previously, successful front drives had always been small, fwd being most often found in imports. And earlier domestic fwd autos like the Ruxton and Cord can't really be called commercial successes, fondly remembered as they are.

Times change, and GM is currently



**Toro's styling rates high with owners, but a few consider grille design too uninspired.**

joining the worldwide fwd revolution in a major way, especially with its downsized 1979 E-cars (Toronado, Eldorado, Riviera) and now with its crop of 1980 compact X-cars—Citation, Phoenix, Skylark and Omega (see page 108).

General Motors did amazing things with its first-generation Toronado. The drive train incorporated an automatic

## PM OWNERS REPORT: OLDSMOBILE TORONADO

transmission—quite unusual for a fwd car back then. The break-through that made the automatic possible was a silent Hy-Vo chain developed especially for this car by GM's Hydra-Matic Div. and Borg-Warner's Morse Chain Div.

The car also had lubed-for-life, constant-velocity joints, plus torsion-bar suspension. The Toro came with a totally flat floor, and most power accessories were standard.

In 1967, the Eldorado borrowed the Toronado's basic engineering and became, in effect, Cadillac's Toronado.

All of which brings us to the new 1979 E-car—again an amazing piece of fwd engineering and perhaps even more successful than the first generation because of its smaller, lighter, better-balanced

packaging. The downsized Toronado has been highly praised in the motoring press and also here in PM's pages. So we were curious to get Toro owners' opinions. We questioned hundreds of them.

Because this survey was done early in the 1979 model year, our questionnaires reached only those who purchased their cars in September and October of 1978. Oldsmobile hadn't yet begun installing diesel engines in Toros. None were installed in September and only one diesel V8 was released by the factory during October. That's why there are no diesel owners in the results (diesel mileage estimated by EPA is 21 mpg).

### Styling, fwd are favorites

Front-wheel drive and styling ranked as our owners' first and second reasons for choosing the Toronado, with nearly 11

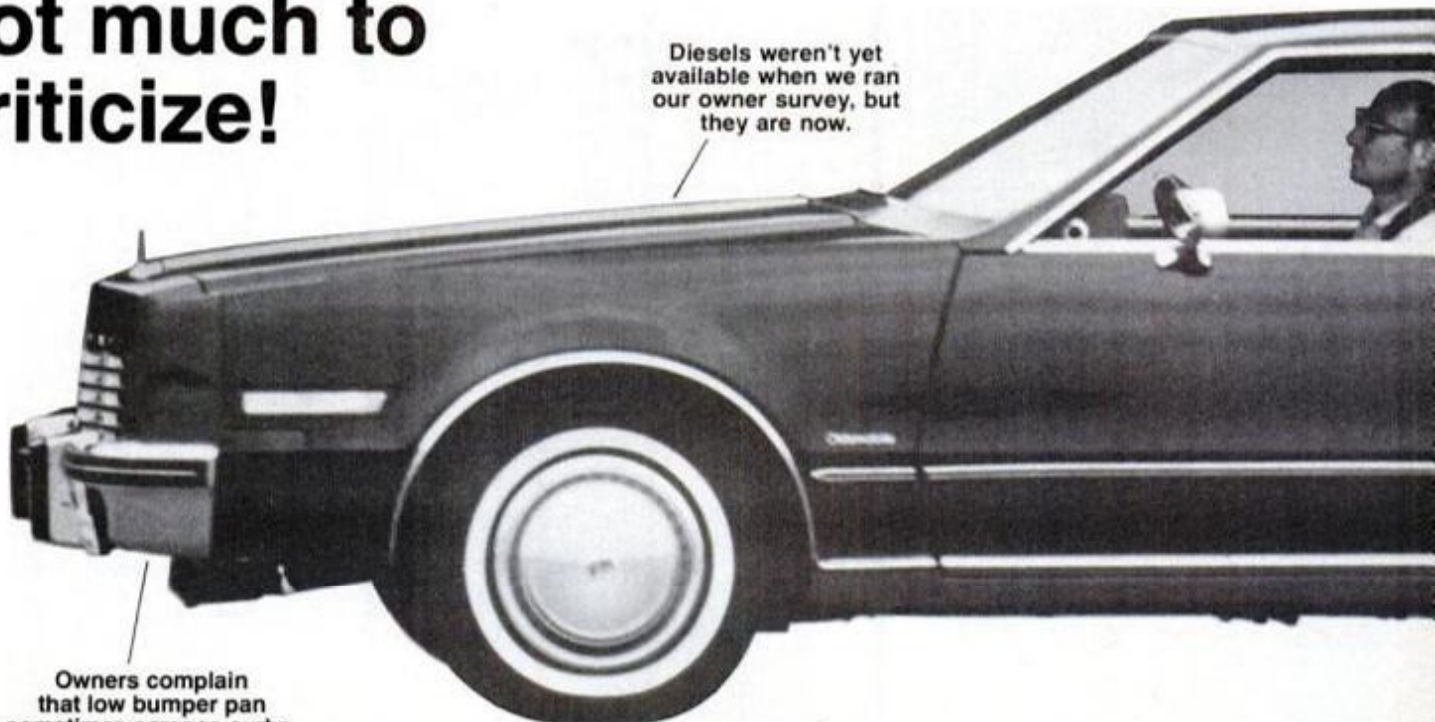


**Seating space, including legroom, was increased over last year's Toronado.**

BY MICHAEL LAMM WEST COAST EDITOR

# When 93 percent of owners surveyed would buy another, there's not much to criticize!

Diesels weren't yet available when we ran our owner survey, but they are now.



Owners complain that low bumper pan sometimes scrapes curbs.



percent having owned Toros before. A Wisconsin mechanical engineer summed it up for many owners when he told us, "Having owned a 1966 Toronado, I wanted to try this new model because the style and size appealed to me, along with the advantages of front-wheel drive."

"Good-looking car!" enthuses a Louisiana real estate and rental agent. "I was at my dealer making arrangements to buy a Buick Regal. The Toronado came in on



**Fwd and independent rear suspension add to rear seat space. Big doors ease entry.**

a delivery truck. My wife had to have it!"

A Wisconsin lab technician explains his confidence in Toronados based on past experience: "I've been driving Toronados for 12 years. I like front-wheel drive and to date have had very little trouble with it."

Handling brought extremely high praise, with over half our respondents list-

ing it as the attribute they like most about the car. They're not talking, though, about sports-car-like cornering power at high speeds; they mean, as a Nebraska accountant put it, "The Toro's front-wheel drive gives me security behind the wheel, especially driving on snow and ice. We live in the country where the roads are bad—lots of mud when it thaws. The Toronado handles and responds beautifully under these conditions. The next-best vehicle would be a four-wheel drive, but then you lose comfort and gas mileage."

A Texas loan officer says, "This car has driving stability. It handles excellently in rain or on ice. Quiet, smooth ride. Feels like my previous big cars but handles like a Vette."

And a Florida investment broker: "Handles beautifully in traffic, easy to park, rides like a dream, thanks to reduced size and weight."

Not everyone, though, appreciated the Toronado's reduced size and weight. "The car manufacturers are getting rich," cracked a North Carolina clergyman, "because they're making them half the size for twice the price!"

Price, in fact, became an area of minor complaint, with 7.8 percent feeling strongly enough to mention it. "It's a fantastic car," notes a Georgia medical specialist, "with all the beauty, ride and per-

*(Please turn to page 278)*

## Fwd for its 14th year

General Motors had no choice but to downsize its larger cars. The campaign began in 1977 with the B- and C-bodied full-sized sedans and wagons. It moved through GM's intermediates for 1978 and includes 1979 E-bodied specialty coupes—Toronado, Eldorado and Riviera.

In the process, the Toronado, introduced with front-wheel drive in 1966, has shed 900 pounds and 20 inches. Yet most interior dimensions actually increased over last year, particularly legroom and headroom. Only hip space suffered slightly.

Standard engine is a 350-cu.-in. V8 of 165 net horsepower and a diesel V8 of the same displacement is optional. Diesels, though, didn't get installed in Toros in any quantity until last December.

Engineering nuances abound in the new E-Cars. The suspension system, designed by Cadillac, is independent at all four wheels. Springing comes via torsion bars up front, with the rear on coils with semitrailing arms. Automatic load-leveling assures level ride and headlamp aim. Independent rear suspension and lack of a driveshaft and rear differential increase trunk and seat space. Fuel tank holds 27.5 gallons.

Toronados have lost none of their luxury. Standard items include airconditioning, six-way driver's seat, digital clock, power windows. AM/FM stereo, side-glass defogger, plus usual power necessities. Leather upholstery, reclining seats and heavy-duty suspension are optional.

## A NATIONWIDE SURVEY BASED ON 570,530 OWNER-DRIVEN MILES

Formal roof creates blind spot, needs side opera window.

Toronado owners get a choice of diesel- or gas-powered V8s; both are good performers at 350 cu. in.

Thinline spare aids trunk capacity, but buyers miss extra conventional wheel for snow tire.



Vertical taillamps trap snow in wintertime.

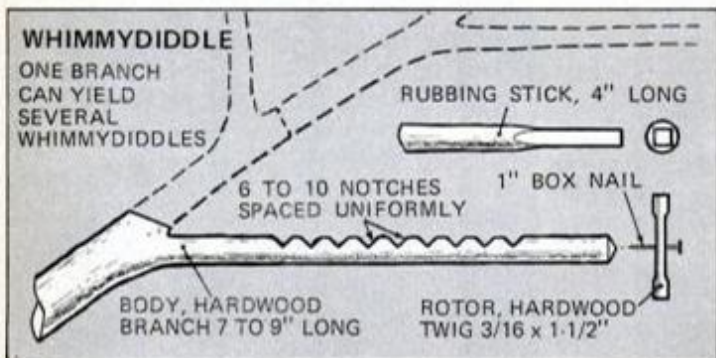
Independent rear suspension helps riding qualities and handling, adds spaciousness.

# Easy-to-make toys from the past

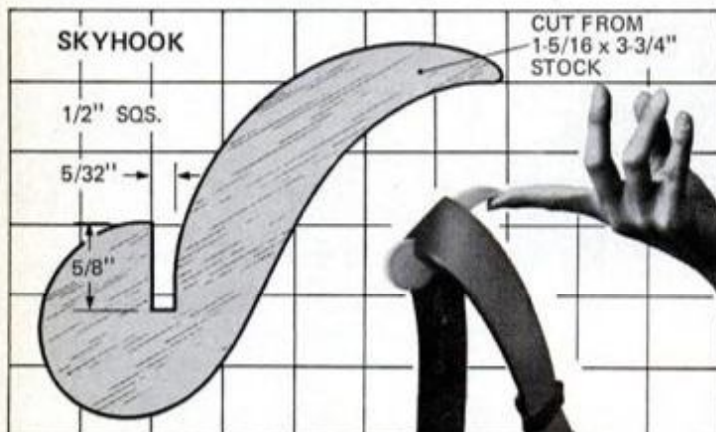
by Dick Schnacke



American folk toys are from left: climbing bear, spool tractor, skyhook, whimmydiddle, flying machine (inset).



**MATERIALS:** 7 to 9-in. hardwood branch body; 4-in. branch rubbing stick; 3/16-in.-dia. x 1½-in. rotor; 1-in. box nail.



**MATERIAL:** 5/16-in. hardwood.

**B**efore toys were commercially made, families fashioned their own, using available materials—wood, scraps of cloth, corncobs and string. The knowledge of how to make these toys was passed from one generation to another. Here are directions for putting together five classic American folk toys.

## Whimmydiddle, hoey stick or gee-haw

This stick works like magic. When you rub a stick across the notched stick, the little rotor at the end turns. Rub the notched stick in the opposite direction and the rotor turns the other way. These “gee” and “haw” movements created a legend that the whimmydiddle was a lie detector, but it is the operator who actually controls the “true” and “false” answers. Try giving a branch multiple rotors.

**Directions:** Use a small hardwood branch that does not have a pithy center. Cut the sticks as shown. Carve the rubbing stick, cut six to 10 notches about 1/8 in. deep and evenly spaced on the top edge of the body, and shape the rotor so its ends have the bulk of the weight. Bore a hole in the center of the rotor for the nail. Drive the nail into the end of the body, leaving the rotor free to rotate. Test the whimmydiddle by rubbing the notches briskly with the rubbing stick. If the rotor won't turn or reverse properly, continue diminishing the body diameter and/or deepen notches until whimmydiddle reaches a “happy spot.”

## Skyhook

Many people have heard of a skyhook, the legendary

device for supporting a weight without any visible means. As with "pulling yourself up by the bootstraps," few would believe a skyhook really exists. But it does; it has been known for generations. A peculiarly-shaped piece of wood, a skyhook balances itself at the end of your finger—but only if a leather belt is hung in its groove. It looks impossible and *feels* even more impossible.

**Directions:** Use a jigsaw or carve the wood to shape. The edge at the point must be straight, broad and sharp. It works with any leather belt.

### Flying machine

This helicopter-like toy was known before the invention of powered aircraft. Place the dowel between the palms of your hands, rub them together briskly, then release. The propeller rotates and rises into the air. As it slows, it will descend.

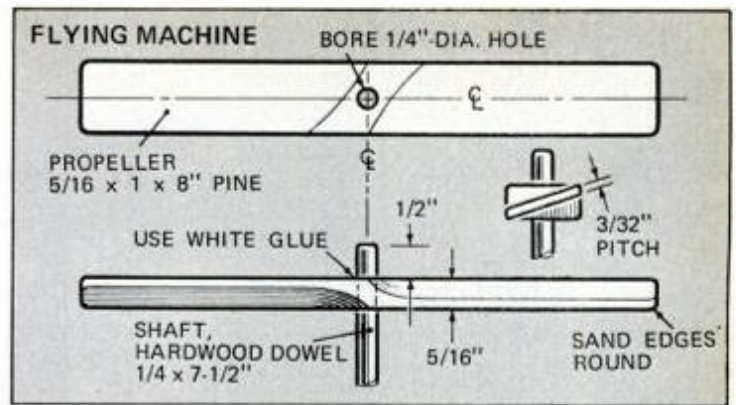
**Directions:** Cut the propeller blank to size, marking the exact center point for the shaft. Bore a hole through the propeller, being careful to make it exactly perpendicular to the blade hub. Mark guidelines and carve the propeller, a little at a time on each side and end. Round the propeller ends and smooth them with sandpaper. Cut the shaft to length from a dowel and taper one end. Insert and glue it into the propeller. Test by rolling the shaft along a tabletop with the propeller turning over the table edge. Adjust blade alignment if not absolutely square with the shaft.

### Spool tractor

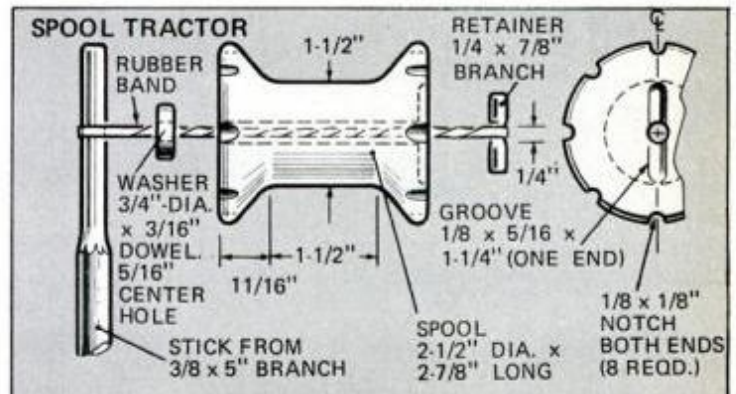
This early-day power toy is made of a wooden spool, a rubber band and a stick. When the assembly is wound and placed on the floor, it becomes a self-powered vehicle and will travel quite a distance. The rims of the spool may be notched for traction. A little wax or soap applied between the washer and spool can make it operate better.

**Directions:** Turn a wood spool on a lathe (or use a ready-made spool of proper size). Bore the center hole, carve the notches in the rims and the shallow groove in one end to hold the retainer. Cut the retainer, stick and washer. To assemble the tractor, loop the rubber band around the stick and through the washer. Then pull the rubber band through the spool with a wire hook and anchor it around the retainer which should be positioned in its groove on the spool.

**MATERIALS:**  $\frac{3}{4}$  x 2 x 5 $\frac{1}{4}$ -in. hardwood body;  $\frac{3}{8}$  x  $\frac{3}{4}$  x 6 $\frac{3}{4}$ -in. wood hanging bar; 3,  $\frac{5}{8}$ -in.-dia x  $\frac{5}{8}$ -in. dowel beads; 4,  $\frac{5}{8}$ -in. box nails for eyes; 2 red thumbtack noses; black felt-tip pen for mouth; 5/32-in.-dia. x 9-ft. hard-braided cotton cord; 4x5-in. scrap jumper material; 4 small jumper buttons.



**MATERIALS:** A piece of 5/16 x 1 x 8-in. white pine for the propeller blade; a 1/4-in.-dia. x 7 $\frac{1}{2}$ -in. hardwood dowel for the shaft; white glue to attach the shaft to the propeller.



**MATERIALS:** 2 $\frac{1}{2}$  x 2 $\frac{1}{2}$  x 2 $\frac{7}{8}$ -in. block of wood for the spool (or a 2 $\frac{1}{2}$ -in.-dia. x 2 $\frac{7}{8}$ -in. commercial wood spool if available);  $\frac{3}{8}$ -in.-dia. x 5-in. wood tree branch; 1/4-in.-dia. x 7/8-in. branch retainer; 3/4-in.-dia. x 3/16-in. wood washer cut from a birch dowel; 1/4 x 2 $\frac{1}{2}$ -in. rubber band.

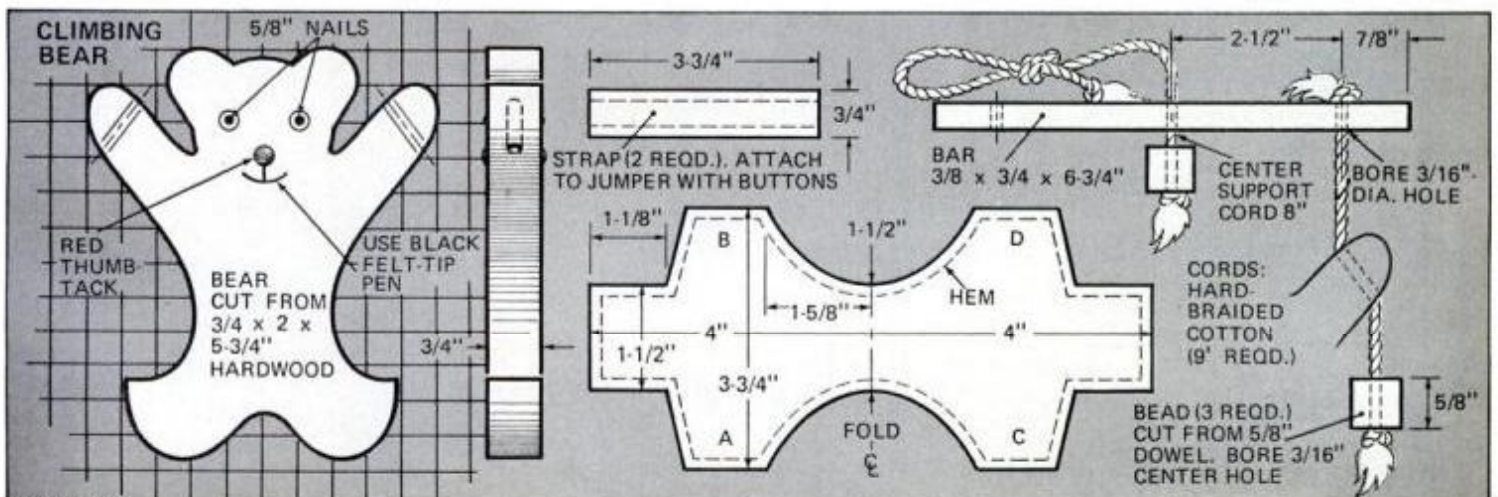
### Climbing bear

Hang the cord loop on a hook in the wall or ceiling and pull alternately on the cord ends to make the bear climb. When he reaches the top, release both cords and the bear will slide to the bottom.

**Directions:** Lay out and cut wooden parts. Bore holes through the bear's paws, the bar and the beads. Add the face decoration to both sides of the bear. Cut and seam jumper material and sew it on the bear. Cut two lengths of cord, each 50-in. long, and thread them through the bar, bear and beads. Then knot the ends. Use remaining cord as the center support, passing it through the bar and bead.

FM

Excerpted from American Folk Toys by Dick Schnacke; hard cover, \$12.95, G.P. Putnam's Sons; paperback, \$3.95 Penguin.



1/4" SQUARES



# Use the sun to heat your swimming pool

by Joseph R. Provey  
ASSISTANT HOME AND SHOP EDITOR

**U**nless you're part polar bear, the thought of a cold pool isn't very inviting. A solar pool warmer, however, will cure the most hopeless case of blue lips or cold feet. In addition, it will let you start enjoying your pool weeks earlier in the spring and later in the fall.

If you already have a gas-burning pool heater, consider a solar assist to

conserve gas. Soon you may be forced to consider solar if you want a heated pool. Several states have already proposed banning natural gas for new swimming pool heaters.

## How a pool loses heat

Every pool—solar or not—is heated by the sun, but an uncovered pool will rapidly lose most of the

heat it collects. Three factors contribute to this loss. First, heat is transferred from the water surface to the air by convection. Wind increases this loss. Second, heat is radiated from the pool surface to the sky and its surroundings. Third—and most significant—heat from the pool is absorbed to change water from liquid to vapor. This is called

**Solar Pool Blanket** (top photo and below, left) raises water temperature 10° F. It consists of air bubbles trapped in polyethylene. Comes in standard pool sizes—or can be cut to irregular shapes. 50 cents per sq. ft. from Sealed Air. Reel is optional.



**Thermo/globes** also retard evaporation and heat loss. Advantage over Lof Solar Comforter (inset) is that they don't have to be removed before swimming. Disadvantage: Plastic balls are about four times more costly (\$1.27 per sq. ft.).

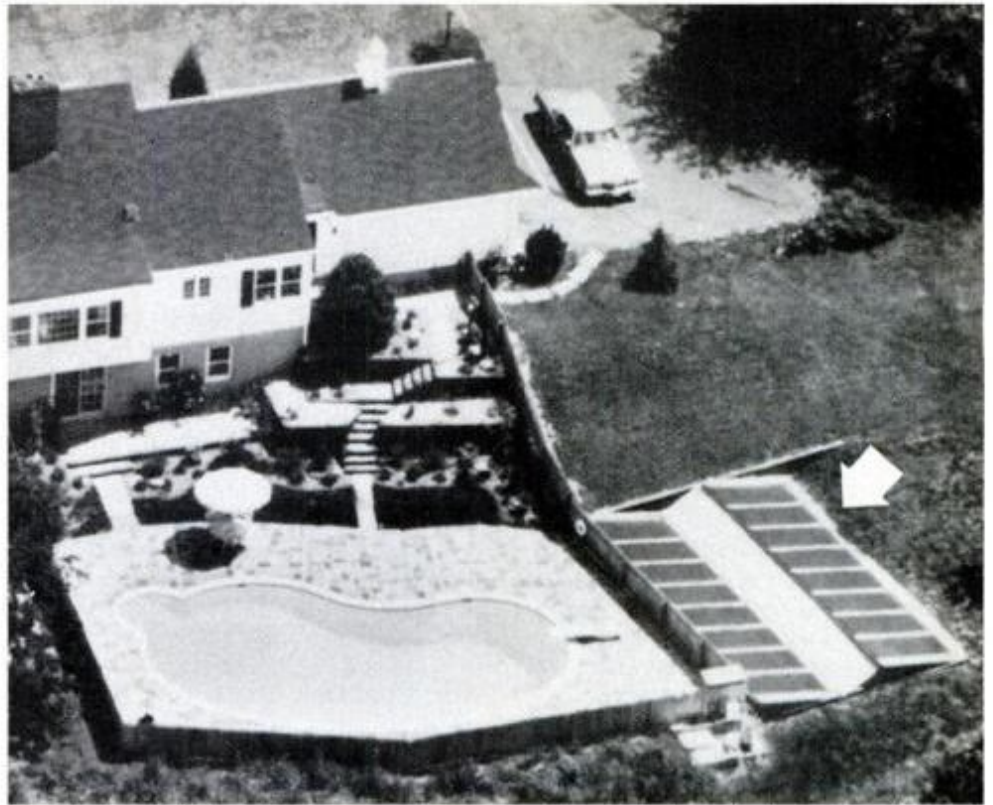


evaporative heat loss and can be drastic when the temperature is high, humidity low and there is a wind. Evaporation accounts for up to 65 percent of a pool's total heat loss.

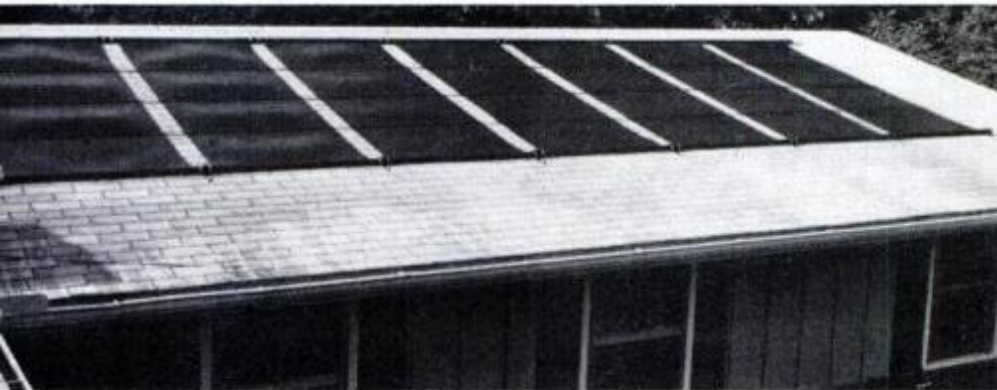
### What a solar pool cover does

Any pool cover will cut down heat loss since it minimizes convection and evaporation. Solar pool covers, a form of passive solar collection, are especially designed to trap the sun's rays. They are usually made of clear or translucent sheets of polyethylene with a UV (ultraviolet) inhibitor that helps keep the plastic from clouding and deteriorating. A cover recently introduced by Andray Products, Inc., for instance, is made of clear polyethylene with foam strips laminated to the perimeter and across the width for buoyancy. A 16 x 32-ft. cover weighs about 20 lbs., costs between 20 and 30 cents per sq. ft. and is sold with a two-year warranty.

Solar pool covers can be used independently or in conjunction with

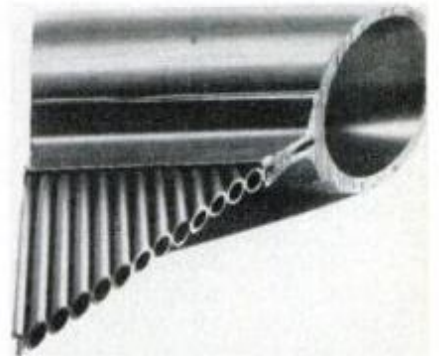


Roof with unsuitable exposure may dictate ground-mounted panels (arrow).



Solex plastic solar collectors are anchored to roof with sliding clamps that allow expansion, contraction. Panels are held flat to

roof in winds with straps. Complete pool heating kit for average sized pool (eight 4 x 10-ft. panels): \$1431.



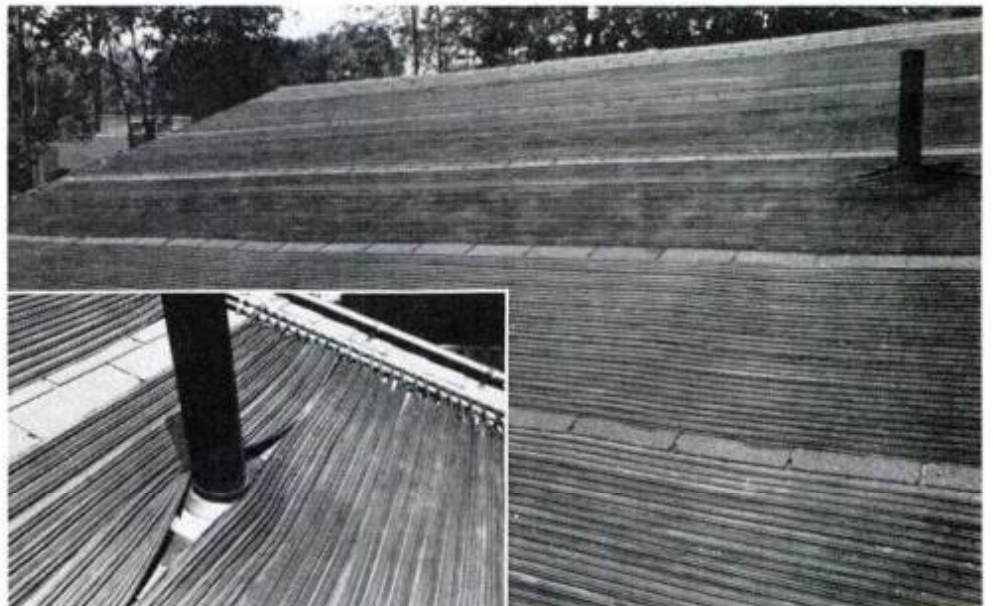
Cutaway of Fafco plastic collector shows absorber tubes, header. Design maintains high flow rate, 65 to 85-percent efficiency. System installed is \$2200 to \$3500.

other pool heating devices. According to the National Swimming Pool Institute (NSPI), a solar cover alone can keep a pool 10°F. to 15°F. warmer than if it were uncovered. The NSPI also notes that a solar cover used with a back-up gas heater will reduce your season's gas consumption by at least 50 percent.

The catch is that a pool cover must be used regularly to be effective. It takes several minutes before your swim to take the cover off and afterwards to replace it; two people are required to handle it conveniently. Note that solar pool covers are lightweight and made to float on the pool's surface—they are *not* a substitute for safety pool covers.

### Active solar pool heaters

Outdoor solar pool heating systems are low-temperature, highly efficient applications of active solar



Solaroll's low-cost collector components (\$3.25 per sq. ft.) roll out on roof, easily accommodate vent pipes. Drilling into roof is

normally not necessary. Panels, extruded from durable EPDM elastomer, can be site assembled or bought as modules.

Материал, защищенный авторским правом

technology. They work by diverting pool water from the filter line to a bank of unglazed solar collector panels. The collector panels typically heat the water 3° to 7°F. before it is once again returned to the pool. The existing filter pump usually provides enough heat to assure adequate flow rate through the collector panels. If not, a booster pump can be added to the system. Standard flow rate for a 4 x 10-ft. panel is 4 gal./min.

Pool water flows through the collector loop only when the solar sensing devices indicate that sufficient solar energy is available to the collectors. Electronically controlled systems automatically bypass the panels when no energy can be collected. Aside from being a convenience, automatic controls will assure that you get the most from your system. Manually controlled systems require the pool owner to observe weather conditions and operate valves by hand.

### Metal vs. plastic collectors

The trend in the solar pool heating industry during the last few years has been to plastic collectors. They are a boon to do-it-yourselfers since the panels are lightweight and easy to install. The black dyes in the plastic will not peel—as black-coated metal collectors sometimes do. Plastics will not react with pool water or chemical additives, thereby ruling out corrosion and water discoloration. Some of the new polymers, notably the one used by SolaRoll made by Bio-energy Systems, Inc., have a

projected life span of over 30 years.

Metal collectors, on the other hand, are less susceptible to damage due to high winds and mishandling during installation. That they will not burn is also important in areas subject to brush or forest fires.

The deciding factor for most solar buyers is cost per B.T.U. collected. Here again plastic has the edge. Systems with plastic collectors cost up to \$1000 less than equivalent systems with metal panels.

### Cover or collectors?

The claims of most active solar pool heater manufacturers are modest. Fafco, which boasts over 100,000 installed panels, merely states that its system will raise your pool temperature 5 to 15°F. over several days of good weather. Solar Industries, Inc., manufacturers of the only solar pool collector thus far approved by the Florida Solar Energy Center, size their installations to "provide a pool water temperature rise of 10°F. during six average sunny days during the earliest and latest months of the desired pool season..." Similarly, Solex, Inc. predicts that their system, properly installed, will recoup nightly heat loss, plus raise the pool temperature 2°F. for every sunny day of operation. None of these claims go beyond those of solar pool cover manufacturers. In fact, a solar pool cover if left on the pool all but four hours per day will conserve *more* heat than could be produced by an active solar system with a collector area equal to 50 percent of the



Controller, valve by Heliotrope General are used in many solar pool-heating systems. Combination detects temperature differentials as low as 1° F. and diverts flow accordingly. (See schematic below.)

pool surface area. What's more, a solar pool cover is relatively inexpensive—\$150 to \$300 as compared to \$1500 to \$3000 for typical active solar pool heaters.

So why even consider an active heater? Mostly for convenience and esthetics. The plain truth is that many people will use a cover only infrequently—usually in the spring and fall when heat losses are greatest and the inconvenience of removing it for frequent swimming is not great. And for many, a pool cover detracts from how a pool looks. Also note that the cost disparity is not as much as it might seem at first—pool covers need to be replaced more frequently than active systems, which are often warranted for 10 years.

The ideal system as suggested by Sealed Air Corp., manufacturers of both active and passive pool warmers, would be one that combines both solar collectors and a solar cover. This arrangement would give you comfortable, stable pool temperatures and the longest possible swimming season without resorting to heat from fossil fuels or electricity. It would also be the most expensive alternative in terms of initial dollar outlay.

### Install it yourself?

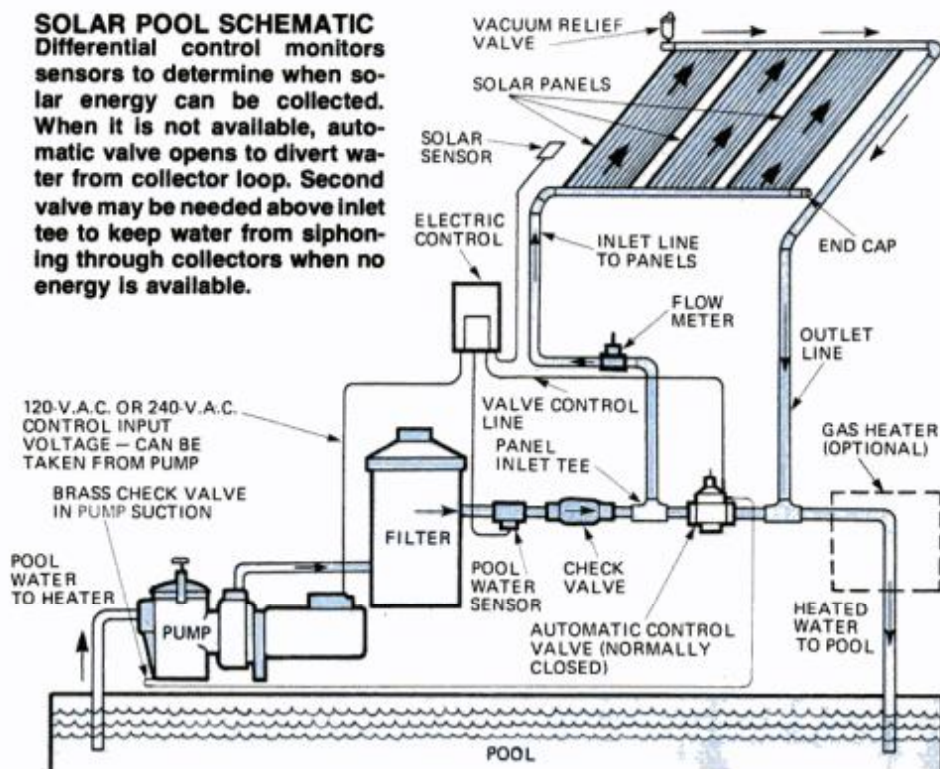
If you're willing to study the manuals, have basic electrical and plumbing skills and are not afraid of working on the roof, installing a system yourself can save you about 30 percent of the installed cost. Companies like SolaRoll, Solex, Fafco and Grumman all package complete kits for the do-it-yourselfer. Solar Industries, Inc. has tailored kits specifically for above-ground pools.

Some manufacturers don't recommend that you attempt an installation by yourself. They maintain that the job is a simple one only after you've done it once. Unfortunately most homeowners don't get a prac-

(Please turn to page 286)

### SOLAR POOL SCHEMATIC

Differential control monitors sensors to determine when solar energy can be collected. When it is not available, automatic valve opens to divert water from collector loop. Second valve may be needed above inlet tee to keep water from siphoning through collectors when no energy is available.



# Speed up house painting on a scaffold you build

by Carl and Ruth Wendorff

**T**ired of carrying heavy ladders and erecting scaffolding for those painting jobs? Then try these fold-up scaffold ladders. They take up much less room than the rigid ladders used for scaffolding and are easy to carry to the work site.

Extensions on the legs let you lengthen or shorten the ladders, or adjust them for dips in the ground surface. By loosening or removing a few bolts, you can adjust the leg length, or swing the legs out for use or in for carrying.

To build, cut the lumber to the lengths shown in the materials list (page 260). Then shape the top ends of the 72-in.-long uprights (B) as shown in the inset drawing (page 260).

Drill lead holes for 10d nails that will fasten the crosspieces to the uprights. Attach piece (E) to the uprights so its top is flush with the bottom of the shaped areas of the uprights (see art, page 260). Nail crosspieces (F, G and H) to the uprights about 14½ in. apart. Nail

*(Please turn to page 260)*

## SCAFFOLD SAFETY

Here are some common-sense rules for working on scaffolds safely:

- Adjust leg supports until they are firmly and squarely planted on the ground and the planking laid across them is level. If ground is soft or soggy, use scrap boards under legs for stability. If you rent metal scaffolds, use adjustable screw-type plates instead of blocking to adjust to uneven ground. Plumb and level the scaffold as you erect it. Don't force braces to fit—move scaffold if needed to level it.

- Don't overload working platform on which you will sit or stand. If it bends under load, substitute thicker planking or move supports closer together. If you rent scaffolding, ask renter about weight limits.

- Planking should extend beyond leg supports but not by much. If unsupported ends are too long, they might bend and dump you off if stepped on accidentally. Forgetful types should add safety grab rails to ends of planking (the rails are supplied with rented metal scaffolding).

- Secure planking to leg supports with temporary scaffold nails or clamps where it overlaps leg supports, to keep planks from sliding under you or popping up if you move too far to one side.

- Never use ladders or makeshift devices on top of scaffolding to increase height. And keep working platform free of objects.

- Make sure all fastenings are tight. Replace any that have badly rusted.

- Avoid touching overhead power lines. Use extreme caution when erecting metal scaffolding.

- Don't overreach—you may fall. Place scaffolding where you can reach work handily without stretching.

- Wear nonskid, rubber-soled shoes to keep from slipping and don't try to work on the scaffold in the rain when the platform gets wet.



There's no handling of heavy, awkward equipment with these fold-up ladders. They can be set up quickly and moved easily. Leg extensions let you lengthen the ladders and adjust the legs for uneven ground surfaces.



With top structure and leg extensions folded in, ladders can be carried atop a car (above) or tucked inside a station wagon (left).

# You can build PM's potting



Generously proportioned work surface (above) includes slop sink with drain for bathing, feeding and watering plants—plus removable dry sink that's great for localizing the mess during repotting jobs. Shelf with circular cutouts provides accessible storage for pots and keeps them from getting broken. Handy tool rack (left) keeps trowels, pruners and other potting tools within arm's reach.



# bench in time for spring

If your green thumb is looking for a spot to call its own, build our bench for about \$150.

by Rosario Capotosto

**T**his PM-designed potting bench not only looks good enough to be the centerpiece in a porch, solarium, greenhouse or back-yard patio—it's also a sturdy, functional work center that will meet all the needs of even an expert gardener.

It's framed with 5/4-in. pine stock and the working surface is made butcher-block fashion with kiln-dried fir. Exterior-grade fir plywood in various thicknesses is used for the shelves and cabinets, and 3/4-in. pine stock for the drawer compartments.

## How to build the bench

First rip and cut 5/4-in. stock to length for upper and lower rails. Assemble rectangular frames with bar clamps to facilitate drilling pilot holes for screws. For neat appearance and to prevent rusting, all screws are recessed and plugged. Mark all the members for easy assembly later and remove the clamps. Then cut the contour for the sink section with a sabre saw.

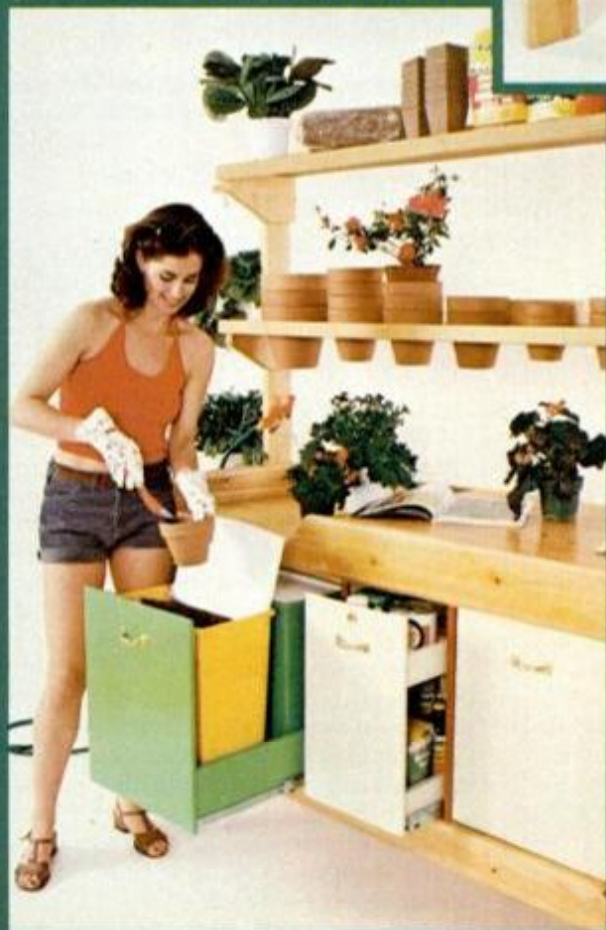
Mix plastic resin glue and assemble the two rectangles. Check corners with a large square. If they're not true, pull (rack) the unit to shape and tack-nail diagonal strips across the edges until the glue has dried.

The four legs are fitted with cleats which add extra glue surface, but, equally important, they help the assembly. Nail and glue in the cleats, then clamp the legs in place and bore the screw pilot holes. *Note:* Do not glue the legs in place until the lower cabinet has been completed and installed. For temporary assembly, use screws only.

To make the two tabletops, cut 2x3s to the lengths required—plus a few extra inches—then rip them in half to get two 1 $\frac{3}{4}$  x 1 $\frac{1}{2}$ -in. pieces from each 2x3. The lumber you select should be straight with small, tight knots.

To glue the tops together, follow this procedure: Clip the head from a 1-in. nail and use it as a bit to bore a pair of holes in one side of each strip, about 1/2 in. deep. Clip the heads from a bunch of same-sized nails and push them into the holes with pliers so that about 3/8 in. of each point protrudes. Lay the strips, sawed edge down, on a flat surface. Then press them together so the nail points mark the mating piece. Number the pieces in sequence so they don't get mixed up during gluing, then take them apart. The nails offer the joint no strength, but will serve nicely to keep each strip in alignment and prevent slipping while clamping.

Use several pairs of boards clamped to the front and back of  
*(Please turn to page 262)*



Dowel supports (top photo) let you preen hanging plants in display format. Deep sliding drawers (left) hold planting mediums—middle drawer locks to store poisonous plant supplies. Rack (above) keeps hose from tangling underfoot.

PM photos: Color, Harry Hartman; black-and-white by the author.

Plants and supplies: Chestnut Grove Nurseries, New City, N.Y.

# Build PM's patio table and chair set



Furniture set is a two-weekend project for home craftsman. Material for table and stool tops is standard and better grade fir. Legs and supports are good grade utility fir.

This handsome outdoor furniture was built entirely of Douglas fir. It was given a natural finish so the beauty of the wood can be enjoyed each time it is used.

by Harry Wicks HOME AND SHOP EDITOR

**Y**ou'll enjoy your patio or deck far more this summer if you outfit it with furniture like that shown above. With a reasonably well-equipped workshop, you can complete the set in two weekends, finishing the table the first weekend, and the stools the second.

This project was developed jointly by *Popular Mechanics* and the Western Wood Products Assn. Designer Bill Rooney achieved a particularly pleasing look through the effective use of basic geometric shapes.

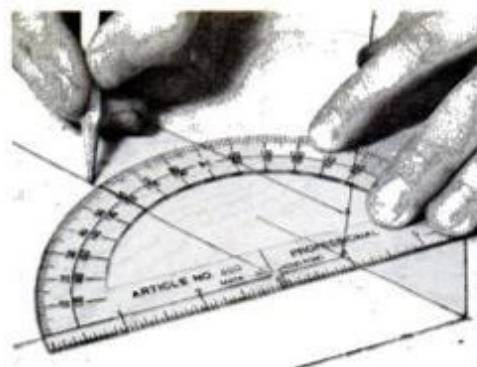
For appearance, we used a standard or better grade of fir on the table and stool tops. To keep down costs, we used utility grade fir for the table and stool legs and other

underneath, out-of-sight pieces.

Use hot-dipped galvanized nails for all joinery and, to keep from splitting any wood, bore pilot holes before driving nails. Be careful driving a galvanized nail. If you hit it a glancing blow—rather than square on the head—you can chip off the rust-resistant covering.

If you are a purist when it comes to wood joinery, substitute flathead wood screws for the nails. Use either galvanized or brass screws and turn them into predrilled and counter-bored holes. Once screws are counter-bored, you can cover their heads with thin slices of dowel for a finely crafted appearance.

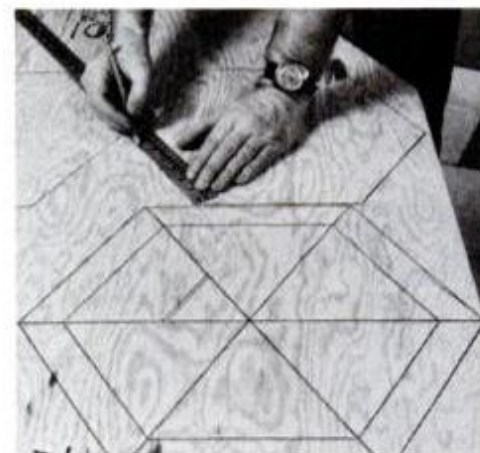
For durability, use weatherproof



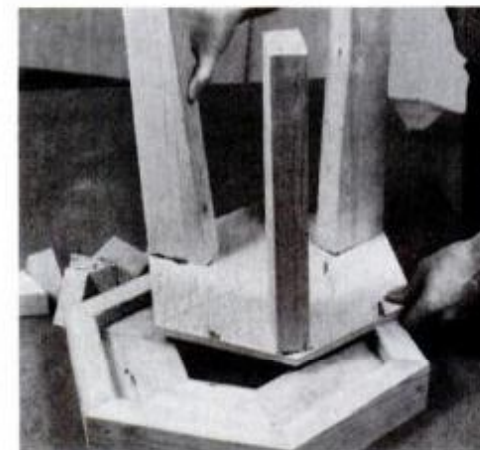
**1** Start table by laying out design on a 4x4 plywood sheet resting on two saw-horses. Make layout using a protractor.



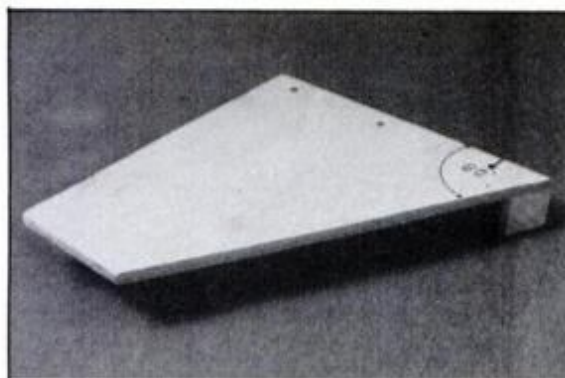
**4** Cut and bevel divider strips to fit. One piece spans the top; other four meet in the middle. Pre-drill for the nails.



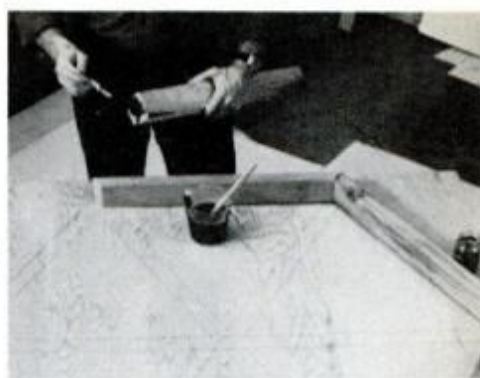
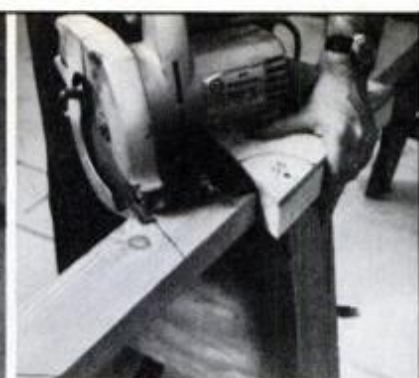
**8** To lay out stools, flop plywood panel and draw pattern for stool top (page 288) on the back of the plywood panel.



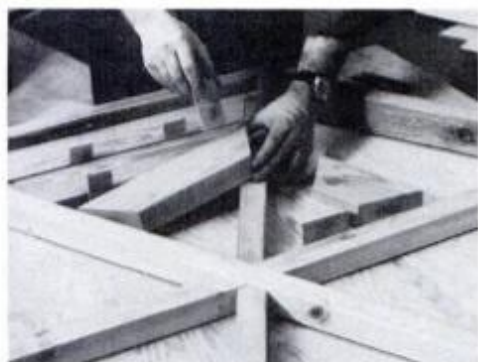
**12** Flop leg assembly and test fit inside the stool rim. If plywood fit is not snug, temporarily toenail in place.



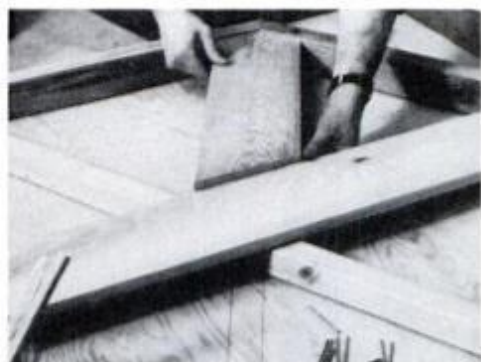
**2** Make a small cutting jig of plywood and short 2x2 strip. Trim off corner at 60° and you have an accurate marking/cutting jig to speed layout and cutting.



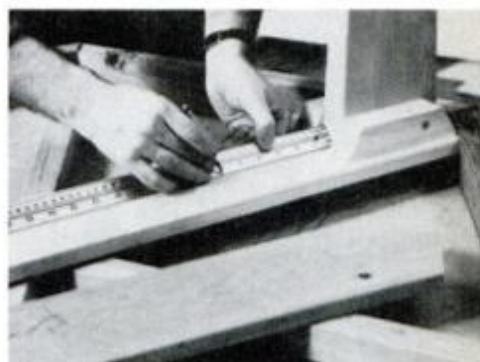
**3** Using plywood pattern, cut and miter six table edges. Then predrill nail holes and nail table rim pieces together.



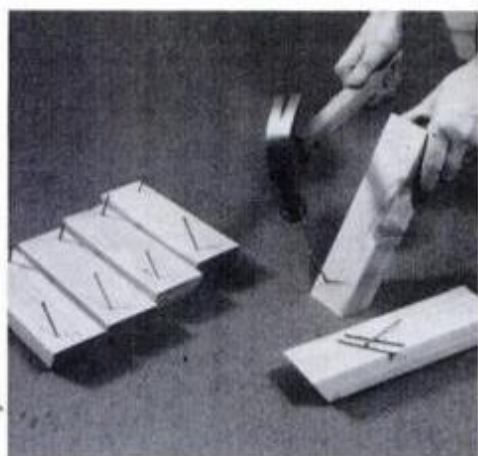
**5** Cut and fit tabletop sections that go between the dividers. Make sure all top pieces are placed best side down.



**6** Cut support pieces and test for a tight fit. For strength, run the longest support at right angles to longest divider.



**7** Measure supports for at least two screw holes per section. Then drill holes and fasten supports to the dividers.



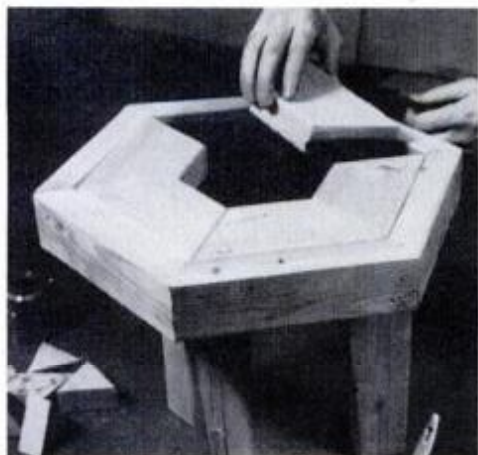
**9** Cut all stool edges to right length and bevel. Predrill nail holes before joining the edges to form the stool rim.



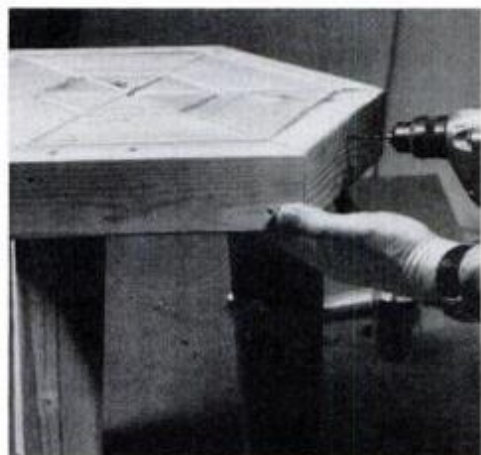
**10** Fasten the stool edges together using glue and nails. Then repeat the procedure for the remaining five stools.



**11** Cut plywood seat bottoms and tapered legs and glue and screw the plywood to legs. Countersink screw heads.



**13** With stool upright, spread glue on plywood and bottom half of edge pieces, and insert stool top pieces.



**14** Glue is probably sufficient, but for strength drill and nail through each stool side into nearest top piece.

glue throughout. The set shown was glued together with a mixture of exterior resorcinol-powder and liquid catalyst. It costs more but considering the time, labor and money you will put into this project, don't skimp on glue.

### Building the table

Though the furniture can be built with hand tools, it will go a lot faster, and cuts and fitting will be more accurate, using some basic power tools. If you don't have stationary power tools, a portable circular or sabre saw will serve very well.

Except for the leg braces (J in the drawing, page 288), all angles are

*(Please turn to page 288)*

# The secrets that



Contrary to popular misconception, it doesn't take a small fortune to get started in woodturning. Four-speed lathe (A) from Sears sells for \$160; a decent set of chisels costs about \$50. Items in photos B and C were turned on lathe above; on page 290 you'll find plans for candle holder with chimney.



PM photos by the author

## How to get a professional finish



Pour small amount of shellac from paper cup into a clean, lint-free cloth.



Immediately add a couple of drops of boiled linseed oil to the shellac-dampened rag.



Apply by moving rag across work with lathe at slow speed. Replenish rag as needed.



Apply rag to all wide, easy-to-get-at surfaces on the cylinder's top and base.



To work finish into valleys and crevices, wrap rag around small-diameter stick.



Repeat procedure on base; keep rag moving or you may create burn marks.

# make you a woodturning expert

PM's resident craftsman shows you how to master faceplate and spindle turning.

by Harry Wicks  
HOME AND SHOP EDITOR

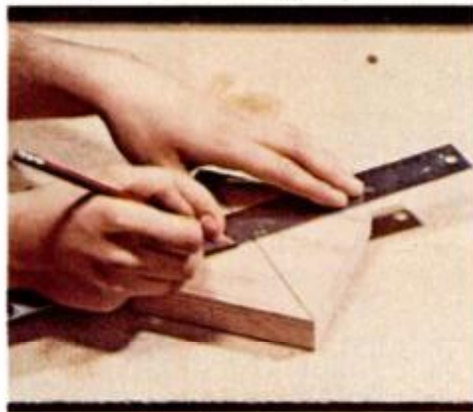
In PM's first installment on lathes (July '78, page 96), we discussed the very basics of woodturning—how to get started in woodturning, what tools you should own, and how to keep them sharp. Now we'll focus on the two types of turning you must master to tackle any lathe project: faceplate and spindle turning.

As a bonus for those who have advanced on their own, we show how to

get a professional-looking finish with very little effort—even on your first try. First, the wood should be thoroughly sanded, dusted and wiped with a tack rag. Then, upon application, set the lathe at slow to medium speed (about 600 rpm) and keep the rag moving to avoid burn marks in the shellac.

After reading Part 1, several readers wrote that a dust or respiratory

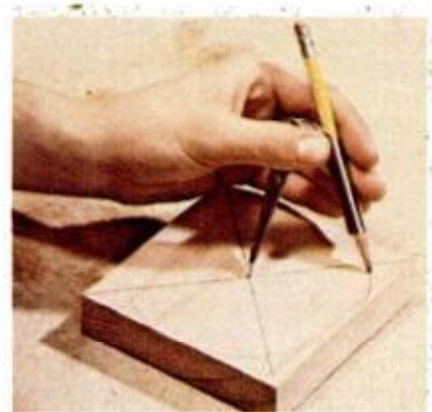
## Faceplate turning basics



Square up stock, find center by marking diagonals using a straightedge and pencil.



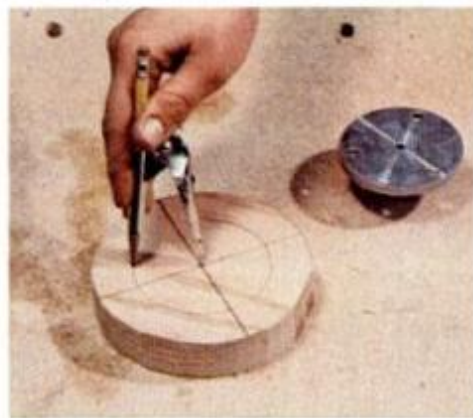
Make a permanent mark at the center by tapping a punch lightly with a hammer.



With compass, lay out and mark circle  $\frac{1}{8}$  in. larger than desired finished dimension.



Use bandsaw to cut stock to rough dimension; cut on the waste side of line.



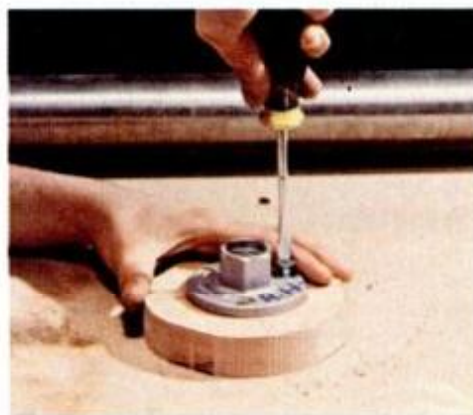
Select faceplate, set compass  $\frac{1}{8}$  in. more than its radius and draw a circle.



Center faceplate on stock, line up two screws with grain, mark for screwholes.



Bore pilot holes for faceplate screws; use tape stop on bit at desired depth.



Use heftiest possible screws to secure to faceplate; choose screw length carefully.



Holding lathe spindle rigid, mount the workpiece on lathe, tighten with a wrench.



Set machine at low speed, and scrape across edge of stock with gouge or chisel.

mask is a must for a lathe turner. To use or not use a mask is a personal choice; I generally don't when cutting but *always wear one* when filing, sanding, dusting or finishing. I opt for the low-cost mask with throwaway filter liner (such as that made by 3M). Those with allergy problems should probably keep the mask on during all lathe operations.

### A couple of viewpoints

Lathe purists also argued that safety glasses are unnecessary because a tool torn from the operator's grip or a workpiece flung from the lathe tends to follow a downward path. Though the trajectory argument is valid, I prefer wearing safety goggles—and insist that students in my woodworking class do, too. I urge readers to adopt the same attitude.

When the work cannot be turned between centers, it must be mounted on a faceplate or other workholding device. All cutting in faceplate work is done with chisels in the scraping manner.

If you should try to apply a shearing cut on the edge of a piece of faceplate-mounted work, you will probably produce a hogging cut. That is, the chisel will tear a chunk from the wood and, in turn, be torn from your hands because the end grain is presented twice to the operator on every revolution.

### Turning on the faceplate

Once you have selected the stock for a faceplate turning, cut it square. Then cut the rough-round shape on a bandsaw, keeping the blade on the waste side of the line. Select the largest-diameter faceplate you can use on the workpiece. Mount the block as shown in the photos. Always use the heaviest possible screws to mount wood on a faceplate.

Make certain that screws are of the right length for the project; they mustn't come in contact with the chisels. (For some designs, conventional faceplate mounting cannot be



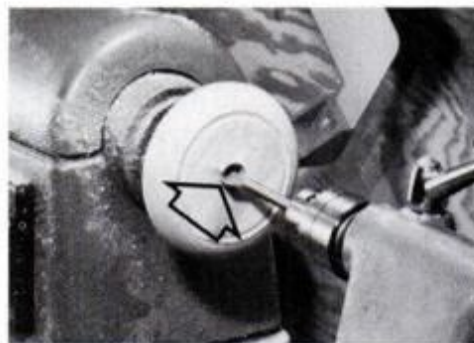
To shape the outside corner, a skew can be used in a scraping fashion.



Small round-nose chisel is used to turn the decorative half-round groove.



After smoothing face with square-nose chisel, use pencil to mark cuts on face.

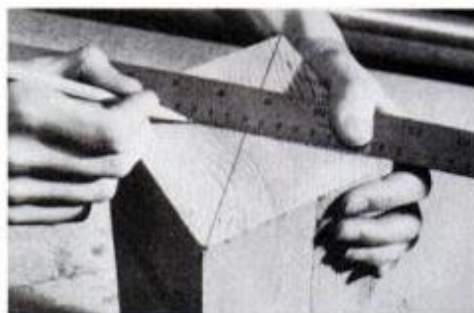
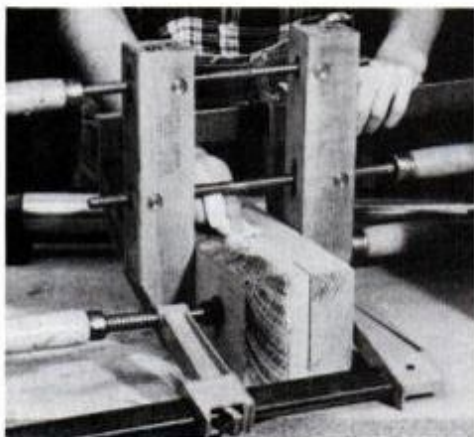
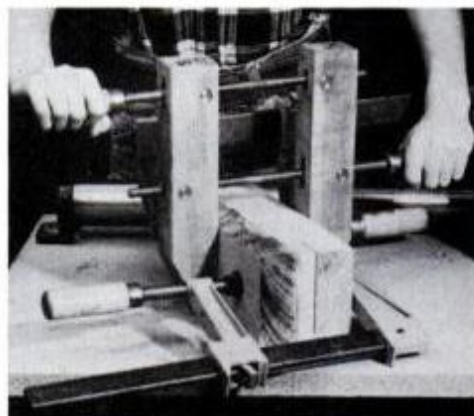


Bore mortise for spindle stub with work still on lathe. Note tape depth stop on bit.

## Turning a spindle



To glue up stock for a spindle turning, apply liberal amount of glue to mating surfaces (above). Use a number of clamps (right) to hold work until glue dries.



Immediately wipe off squeezed-out excess glue and set work aside for 24 hours. Then find centers on both ends using diagonal lines method as shown here.

used. Glue mounting, glue-chuck or ring-clamp methods are then required. These techniques will be discussed in a future issue.) To turn the hurricane lamp base shown on page 144 (drawing, page 290), you can use conventional faceplate mounting.

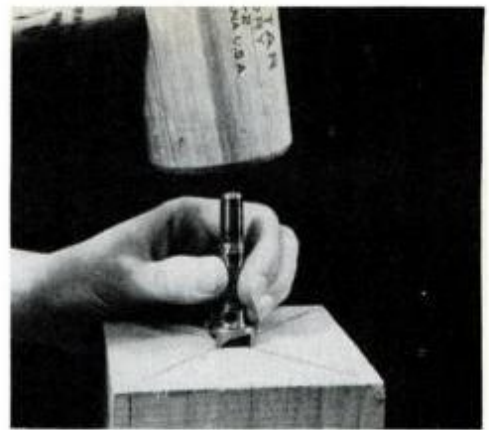
With the block securely fastened, turn the faceplate all the way onto the lathe spindle. If your lathe has a system for locking the spindle while you tighten the faceplate, use it. Adjust the toolrest so it is about  $\frac{1}{8}$  in. away from the work and the chisel's cutting edge will be at the center



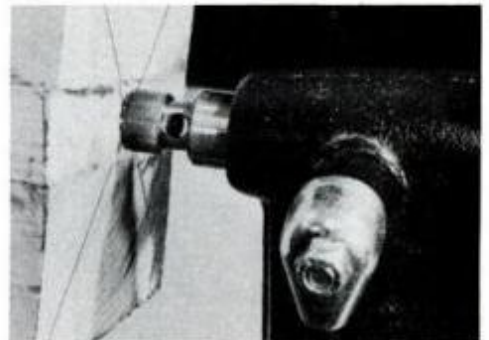
On spur center end of work, saw 1/8-in.-deep kerfs along both diagonal lines.



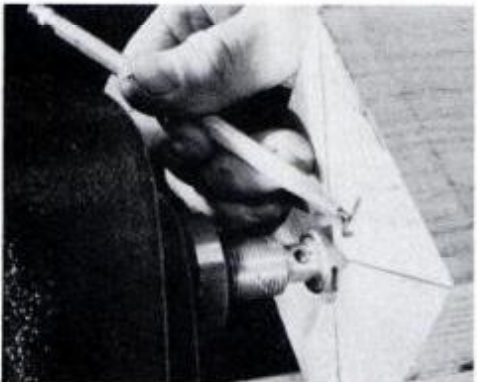
On both ends of the stock, center-punch holes at exact center (about 1/16 in. dia.) Use a wood mallet (right), which won't damage center, to drive the center into stock.



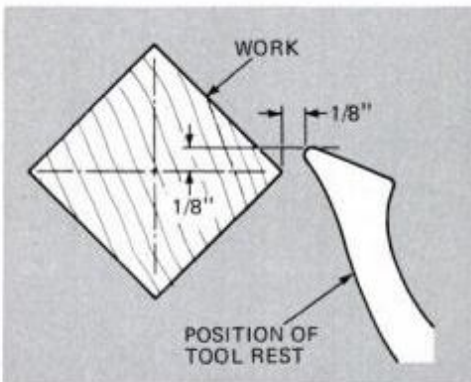
Mount work in lathe; before advancing cup center, apply lubricant to the cup center.



Advance cup center into stock until secure, back off 1/4th turn, lock the spindle clamp.



If work must be removed, mark at head-stock using reference on spur center.



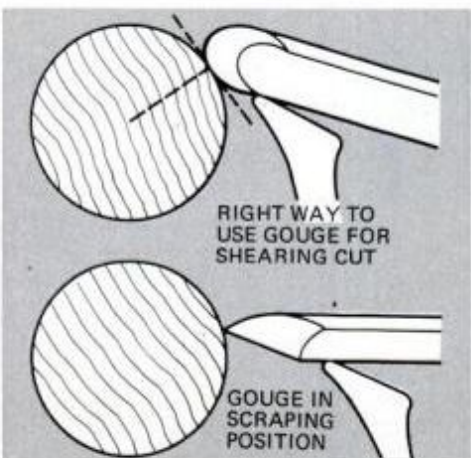
Adjust toolrest as shown, clamp. Turn work by hand to make sure it clears rest.



Using gouge, rough-round right end, mark with pencil to determine cylinder size.



Start lathe and use gouge to make a series of 1 1/2 to 2-in.-long shearing cuts back to the right. Beginners should use light cuts and low speed to rough-round the stock.



When you're about 2 in. from left end, roll gouge over and work toward the left end.

line. Rotate the work by hand to make certain it clears the toolrest. Run the machine at slow speed. Check the lathe manufacturer's speed chart because the roughing speed varies with the type and diameter of the wood.

Generally, a woodturner shapes

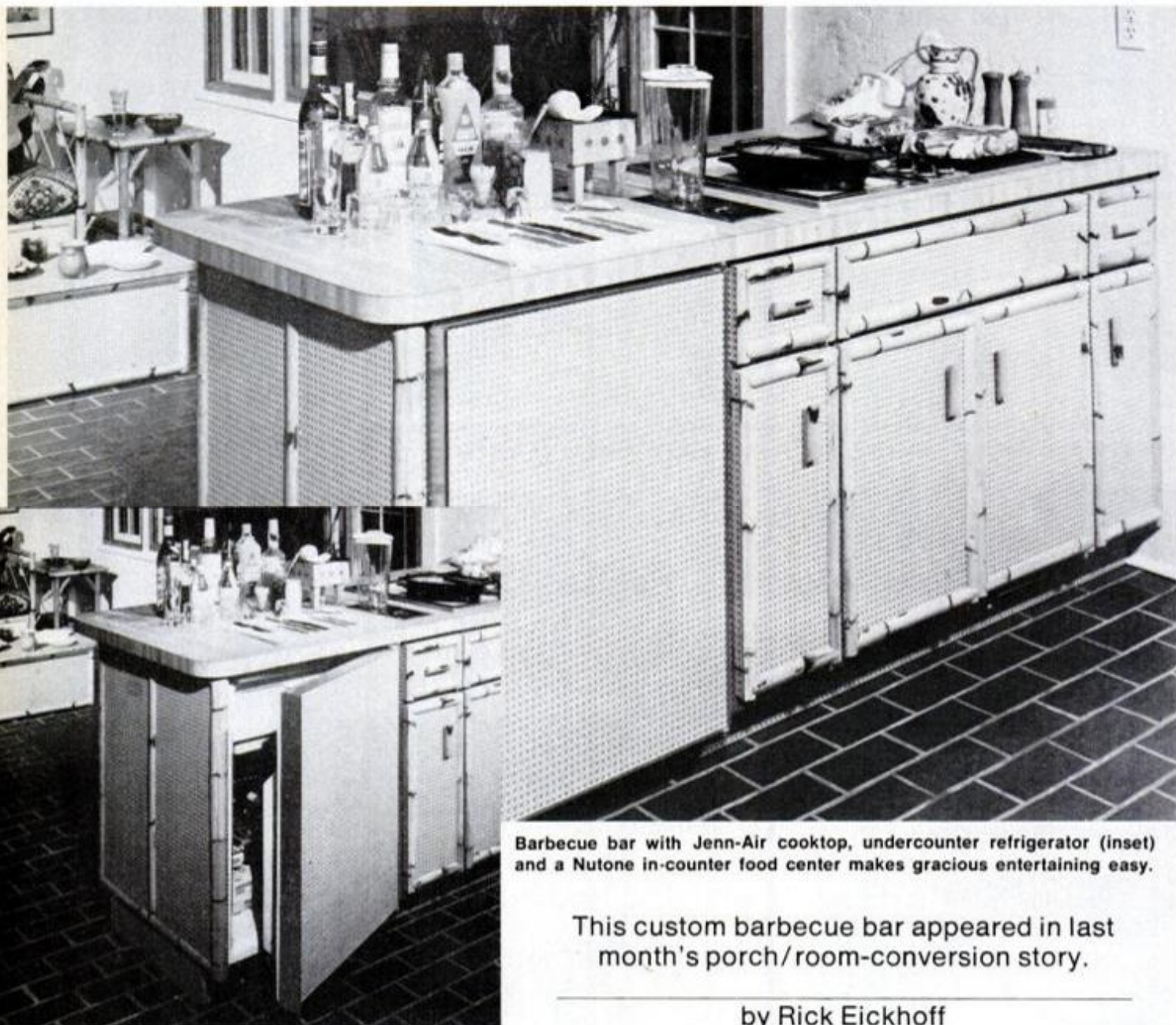
the outside diameter first with a square-nose chisel. Since there are no square-nose chisels available commercially (that I know of), you'll have to grind your own. The best tool for final smoothing of an outside edge is the spear-point chisel. Use it to pick up a scant bite at one corner

and carry the bite right across the edge.

Truing the work's face can be done with either a skew, square-nose or diamond-point chisel held in the scraping attitude. Move the tool from the center of the workpiece to

(Please turn to page 290)

# Build PM's barbecue bar for your family room



Barbecue bar with Jenn-Air cooktop, undercounter refrigerator (inset) and a Nutone in-counter food center makes gracious entertaining easy.

This custom barbecue bar appeared in last month's porch/room-conversion story.

by Rick Eickhoff

PM photos: Matt Doherty

**A**lthough the PM barbecue bar is designed with special convenience features, it is simply constructed and finished with a durable plastic laminate. A twin-grill convertible cooktop, refrigerator and food center are incorporated into the bar. It is finished with Nevamar's Butcher Block and Classic Cane laminates and trimmed with rattan.

Materials left over from the bar will make a companion coffee table. A hinged top covers the table's storage area.

The plastic laminate is available locally, or write to Nevamar Corp., 8339

Telegraph, Odenton, Md. 21113. Rattan poles provide an attractive trim. Check your classified directory under "Bamboo" for a dealer. You might consider substituting bamboo, which is much less expensive and available by mail from Gee Lumber Co., 2600 West 79th St., Chicago, Ill. 60652.

## Making the cabinet frame

Cut bottom I and kickplate pieces F, J. Using glue and ringed nails join pieces, keeping assembly square.

Lay out and cut the two end panels G and attach to assembly with 8d finishing nails and white glue. Nail Z and

Y to the refrigerator end panel and nail a temporary 1x2 brace across the refrigerator opening.

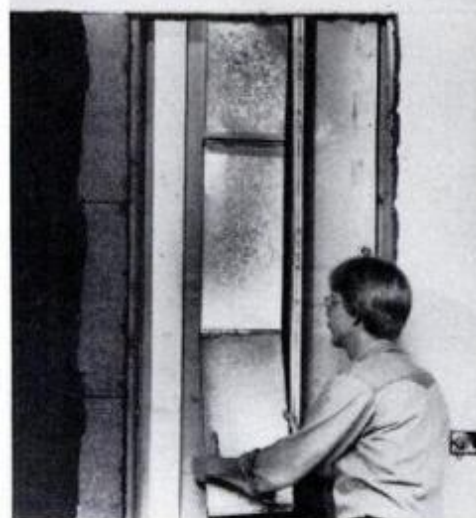
Lay out and cut partitions G and H. Mark their locations on the plywood bottom. Turn the cabinet on its face (drawer) side, glue and nail partitions through the bottom with 8d nails.

Cut out the back E. With cabinet face down and everything square, nail and glue E in place. Nail rail K in partition notches.

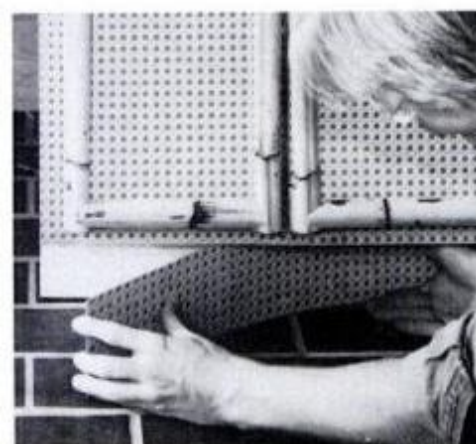
Measure and cut facing pieces: horizontal rails O, P, Q, R and vertical stiles S. Use doweled joints on the facing frame. Dry assemble, then glue

Материал, защищенный авторским правом





To retain Jenn-Air effective exhaust system, use large ducts. For good flow of air, use a minimum number of elbows. A 5-in. elbow, 3x10-in. roof duct and a Broan No. 435 roof jack worked here.



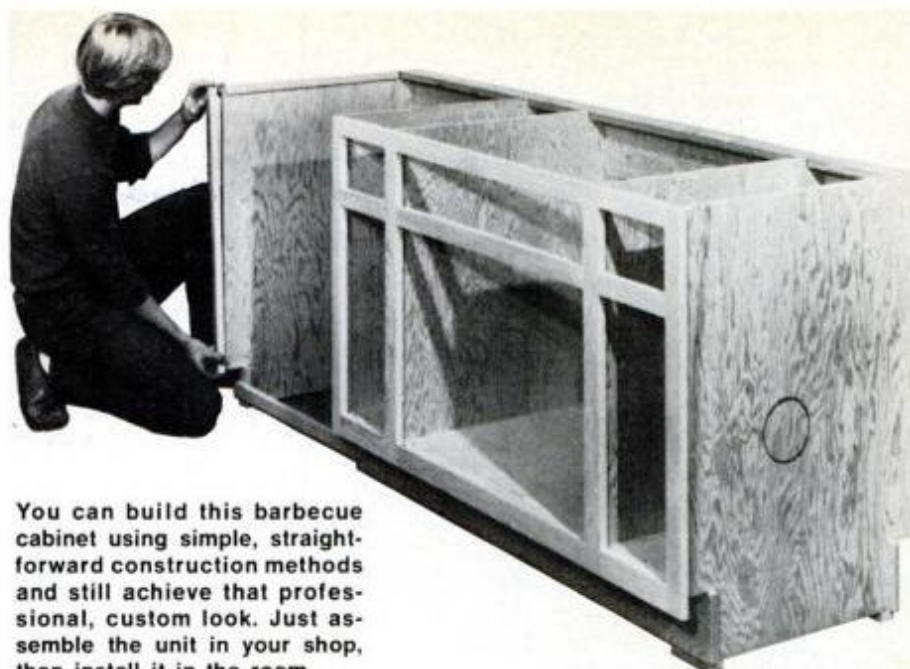
Cut and fit the cane plastic on the kickplate with the bar in position.

joints and clamp with 6-ft. bar clamps. Make sure assembly is square.

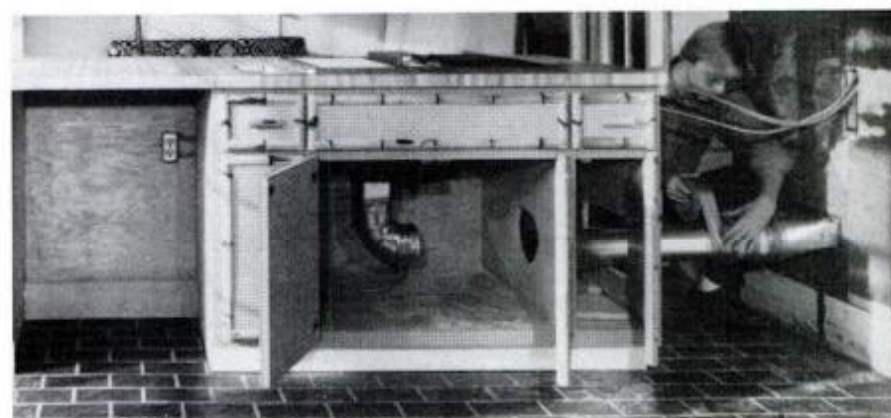
When facing frame is dry, nail and glue it to cabinet base, ends and partitions, checking alignment. Cut, nail and glue AA and X. Add corner blocks BB for securing top.

### The laminating process

Plane or sand all facing joints flush. Cut vertical laminations to run full length of stiles; apply contact cement to mating surfaces. Butt-cut and apply end laminate. Cut and apply back laminate in one sheet. End and back edges will be covered with trim.



You can build this barbecue cabinet using simple, straightforward construction methods and still achieve that professional, custom look. Just assemble the unit in your shop, then install it in the room.



Install finished cabinet in the room after the floor is laid—if you're remodeling the entire room. Wrap all exhaust-duct joints so they're airtight.

Lay out and cut plywood doors T, U, V, W. Cut laminate for door edgings ( $\frac{1}{4}$  in. oversize), facings and backs. (Laminate backs to guard against warpage.) Glue laminate to backs, edges and then fronts, routing edges flush after each gluing. File corners smooth.

### Building the drawer

Cut drawer sides L and M. Dado the lower edge for bottom N. Cut, then slide the bottom in place and attach lamination to the front. Fit piece CC to the cabinet and hardware to the drawer and cabinet. Screw on laminated false drawer front.

Hang the doors next. After adjusting the blade for depth, use a circular saw to cut a slot in the door for the pin hinge. Screw-fasten the hinge to the door, assemble doors to cabinet stiles and install magnetic catches.

### Applying rattan trim

Halve rattan HH or bamboo poles on the circular saw and keep matching halves together. Cut trim to length and apply it with dark areas opposite

each other. Put cabinet on its back and apply vertical trim to the front with white glue and 4d finishing nails. Cope horizontal rails into the stiles. Trim outside corner with matching pieces. Next, lay the cabinet carefully on its face. Trim back corner with two rattan pieces. Plane the edge of the second piece for a tight fit. Add all rattan trim on the back.

Cut and install laminate facing on the refrigerator front. Add shelving if desired. Varnish interior.

### Assembling the countertop

Cut countertop A to size. Cut reinforcing pieces D and B, glue and nail in place. Then cut and add strips C. Cut the corner radius with a sabre saw and sand smooth, keeping top edge square. Cut laminate self-edge slightly oversize, bond it in place and rout the overhang flush with a straight carbide cutter in the router. File it even with the top surface. Then cut the top laminate oversize, bond it in place and dress its edges.

Bore starter holes into cutouts and complete cutouts with a hacksaw blade

in your sabre saw. Rout and file all edges as needed.

Cut handles, shellac their ends and attach with 1½-in. No. 8 fh wood screws. Position barbecue bar, then cut and cement laminate to the kickplate.

To build the coffee table cut base FF and side pieces DD and EE. Assemble the box, then laminate four surfaces and top edges. Apply trim, coping top and horizontal pieces to fit the uprights.

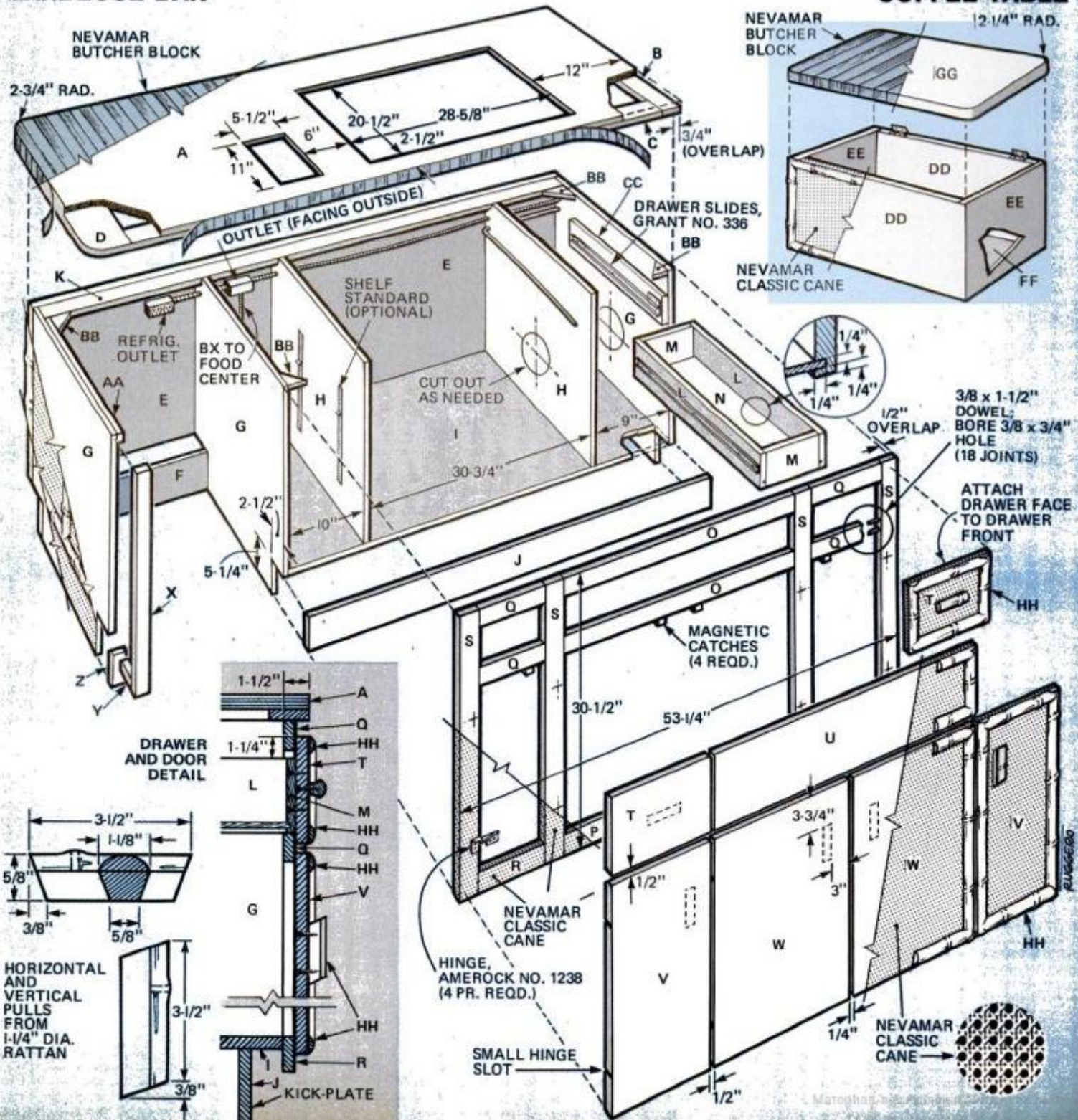
Use cutout from grill for GG. Cut, joint edges square and apply edging; rout edges flush. Laminate both sides of GG. Attach hinges and paint or varnish interior.

### BARBECUE BAR/COFFEE TABLE—MATERIALS LIST

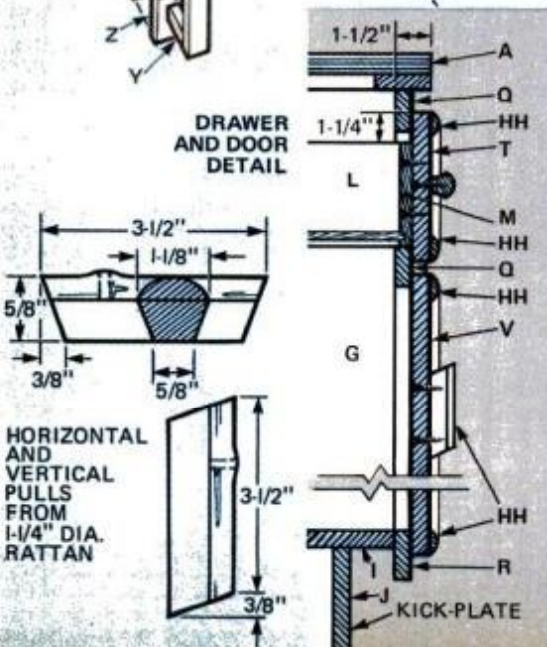
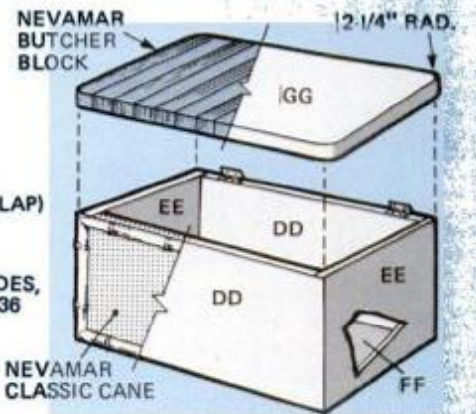
Key	Pcs.	Size and description	Key	Pcs.	Size and description
A	1	¾ x 29 x 80½" particleboard	R	2	¾ x 2 x 8¼" pine
B	1	¾ x 2½ x 29" plywood	S	4	¾ x 2 x 30½" pine
C	2	¾ x 2½ x 73" plywood	T	2	¾ x 6¾ x 9¾" plywood
D	1	¾ x 5 x 29" plywood	U	1	¾ x 6¾ x 30¼" plywood
E	1	¾ x 29¼ x 78¼" plywood	V	2	¾ x 9¾ x 21¾" plywood
F	1	¾ x 5¼ x 78¼" plywood	W	2	¾ x 15 x 21¾" plywood
G	3	¾ x 24½ x 34½" plywood	X	1	¾ x 1½ x 29¼" pine
H	2	¾ x 24½ x 28½" plywood	Y	1	¾ x 1 x 2½" pine
I	1	¾ x 24½ x 51¼" plywood	Z	1	¾ x 1½ x 5¼" pine
J	1	¾ x 5¼ x 52¾" plywood	AA	1	¾ x 1 x 22½" pine
K	1	¾ x 2 x 76¾" plywood	BB	4	¾ x 5 x 5" pine
L	2	½ x 4½ x 22¼" fir plywood	CC	1	¾ x 5 x 22" plywood
M	2	½ x 4½ x 6¼" fir plywood	DD	2	¾ x 12¼ x 22½" fir plywood
N	1	¼ x 6¾ x 22½" plywood	EE	2	¾ x 12¼ x 14¾" fir plywood
O	2	¾ x 1¾ x 28¾" pine	FF	1	¾ x 13¼ x 22½" fir plywood
P	1	¾ x 2 x 28¾" pine	GG	1	¾ x 16¾ x 26" particleboard
Q	4	¾ x 1¾ x 8¼" pine	HH	8	1¼"-dia. rattan poles

Misc.: 3 4x8 sheets Nevamar Classic Cane plastic laminate (No. RC-2-2 701); 1 4x8 sheet Nevamar Butcher Block plastic laminate (No. WV 830); 2 Grant 22-in. drawer slides (No. 336); 4 magnetic catches; 4 prs. Amerock burnished brass hinges (No. 1238); 8d finishing nails; 4d nails; 1¼-in. No. 8 fh wood screws; 1½-in. No. 8 fh wood screws; 1¼-in. ringed nails; 1 pr. 1½-in. brass butt hinges; ¾-in.-dia. dowel; white glue, shelving hardware; contact cement, varnish or shellac.

### BARBECUE BAR



### COFFEE TABLE



HORIZONTAL AND VERTICAL PULLS FROM 1-1/4" DIA. RATTAN

Popular  
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# CAR CARE GUIDE

PUT THE FUN BACK INTO OWNING A CAR! THIS SEVENTH ANNUAL SPECIAL SECTION, PREPARED BY THE AUTO EDITORS, ANSWERS QUESTIONS MOST ASKED OF PM'S CAR CLINIC—IT'LL MAKE YOU MASTER OF YOUR MACHINE!

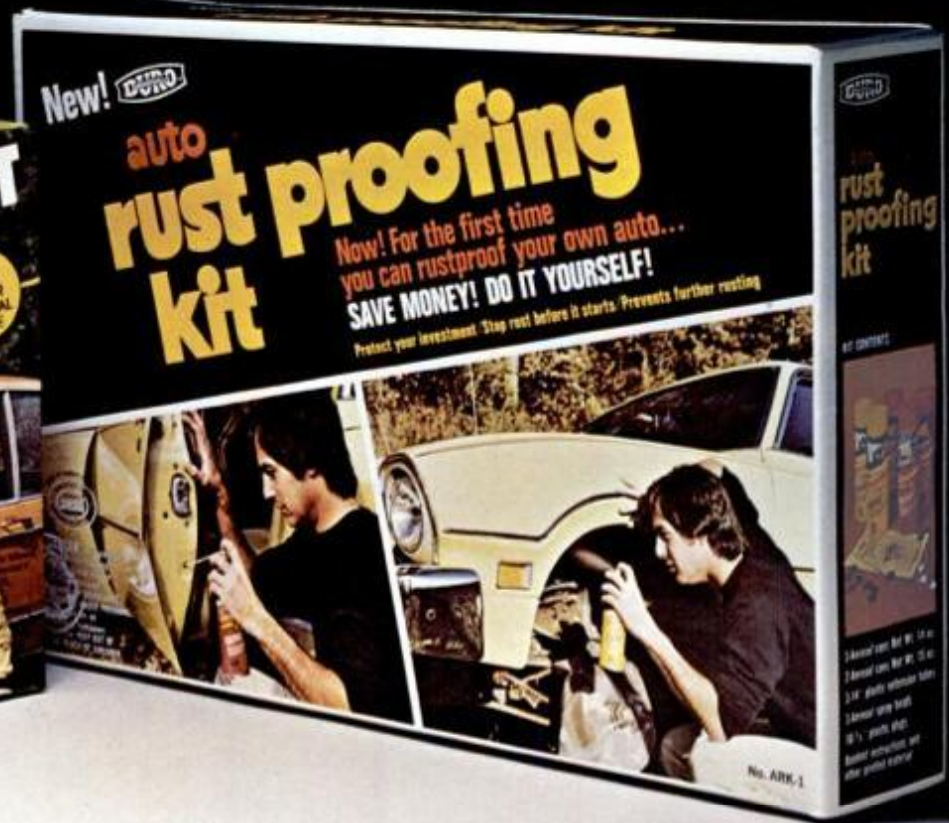


1922 FORD MODEL T  
STATION WAGON

**Hard starting** has always been, and still is, a car owner's number one problem—but not if you know the secrets of good car care! **Stalling** and **hesitation** are also tops on the list of problems with late-model cars. **Missing, surging** and **lack of power** run close seconds. Have you experienced any of these so far? How about **poor fuel economy**? Getting more mpg is more important now than ever. **Power train noise** can be shut out with earmuffs but that's no cure. Shimmy and shakes are among the symptoms in the **poor roadability** problem area. **Oil loss** is another messy thing many of you have experienced. Add **brakes, overheating, tires** and **paint** and **body problems** and you know why cars are first on the official list of consumer complaints these days. **Extra:** we name the **cars recalled** during the last 10 years—check to see if yours is on the list.

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# CAR CARE GUIDE

## Contents

### **PINPOINT THE PROBLEMS!**

**YUP, CAR CARE REALLY IS EASIER THAN EVER!**

**SECTION 1.**  
Hard starting, stalling and hesitation

**SECTION 2.**  
Missing, surging and lack of power

**SECTION 3.**  
Poor fuel economy

**SECTION 4.**  
Power train noise

**SECTION 5.**  
Poor roadability

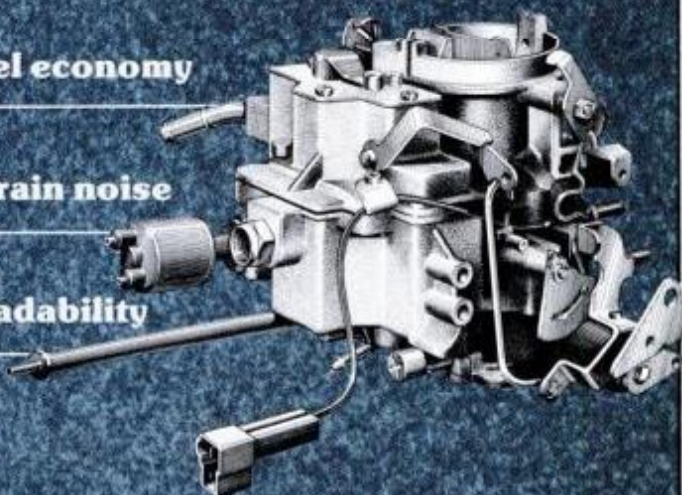
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Prepared by the editors of Popular Mechanics with technical art by Dale Gustafson, Fred Wolff, Adolph Brotman, Hank Iken, Ed Lipinski, Ron Bertuzzi and Pat Ruggero. Photography by Jack Whitehead. Old cars photos courtesy General Motors Corp., Chrysler Corp., Ford Motor Co. and the Henry Ford Museum. Design of the Car Care Guide by Don Mannes.

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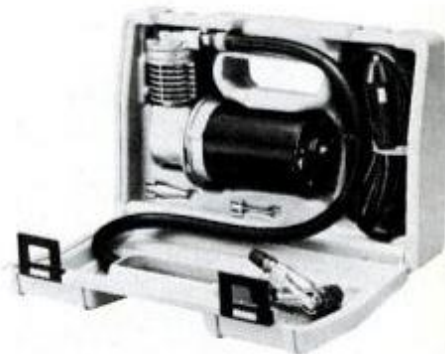


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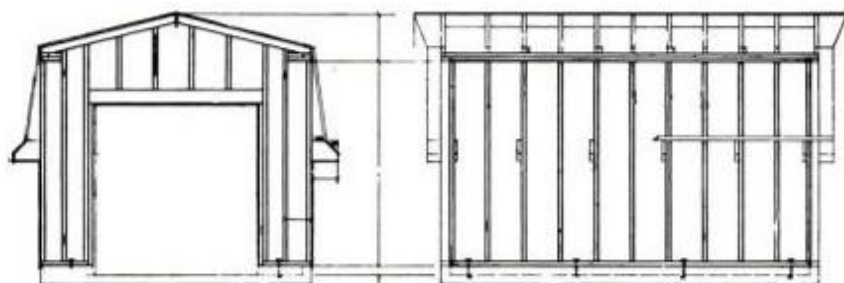
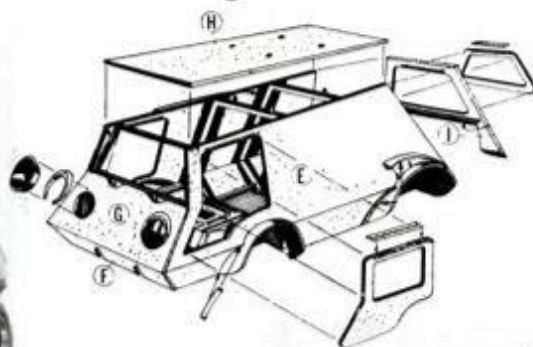
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(Featured in Dec., 1973 issue)

**BOONIE BUG**—A dynamic, new vehicle concept! Constructed from a VW bus chassis, the 'Boonie' offers the go-anywhere ruggedness

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(Featured in March, 1974 issue)

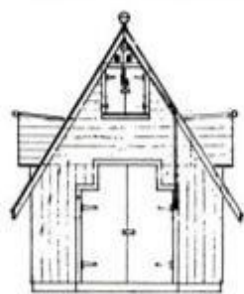
**DUTCH MINI-BARN**—You can erect our most popular backyard storage structure for under \$600. The roof design is somewhere between gambrel and mansard but it reminds us of Dutch colonial architecture. With 8 ft. of headroom inside and 10 ft. by 13½ ft. floor space it's fairly large although

it looks small. More than enough room for bicycles, lawn furniture, garden tools or use it as an office workshop or potting shed. Two sets of plans included, one for yourself and one for your building department. **\$5.95**

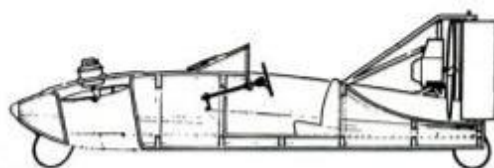
(Featured in August, 1972 issue)

**STORYBOOK PLAYHOUSE**—Put up a shed and the neighbors may hate you, but build this handsome little house and you'll be the hero of the neighborhood—especially among the small fry! This compact structure looks more like a storybook cottage than a tool-house—but you can readily use it for storage. In fact, wide barn-type

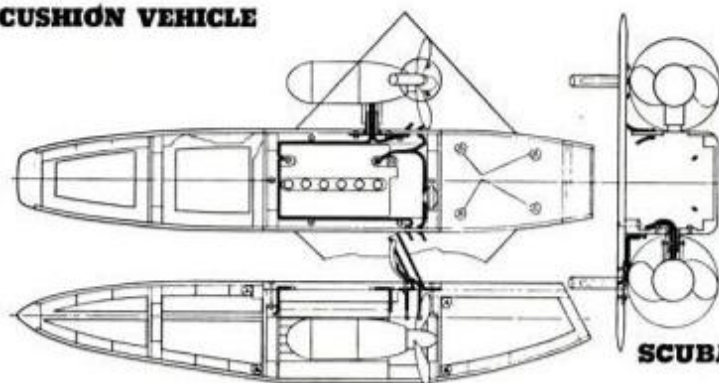
# AND UNDER THE SEA



**STORYBOOK PLAYHOUSE**



**LAND & WATER AIR CUSHION VEHICLE**



**SCUBA-TOW**



doors in the back lead to a special tool-storage room walled off from the playrooms. You can hang a lot of garden tools inside and still provide plenty of play space. An extra set of plans is included for a building permit. **\$5.49**

(Featured in July, 1973 issue)

**LAND AND WATER AIR CUSHION VEHICLE**—A go-anywhere air-prop craft, the exciting Cobra ACV skims land or sea at speeds up to 60MPH. 14 ft. long, with room for two passengers this innovative vehicle will cost you less than \$800 to build. A unique project for the serious do-it-your-

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## CAR CARE GUIDE

# Yup, car care really is

In the old days you lubed so often you might as well have kept your grease gun in a holster!

**U**pset because he found it difficult to replace a fan belt on a 1978 Pontiac with airconditioning, a friend of ours recently muttered this oft-repeated lament: "They don't make 'em easy to work on like they used to."

Have the passing years dulled our memories, we wondered, or was this chap correct? Is modern-day car care for the Saturday mechanic more difficult than it was, say, in the 1930s, '40s and '50s?

So we wouldn't have to rely on

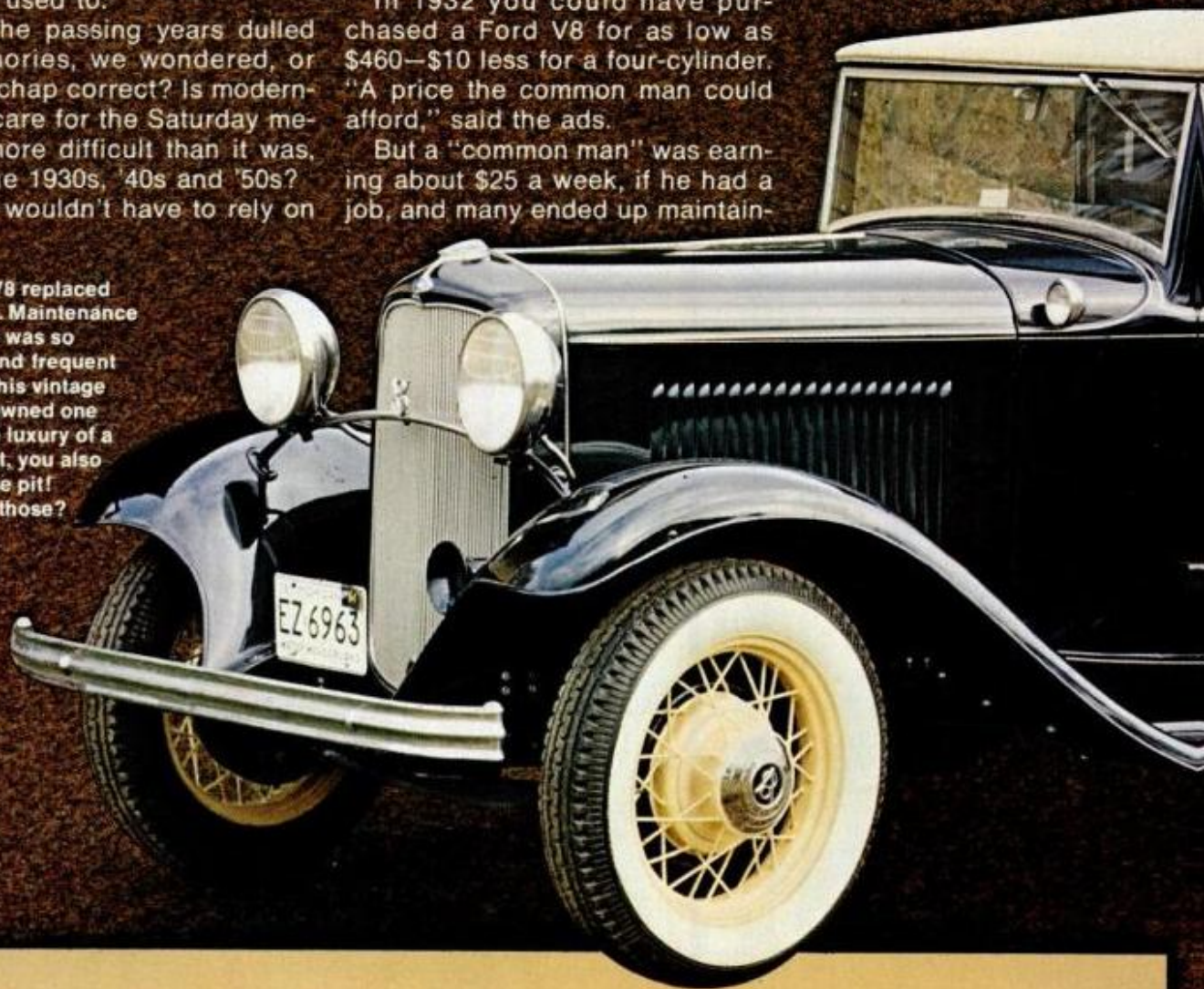
memory, we hunted up old service instructions and a couple of old-time cars. This article reports facts—not impressions glossed by time.

### Car care, 1930s style

In 1932 you could have purchased a Ford V8 for as low as \$460—\$10 less for a four-cylinder. "A price the common man could afford," said the ads.

But a "common man" was earning about \$25 a week, if he had a job, and many ended up maintain-

1932 Ford V8 replaced the Model A. Maintenance and service was so extensive and frequent on cars of this vintage that if you owned one and had the luxury of a garage for it, you also had a grease pit! Remember those?



1957 Chevrolet Bel Air convertible used mechanical breaker points that needed adjustment, cleaning and periodic replacement. What do you have on your new Chevy? Why, breakerless ignition, of course!



# easier than ever!



1956 Oldsmobile Super 88 four-door sedan had a lead-acid battery under the hood, and so do late-model Olds cars. But now it's maintenance free!



1941 Lincoln Continental is a looker, but keeping it in top trim took more frequent visits to the shop than it does today to keep your Mark V or Continental in fine running condition.



# CAR CARE GUIDE

**YUP, CAR CARE REALLY IS EASIER THAN EVER!**



1949 Chrysler Town & Country with its woodie sides had its own special maintenance problem: you needed sandpaper, oxalic acid and varnish to properly care for the body!

ing cars themselves to save a buck. This meant doing 221 individual servicing procedures over a year's period. By comparison, the 1979 Ford Mustang requires 33 scheduled maintenance procedures over a 50,000-mile period (equivalent to four years).

Things didn't change much during the '30s and into the '40s. There was no such thing as a Saturday mechanic. An owner of a 1939 DeSoto, for instance, had to be a Saturday-Sunday-and-half-of-Monday mechanic. Proof lies in these scheduled procedures he had to do:

■ Every 1000 miles, lubricate lower control-



1939 DeSoto was a car in the Chrysler family. The marque bit the dust in 1961.

arm pivot pins, lower control-arm pivot shafts, intermediate arm bushings, drag link, inner and outer tie rods, kingpins, upper control-arm pivot pins, rear-spring shackles, universal joints, rear-spring front bolts, brake and clutch pedal bearings, clutch auxiliary shaft, starting motor, distributor shaft, distributor cam, generator, door-lock oil pads, door hinges, door handles, cylinder locks, door-check linkages, window-regulator arms and hood.

■ Every 1000 miles, fill the transmission, rear axle, brake master cylinder, battery and shock absorbers.

■ Change engine oil every 2000 miles.

■ Twice yearly (5000 miles), drain, flush and refill the rear axle, cooling system and standard transmission; lubricate the speedometer cable and refill the steering gear; drain, clean and refill the carburetor oil-bath air cleaner.

## PAST AND PRESENT SERVICING COMPARED

1949 CHRYSLER		1979 CHRYSLER	
SERVICE	INTERVAL	SERVICE	INTERVAL
Lubricate chassis.	1,000 miles.	Lubricate chassis.	30,000 miles.
Service carburetor air cleaner.	1,000 miles.	Replace carburetor air filter.	30,000 miles.
Rotate tires.	2,500 miles.	Rotate tires.	10,000 miles.
Change motor oil.	5,000 miles.	Change motor oil.	12 months or 12,000 miles.
Change oil filter.	5,000 miles.	Change oil filter.	12 months or 24,000 miles.
Service oil filler pipe cap air cleaner.	5,000 miles.	Clean crankcase inlet air cleaner.	30,000 miles.
Adjust brakes.	5,000 miles.	Adjust brakes.	Not required.
Check generator charging rate.	5,000 miles.	Check alternator charging rate.	Not required.
Adjust clutch.	5,000 miles.	Adjust clutch.	12,000 miles.
Inspect, adjust drive belt.	5000 miles.	Inspect, adjust drive belts.	24,000 miles.
Engine tuneup.	10,000 miles.	Engine tuneup.	24,000 miles.
Engine tuneup.	10,000 miles.	Engine tuneup.	24,000 miles.
Drain, refill automatic trans.	10,000 miles.	Drain, refill automatic trans.	Not required.
Drain gas tank (to clean out sediment).	10,000 miles.	Replace fuel filter.	30,000 miles.
Service front wheel bearings.	10,000 miles.	Service front wheel bearings.	30,000 miles.
Adjust headlights.	10,000 miles.	Adjust headlights.	Not required.
Lubricate speedometer cable.	10,000 miles.	Lubricate speedometer cable.	Not required.
Drain, flush, refill rear axle.	20,000 miles.	Drain, flush, refill rear axle.	Not required.
Remove and repack universal joints.	20,000 miles.	Remove and repack universal joints.	Not required.
Lubricate rear wheel bearings.	20,000 miles.	Lubricate rear wheel bearings.	Not required.
Drain, flush, refill cooling system.	Early spring, fall.	Drain, flush, refill cooling system.	24 months, then every year or 30,000 miles.

■ Yearly (10,000 miles), drain, flush and refill the automatic transmission, and repack the rear chassis springs and covers.

What about durability? Did cars of the '30s and '40s give less trouble? Consider:

■ How valves in Fords, Mercurys and Lincolns of the 1930s needed frequent adjustment. If valves weren't adjusted promptly, pounding damaged them.

■ How the power brake shaft in the 1934 Chrysler Airflow (yes, it had a power brake), which was situated on the lower rail, accumulated road spray, rusted and jammed.

■ How the rear Duflex springs of the 1938, 1939, 1940 and 1941 Pontiac didn't flex enough and used to break; or how the timing chain in the same cars had a way of snapping.

■ How crankshafts in 1941 and 1942 Buicks went out of round.

■ How transmissions in 1946, 1947 and 1949 Chevys jammed in gear.

Factory service bulletins are nothing new. They were in existence back then, too.

### Car care, 1940s style

Those who think fondly of the "old days" often point out the difficulty of working on a modern car. Some do-it-yourselfers point out that it takes "forever" just to get at sparkplugs for replacement because of airconditioning, emissions controls and other plumbing. In some cases, replacing sparkplugs of newer cars is more difficult than doing the job on an oldie, but, remember, you only have to do the job half as often. Engine tuneups have been stretched to as much as once every 24,000 miles!

The chart (left) shows it takes much less time to service a 1979 than older cars.

### Car care, 1950s style

Throughout the 1950s and into the 1970s, automobiles have become more complex, but car care has become easier. How can we account for what appears to be a paradox? The answer can be found in comparing two cars—the 1959 Oldsmobile and 1979 Olds.

■ The '59 Olds had distributor points that needed cleaning and adjusting (often replacing) every 10,000 miles. Points, condenser and distributor cam—parts that required care—have given way in the '79 Olds to maintenance-free electronic ignition.

■ The '59 Olds had three unsealed universal joints that needed cleaning and repacking every 10,000 miles. Today, U-joints are sealed and may not have to be replaced ever.



1934 Chrysler Airflow aerodynamics started car buffs. It was called "streamlining." Automatic transmission overdrive was also offered in Chrysler and DeSoto Airflow.

■ There was a non-maintenance-free battery in the '59 Olds that expelled acid, causing corrosion to form on the battery and cables. The cables and battery had to be cleaned every 10,000 miles or suffer early failure. The '79 Olds has a maintenance-free battery, which doesn't even require a check for water.

■ Remember brakes that required adjusting every 10,000 miles? The '59 Olds had them.

"They don't make 'em easy to work on like they used to," said my friend. But the facts don't bear him out. Neither does the Automotive Information Council.

"Newer cars need far less maintenance than did earlier ones," the Council states. "Unfortunately, people tend to overlook some of the recommended servicing intervals. That's usually why things go wrong."

The solution to a lot of problems, therefore, is to do maintenance when it's called for by the schedule in the owner's manual. As you go about your work, be comforted by the fact that car care today is easier than ever! **PM**



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# 7<sup>th</sup>

## ANNUAL

**POPULAR MECHANICS**

**AUTOMOTIVE PARTS &  
ACCESSORIES ASSN.**

# May is Car Care Month

POPULAR MECHANICS and the Automotive Parts & Accessories Association want you to "Drive a Happy Car" in 1979! For the seventh consecutive year, POPULAR MECHANICS and APAA have teamed up to bring you the "May is Car Care Month" program. It's designed to keep your car in top shape by bringing you valuable car care advice as well as money-saving specials on auto products. The involvement of APAA reflects its continuing dedication to provide you with safer, more reliable automotive parts and products. With more APAA member retail outlets and manufacturers participating than ever before, this is the best Car Care Month yet!

The Car Care Month retailers, listed in the directory on Page 232, are your headquarters for the many fine products advertised in the POPULAR MECHANICS Car Care Guide. And on page 234, you'll find a directory for the cooperating Car Care Month manufacturers, including the products they'll be featuring during May. In addition, hundreds of newspapers across the country are bringing you Car Care Month sections where you'll find even more care care know-how and special offers from your neighborhood retailers headquarters. Be sure to watch for them!

The POPULAR MECHANICS Car Care Guide, beginning on the following page, is jam-packed with valuable car maintenance hints to get your car smoothly through the first 100,000 miles. The convenient "magazine-within-a-magazine" format allows you to remove the section easily. Simply bend the magazine pages away from the front and back of the Guide. Pull the Car Care Guide out and you'll have a handy automotive reference manual always at your fingertips.

Look for the stores and products displaying the POPULAR MECHANICS Product Feature Mark and the APAA symbol.





**Dayton introduces Quadra.**

**For confidence in  
the crummiest driving  
conditions.**

Nothing shakes your confidence like beastly driving conditions and worn tires on slick pavement.

And nothing restores it quicker than Quadra, the new, smooth-riding, always-in-season radial from Dayton.

Quadra's precision-engineered radial construction and year-round tread design give you confidence in the country's crummiest driving conditions. Winter blizzards and icy roads up North.



Blistering heat down South. Record rains out West. Slush and snow in the East.

For long wear and improved mileage potential get Quadra, the year-round radial. And feel confident, even in the crummiest driving conditions. Check the yellow pages for your nearest Dayton dealer.

*The safety and mileage of any tire depends on inflation pressure, vehicle weight and driving conditions.*

## Hard starting, stalling and hesitation

**H**ard starting describes an engine which fails to start promptly or does not start at all. The condition may occur all the time or only when a particular set of circumstances is present. For example, the engine may start promptly when cold, but not when warm. On the other hand, it may not start in cold weather, but may kick-off in hot weather at the touch of the starter.

**Stalling** defines an engine that starts, but fails to keep running. The condition is often referred to erroneously as hard starting; if the engine stalls immediately after it starts. Some conditions that cause hard starting cause stalling. In fact, an engine that stalls may become an engine that's hard to start if the condition is allowed to continue.

**Hesitation** describes a letdown in engine response as the vehicle is accelerated. There is a noticeable pause, and the engine may seem about to stall. Sometimes it does. Several malfunctions that cause hesitation also cause stalling.

### HARD STARTING

#### Tracking down the cause

Why don't engines start? The causes are summarized under the following conditions:

**Condition 1**—When the engine (cold or hot) cranks, but fails to start promptly or does not start at all.

- Improper starting procedure.

#### Ignition system

- Damaged distributor cap or burned terminals.
- Broken rotor contact.
- Bad ignition coil.

#### Conventional ignition

- Worn or damaged distributor points.

#### Electronic ignition

- Faulty component, such as pickup coil, electronic control module, ballast resistor.
- Worn distributor shaft.
- Broken or loosely connected primary wire.
- Defective ignition switch.
- Cracked, worn, improperly adjusted sparkplugs.
- Bad sparkplug (secondary) cables.

#### Fuel system

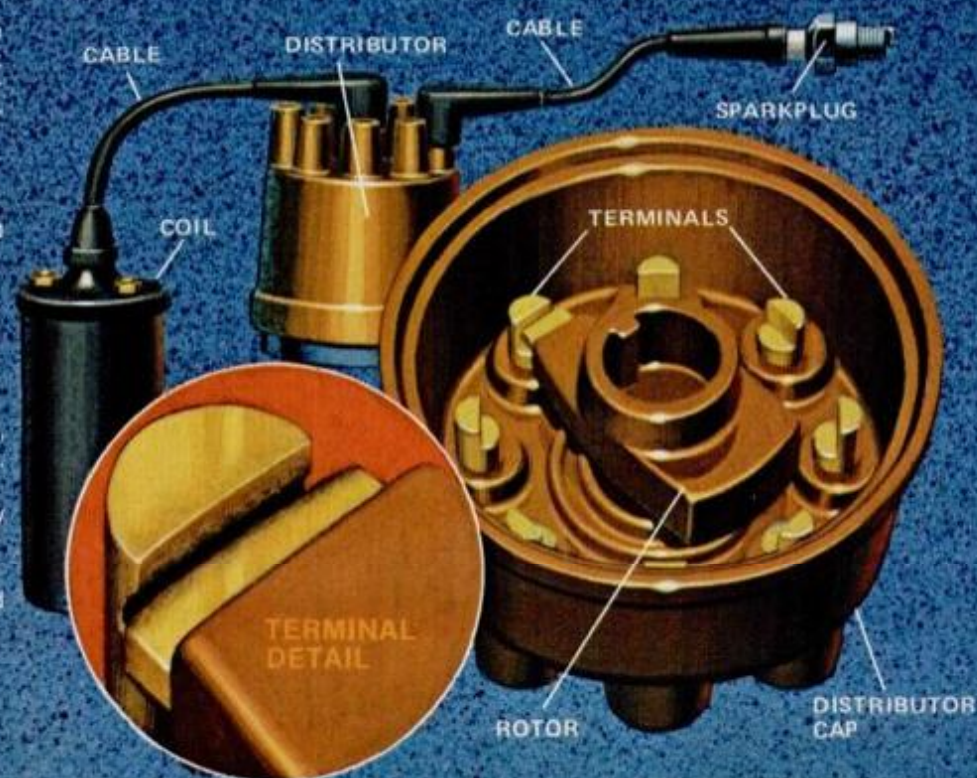
- No gas.
- Clogged fuel filter or fuel line.



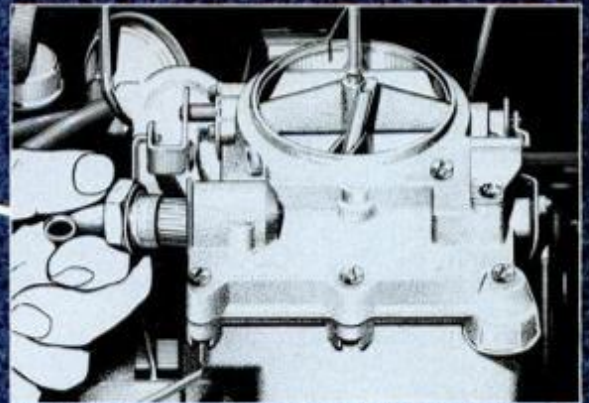
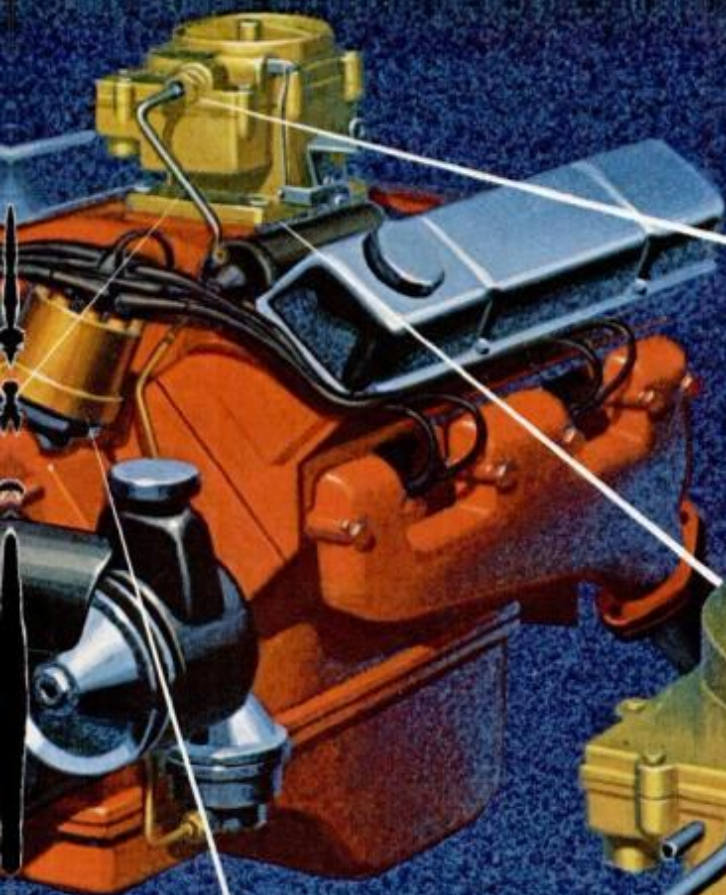
Hard starting problem? Check first for spark and fuel. As shown above, pull sparkplug boots, not cables. Work throttle lever, right, to see if fuel is entering carb. Check tightness of coil-to-distributor and sparkplug cables; below. Also inspect terminals in distributor cap; if corroded, you won't start.



PM art: Fred Warff

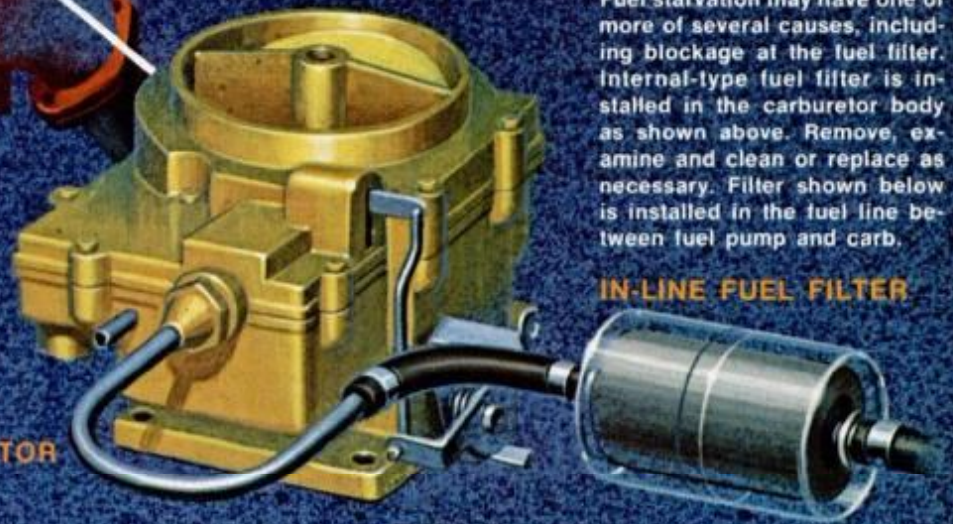






Fuel starvation may have one or more of several causes, including blockage at the fuel filter. Internal-type fuel filter is installed in the carburetor body as shown above. Remove, examine and clean or replace as necessary. Filter shown below is installed in the fuel line between fuel pump and carb.

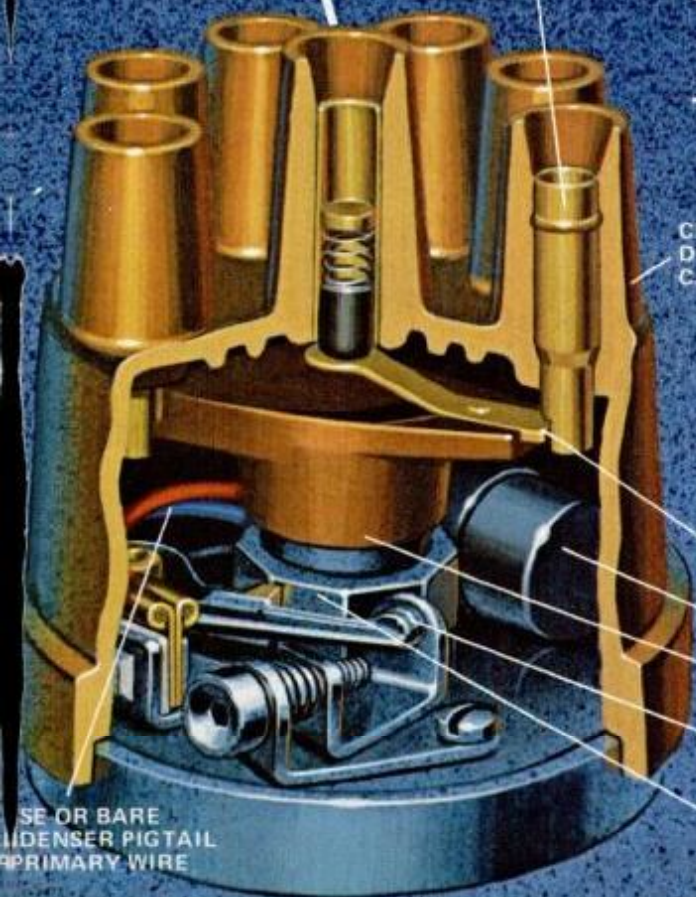
**IN-LINE FUEL FILTER**



**CARBURETOR**

**DISTRIBUTOR**

**TERMINAL CORROSION**



CRACKED DISTRIBUTOR CAP

DAMAGED ROTOR TERMINAL

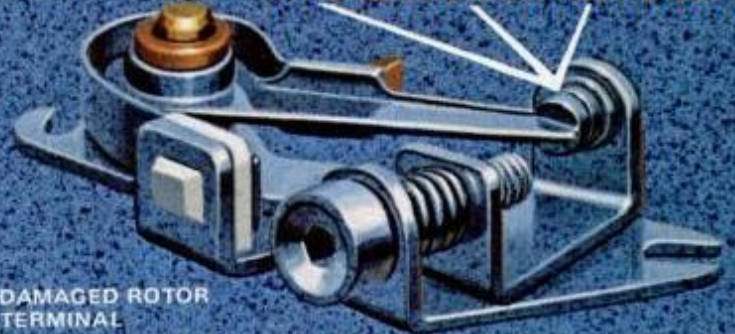
BAD CONDENSER

DAMAGED ROTOR

BAD DISTRIBUTOR POINTS

WORN CAM AND/OR DISTRIBUTOR SHAFT

**TYPICAL BREAKER POINTS SET**



PM art Dale Gustafson

Distributor problems that may cause hard starting are shown at left. Shown above is a set of breaker points which may have to be removed from the distributor for close examination. Details of the points shown right to left, above, are oxide-coated which make poor contact, and eroded points which are the results of a bad condenser.

# CAR CARE GUIDE

SECTION 1

- Malfunction in carburetor.
- Defective fuel pump.
- Fuel system vacuum leak.

**Condition 2**—When the engine barely cranks if warm, but starts promptly if cold.

- Excessive carbon in the engine.
- Carburetor percolation.

**Condition 3**—When the engine cranks, but fails to start in wet weather; starts promptly in dry weather.

- Cracked distributor cap.
- Cracked coil.

### Electronic ignition

- Damaged electronic control unit.
- Bare primary or secondary wires.
- Brittle, cracked sparkplug boots (covers).

**Condition 4**—When the engine doesn't crank or only emits surly growls.

- Corroded, loose or damaged battery cables.
- Weak battery.
- Bad starter switch, relay or motor.

### Zeroing in on Condition 1

In the case of hard-starting Condition 1, determine if the engine is being started properly. People have a tendency to flood engines, especially in cold weather.

Consult your owner's manual for proper starting procedure. If the manual is not available, depress the gas pedal to the floor once (to set the automatic choke), let the pedal up all the way and then position it halfway to the floor. Crank the engine. If the engine doesn't start in 15 seconds, let it rest for 20 seconds. Keep your foot away from the gas pedal and the ignition key off. Then, try again. If the engine doesn't start now, forget it. Don't add a dead battery to your problem.

### Tackle ignition system testing next:

**1. Disconnect a cable from a sparkplug.** Use a pair of sparkplug cable pliers so you don't damage the cable. If pliers aren't available, pull the cable free by twisting and pulling the sparkplug boot—not the cable.

**2. Insert a screwdriver** having a non-conductive handle inside the sparkplug cover, so the tip of the screwdriver touches the cable terminal.

**3. Place the screwdriver shank** ¼ to ½ inch from a clean ground on the engine block. Hold the screwdriver by the handle to avoid shock.

**4. Have someone crank the engine** momentarily. The ignition system is not causing hard starting if a blue spark jumps the gap between the screwdriver and ground. A yellow or orange spark, or no spark, signals a malfunction.

Don't continue cranking, which may damage the ignition system. One spark is all that's needed to judge ignition performance.

### A fuel-system problem will result in an engine getting little or no fuel, or too much fuel.

To see if little or no fuel is reaching the engine, remove the carburetor air cleaner. If the choke plate is closed, open it by tripping the choke lever. Move the throttle linkage back and forth once or twice as you look down the carburetor throat. If the fuel system is working, strong gas jets will stream into the carb.

If an engine gets too much gas, you will

probably smell it. If you aren't sure, remove a sparkplug or two after trying to start the engine. If sparkplug tips are wet, the engine is flooding.

### Pinpointing ignition failure

If the reason for hard starting is in the ignition system, this orderly troubleshooting procedure will help you find the cause:

**1. Tighten primary wire connections** at the coil if they are loose.

**2. Examine the coil.** Replace, if cracked.

**3. Examine and test sparkplug cables,** including the cable from distributor to coil. If one cable is bad, the engine will start, but misfire. If more than one cable is ineffective, starting becomes difficult.

If the distributor-to-coil cable is bad, the engine won't start since high voltage can't reach sparkplugs. The cable allows the coil to feed voltage to the distributor cap, rotor and plugs.

A visual examination may reveal a bad cable. Cracks and brittle insulation are conditions to look for. However, a visual examination doesn't always reveal faulty cables, since wires inside the insulation may be damaged.

The most accurate way of testing cables is with an ohmmeter. Each cable is rated at a particular resistance, depending upon the length of the cable. Short cables are rated at a lower resistance than longer cables.

If you have an ohmmeter, do this with the ignition off:

- Remove the distributor cap.
- Disconnect one cable at a sparkplug.
- Insert the ohmmeter probe in the sparkplug end of the cable so it touches the terminal. Hold the other ohmmeter probe against the electrode inside the distributor cap that the cable serves. Be sure ohmmeter probes make solid contact.

**D** If the meter shows that cable resistance is more than the ohm rating given in the car's shop manual (See *Car Clinic*, page 52, Apr. '77, for information on how to obtain your car's shop manual.), detach the cable from the distributor cap. These instructions do not apply to the distributor-to-coil cable (see below).

**E** Test the suspicious cable again. If the cable still fails to meet specification, replace it. However, if cable resistance falls into line, there's a defect in the distributor cap. The terminal is probably corroded or burned, so clean cap towers with a distributor cleaning tool, polishing contacts. Also polish terminals on the distributor side of the cap.

**F** Reconnect the cable and test resistance again. If resistance is still too high, replace the distributor cap.

**G** Start the engine and let it warm up; then shut it off. Disconnect the distributor cap and connect the ohmmeter between the center contact of the cap and one of the primary terminals at the coil. Resistance should not exceed the ohms rating in the shop manual.

If resistance is greater, remove the distributor-to-coil cable at the coil and test resistance by touching a probe to the cable terminal and a probe to the distributor contact. If resistance is still greater than specification, replace the cable. If resistance falls into line, tighten all connections and test overall resistance again. If overall resistance still exceeds service manual specifications, the coil is probably faulty. Replace it.

**4. Examine the distributor cap** for physical damage. A carbon track is damage indicating a hairline crack. Look also for burned or eroded terminals.

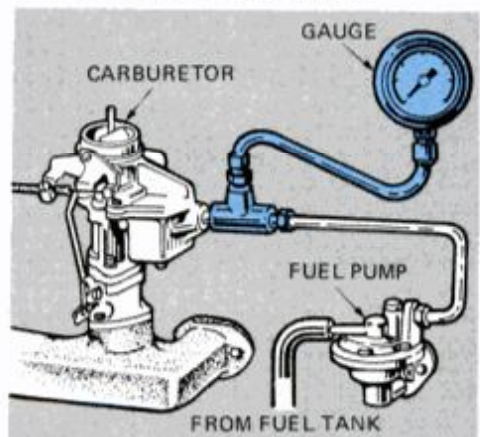
If you have to replace a distributor cap, make sure each cable is installed in its proper tower. Line up the replacement cap so distinguishing marks parallel the old cap's distinguishing marks. Transfer one cable at a time from one cap to the other.

**5. Remove the rotor.** Replace a broken rotor, or one having a broken, burned or eroded metal contact.

**6. Conventional ignition:** It is usually difficult to examine distributor contact points with points mounted in the distributor. You may have to remove them.

Spread points apart. A silver-gray finish (smooth or slightly rough) is acceptable. Replace pitted, burned or eroded points. Also replace the condenser.

*Note:* A bad condenser allows electrical surges to destroy points. A faulty resistor or excess lubricant splashing from the cam also leads to premature failure of points.



Measure fuel pump pressure with a gauge to manufacturer's manual specifications.

**7. Electronic ignition:** Unlike conventional ignition systems, electronic ignition systems differ from one car to the next. Testing electronic ignition systems, therefore, differs from car to car.

The April and June 1978 issues of *Popular Mechanics* presented detailed information on electronic ignitions. The April issue covers the AMC Breakerless Inductive Discharge (BID) System and the Chrysler electronic ignition system. The June issue deals with Ford's Solid State (S/S) System, GM's High Energy Ignition (HEI) and International Harvester's electronic ignition system.

*Note:* Beginning with 1978 models, AMC adopted a solid-state electronic ignition system for V8 engines that is similar to Ford's.

**8. Ignition failure** can also result because of a malfunction in the ignition switch circuit. This circuit unit consists of an ignition switch and an ignition wire that plugs into a wire junction box on the firewall before passing on to the coil. Make sure the connection at the junction box has not worked loose. See that the wire at the coil and ignition switch are tight. Check the switch.

### Sparkplugs are special

The only way to determine if hard starting is caused by bad sparkplugs is to remove plugs

from the engine for examination. Look for damaged or worn electrodes, in particular.

### Pinpointing fuel system failure

Suppose little or no gas reaches the carburetor during the fuel system "squirt" test (see *Zeroing in on Condition 1*). The cause of the trouble is one of the following:

- Clogged fuel filter.
- Defective fuel pump.
- Clogged fuel line.
- Vacuum leak.
- Blockage in the fuel tank.
- Trouble in the carburetor bowl (clogged internal fuel filter, sticking float needle, binding float, clogged circuits).
- No gas.

To trace fuel starvation to a particular point, disconnect the fuel line at the carburetor bowl.

**Caution:** No smoking! Keep the engine off. The engine should be cold. Disconnect the battery ground cable. Place a small plastic container under the fuel line fitting to catch gas that may drip.

With the line disconnected, face its end toward a container. Have someone briefly crank the engine. If no gas, or only a dribble, flows into the container, look for a fuel filter in the fuel line between the carburetor and fuel pump. This metal or plastic cylinder is called an in-line fuel filter. Most Chrysler Corp. and AMC models have one. Replace it.

Ford and GM models usually have fuel filters in the carburetor inlet. If this filter gets blocked, gas will get to, but not through the carburetor. There will be no jets of gas when you activate the throttle linkage (see *Zeroing in on Condition 1*).

Remove this filter, reconnect the fuel line and check starting. If the engine starts, the filter is clogged. Replace it.

After the fuel filter, the next component to test if fuel isn't getting to the carburetor is the fuel pump. Before doing this, make sure fuel system fittings are tight. Inspect for gas leaks at all connections from fuel tank to carburetor.

A loose fitting allows air to enter the fuel system. Air disrupts vacuum, which is necessary to get gas to the carburetor. Also, make sure fuel hoses aren't flattened, kinked or clogged. Disconnect the fuel line at both the carburetor and fuel pump. Blow through the line to make sure it's not clogged. Reconnect the line. If fuel still doesn't flow from the fuel line, test the fuel pump:

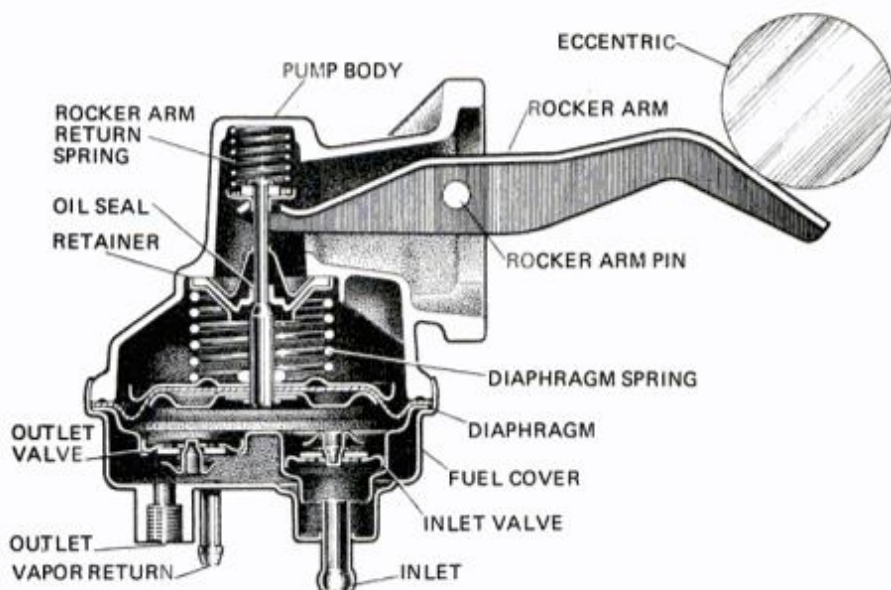
**1. Connect a fuel pump pressure gauge** to the disconnected end of the fuel line at the carburetor (see drawing, facing page).

**2. Start the engine and check fuel pump pressure** as you rev the engine from idle to moderate speed.

**Note:** If the car is equipped with a fuel evaporation emission control system, as most 1970 to present models are, squeeze off the fuel pump vapor return hose to get an accurate reading.

**3. Fuel pump pressure** should remain constant at engine idle and throughout the acceleration range. Pressure should be on target with the fuel pump pressure specification in the service manual. This specification varies from car to car.

If fuel pump pressure is too low, too high, or



Note how the rocker arm strikes the eccentric; also the vapor-return fitting.

shifts significantly at different engine speeds, replace the pump.

**4. Equip yourself with a graduate** marked off in pints and a watch with a second hand.

**5. With the fuel line disconnected** at the carburetor, aim the line into the graduate.

**6. Start and idle the engine.** Watch your watch. The fuel pump should deliver one pint of gas in 30 seconds or less. If the flow is below this, check again for a loose connection or restricted line.

### Replacing a fuel pump

Replacing a fuel pump is no big deal. Here's how:

**1. If you can't reach the fuel pump** from beneath the hood, raise and support the car.

**2. Disconnect the fuel tank-to-fuel pump** gas line at the inlet side of the fuel pump. Plug the line. A golf tee or short pencil makes a suitable plug. Fold a cloth over the pump connection to absorb fuel that leaks.

**Caution:** Where possible, use two wrenches to avoid damage. Hold one fitting with one wrench and use the other to loosen or tighten. Use the same technique to connect and disconnect the fuel line at the carburetor.

**3. Disconnect the fuel vapor return hose** from the fuel pump fitting and plug the hose.

**4. Disconnect the fuel pump-to-carburetor** gas line at the fuel-pump outlet. Plug the end of the line.

**5. Remove the fuel-pump mounting bolts.**

**6. Tipping the pump up,** pull it straight back from the engine.

**7. Clean the fuel-pump mounting flange** on the engine using a brush with kerosene. Be sure loose gasket material and other dirt doesn't remain.

**8. Coat a new gasket with gasket cement.** Put the gasket in place.

**9. Install the new pump.** If you have trouble getting the pump into the engine, remove the pump and crank the engine until the shaft's fuel pump eccentric (cam) is at a low point. The eccentric must be in contact with the

fuel-pump rocker arm, as shown in the drawing above.

**10. With pump in place, install hardware,** but don't tighten until you lift up on the pump. Tighten screws to 13-15 foot-pounds.

**11. Reconnect all lines.** Start the car, run the engine and check for leaks.

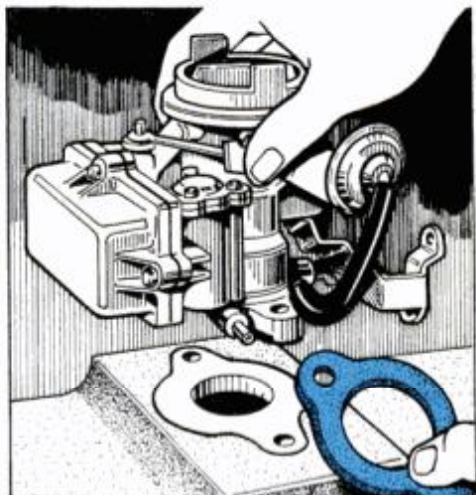
### Zeroing in on Condition 2

In every batch of mail we get at *Car Clinic*, there are letters complaining of engines that are hard-starting only when warmed up. Usually, the problem affects older engines.

Carbon buildup is the trouble in most cases. Carbon, when it gets hot, has the effect of increasing an engine's compression ratio, which makes it difficult for the starter motor to crank the engine. In fact, many people who write blame the battery or starter motor since the engine sounds the same as it would if the battery were weak or the starter motor were defective.

To check for carbon, do a compression test with the engine warmed to operating temperature. If the test shows overall compression in excess of normal specification (consult manu-

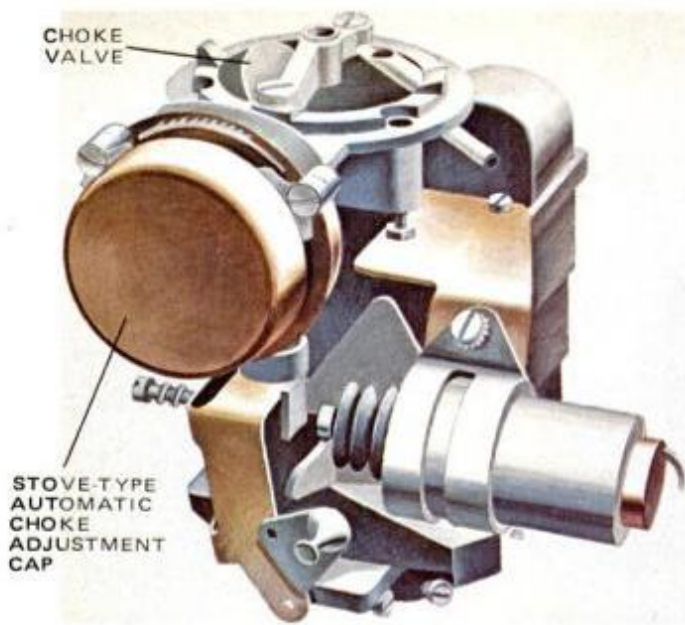
*Please turn to page 168*)



A thicker gasket between carburetor and intake manifold may eliminate percolation.

# CAR CARE **1** GUIDE

## SECTION



Carburetor details show stove-type automatic choke (left), well-type (below), and idle-adjustment screws (bottom). Automatic choke provides proper fuel/air mixture for stall-free cold starts. Fast-idle screw, which rides on stepped cam, selects ideal engine speed in relation to choke-valve opening.

factor's specification in your shop manual), carbon exists. The engine may have to be disassembled and cleaned.

Try the simple, inexpensive way first. Get GM Top Engine Cleaner, or equivalent, and use as directed. If you're lucky, you may get rid of carbon and your problem.

Carburetor percolation also causes hard starting when the engine is warm. However, the engine will crank more briskly than if it were loaded with carbon.

Percolation refers to gas in the carburetor bowl boiling over and flooding the cylinders. Heat is the cause.

To cure the problem, reduce heat. One way is to discard an underhood insulating pad. Another is to use a thicker gasket between the carburetor and manifold. This raises the carburetor off the hot engine, maybe just enough to eliminate the trouble.

### Hard-starting Conditions 3 and 4

The ignition system is usually at fault if an engine won't start in wet weather but may start in dry weather. Check for cracked distributor cap or coil and replace either or both if they are defective.

Another hard-starting condition occurs when the engine may growl or be silent but won't catch at all. This signals a defect in the starting system, which consists of the battery, battery cables, starter relay and/or switch (solenoid) and starter motor. The engine will barely turn over, if it cranks at all.

Examine battery cables and terminals first. Cables must be tightly connected and have no breaks in insulation. If terminals and battery posts are corroded, clean them since such foreign matter hampers the flow of current.

Use a battery hydrometer to test battery electrolyte for specific gravity. This test, which determines the percentage of sulphuric acid in electrolyte, will pinpoint a weak battery. In a battery that is losing charge, plates absorb sulphuric acid from the electrolyte, consequently causing a drop in specific gravity. (The specific gravity of some maintenance-free batteries cannot be tested, because the battery seal

*(Please turn to page 170)*

### CARBURETOR

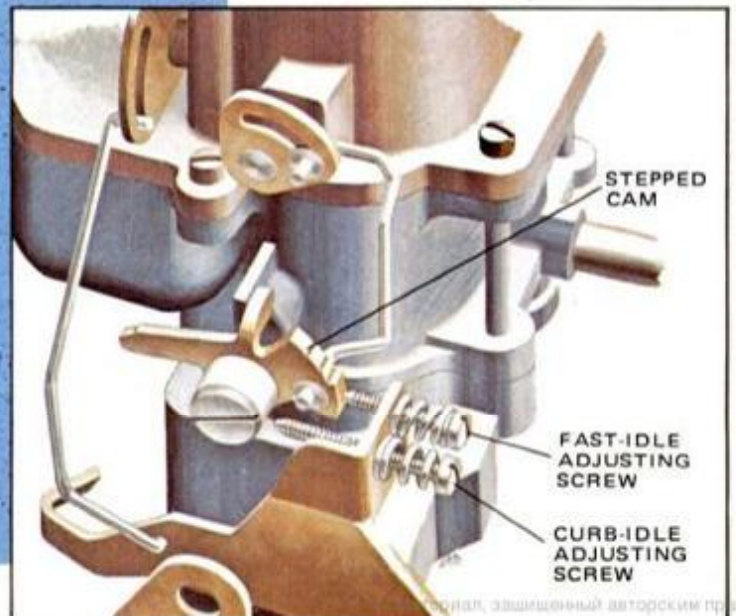
CHOKE VALVE CARBURETOR THROAT

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SATISFACTION GUARANTEED

# CAR CARE GUIDE

## SECTION 1

cannot be broken. It is, therefore, necessary to test a maintenance-free battery with a battery tester.)

Test specific gravity of a conventional battery as follows:

**1. Add water**, if necessary, to bring electrolyte in each cell to proper level. If water is added, run the engine at fast idle for 15 minutes before testing, so fresh water mixes with electrolyte.

**2. Remove battery vent caps.**

**3. Draw electrolyte from one cell** into the hydrometer. Make sure that the hydrometer float is riding freely in the hydrometer tube.

**Caution:** A battery emits highly explosive gas. Do not smoke when near a battery. Disconnect the ground (negative in most cases) cable to prevent sparks. If electrolyte gets on your skin, flush with water immediately. If electrolyte splashes in your eye, flush with water and get to a physician immediately. Electrolyte is an acid that can result in burns and blindness.

**4. Hold the hydrometer at eye level.**

Note the reading. Return electrolyte to the cell and take readings, one at a time, of all other cells.

(Specific gravity varies with electrolyte temperature. Each reading has to be interpolated



**Safety first, always. Use a strong supporting tool for carrying a heavy battery.**

to 80° F. If your hydrometer doesn't have a built-in temperature compensator, which automatically gives direct readings, insert a thermometer in electrolyte to obtain its temperature. For every 10° that this temperature is

## TROUBLESHOOTING STALLING

CAUSES TO CHECK	CORRECTION	REFER TO
<input type="checkbox"/> Sticking automatic choke, including inoperative vacuum break.	Repair and adjust.	
<input type="checkbox"/> Incorrect slow and fast-idle speeds.	Adjust.	
<input type="checkbox"/> Bad sparkplugs and/or sparkplug cables.	Replace.	Sect. 1: Sparkplugs Are Special.
<input type="checkbox"/> Damaged conventional or electronic distributor parts, including loose or bare primary wire.	Replace.	Sect. 1: Pinpointing Ignition Failure.
<input type="checkbox"/> Carbon inside engine, especially at exhaust manifold ports.	Treat with carbon solvent, such as GM Top Engine Cleaner.	Sect. 1: Zeroing In on Condition 2.
<input type="checkbox"/> Dirt-clogged carburetor air filter.	Replace.	
<input type="checkbox"/> Partially clogged fuel filter.	Replace.	Sect. 1: Pinpointing Fuel System Failure.
<input type="checkbox"/> Contaminated fuel.	Drain fuel system, including fuel tank, and flush with cleaner.	
<input type="checkbox"/> Clogged PCV valve.	Replace.	
<input type="checkbox"/> Carburetor repairs.	If carburetor has not been serviced in 30,000 miles, clean and overhaul it, using parts in the carburetor repair kit for your model carburetor.	
<input type="checkbox"/> Weak fuel pump.	Replace.	Sect. 1: Pinpointing Fuel System Failure.
<input type="checkbox"/> Inoperative thermostatic air cleaner.	Replace.	
<input type="checkbox"/> Vacuum loss through loose or split vacuum hose.	Repair or replace.	
<input type="checkbox"/> Vacuum leak from carburetor-manifold area.	Repair.	
<input type="checkbox"/> Inoperative manifold heat-control valve or vacuum-controlled fuel vaporization valve.	Free or replace.	
<input type="checkbox"/> Bad EGR valve.	Replace.	

above 80° F., add .004 to the specific gravity reading. For every 10° that the temperature is below 80° F., subtract .004 from the reading.)

**5. Compare readings.** A difference of .050 or more points between readings reveals a shorted cell or cells. Replace the battery.

If overall specific gravity is below 1.225 points, slow-charge the battery and retest. You're looking for a minimum overall reading of 1.225 either before or after charging. If the battery doesn't attain this, replace it.

If the battery and battery cables are sound, test the starter system to determine if the cause of hard starting is in the starter switch, starter relay or starter motor.

### Inherent starting problems

Some service bulletins covering hard starting which have been issued are as follows:

#### Chrysler Corp.

■ 1974 models with 318-cu.-in. engines and 1½-in. BBD carburetors—hard starting when hot. *SB 14-08-74T.*

■ 1975 models with 318-cu.-in. engines and automatic transmissions—hard starting after partial cool-down. *SB 14-10-75.*

#### FoMoCo

■ 1973-74 models with 4300 4V carburetors—hard cold starts. *SB 59.*

■ 1976, all models—hard starting with slow cranking speed. *SB 111.*

■ 1976 models with 351-cu.-in. engines—hard starting at temperatures below 32° F. *SB 119.*

■ 1977 models with 2.3L engines and automatic transmissions—hard starting during sub-zero temperature conditions. *SB 129 and 133.*

## STALLING

### Tracking down the cause

An engine can start and then stop running when idling or cruising whether it's cold or warmed up. The chart at left summarizes causes of stalling and the cures. Where the same problem causes both stalling and hard starting, you are referred to the cure already discussed.

### Driver's role

One cause of stalling not listed in the chart is driver impatience. According to the National Highway Traffic Safety Administration, "A vehicle's engine operates at maximum efficiency when the engine is warmed to operating temperature. Trying to get a lot of speed or acceleration from a cold engine, especially today's more sophisticated engines, invites stalling."

In other words, don't expect to start a cold engine and drive immediately at freeway speeds. The engine probably won't take it.

Still, don't let a cold engine idle excessively in an attempt to warm it up, especially if the car has a catalytic converter. Idling causes unnecessary wear and leads to damage.

The key word is *moderation*. Start the engine and drive slowly for a few minutes.

### What you should know about chokes

A malfunctioning automatic choke is high on the list of causes that lead to stalling. Before working on a choke, you have to know how and why chokes act as they do.

A choke provides the right fuel mixture for  
(Please turn to page 172)



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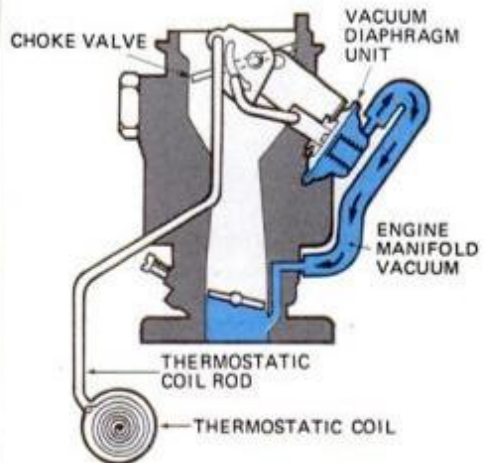
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**TIRED  
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## CAR CARE **1** GUIDE SECTION

quick cold-engine starting and warm-up. When the engine is cold, thermostat coil tension holds the choke valve closed over the carburetor throat so the engine gets a mixture rich in gas. The thermostat coil is usually located in a



**Automatic choke system gives engines the right mixture for stall-free starts.**

choke cap on the carburetor or in a well in the engine.

The thermostatic coil is connected to the choke valve in the carburetor throat. If the coil is housed in the choke cap, it is connected to the choke valve by a piston and shaft. If the coil is housed in a well in the engine, it is connected to the choke valve by a long rod.

Chokes having the thermostat coil in a choke cap are called stove-type chokes. You will find stove-type chokes on carburetors used on AMC, Ford and GM engines. Chrysler Corp. engines generally use well-type chokes. Let us use a stove-type choke to explain how chokes work.

As you crank a cold engine, air pressure against the offset choke valve and the action of a choke piston cause the valve, which is closed tightly over the carburetor throat because of thermostat coil tension, to open slightly. A thermostat coil is at maximum tension when it is cold and releases tension as it gets warm.

As for the action of the choke piston, intake manifold vacuum pulls the piston down in its cylinder, which helps to pull the choke valve open slightly when the engine is cold. All this action is to make sure that even when a cold engine is cranked, it won't get a fuel mixture consisting of 100 percent gasoline. Pure gas can't burn. It needs air.

When the engine starts, continued pull on the piston by engine vacuum and the force of air against the choke valve overcome thermostat coil tension to allow the choke valve to assume a partially open position. As the piston moves down in its cylinder, slots in the sides of the cylinder open so heated air from the exhaust manifold enters the thermostat coil housing. This warm air causes the thermostat coil spring to gradually lose tension, and the coil releases its hold on the choke valve. Within a minute or so after a cold engine is started, the choke valve attains a fully open position.

### **Other cold-engine assist-starting mechanisms**

The automatic choke works hand-in-hand with the carburetor fast-idle mechanism to pre-



vent stalling during engine warm-up. A fast idle cam, which activates the carburetor throttle plate, is located on the side of the carburetor. It is attached to the choke valve shaft by a linkage. The cam rotates into position against a fast idle screw when the shaft moves.

On the cam are indentations called "steps." As the choke valve shaft moves and the cam rotates, the fast-idle screw skips from one step to another to provide the ideal engine speed in relation to the choke valve opening. When the choke valve is fully opened, the fast-idle cam rotates free of the fast-idle screw, which allows the carburetor throttle plate to return to curb-idle position.

Most models produced in the 1970s also have a vacuum break and electric assist unit to increase the efficiency of automatic chokes. These components open the choke plate as quickly as possible to provide the leanest fuel mixture needed for starting. Getting the plate open quickly reduces the richness of fuel the engine consumes and, therefore, cuts down on exhaust emissions. If either the vacuum break or the electric-assist unit malfunctions, the air to gas ratio is upset and stalling can occur.

**Note:** If an engine floods during starting, you can clear fuel from the intake manifold by slamming the gas pedal to the floor and keeping it there as you crank the engine. With the accelerator in this position, a tang on the throttle lever hits against the fast-idle cam, which causes the choke rod to move up. This opens the choke valve allowing air into the carburetor, which helps clear the flooding condition.

### Testing chokes

Testing an automatic choke is done by observing.

**1. Remove the carburetor air cleaner while the engine is cold.** The choke valve should be closed tightly over the carburetor throat. If it isn't, have an assistant press the accelerator pedal to the floor and let it up. The valve should close. If not, the choke mechanism probably needs servicing.

**2. Crank the engine.** As this is being done, the choke valve should open slightly. As the engine starts and begins warming up, the valve should continue opening and engine idle should gradually drop from fast to normal speed.

**3. Clean linkage** (if the choke mechanism needs servicing) to eliminate a sticking condition. Also, apply carburetor cleaner around the choke valve. If this doesn't solve the problem, you may have to disassemble the choke mechanism to replace the thermostat coil and free a binding piston, but first test both the vacuum break and the electric-assist unit.

### Testing a vacuum break

If the choke valve doesn't open and there is a vacuum break on the carburetor, verify that the vacuum break is working. Start engine, and alternately pull and push the vacuum hose off and on the vacuum break. If vacuum break linkage doesn't move, replace vacuum break.

### Testing an electric-assist unit

The procedure for testing an electric-assist unit varies from one car to another. The following explanation applies to a single-stage control, consisting of a control switch and ceramic

*(Please turn to page 174)*



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# CAR CARE GUIDE

## SECTION 1

heating element, which is used on many Chrysler Corp. engines. The procedure is offered as an example to demonstrate that testing the mechanism is not difficult.

### To test the control switch:

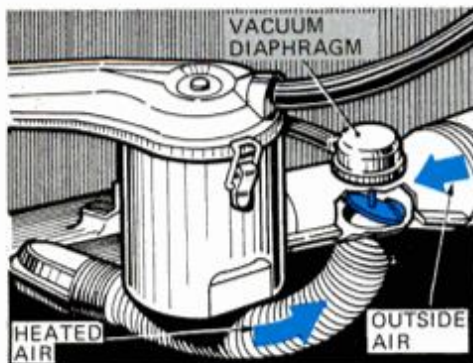
1. Remove **BAT electric terminal** from the control switch.
2. Connect a **12-volt testlight** to the switch's load terminal, which is the small terminal, and to ground.
3. Start the engine.
4. Reconnect the **BAT electric terminal**. The testlight should light. It may stay lit for a few seconds or longer, but it must not stay on for more than five minutes. If the testlight doesn't work this way, replace the control switch.

### To test the heating element:

1. Remove **BAT electric terminal** from the control switch.
2. Connect an **ohmmeter to choke** housing and touch the other lead to a bare spot on the choke wire connector of the control switch, but do *not* touch the ohmmeter to the BAT terminal. A reading of 4 to 12 ohms means that the heating element is working. If you don't get this reading, replace heating element.

### Handling a troublesome thermostat air cleaner

Thermostatically controlled air cleaners have been used since the early 1970's to reduce the amount of carbon monoxide generated by cold engines. A thermostat air cleaner does this by regulating the temperature of air entering the carburetor.

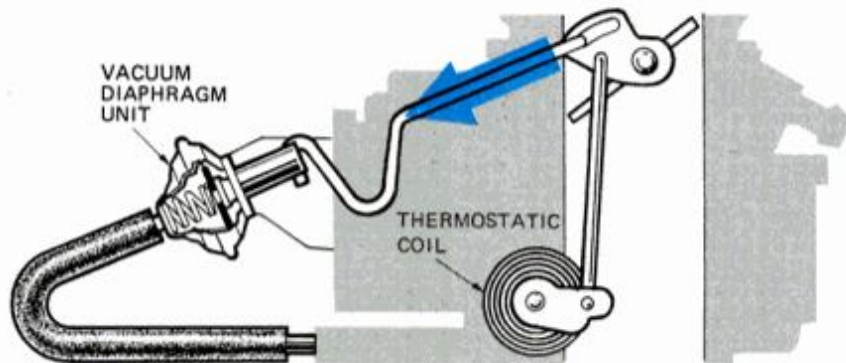


This diagram of Omni air cleaner depicts control damper door has over inlet air.

A damper door in the air cleaner inlet (snorkel) closes when the engine is cold. No cold air can enter. Instead, warm air from the exhaust manifold is diverted through a tube to the carburetor. This cuts down on carbon monoxide, since less carbon monoxide is produced when gasoline is mixed with warm air.

If the damper door in the snorkel fails to close when a cold engine is started, stalling occurs, because the engine isn't calibrated to accept cold air. To determine if the thermostat air cleaner is causing a stalling condition as a cold engine is being started, check the air cleaner by observing the damper door.

If you can't see the damper door by looking into the nose of the snorkel, remove the air cleaner cover and filter element, and check damper door operation from the backside. You now have a chance to also examine the filter element, which has to be clean and unclogged



Vacuum break pulls the choke plate open to let air mix with gas for combustion.

to prevent a stalling problem. A dirty air cleaner chokes off air entering the engine, forcing the engine to run on a richer-than-normal fuel mixture.

If the damper door is not closed as you start the engine (cold), look for:

- Split or loose hot air tube from the manifold to the air cleaner. Replace or reconnect.
- Defective vacuum motor. Unhook the vacuum hose that is connected to the vacuum motor at the engine end. Draw in on the hose by mouth or with a vacuum pump. If the damper door does not close, replace the vacuum motor.
- Defective sensor. If applying vacuum to the vacuum motor closes the damper door, the sensor is bad. Replace the part by straightening the tangs holding it to the air cleaner housing.

A thermostat air cleaner malfunction causes warm-engine as well as cold-engine stalls. As the engine starts and warms up, the damper door should open. If it stays closed, the engine will stall. A defective sensor is usually to blame for the damper door staying closed when it should open.

### Other causes of stalling

■ Carburetor idle speeds—Correct slow and fast idle-speed adjustments are basic to a properly running engine. Adjust to the specifications of the car manufacturer.

The propane-assisted method of setting carburetor idle has been endorsed by manufacturers of domestic cars. According to Chrysler Corp., "The method of propane idle set is the only effective and approved procedure to properly set the curb idle speed on all domestic engines. This procedure is absolutely essential to assure proper performance of a vehicle as well as emission reliability."

The propane method of adjusting the carburetor can help engines that experience not only stalling, but also hesitation, surge and rough idling.

■ Contaminated fuel—Contaminated fuel refers to gasoline that contains water, dirt or other foreign material. Disconnect the fuel line at the carburetor. Let some gas drop in the palm of your hand. If gas contains water, drops will remain after the gas evaporates. Usually, dirt or other foreign matter makes fuel feel gritty as you rub your finger in it.

Contaminated gasoline requires draining of the fuel system and replacing both the pick-up filter in the fuel tank and the fuel line filter. Drop the fuel tank, dump contents, wash the tank with kerosene and replace the pick-up filter.

■ Clogged PCV valve—A clogged PCV

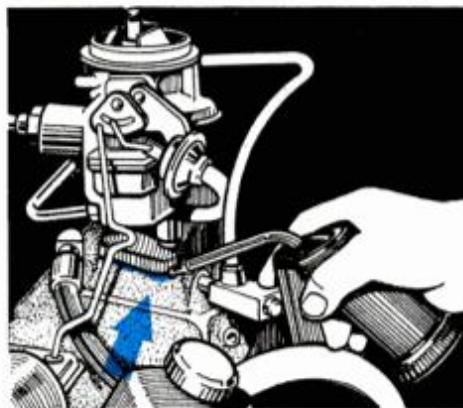
valve, or hose, upsets the air to gas ratio. Stalling results.

Start the engine and remove the PCV valve from its seat in the engine. Hold your finger tightly over the tip of the valve. Lack of suction indicates a clogged system.

Replace the PCV valve, which is the likely suspect, but don't overlook the possibility of a clogged, loose or kinked PCV hose.

■ Vacuum loss—The engine must maintain vacuum to keep from stalling and/or idling rough. The engine can lose vacuum if a vacuum hose serving a vacuum-operated component loosens or splits. Vacuum is also lost if carburetor fittings loosen or the carburetor-intake manifold gasket ruptures.

Connect a vacuum gauge to a vacuum port on the engine. Start the engine and let it run at idle speed. If the vacuum gauge shows a reading below normal specification, which is generally 17-21 inches of mercury (less for some engines), examine hoses. Then, check for vacuum loss around the carburetor and intake manifold by spreading an oil-kerosene mixture



Vacuum loss from air leak around carburetor is pinpointed with oil-kerosene mix.

around joints. An increase in vacuum on the vacuum gauge signifies that the mixture has sealed a leaking area. Tighten bolts or replace the gasket.

■ Inoperative heat valve—If your engine has a manifold-heat-control valve, there is a counterweight under the exhaust manifold. With the engine cold, try moving the counterweight. If it is stuck, the valve is stuck.

Lubricate the valve shaft by poking the nozzle of a can of manifold-heat-control-valve lubricant on the engine side of the counterweight. Tap the counterweight with a hammer.

If this doesn't free the manifold-heat-control valve, consider replacing the manifold.

Some engines use a vacuum-operated vaporization valve, which is controlled by a thermostat vacuum switch. This unit will malfunction if a vacuum hose loosens or splits, if the thermostat vacuum switch fails or if the valve binds because of corrosion or dirt.

This device directs heated air to the intake manifold so fuel vaporizes as a cold engine warms up. If vaporization doesn't occur, the fuel mixture will be too concentrated, causing the engine to flood and stall. The same thing occurs when a manifold-heat-control-valve fails to function.

■ **Bad EGR valve**—The exhaust gas recirculation (EGR) valve should not leak. If it does, vacuum is lost and the engine will stall.

If the type of valve on your engine allows you to feel the rubber diaphragm, test as follows (other EGR valves have to be taken from the engine for testing):

**1. Set the transmission in PARK or NEUTRAL** and apply the parking brake. Run the engine at between 1400-1600 rpm. Let the engine warm up a minute or two.

**2. Place a finger under the EGR valve** and disconnect the vacuum hose. Engine speed should increase and the diaphragm should move down.

**3. Reconnect the hose.** The diaphragm should move up as engine speed decreases.

If these things don't happen, put your finger over the end of the hose. You should feel pulling. If you do, vacuum is present at the hose. The EGR valve should be serviced or replaced.

If you don't feel vacuum, check the hose and carburetor port for a blockage. As a last resort, replace the thermostatic vacuum switch that controls the EGR valve.

### Inherent Stalling Problems

The Department of Transportation has issued several recalls to cure stalling problems. Two in particular involve 1974-76 AMC passenger cars and Jeeps with electronic ignition systems, and 1975-77 Chrysler Corp. cars. See your dealer.

Some service bulletins that have been issued by manufacturers to eliminate inherent stalling problems are as follows:

#### Chrysler Corp.

■ 1975 models with Holley 2245 carburetor—a repair to allow the vehicle to get a correct idle adjustment. *SB 14-06-75.*

■ All models—fuel system contamination cleaning procedure. *SB 14-11-75.*

■ 1976 California models with 400-4V engines—stalls and/or sags at medium to heavy acceleration before engine is warmed up. *SB 14-13B-76.*

■ 1976 models with electronic lean burn engines—idling and/or stalling. *SB 14-16-76.*

■ 1977-78 models—propane assisted curb idle speed and mixture setting procedure. *SB 14-12-78.*

#### FoMoCo

■ 1973 six and eight-cylinder engines with air cleaner valve and duct vacuum motor assembly—stalling on cold engine driveaway. *SB 30C.*

■ 1974 Mustang and Pinto with 2300-cc engines and manual transmission—stalling on

*(Please turn to page 177)*

## Most shade-tree mechanics begin here.



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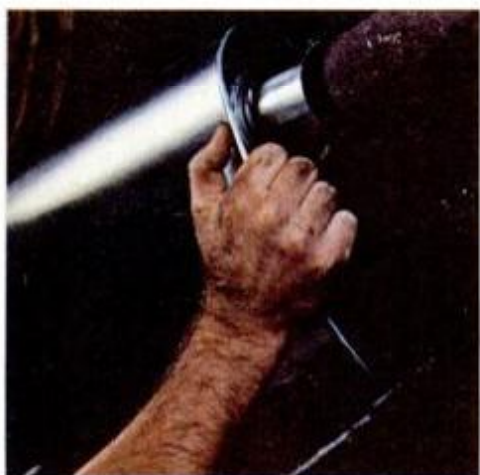
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cold engine driveaway. SB 71.

■ 1974 Mustang II with 2800-cc engines—stalling on cold engine driveaway. SB 76.

■ 1975 models with 351W engines—stalling on cold engine start-up. SB 83.

■ 1975 models with 460-cu.-in. engines—stalling on cold engine driveaway. SB 91.

■ 1976 Granada, Maverick, Monarch and Comet with 302-cu.-in. engine and automatic transmission—stalling on heavy acceleration after cold start. SB 112.

■ 1976-77 models with 460-cu.-in. engines—stalling on stopping and turning. SB 130.

■ 1977 Granada and Monarch with 250-cu.-in. engines and automatic transmission—stalling with air conditioner operating. SB 125.

## HESITATION

### Tracking down the cause

Engine hesitation on acceleration, which is also called flat-spot acceleration, is usually caused by one of the conditions outlined in the chart on the following page.

The cause of hesitation is usually found in the fuel system. Causes listed under this heading in the troubleshooting chart are in order of difficulty. The least difficult to troubleshoot is first. What follows is an explanation of tasks to do in an attempt to resolve hesitation. Procedures discussed previously are listed in the chart's "Refer To" column. After making each adjustment or repair, road-test your car to determine if the hesitation problem has been alleviated.

### Testing throttle cable

**1. Check throttle-cable movement** by removing the air cleaner and observing throttle cable action as an assistant depresses and releases the accelerator pedal.

**2. Clean off dirt if the cable binds.** Use carburetor cleaner. See that the throttle lever is also dirt-free.

Hesitation in some models has been caused by a plastic retainer at the throttle lever end of the accelerator cable slipping and catching. If this is happening, try to reposition and secure the retainer with wire, or replace the cable.

### Testing the accelerating pump circuit

A damaged accelerating pump is the No. 1 cause of hesitation. The purpose of this pump is to inject a quantity of gasoline into the carburetor through a special accelerating circuit when rapid acceleration takes place. This quick spurt of gas compensates for the rapid rush of air into the carburetor that takes place during step-down acceleration.

Without an accelerating pump in the carburetor, the air-to-gas ratio would be thrown off, and the engine would starve for gas until the flow of fuel caught up with the rush of air. In other words, engine hesitation on acceleration would take place.

To test the accelerating pump and circuit, warm up the engine. Turn off the engine and remove the carburetor air cleaner. Activate the throttle lever rapidly two or three times. If full streams of gas aren't ejected from the jets, the accelerating circuit needs work.

### Working on the accelerating pump

The external rod that operates the accelerating pump can usually be adjusted. Check this (Please turn to page 178)

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Another Tidy Car Success Story...

**'With twin babies, you'd think I'd want to hang on to a \$30,000 a year job, but I wanted to make real money.'**

Marty Brown, Nebraska



An accountant turned salesman, Marty started looking around for something that could make "real money." But that meant taking some risks.

"I didn't have a lot to invest and I also didn't want to be taken in by the usual 'get rich quick' schemes. Then I read an article by Gary Goranson, president of Tidy Car, that offered a chance to get into the car appearance maintenance business. The article said you could earn \$30 an hour giving your neighbor's cars showroom shines. It sounded great but I was skeptical.

#### Your own business for under \$900.

"When I read you could get into business for under \$900, it seemed too good to be true. Another benefit was that you could start part-time to try out the business before you had to quit that \$30,000/year job.

"Having been an accountant I got busy figuring out the 'numbers.' And, it seemed clear that the Tidy Car business had the potential to grow into the 'real money' I was looking for. And, now I'm sorry I hesitated at all."

#### 200 jobs in one month.

Within six months, Marty's business was up to 200 Tidy Car jobs in a single month ranging from \$45 to \$135 each.

#### How our exclusive process earns big profits.

Preserv-A-Shine™ is Tidy Car's exclusive surface protection treatment that goes far beyond waxing. It is a restoring and preserving process that puts an astounding hard-glass finish on cars, trucks, vans, boats and aircraft.

#### Guaranteed performance.

Our exclusive Preserv-A-Shine process protects against the ravages of weather, salt, sun, oxidation and pollution. With an inexpensive annual resealant, the shine lasts for as long as the customer owns the car. And we guarantee that in writing.

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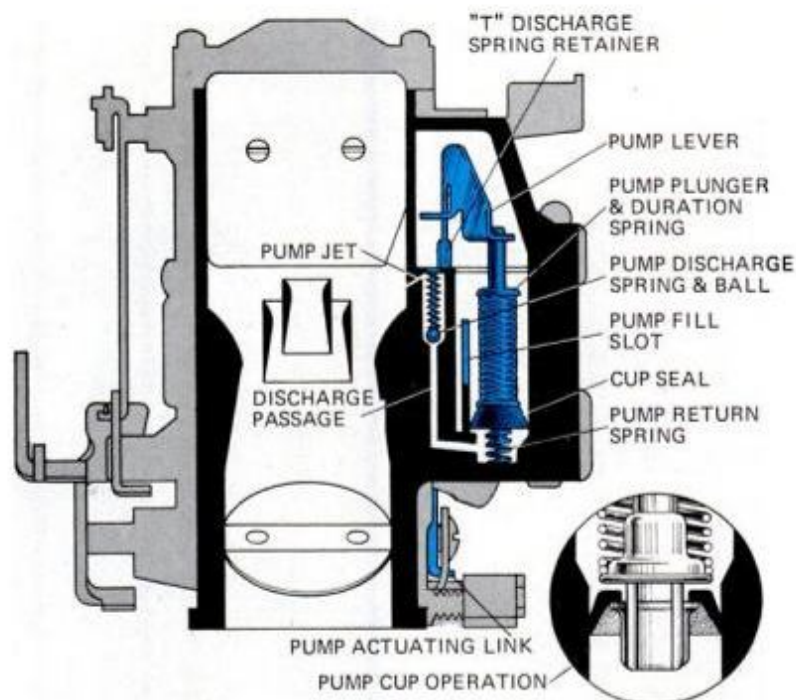


I'm interested in Tidy Car! Please send me a free 14-page brochure on how to become a Tidy Car dealer.

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# CAR CARE GUIDE

## SECTION 1



Accelerating circuit's pump injects gas for rapid engine response on step-down.

adjustment first. You may not have to open the carburetor.

The adjustment procedure and specification for each carburetor differ, so consult your car's shop manual. The following procedure, which applies to late model Rochester 2GC carburetors on GM cars, gives you an idea of how the job is done. The pump-rod specification for the 2GC carburetor is either  $1\frac{1}{16}$  or  $1\frac{1}{32}$  inch.

**1. Back out the idle-speed adjusting screw.** Hold the throttle lever so the throttle valve is completely closed.

**2. Place a gauge from the top of the**

*(Please turn to page 180)*

### TROUBLESHOOTING HESITATION

CAUSES TO CHECK	CORRECTION	REFER TO
<b>Fuel System</b>		
<input type="checkbox"/> Binding throttle cable.	Repair.	
<input type="checkbox"/> Choke too lean (hesitation occurs with engine cold).	Test; adjust or repair if defective.	Sect. 1: <i>What You Should Know About Chokes.</i>
<input type="checkbox"/> Malfunctioning vacuum break or choke electric-assist unit.	Test; replace if defective.	Sect. 1: <i>Testing a Vacuum Break.</i>
<input type="checkbox"/> Dirty carburetor air filter; damaged thermostat air cleaner.	Replace filter; repair damaged air cleaner.	Sect. 1: <i>Troublesome Thermostat Air Cleaner.</i>
<input type="checkbox"/> Contaminated fuel.	Drain fuel system, including fuel tank, flush with cleaner.	Sect. 1: <i>Contaminated Fuel.</i>
<input type="checkbox"/> Partially clogged fuel filter.	Replace.	Sect. 1: <i>Pinpointing Fuel System Failure.</i>
<input type="checkbox"/> Low fuel pump pressure.	Test; replace if defective.	Sect. 1: <i>Replacing a Fuel Pump.</i>
<input type="checkbox"/> Damaged accelerating pump.	Replace if defective.	
<input type="checkbox"/> Dirty carburetor circuits or damaged parts.	Clean and overhaul, or replace the carburetor.	
<b>Engine</b>		
<input type="checkbox"/> Leaking valves.	Repair.	
<input type="checkbox"/> Restricted exhaust system.	Clear or replace clogged part.	
<input type="checkbox"/> Vacuum leak.	Repair.	Sect. 1: <i>Vacuum Loss.</i>

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All-season multi-grade.



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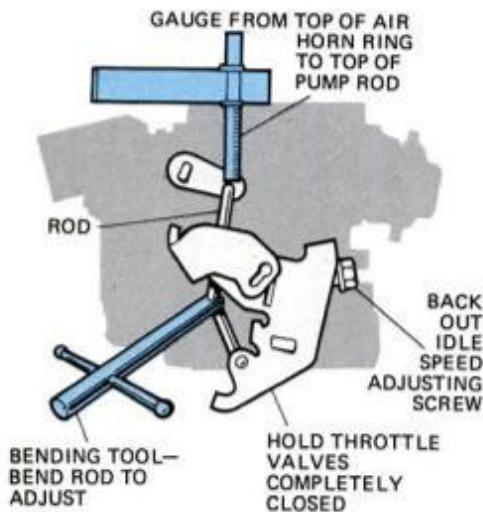


Amoco Oil Company

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# CAR CARE **1** GUIDE

SECTION



Adjusting accelerating pump operating rod of GM Rochester 2GC carburetors.

air horn to the top of the accelerating pump rod. Measure.

**3. If the distance is not to specification, bend the accelerating pump rod to attain the specified distance.**

**4. Set curb-idle speed to specification.**

If the accelerating-pump-rod adjustment is correct, a damaged accelerating pump is probably causing hesitation. To replace the part, do this:

**1. Remove the air horn.**

**2. Check the cup in the end of the accelerating pump.** If it is cracked, split or distorted, replace the accelerating pump. The accelerating pump is usually held by a clip-pin type retainer that is removed with needle-nose pliers.

**3. Replace the air horn, using a new gasket.**

**4. Make sure the air horn is tightened correctly.** An air leak will affect engine performance. Use the applicable air-horn-screw-tightening sequences.

If replacing the accelerating pump fails to bring about a substantial discharge of gas from the accelerating pump circuit, the circuit is

probably blocked or there is other carburetor damage. In any case, remove the carburetor from the engine. Disassemble, clean and overhaul the carburetor with parts contained in a specific rebuild kit for the particular model. If you don't wish to bother with rebuilding, install a new carburetor. A local parts dealer can help you get the right overhaul kit or carburetor.

### Engine causes of hesitation

You can determine if a leaking valve or restricted exhaust system is causing hesitation by hooking up a vacuum gauge. The following vacuum-gauge needle movements are significant:

■ The needle drops to a low reading, returns to normal, drops, returns and keeps doing this. A leaky valve exists. If your car is equipped with mechanical valve lifters, a valve adjustment to specification may solve the problem. If not, replace the bad part.

■ The needle drops slowly to zero as engine speed is increased. There is a restriction in the exhaust system. Look for mud clogging the tail-pipe. Check for a kinked pipe. A restricted catalytic converter can also cause the trouble. Replace damaged parts.

## Checkpoints for shade-tree mechanics.

It's not enough just to tune your car. You've got to keep it in tune. The best way to do that is by installing instruments like...

**The tachometer.** A tach tells you your engine speed in revolutions per minute. So, you can use it to check your car's idle speed. It helps you avoid running your engine too fast or too slow in any gear. And it tells you when your transmission, clutch or wheels are slipping. For an easy-to-install tach you can trust, ask for the Stewart-Warner Sensor Tach. It's accurate, rugged, readable, and modestly priced. The Sensor Tach is part of a complete line of Stewart-Warner equipment designed to meet the needs of the shade-tree mechanic.

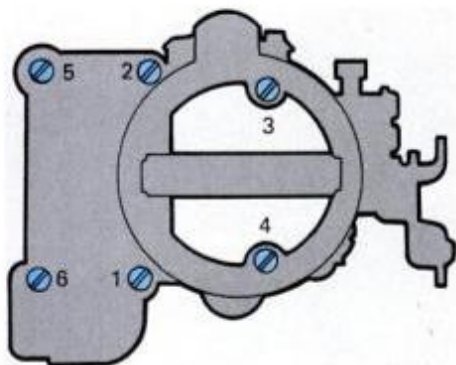
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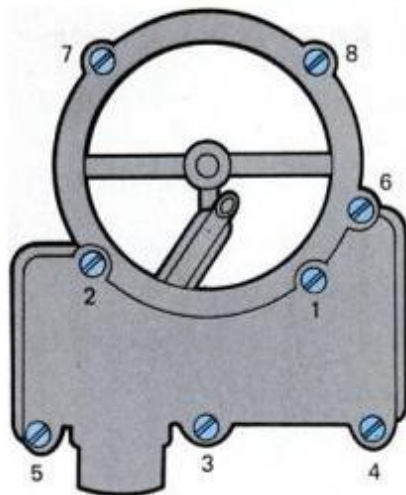
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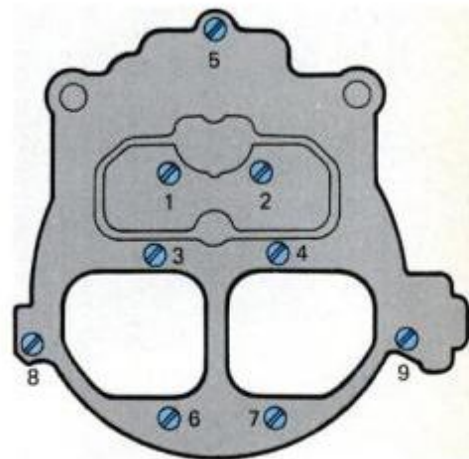




Air horn tightening sequence, 1V carb.



Air horn tightening sequence, 2V carb.



Air horn tightening sequence, 4V carb.

### Toyota recall

The National Highway Traffic Safety Administration warns owners of 1971, 1972 and 1973 Toyota Corolla and Carina models with 1600-cc engines that throttles can stick suddenly in the open position, causing loss of control. The

cause of the problem has been traced to a cracked heat tube from the exhaust manifold to the choke chamber.

Cracking allows exhaust contaminants to enter the choke chamber. An accumulation of sludge in the chamber can bind the throttle

linkage, which causes the throttle to stick.

Throttle sticking is frequently preceded by hard starting, rough idling, stalling or hesitation. If you experience any of these with a 1971-73 Toyota Corolla or Carina, have the heat tubes checked.

## Purolator introduces The HOT ONE

*The oil filter specially designed to take all the heat that trailer-towing cars, vans, pick-ups, RV's, 4WD's and Motor Homes can dish out.*

Specialty vehicles, those used for towing or rough and tumble driving, on and off the beaten track, can cause normal motor oil temperatures to soar to 250° 300° or more.

This surging hot motor oil can inflict severe damage on your oil filter, often causing the paper filtration medium to break down.

That's why Purolator designed the HOT (High Oil Temperature) ONE oil filter. It provides extra protection against sizzling hot oil.

Here's how:

- A synthetically reinforced primary filter medium.
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- A special synthetic rubber heat-resistant gasket.
- Steel end caps and steel center tube.

Take advantage of this new Purolator first. Protect your specialty vehicle's engine with the HOT ONE.

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Purolator Filters Division, Inc., 970 New Brunswick Ave., Rahway, N.J. 07065



# new NORSEMAN RADIAL by ARMSTRONG



**With amazing Aramid fiber that's,  
pound for pound, 5 times as strong as steel!**

Today, the smart move is to radial off-road tires, for some good reasons. Now, the smarter move is to new Norseman Aramid-belted Radials, for even better reasons!

#### **Why radials?**

With their greater belt stability, radials distribute air pressure more evenly than bias ply tires across the entire tread area. This means that if you lower the tire pressure for off road use, the footprint gets substantially longer. And that longer footprint provides better flotation and traction.

Radials with belt stabilized tread elements and lower spring rate, provide a smoother, quieter ride than similar bias tires at turnpike speeds. And since radials don't squirm as much, they roll easier for better gas mileage.

#### **Why new Norseman Radials?**

The new Norseman Radial is made with belts of

Aramid. This amazing fiber is, pound for pound, five times as strong as steel.

Armstrong's Aramid system offers excellent impact resistance, yet it is more flexible and has less unsprung weight than steel-belted and rayon-belted radials available to off-roaders, so it gives an even softer, smoother ride.

This new radial has the full width working tread design of the Armstrong Norseman, with its lateral center lugs and open self-cleaning shoulder lugs.

The new Norseman Radial is available in sizes to fit mini-pickups to light truck campers. See your independent Armstrong dealer this week. Give yourself all the advantages of the new Norseman Radial. There's never been an off-road tire like it before!

**ARMSTRONG TIRES**

## Missing, surging and lack of power

**Missing** occurs under two operating conditions: at idle and under way. An engine that misses at idle runs unevenly and feels as if it's skipping. If the condition is bad enough, the car shakes.

Under way, a missing engine gives a steady pulsating or jerk that usually becomes more pronounced as load on the engine is increased. The sensation is not normally felt above 30 mph. Under way and at idle, a missing engine often causes the exhaust to produce a steady spitting sound.

**Surging** describes an engine that delivers a pronounced variation in power although the accelerator pedal and, thus, the throttle is kept steady. To the driver, it seems as if the car is speeding up and slowing down.

**Lack of power** (or sluggishness) defines an engine that is not delivering the power it should at high speed or when put under load. In other words, the car doesn't accelerate to the speed it should, it loses speed going uphill, and it has less-than-normal top speed for the position of the throttle.

### MISSING

#### Tracking down the cause

What causes stalling can also cause missing. Proceed as follows to zero in on your particular problem:

**1. Check for vacuum loss** through loose or split vacuum hoses (refer to Sect. 1, *Vacuum Loss*).

**2. Make sure no leak exists** at the carburetor-to-intake manifold mounting (refer to Sect. 1, *Vacuum Loss*).

**3. Examine primary ignition wires** at the coil and distributor. Replace wires that have cracked insulation, and see that the wires are tightly connected.

**4. Disconnect carburetor air cleaner vacuum tube**, if one is present. Plug the

tube opening or the opening in the air cleaner or manifold so vacuum is not lost.

**5. Disconnect vacuum hose** of the exhaust gas recirculation (EGR) valve. Plug end of the hose so vacuum is retained.



Disconnect the EGR hose at the near end (arrow) and plug hose to sustain vacuum.

**6. Disconnect and reconnect cables from each sparkplug in turn**, while the engine is running, using insulated pliers to avoid a shock. There should be a drop in engine revolutions per minute (rpm) as each plug is disconnected. If there is a drop in rpm, check the following to find the cause of missing:

- Thermostatic air cleaner (refer to Sect. 1, *Handling a Troublesome Thermostat Air Cleaner*).
- Distributor and distributor points of a conventional ignition system (see below).
- Engine timing and carburetor mixture and idling speed (see below).
- Positive crankcase ventilation (PCV) system (refer to Stalling).
- EGR valve operation (refer to Sect. 1, *Clogged PCV Valve*).

**7. Remove sparkplugs** if there is no rpm drop in one or more cylinders as each plug is disconnected (see No. 6 above), and look for cracks, wear, improper gap, burning or fouling. Recondition or replace plugs, whichever is necessary (see below).

**8. If missing continues, test each sparkplug cable** (refer to Sect. 1, *Pinpointing Ignition Failure*). Then examine the distributor cap and rotor for damage or moisture and dirt (see Sect. 1, *Examine the Distributor Cap*). If the parts aren't damaged, wipe them clean and dry. Retest engine performance.

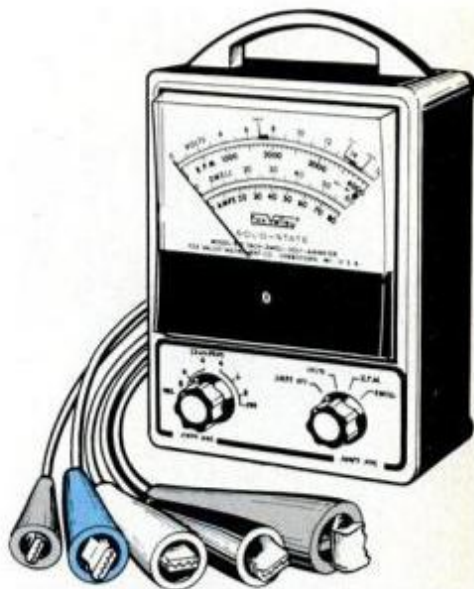
**9. Suspect a problem in the engine** if the above procedure fails to uncover the cause of missing (see below).

#### Look in the distributor

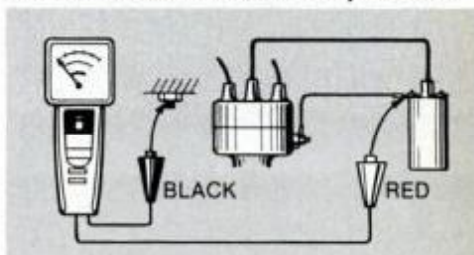
This discussion assumes that the engine is equipped with breaker-point (conventional) ignition. Missing can occur if breaker points are corroded, dirty or incorrectly adjusted, or if the distributor shaft assembly (bushing, shaft, breaker plate and cam) is damaged.

After replacing distributor points and/or setting gap with a feeler gauge to the specification in the manual or on the vehicle emission control decal, set the point dwell with a dwell meter and tachometer. Dwell refers to the duration of time that the points are closed. The measurement and subsequent resetting of point gap, if necessary, establishes point spacing precisely. Proceed as follows:

**1. Connect dwell meter and tachometer** (usually combined as one instrument). Follow hookup instructions in the booklet accompanying the instrument. Usually, the meter



Dwell/tach/volt/ammeter can be combined in one instrument for ease of operation.



Dwellmeter is connected to ground, coil.

(Please turn page for sparkplug color chart  
text continues on page 186)



With this carb, tube can be disconnected at clamp (arrow) and snorkel is blocked.

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## CAR CARE <sup>2</sup> GUIDE

SECTION

### HOW TO 'READ' YOUR PLUGS

In living color at right are sparkplugs taken from 15 different engines. Here's how to "read" them.

1. Almost white, fluffy gray deposit on insulator tip and side electrode is normal for emission-controlled engines using lean mixtures and no-lead fuels. This plug has high mileage and should be replaced.
2. White with light tan tint: The soft deposits on center electrode and darker deposit on side electrode indicate proper heat range for the way this engine is being used—at moderate speeds and loads.
3. Light tan deposits on a well-used plug. The yellow deposit on the side electrode is normal and comes from metallic additives.
4. Yellowish, soft white deposits on the center electrode and insulator are normal for an engine using fuel containing certain metallic additives. Shell deposits are normal, not signs of wrong fuel mixtures.
5. Classic example of a normal plug with fluffy, chocolate brown deposit on the insulator. Note slightly lighter color on side electrode showing that it's running a bit hotter. Sooty black deposit on shell suggests rich mixture, perhaps new air filter needed.
6. Fluffy red deposits are normal in engines using fuels with MMT additives. Slightly oily deposit on the shell may be due to an engine not yet fully broken in. In an older engine it might indicate the beginning of wear on piston rings, valve guides/seals.
7. Detonation damage: The firing end of the insulator is broken and metal transferred from center electrode to the side electrode. Possible causes: a. Overadvanced ignition timing. b. Fuel too low in octane. c. EGR system malfunctioning.
8. Preignition damage. White deposits on a blistered insulator, along with burned electrodes, reveal extreme heat condition. Possible causes: a. Sparkplug too hot. b. Overadvanced ignition timing. c. Glowing deposits in combustion chamber. d. Cooling system clogged. e. Exhaust system blocked.
9. Soot fouling. Fluffy, black soot deposits on insulator and electrodes. Possible causes: a. Excessively rich mixture due to sticking choke or defective carburetor. b. Faulty ignition primary circuit or defective sparkplug wires. c. Excessively cold starting without engine warm-up.
10. Oil fouled. Oily, usually black deposit covering insulator and electrodes. Possible causes: a. Excessive passage of engine oil into combustion chamber due to piston ring or valve guide seal leakage. b. Defective PCV system.
11. Carbon fouled. Hard, black carbon deposits on insulator and electrodes. Possible causes: a. Moderate amount of oil passing rings or valves. b. Defective PCV system. c. Sparkplug too cold. d. Sparkplug not correct type for engine.
12. Dirt fouling. Carbonized and sometimes granular deposits on and around the insulator and electrodes. Possible causes: a. Air cleaner missing. b. Defective air-cleaner mountings.
13. Bridged gap. Carbon particles are lodged in the sparkplug gap. Possible cause: Combustion chamber deposits accumulated during low-speed, light-load use break loose during demand for full power.
14. Glazed insulator. Glassy surface on the insulator as a result of deposits melting on plug. Possible causes: a. Sparkplug too hot. b. Local overheating due to cooling system blockage or similar defect.
15. Splashed insulator. Splashes of black, almost paint-like deposits on the insulator. Possible cause: Delayed correction of an engine miss allows soft, oily deposits to accumulate in cylinder. After tune-up these deposits break loose and foul plug.

## SPARKPLUGS THAT INDICATE NORMAL ENGINE OPERATION



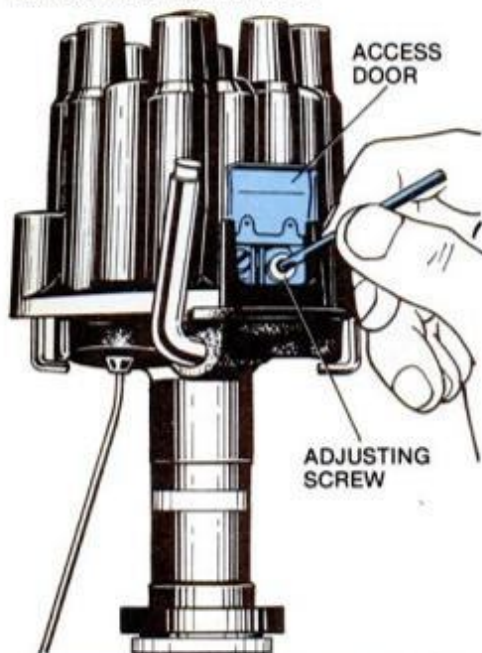
## SPARKPLUGS THAT INDICATE THE NEED FOR TUNE-UP OR REPAIR



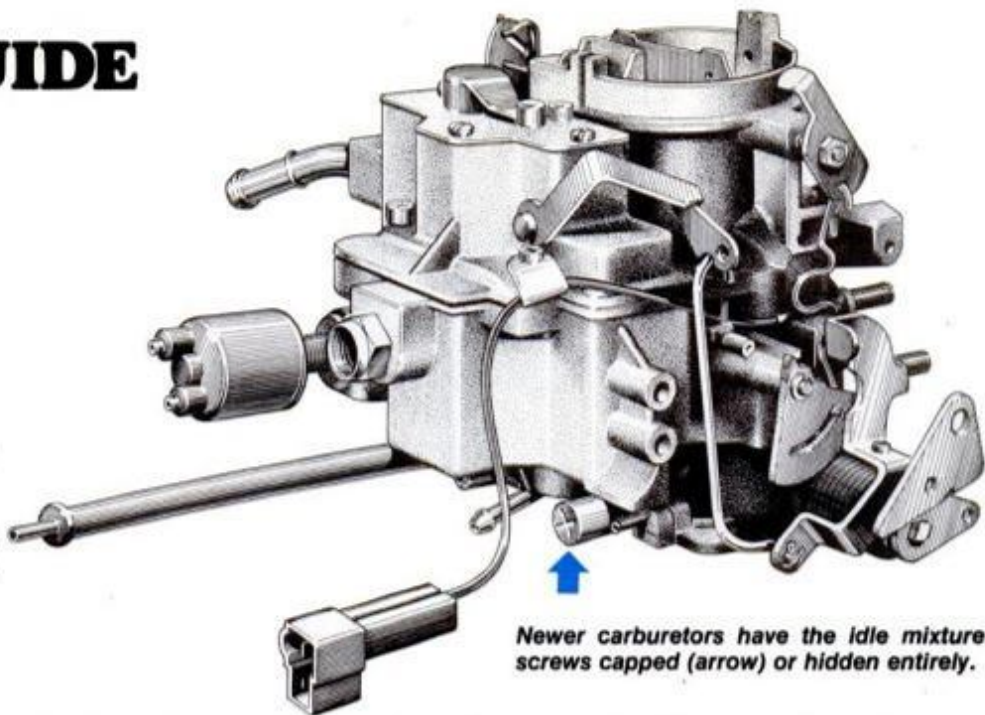
# CAR CARE GUIDE

## SECTION 2

is connected so the ground lead (usually black) is attached to a clean metal part of the engine, while the other lead (red, yellow or any color other than black) is attached to the primary wire terminal at the coil. The primary wire is the thin wire (not the secondary cable) extending from the coil to the distributor.



Some model distributors have access door for adjusting the contact points.



Newer carburetors have the idle mixture screws capped (arrow) or hidden entirely.

**2. Place instrument switches at proper settings.** For example, if you are working on an eight-cylinder engine, set the selector to "8." Place the function switch on "Tach."

**3. Start engine and let it idle.** Read the tachometer. It should show that the engine is idling at the specified carburetor idle speed. If it isn't, set the idle (see below).

**4. Switch dwell meter/tachometer to the dwell function.** The meter should record the dwell specified on the vehicle emis-

sion-control decal or in the manual. This specification is given in degrees, such as 28-32°. Set dwell, if necessary. If the distributor has an access door, slide the door open and engage the distributor point adjusting screw with an Allen wrench. With the engine idling, turn the screw until correct degrees of dwell are recorded.

**Caution:** Make sure the sliding door is closed tightly after making the adjustment. If dirt enters the distributor, the points will fail prematurely.

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Buy Black & Decker's new car polisher now, and get a 50-foot extension cord free.

Introducing Black & Decker's new Random Orbit Polisher — the easy way to put a gleaming healthy shine on your car's finish.

"Random Orbit" means our polishing wheel travels in ever-changing circles — a lot like the natural motion of your hand. So it helps prevent the "swirling and burning" that can spoil your car's finish. Buy one now, and we'll send you a handy, double-insulated 50-foot extension cord free. Details on the package.

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If the distributor doesn't have an access door, turn off the engine, remove the distributor cap and rotor, and reset breaker-point gap.

Bring points closer together if dwell angle is below specification and farther apart if dwell angle is excessive. With a smaller dwell angle, points begin opening farther from the crest of the cam lobe. Thus, they stay open for longer periods and closed for shorter periods. Conversely, with a larger dwell angle, points begin opening closer to the crest of a cam lobe and stay open less and closed longer.

**5. Accelerate engine slowly** with dwell set correctly, until the tachometer shows a reading of 1500 rpm. Note the dwell reading. Then let the engine return to idle and check the dwell reading again. If the dwell readings vary more than 3°, the distributor shaft assembly is damaged. Repair or replace the distributor.

### Setting the carburetor

Stringent emission control standards have made the carburetor mixture tricky to adjust. From one year to the next and from one manufacturer to another, there are differences in procedure. You cannot, therefore, accurately set fuel mixture without specific manufacturer service instructions.

Furthermore, on cars of the '70s, the carburetor fuel mixture was set at the factory. The main reason for this setting going awry is a malfunction in the carburetor which would require overhauling or replacing the carburetor.

As for idle-speed adjustment, which establishes how fast or slow the engine idles when it is warmed up, the procedure is:

**1. Be sure the engine is warm**, so the choke is released.

**2. Check the vehicle emission control decal or service manual** for conditions that establish an accurate adjustment. For instance, some engines require airconditioners and headlights off. Others require airconditioners and/or headlights on.

**3. Obtain your engine's specified idling speed setting** from the decal or manual. This may be referred to as curb idle rpm, slow idle speed or slow idle rpm.

**4. Note under what conditions you have to adjust idling speed** if the carburetor is equipped with a curb-idle solenoid (also called an idle-stop or throttle solenoid). The purpose of this part is to close the throttle valve(s) simultaneously with the ignition shut-off, so fuel can't get past the valve(s) into cylinders. Fuel leaking into the cylinders after the ignition is turned off can cause dieseling—that is, engine run-on.

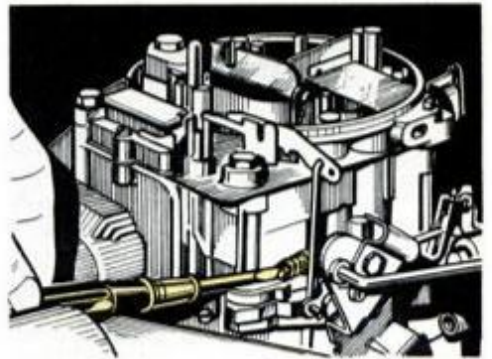
**5. Connect a tachometer** and check engine idling-speed rpm.

**6. Make the adjustment** if rpm is not to specification. In the absence of a curb-idle solenoid, turn the curb-idle screw until the tachometer records the specified idling speed.

If your car has a curb-idle solenoid, the manufacturer will specify, on the decal or in the service manual, how idle speed is to be adjusted. It may be done by turning the solenoid plunger or de-energizing the solenoid (by disconnecting its wire and turning the idle-speed screw).

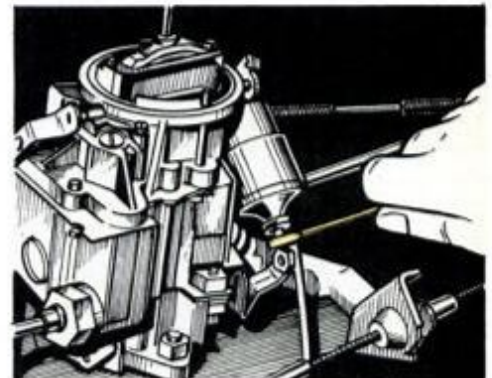
### Setting timing

Timing is the firing of a sparkplug at the instant the piston in the cylinder the plug serves is in position to deliver maximum power. To



Idle speed of some engines is adjusted by means of idle speed screw on carburetor.

Idle speed of other engines is adjusted by turning the plunger of curb idle solenoid.



determine if spark is being delivered at the proper time, you need a stroboscopic timing  
[\(Please turn to page 188\)](#)

# DO YOUR OWN 60 SECOND AUTO LAMP INSPECTION.

Non-functioning lamps are one of the leading reasons for safety inspection failure. But it's easy to make your own safety check. Just turn on your headlamps and four-way flashers. Take a quick stroll around your car and check your headlamps, stoplights, tail, side-marker, parking and license plate lights for burnouts. It could prevent an accident or even save a life.

### Your best replacement — General Electric Plus 25 headlamps.

If your headlamps are burned out, replace with General Electric Plus 25 headlamps. They generate 30% more light than our previous standard headlamps, which helps you see 25 feet further down the road. In fact, you should replace both headlamps with GE Plus 25's to get the full benefit of more light. The easy way to know if you have Plus 25's in your car is to check the number on the back of the light. If it's #4002 or #6012, it's our old model. If it's #4000 or #6014, it's a Plus 25. You can do-it-yourself, or have your service dealer install them. General Electric, Miniature Lamp Products Department #3382, Nela Park, Cleveland, Ohio 44112.

**GENERAL**  **ELECTRIC**



# CAR CARE <sup>2</sup> GUIDE

## SECTION

light. This is aimed at the timing marks, which are located on the crankshaft pulley or flywheel.

Marks correspond to the piston's position in the first cylinder of an engine. The timing light is connected to this cylinder and flashes when spark is delivered. You can tell if ignition occurs at the proper moment in the piston's cycle by the relationship of the flashing light to the position of the timing marks. If timing is not correct, as established by the engine manufacturer, bring it into synchronization by loosening and turning the distributor.

To set ignition timing, first consult the emission control decal to establish necessary conditions. In most cases, warm up the engine and disconnect the vacuum advance hose from the vacuum advance unit. Plug the end of the hose to prevent vacuum loss.

The vacuum advance is a chamber normally attached to the distributor. Its purpose is to advance and retard ignition timing, according to the demands of acceleration and deceleration put on the engine. The action of the vacuum advance depends on the presence of engine vacuum delivered to the vacuum advance unit from the engine through the vacuum hose.

When you check the emission control decal, also determine the ignition timing specification. It's given in degrees, such as so many degrees BTDC, ATDC or TDC (0°).

BTDC stands for Before Top Dead Center. This means that ignition should take place when the piston is the specified number of de-



20°  
BEFORE  
TOP DEAD  
CENTER

*Timing is set at a predesignated spot in piston travel—at TDC, BTDC or ATDC.*

grees before it reaches the top of its compression stroke.

ATDC stands for After Top Dead Center. This means that ignition should take place when the piston is the specified number of degrees after it has passed the top of its compression stroke and is on the downstroke.

TDC (0°) stands for Top Dead Center and means that ignition should take place when the piston is at the peak of its compression stroke.

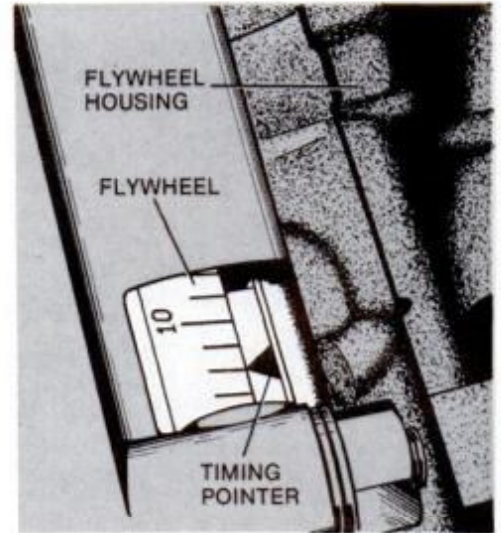
Timing is normally adjusted as follows:

**1. Locate the timing marks.** In most cars, they are on the crankshaft pulley, which is at the front of the engine. In some cars, timing marks are located on the flywheel, which is

at the rear of the engine. In this case, the marks are visible through a peephole in the flywheel housing.

**2. Note the way timing marks are laid out.** There is a 0° mark, designations indicating BTDC and ATDC, and a degree scale of numerals and index marks denoting various degree positions. There is also a pointer. The degree scale moves as the engine runs, but the pointer remains stationary.

**3. If you have difficulty seeing** the degree scale and pointer, clean them with kerosene. Find the mark that coincides with the specified timing of the engine and outline that



*Imported cars, in particular, have timing marks located on the engine flywheel.*

# LOOK SHARP!

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When your car is checked for spring, whether you do it or your service station does, take a good look at the radiator cap, or one of low quality, may not keep your cooling system pressure within safe limits. So when you replace the cap, take another good look. Look for Stant. Don't settle for just any cap... the safest, most dependable radiator cap available anywhere. And for expert tips on cooling system care, write for "The Stant Cooling System Fact Book." Send 25¢ to:

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mark with white paint. Also paint the pointer.

**4. Identify the No. 1 plug.** In four- and six-cylinder engines, the No. 1 plug is the first one at the front of the engine, closest to the radiator.

No. 1 plug of V8 engines, other than Ford, Mercury, Lincoln and Cadillac, is the first plug at the front of the engine, closest to the radiator, on the left (driver) side. Ford, Mercury, Lincoln and Cadillac have the No. 1 plug at the front of the engine, closest to the radiator, on the right (passenger) side. Check the service manual to determine the No. 1 plug if you have a make different from those mentioned here.

**5. Connect the timing light** according to the manual that comes with the instrument. There are two general kinds of lights. One uses an a.c. power source and is connected to a wall outlet. The other uses a d.c. power source and is connected to the car battery.

Whichever light you use, it has a lead that is connected to the No. 1 sparkplug. Usually, it is necessary to remove the cable from the sparkplug and insert an adapter between the cable terminal and plug. Then attach the timing-light lead to the adapter.

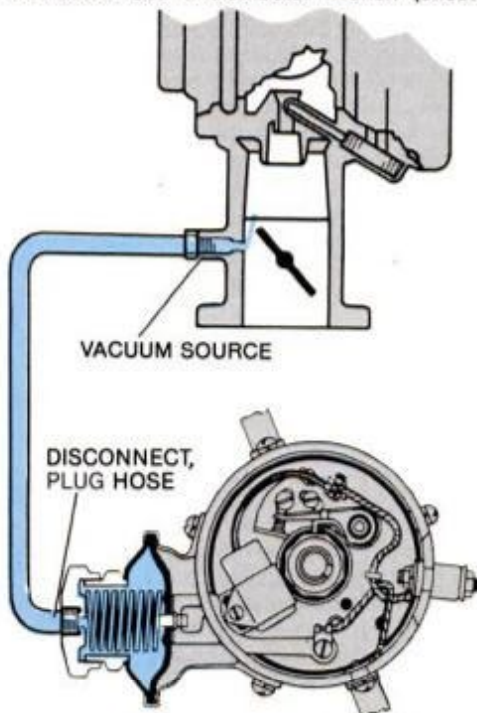
**6. If you haven't checked** point dwell and engine idling speed before as described earlier in this section, connect a dwell meter/tachometer and do it now.

**7. If, according to** the emission control decal, it is necessary to disconnect and plug the vacuum advance hose, use a pencil, golf tee or suitable-size screw.

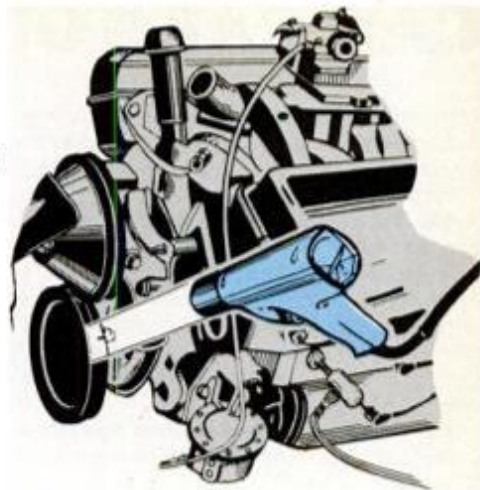
**8. With the engine idling,** aim the timing light directly at the timing marks as if you were pointing a pistol. Sight straight down the center of the barrel and pull the switch trigger. In a car

with timing correctly set, the timing mark and pointer will line up with each other and appear to be stationary. If the pointer and mark don't coincide, and you see the index scale moving, adjust the timing as follows:

**9. Shut off the engine.** Loosen the distributor hold-down bolt until you can turn the distributor. Use a distributor wrench (offset



*Disconnect, plug vacuum advance line to adjust timing accurately to specifications.*



*Observe the timing mark and pointer to determine if the adjustment is set right.*

type), if necessary, to gain access to the bolt. Do not remove the bolt.

If the distributor sticks in the engine, give it a shot of carbon dioxide from a CO<sub>2</sub> fire extinguisher. Put on gloves to turn the distributor.

**10. Restart the engine** and aim the timing light at the timing marks as you slowly turn the distributor by grabbing the vacuum advance chamber. When timing mark and pointer line up, turn off the engine and tighten the distributor hold-down bolt. Be careful not to disturb the distributor position. Then check the adjustment.

**11. With timing set** use the timing light to test the centrifugal advance and vacuum ad-

*(Please turn to page 198)*

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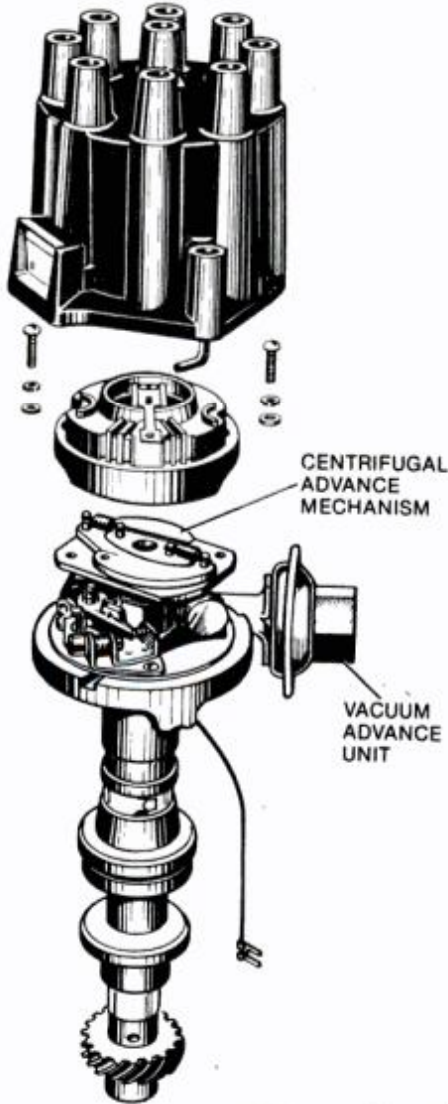
# CAR CARE GUIDE

## SECTION 2

vance mechanisms. The centrifugal advance, a spring-and-weight component in the distributor, changes ignition timing by means of centrifugal force as engine speed varies.

**12. To check centrifugal advance,** aim the timing light at the timing scale as you increase engine speed slowly, from idle to 1500 rpm. The timing mark should advance as engine speed increases, and return to its original setting when engine speed decreases. If this does not happen, the distributor needs repair.

**13. To check the vacuum advance,** unplug and reconnect the vacuum hose to the



*Use a timing light to establish condition of centrifugal and vacuum advance units.*

vacuum advance chamber. Aim the timing light at the timing scale and run the engine at 1500 rpm. The timing mark should advance to a position that is farther than the position it assumed when you tested the centrifugal advance. If this doesn't happen, the diaphragm in the advance chamber is probably leaking, and the vacuum advance chamber should be replaced.

### How to replace sparkplugs

Faulty sparkplugs are the main reason engines miss when the car is rolling. Here is the correct procedure for removing plugs:

**1. Use the correct tools** for the job. Usually, a  $1\frac{3}{16}$ -inch or  $\frac{5}{8}$ -inch hex sparkplug

socket, ratchet wrench and an extension are needed.

**2. Identify each sparkplug cable** with the engine cold. Write identifying numbers on strips of masking tape and attach the tape to the sparkplug cables. This will facilitate correct reconnecting of cables to plugs.

**3. Grasp and rotate each sparkplug boot,** pulling it from the sparkplug

**4. Loosen each sparkplug,** with one turn only.

**5. Blow dirt and carbon** from around each sparkplug. Use compressed air, if possible. If compressed air is not available, aim the end of a length of vacuum hose at the area around the plug and blow through the other end.

**6. Remove each plug** and examine its tip for any unusual condition. The photos and captions on page 185 will help identify plug conditions and indicate what needs to be done in each case.

Incidentally, if a plug binds in the engine, but a few threads are exposed, drip some light oil on the threads and screw the plug back into the engine. Let the oil soak the threads before you try to remove the plug again.

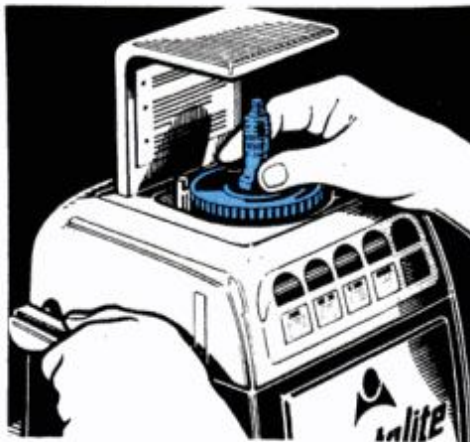
**7. Do a compression test** (see below), with sparkplugs out of the engine, if you suspect that engine missing is being caused by an engine problem.

Suppose the plugs you remove are not worn, just dirty. They can be restored to service if you have a sparkplug cleaner (one for home use is available from a parts and accessories dealer). If you don't have a cleaner, take plugs to a service station for cleaning.

Wipe plugs to get rid of dirt, moisture and oil. Clean wet deposits from the firing tips by washing plugs in kerosene. Use a brush to work the solvent inside insulators.

Dry the plugs with an air hose—even if you have to pay a service station attendant a dollar or two to use his. Sparkplug tips have to be thoroughly dry so solvent doesn't cake inside the plug. This will cause misfiring.

Clean the plugs in a service-station cleaning machine, but do not blast them for longer than



*Sandblasting sparkplugs before reusing is necessary for good performance.*

five seconds. Longer blasts wear down insulators and electrodes.

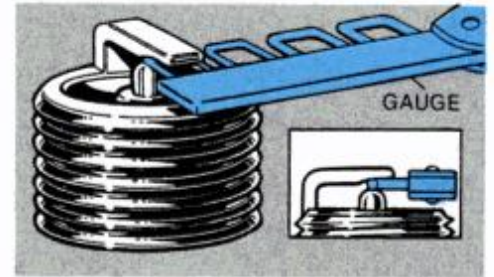
Using the gap adjusting tool of a sparkplug feeler gauge, open the outside electrode of each plug enough to slip a sparkplug file between the electrodes. Do not use pliers or any

tool other than a sparkplug tool or you will damage the plug.

File the center and outside electrodes clean. This requires only a pass or two with the file.

Use a small wire brush to clean threads, but don't touch the electrodes with the brush. You can cause damage.

Use a sparkplug feeler gauge—no other type—to gap plugs. Be sure you have the cor-



*Use a sparkplug feeler gauge to obtain an accurate setting; no other type will do.*

rect specification for your engine. You will find it on the emission control decal or in the service manual.

Insert the correct-size wire gauge and move it in and out. If the gauge is too loose or too tight between electrodes, use the adjusting tool to close or open the gap by bending the side electrode. Bending the center electrode will damage the plug. Gap is set properly when you feel a slight resistance on the feeler gauge as you move the gauge between electrodes.

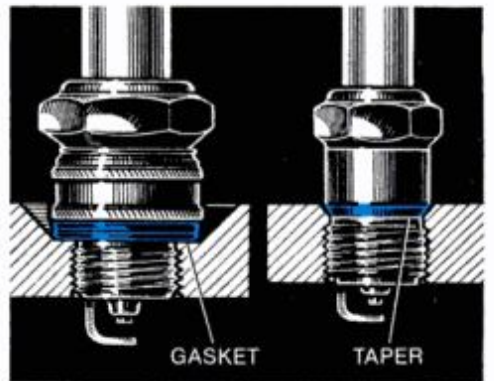
It is important to remember that electrode gaps of new plugs are not preset at the factory. You must set gap before installing new plugs.

To install plugs correctly, do this:

**1. If the car has an aluminum-head engine,** coat the first two or three threads of each sparkplug with a thin layer of graphite to prevent seizing.

**2. Use a small brush** or thread-chaser to clean the threads of sparkplug ports.

**3. If you are installing used plugs,** examine the seat. Plugs with square seats use



*Square-shouldered plug (left) needs gasket; tapered plug, on the right, doesn't.*

gaskets, and new gaskets should be used. If you can't get replacement gaskets, replace the plugs. Using old gaskets causes compression loss. Plugs with tapered seats do not use gaskets.

**4. Screw the plugs into the engine by hand** until they are finger-tight. If plugs use

*(Please turn to page 193)*

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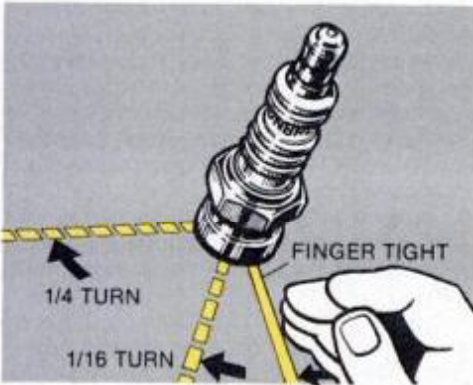
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gaskets, thread gaskets on plugs, so they are flush against the base of the shell, before installing the plugs.

**5. If you have a torque wrench**, torque plugs to the specifications in the shop manual. If you don't have a torque wrench, tighten

PLUG SIZE	WITH TORQUE WRENCH (ft.-lbs.)	
	Cast-Iron Head	Aluminum Head
10 mm	8-12	8-12
12 mm	10-18	10-18
14 mm, gasket seat	25-30	18-22
14 mm, tapered seat	7-15	7-15
18 mm, gasket seat	32-38	28-34
18 mm, tapered seat	15-20	15-20

### Sparkplug torquing specifications.



**Tighten plugs with gaskets 1/4 turn; tighten tapered seat plugs 1/16 turn.**

plugs finger-tight, then with a wrench—1/4-turn for plugs with gaskets, 1/16-turn for tapered-seat plugs.

Overtightening plugs make them difficult to remove the next time around. Not making them tight enough causes compression loss. Get it right.

### Testing engine compression

Low compression in one or more cylinders will cause an engine to miss. Compression refers to the process by which pistons reduce volume within a cylinder, thus increasing pressure of the fuel mixture within the cylinder.

Low compression can be caused by several factors, but whatever the cause, the solution requires engine dismantling. Reasons for low compression include worn piston rings, leaking or sticking valves, and leaking head gasket.

Compression is tested with a compression tester. Readings are compared with manufacturer specifications to determine if there is a compression loss. To test compression, proceed as follows (the task is easier if someone is inside the car to crank the engine and hold the throttle open):

1. Warm up the engine.
2. Remove all sparkplugs.
3. Disconnect the distributor-to-coil secondary cable (that's the thick wire).
4. Screw or push the compression gauge securely into the first cylinder. The seal between the gauge and engine block has to be tight to prevent compression loss and an inaccurate reading.

**5. Have an assistant hold the accelerator pedal to the floor** as he or she cranks the engine using the ignition key. The engine should be cranked the same number of revolutions (at least eight) as each cylinder is tested to obtain an accurate comparison of compression readings between cylinders.

**6. Note the highest compression reading.** If it seems low, go on to the next cylinder and afterward retest the low-reading cylinder. Record readings on paper.

To judge compression accurately, you have to know the manufacturer's specification. This is available in the shop manual and in some owner manuals.

Compression obtained for each cylinder does not have to conform exactly to specification. Manufacturers give a leeway. For example, American Motors, Chrysler and General Motors allow that the lowest reading obtained may be 80 percent of the highest-reading cylinder. Ford allows a 75 percent edge. However, any cylinder that shows compression lower than 100 pounds per square inch (p.s.i.) indicates a defect.

## SURGING

### Tracking down the cause

The accompanying chart summarizes the causes of surging. (References in the "Refer to" column tell where to find applicable information presented in preceding pages. If there is no reference, an explanation follows or the procedure is self-explanatory.)

### Working on the fuel system

You can check fuel lines visually to establish if a malfunction is causing engine surge. Surging can occur if there is a loose connection or leak allowing air to enter the line and inhibit gas flow, or if a kink or other obstruction in a line is curtailing the flow of gas.

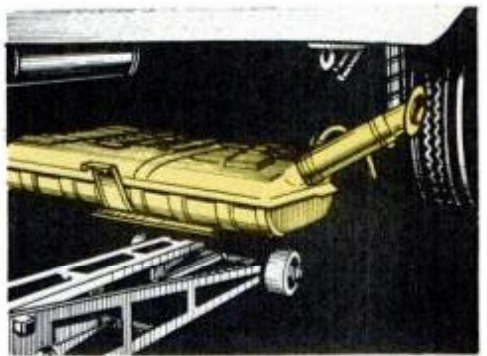
Seldom will a fuel line cause trouble. It is more likely that a fuel tank, which builds up

sediment or rust over the years, is reducing the flow of fuel and causing surge. Foreign matter may be clogging the strainer in the tank or some other part of the system, restricting gas flow.

Fuel-system contamination is apparent if you have to replace the fuel filter often. If your car has an in-the-carburetor fuel filter, verify its condition by removing and examining the filter (refer to Sect. 1, *Pinpointing Fuel-system Failure*). Particles on the filter signal a fuel-system contamination.

To verify the condition in cars with in-line fuel filters, disconnect the fuel line at the fuel pump end of the filter and allow fuel to drip into a container. Examine the fuel for contaminating particles.

Cleaning the fuel tank and fuel system is not a job for the ordinary home mechanic. If you



**If the fuel system is contaminated, the fuel tank should be removed and cleaned.**

want to give it a try or know what a mechanic should do, the general procedure follows:

### Cleaning fuel systems

1. Disconnect the battery.
2. Siphon fuel from the fuel tank into a clean container. *(Please turn to page 194)*

## TROUBLESHOOTING SURGING

CAUSES TO CHECK	CORRECTIONS	REFER TO
<input type="checkbox"/> Inoperative thermostat air cleaner.	Repair	Sect. 1: <i>Handling a Troublesome Thermostat Air Cleaner.</i>
<input type="checkbox"/> Vacuum loss through loose or split vacuum hose.	Repair or replace.	Sect. 1: <i>Vacuum Loss.</i>
<input type="checkbox"/> Vacuum leak from carburetor-manifold area.	Repair.	Sect. 1: <i>Vacuum Loss.</i>
<input type="checkbox"/> Defective or loose primary ignition wires at coil and distributor.	Tighten or replace.	
<input type="checkbox"/> Incorrect ignition timing.	Adjust.	Sect. 2: <i>Setting Timing.</i>
<input type="checkbox"/> Malfunctioning centrifugal advance and vacuum advance units.	Repair or replace.	Sect. 2: <i>To Check Centrifugal Advance and Vacuum Advance.</i>
<input type="checkbox"/> Dirty fuel filter.	Replace.	Sect. 1: <i>Pinpointing Fuel-System Failure.</i>
<input type="checkbox"/> Defective sparkplugs.	Service or replace.	Sect. 2: <i>How to Replace Sparkplugs.</i>
<input type="checkbox"/> Weak fuel pump.	Replace.	Sect. 1: <i>Start Engine and Check Fuel-Pump Failure.</i>
<input type="checkbox"/> Split, leaking or kinked fuel line or hose.	Replace.	
<input type="checkbox"/> Clogged fuel tank strainer and dirty fuel tank.	Replace strainer; clean fuel tank.	
<input type="checkbox"/> Dirty carburetor; damaged parts.	Overhaul.	

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## CAR CARE <sup>2</sup> GUIDE

SECTION

**3. Disconnect the fuel line** and vapor return hose, if the car is equipped with one, at the fuel tank.

**4. Disconnect the ground wire** and unplug the wire from the fuel tank sending unit.

**5. Disconnect the vent hose.**

**6. Unhook the support strap** and lower the fuel tank.

**7. Loosen and unscrew the fuel tank sending unit cam ring** and remove the sending unit assembly, which probably contains the fuel tank strainer. Install new strainer.

**8. Remove the fuel filter** in fuel line or carburetor. Leave fuel line disconnected.

**9. Place the tank away from flame and heat.** Remember, you are dealing with components that store and carry gas.

**10. Finish draining the fuel tank** by rocking it back and forth, letting gas run out the sending unit hole. If rust comes out, get a new gas tank. Rusted tanks can't be salvaged.

**11. Clean the inside of the tank** with steam or running hot water for at least five minutes. If you use water, make sure none remains in the tank.

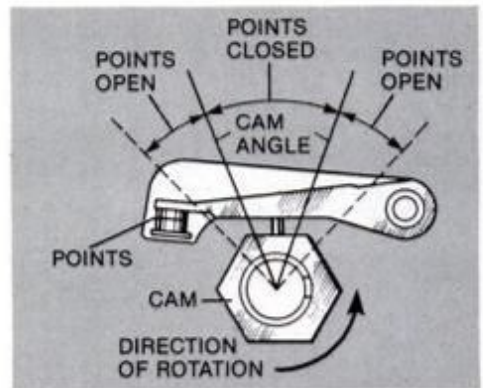
*Caution:* Despite cleaning, fuel vapors remain in the fuel tank. Do not bring flame or heat near the tank.

**12. Disconnect the fuel tank-to-fuel pump line** at the fuel pump. Introduce air pressure into the line at the fuel tank end to blow the line clean. Pipes on the fuel-tank sending unit should be cleaned out with low air pressure.

**13. Install the fuel-tank sending unit,** using a new gasket.

**14. Install the new tank** and connect wires and lines, including the fuel line at the fuel pump. However, do not reconnect the fuel pump-to-carburetor fuel line. Instead, connect a 3-foot-long vacuum hose to the end of this fuel line.

**15. Reconnect the battery,** but disconnect the coil-to-distributor secondary (heavy) cable.



*Dwell (cam angle) is number of degrees of rotation that contact points stay closed.*

**16. Put several gallons of clean gas into the fuel tank.** Direct the vacuum hose at the end of the fuel line into a container. Operate the car's starter until two quarts of gas flow into the fuel can. This flushes the fuel pump and fuel lines. Discard the gas in the container since it has probably become contaminated.

**17. Remove the vacuum hose** and reconnect the fuel line. Hook up the coil-to-distributor cable. Start the engine and check all connections for leaks.

As far as cleaning the carburetor is concerned, try one of the products that permit cleaning with the carburetor remaining in the car.

If dirt has built up to an extreme point, remove and disassemble the carburetor. Clean parts individually and rebuild the carburetor, using a carburetor rebuild kit.

### LACK OF POWER

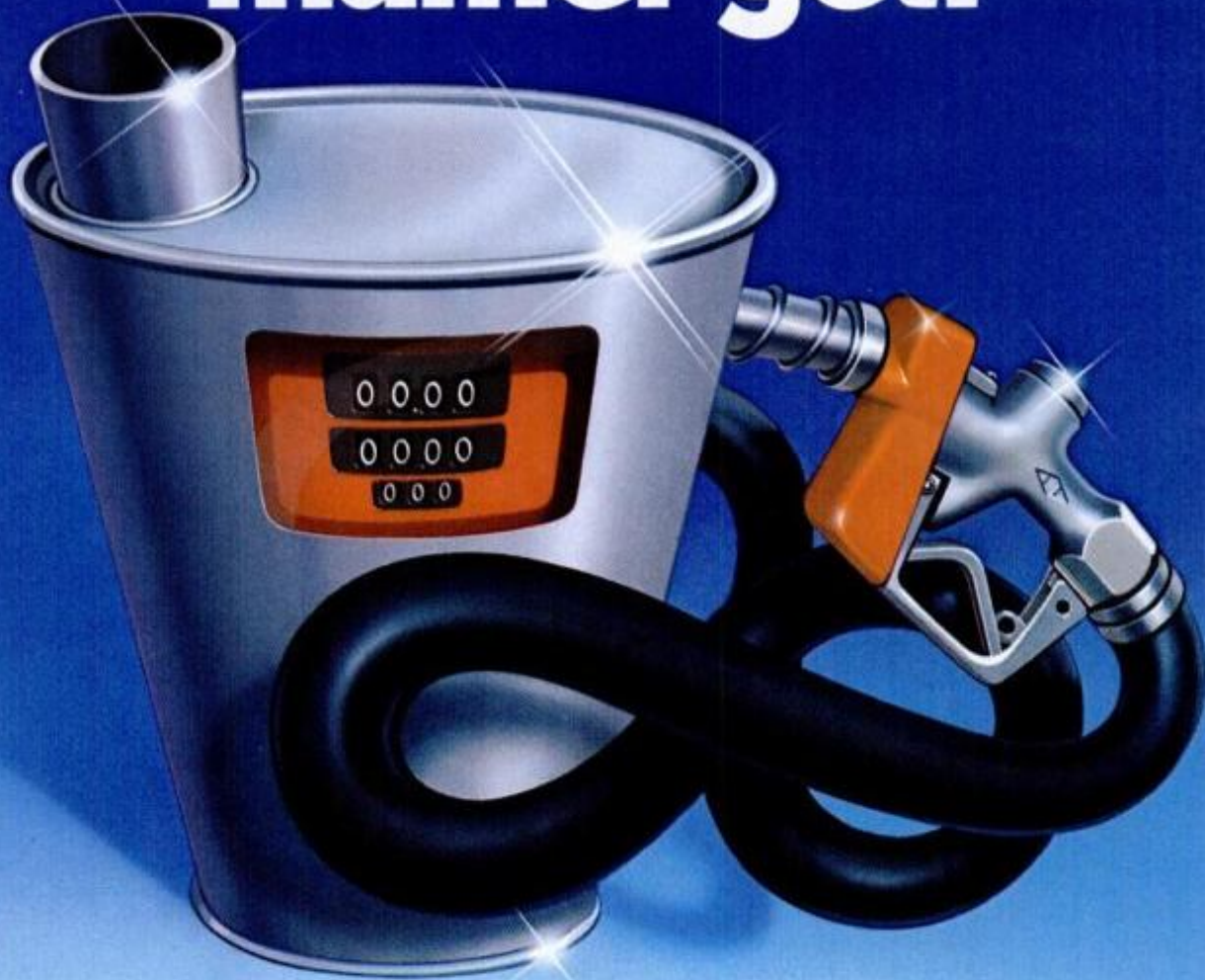
#### Tracking down the cause

The chart below summarizes the causes of lack of power. (Notes in the "Refer To" column tell where to find applicable information in preceding pages.)

#### TROUBLESHOOTING LACK OF POWER

CAUSES TO CHECK	CORRECTION	REFER TO
<input type="checkbox"/> Dirty air cleaner filter.	Replace.	
<input type="checkbox"/> Inoperative thermostatic air cleaner.	Repair.	Sect. 1: Handling Troublesome Thermostat Air Cleaner.
<input type="checkbox"/> Incorrect ignition timing.	Adjust.	Sect. 2: Setting Timing.
<input type="checkbox"/> Malfunctioning centrifugal advance and vacuum advance units.	Repair or replace.	Sect. 2: To Check Centrifugal Advance and Vacuum Advance.
<input type="checkbox"/> Defective sparkplugs.	Service or replace.	Sect. 2: How to Replace Sparkplugs.
<input type="checkbox"/> Malfunctioning automatic choke.	Adjust or repair.	Sect. 2: What You Should Know About Chokes.
<input type="checkbox"/> Bad EGR valve.	Replace.	Sect. 1: EGR Valve.
<input type="checkbox"/> Dirty carburetor or defective part.	Repair or replace.	Sect. 2: Remove the Vacuum Hose.
<input type="checkbox"/> Sticking valves.	Test compression; repair.	Sect. 2: Testing Engine Compression.

# How many mpg does your muffler get?

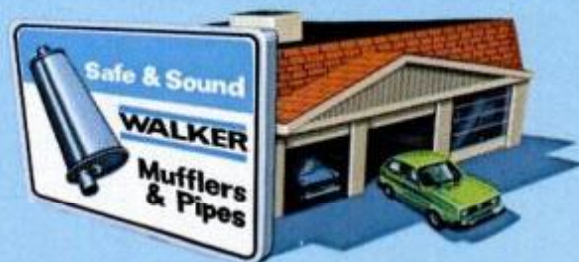


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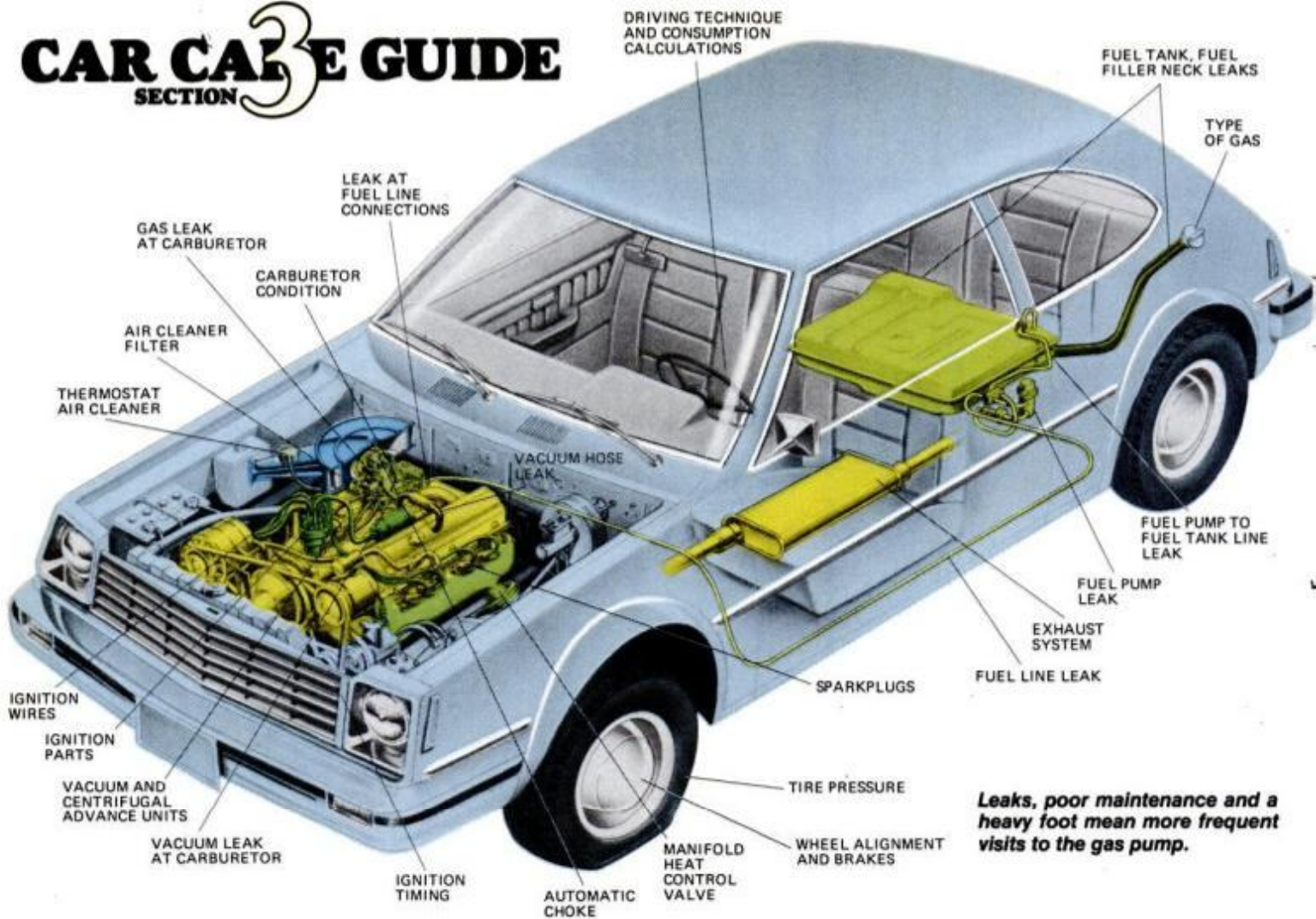
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# CAR CARE GUIDE

## SECTION 3



# Poor fuel economy

The troubleshooting chart on page 201 summarizes causes of poor fuel economy and high fuel bills. The "Refer to" column tells where to find applicable information in other sections. If there is no reference, an explanation follows or the repair procedure is considered self-explanatory.

### Pick the right gas

There's a right and wrong gasoline for a car engine. The right gasoline helps to prevent engine knock (ping). The wrong one causes ping.

Whether or not an engine knocks depends on gasoline octane. Knock is a metallic rattle

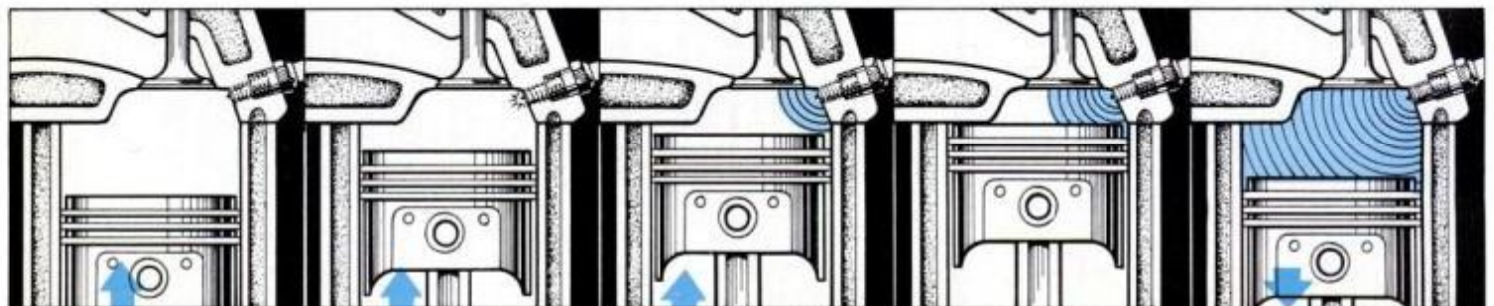
coming from the engine during acceleration. In technical terms, knock is called detonation. Understanding how detonation occurs requires a knowledge of the combustion process.

In normal combustion, the sparkplug ignites the fuel mixture at a specific point in the piston's travel as the piston compresses the fuel mixture. The fuel mixture begins burning at the point nearest the sparkplug. The flame spreads at a controlled rate of speed across the combustion chamber until all fuel is burned completely.

In an engine that is detonating, normal combustion does not take place. Although the

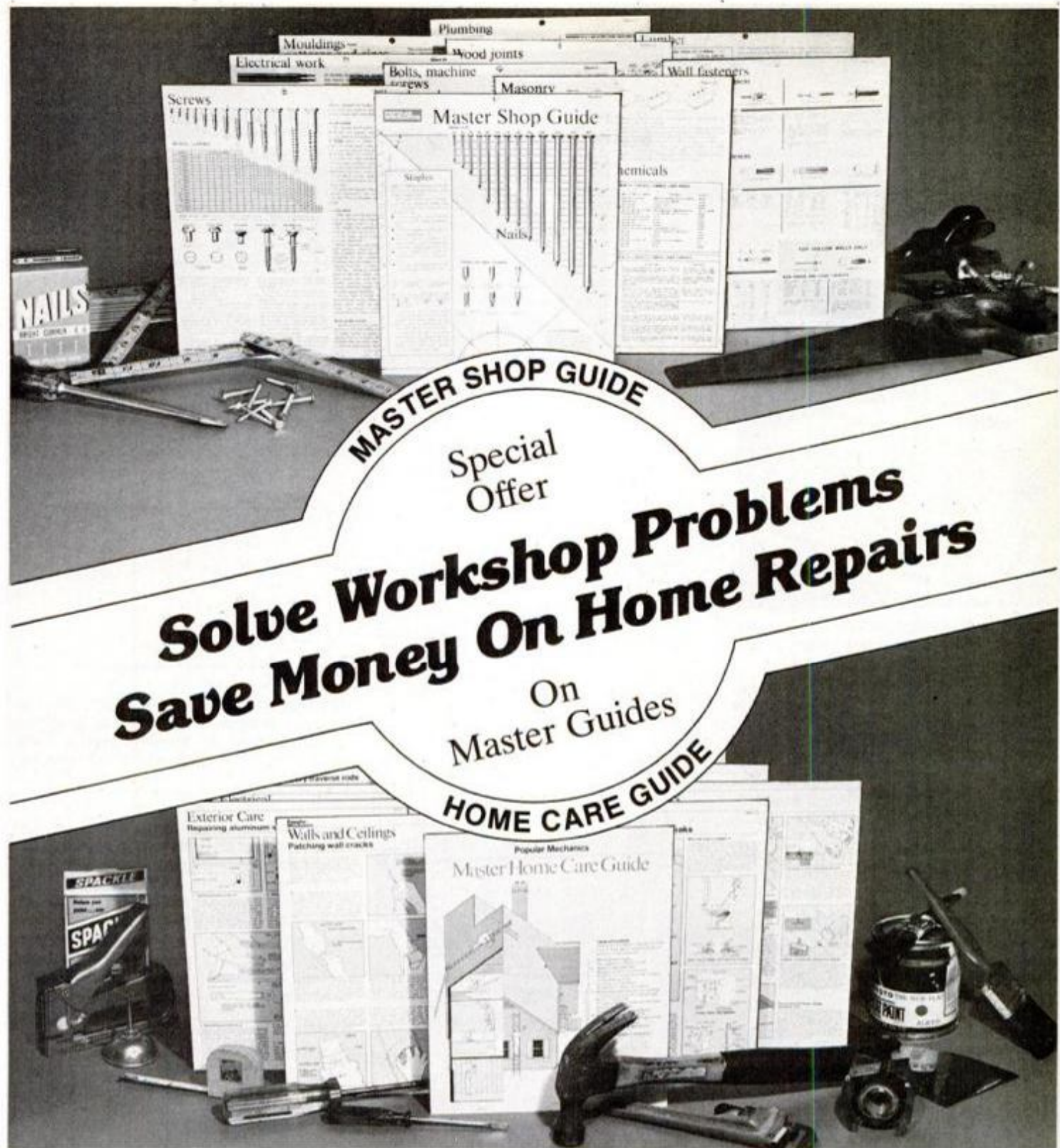
sparkplug ignites the fuel mixture at the proper moment and the fuel mixture begins burning, the flame does not spread across the combustion chamber. Fuel which is not reached by this flame explodes suddenly, because it can't withstand pressure and heat, and starts burning independently. When the two flame fronts meet, the intense heat and pressure that result generate shock waves which rattle parts of the engine. You hear this as ping. Heavy or prolonged ping can ruin an engine by damaging pistons and bending connecting rods.

(Detonation should not be confused with preignition, which is a different engine condition.)  
(Please turn to page 198)



In normal combustion, a spark ignites the fuel and a flame fans smoothly through the cylinder.





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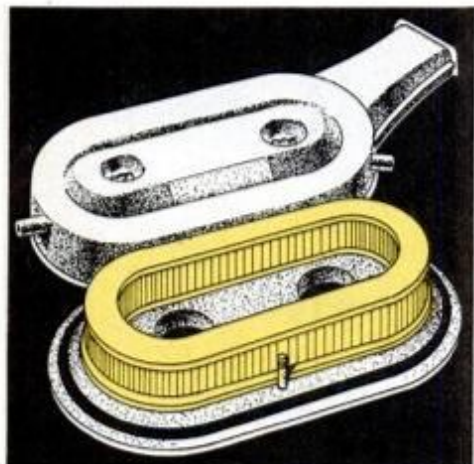
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# CAR CARE GUIDE

## SECTION 3

tion that also causes knock. Preignition is premature igniting of the fuel mixture in a cylinder. The sparkplug does not cause ignition. Instead, the fuel mixture is ignited by some foreign substance, such as a piece of very hot carbon.)

The two major causes of detonation are incorrect ignition timing and using gasoline of in-

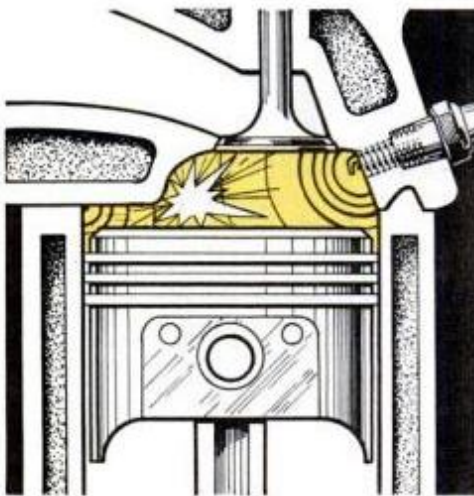


**Dirty air cleaner filter chokes off air to engine, causes increase in gas usage.**

sufficient octane. Octane is a numerical designation representing the ability of gasoline to resist detonation.

Suppose you visit three different gasoline stations and find unleaded gasoline having octane value ratings of 87, 89 and 90.5. Some engines can use the 87 gas without knocking. Some need gasoline having the 89 or 90.5 designation.

(The numerical designation of gasoline found on gas pumps is not octane. The two methods used to determine octane are called Research and Motor. The numerical designations on pumps is an average of these two [that is,  $\frac{R+M}{2}$ ], which is called the octane value rating.)



**Detonation is when gas explodes; intense pressure causes engine parts to vibrate.**

Other than numerical ratings to indicate ability to resist detonation, the only difference between the three blends of gasoline will be

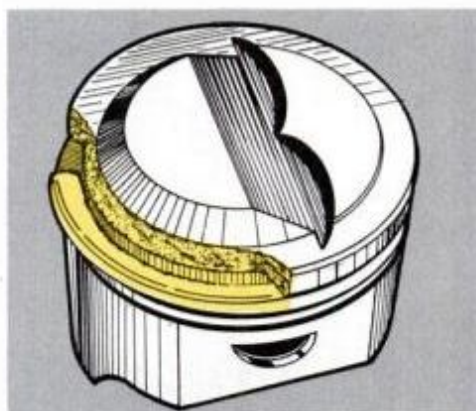
price. Gasoline having a higher octane value than another will be more expensive. This is why there is a difference of as much as 14 cents per gallon between blends of unleaded gas, and between blends of regular leaded and premium leaded gas.

What does all this have to do with poor fuel economy? Drivers who use higher designated gas in engines that can run without pinging on lower designated gas are wasting money. No other benefit except the ability to withstand detonation is derived by using a higher-designated gas. If your engine runs on unleaded gas having an 87 designation (price, say, of 64.9 cents per gallon), you will spend needlessly by using gas having a designation of 90.5 (price, say, of 74.9 cents per gallon).

### How to figure fuel consumption

Calculating fuel consumption accurately requires a gas-per-mile gauge, which some garages have. Its use takes a considerable amount of time and, therefore, costs a considerable amount of money. However, you have an alternative. You can estimate the amount of gas your car is consuming by following these steps:

**1. Fill the fuel tank.** The tank has to be "topped off." When gas gets near the filler neck, pump gas slowly to prevent loss and to allow air in the tank to escape.



**Intense, prolonged detonation can cause piston cracking, bent connecting rods.**

**2. Drive the car 1000 miles,** or more. Keep accurate records of how much fuel you add. Remember to record the odometer reading at the beginning of the test period.

**3. During the test period,** drive your car for maximum fuel economy (see driving suggestions outlined later). If you use your car mostly in city traffic, it will use more gas than on the highway at 55 mph.

**4. After the test period,** calculate results by subtracting the starting mileage from the final mileage, and then dividing the results by the gallons of fuel consumed. (Final mileage - starting mileage ÷ total gallons put into tank = fuel consumption in miles per gallon).

### EPA fuel economy test

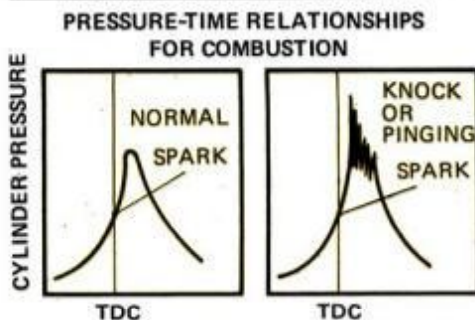
New cars have fuel-economy estimate stickers on their windows. Estimates are based on

standardized laboratory tests conducted by the Environmental Protection Agency (EPA).

Tests are conducted under controlled conditions and are intended to give consumers a way of judging gas consumption of one model with others. In no way do estimates specify the exact gas mileage the car will give. There are too many variables in driving conditions and types of drivers for estimates to be exact.

EPA tests are run on dynamometers by skilled drivers at an ambient temperature range of 68 to 86° F. Tests simulate stop-and-go city driving for a distance of 7.5 miles at an average speed of 20 mph, and highway driving for 10 miles at about 50 mph.

Testing does not take into account such things as cold-weather starting and driving,



**Gasoline with octane rating that's too low for your engine will explode in cylinders (right), instead of burning evenly (left). You'll detect a pinging sound from engine.**

long periods of engine idling, effects on fuel consumption of cold engine oil and other lubricants that put a drag on the engine, winter versus summer gasoline ("winter" gas is blended to be more volatile), driving uphill, and the effects of head winds. Furthermore, a car delivers better fuel economy after it is broken-in, since the tight fit of new parts creates more friction. The break-in period normally takes several thousand miles.

### Nonmechanical causes of fuel consumption

The following is a summary of driving habits and other factors that contribute to higher fuel consumption.

■ **Jack rabbit starts**—Fast starts cut fuel economy. Slow starts, getting into high gear as quickly as possible, and moderate, consistent driving will significantly improve your fuel economy record.

■ **Stop-and-go passing**—To pass another car, avoid running up its back, slamming on the brakes and hitting the accelerator pedal to get around. Instead, start your pass well to the rear, so you can swing out smoothly and execute the pass without braking and then hitting the accelerator pedal.

■ **Tailgating**—It is both dangerous and uneconomical to tailgate. From a fuel consumption standpoint, a tailgater is alternately hitting the brake pedal and accelerator pedal. This wastes fuel.

■ **Speeding**—No doubt about it, gas consumption increases with speed. When you're driving at a steady 50 mph, approximately half

*(Please turn to page 201)*



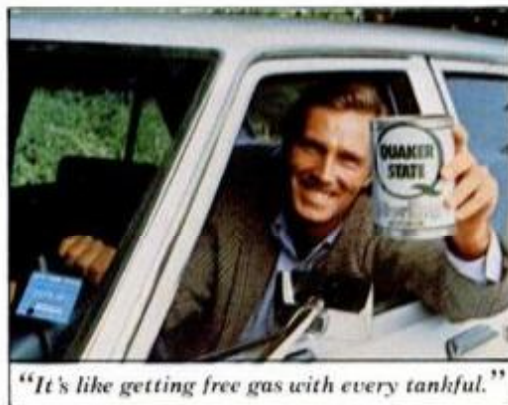
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# CAR CARE GUIDE

## SECTION 3

### TROUBLESHOOTING POOR FUEL ECONOMY

CAUSES TO CHECK	CORRECTION	REFER TO
<input type="checkbox"/> Incorrect gas for engine.	Use gas with another octane rating.	
<input type="checkbox"/> Poor driving technique.	Carefully evaluate your own technique.	
<input type="checkbox"/> Underinflated tires.	Correct.	
<input type="checkbox"/> Dirty air-cleaner filter.	Replace.	
<input type="checkbox"/> Inoperative thermostatic air cleaner.	Repair.	Sect. 1: <i>Handling a Troublesome Thermostatic Air Cleaner.</i>
<input type="checkbox"/> Fuel leak.	Find and repair.	
<input type="checkbox"/> Inoperative automatic choke.	Test; repair or replace.	Sect. 1: <i>What You Should Know About Chokes.</i>
<input type="checkbox"/> Vacuum leak through loose or split vacuum hose.	Repair or replace.	Sect. 1: <i>Vacuum Loss.</i>
<input type="checkbox"/> Vacuum leak from carburetor-manifold area.	Repair.	Sect. 1: <i>Inoperative Heat Valve.</i>
<input type="checkbox"/> Defective or loose primary ignition wires at coil and distributor.	Tighten or replace.	
<input type="checkbox"/> Incorrect ignition timing.	Adjust	Sect. 2: <i>Setting Timing.</i>
<input type="checkbox"/> Malfunctioning centrifugal advance and vacuum advance units.	Repair or replace.	Sect. 2: <i>To Check Centrifugal Advance.</i>
<input type="checkbox"/> Damaged ignition part.	Replace.	Sect. 1: <i>Tackle Ignition System Testing.</i>
<input type="checkbox"/> Defective sparkplugs.	Service or replace.	Sect. 2: <i>How to Replace Sparkplugs.</i>
<input type="checkbox"/> Restricted exhaust system.	Repair.	Sect. 1: <i>Engine Causes of Hesitation.</i>
<input type="checkbox"/> Inoperative manifold heat-control valve or vacuum-controlled fuel vaporization valve.	Service or replace.	Sect. 1: <i>Inoperative Heat Valve.</i>
<input type="checkbox"/> Faulty wheel alignment.	Adjust.	Sect. 5: <i>Servicing Wheel Bearings.</i>
<input type="checkbox"/> Brake drag.	Repair.	Sect. 7: <i>Brake Trouble.</i>
<input type="checkbox"/> Dirty carburetor; damaged parts.	Overhaul.	

of the fuel used by a car is used to push air out of the way.

■ **Unnecessary braking**—If you can, keep rolling. Don't stop. This means trying to time traffic lights. If a light in the distance is red, coast up and brake slowly. If the light turns green before your car reaches the intersection, apply steady pressure on the gas pedal. Stay off the brake pedal if you can.

■ **Excessive idling**—An engine that idles for three minutes uses as much gas as a car that is driven one-half mile at 30 mph. In winter, don't let the engine idle for minutes on end to heat the passenger compartment and defrost the windshield. Use a windshield scraper. Then, start the engine and let it run for 30 seconds, at most. Get rolling at a speed of between 25 and 30 mph for the first mile or two. By this time, the engine will be warm enough to provide heat.

■ **Improperly inflated tires**—Keeping tires inflated to the correct air pressure and having front wheels properly aligned reduces friction that puts drag on the car. The engine must work harder with improper inflation, consuming more gas to overcome drag. Radial tires have

less rolling resistance than bias plies and therefore improve fuel mileage.

#### Seal Leaks

You can frequently smell gas if there's a leak in the fuel system. The most common areas where fuel leaks occur are at the carburetor/fuel-bowl screws, carburetor/fuel-line connection, fuel-pump/fuel-line connections, fuel-line/fuel-tank connection, and fuel-tank/fuel-filler neck seam.



**Air filters come in various shapes and sizes. Make sure you get the right one.**

## When Should YOU Change Engine Oil?

How you drive determines how far and how often you should change your crankcase oil. It is nearly impossible to drive a car properly so that yearly changes of oil would be safe for your engine.

Traffic jams, winter warm-ups, short runs, taking kids to school, and those short trips to the store all tend to shorten the life of your oil.

On top of that, today's engines are smaller, work harder and run hotter. All of these things help foul up engine oil, create varnish, gum and sludge as they use up the additives in the motor oil.

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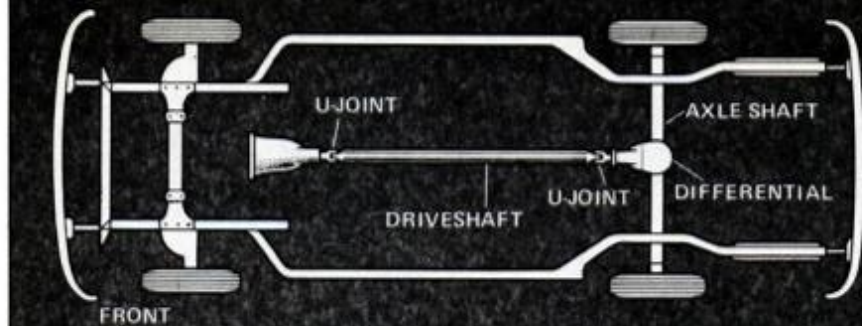


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Differential, axle shaft and u-joint are detailed above.

# Power train noise

The power train of cars with rear-wheel drive consists of an engine, clutch and manual transmission, or automatic transmission, propeller shaft, universal joints, and rear-drive train composed of a differential, axle shafts and axle-shaft bearings. In a discussion of power-train noise, front suspension and tire/wheel assemblies, although not parts of the power train, have to be considered.

The power train of cars with front-wheel drive consists of an engine and a front trans-axle made up of a clutch and manual transmission, or an automatic transmission, front differential driveshafts and shaft bearings. There are no propeller shaft, universal joints or rear-drive train. However, tire/wheel assemblies, although not parts of the power train, have to be considered when discussing noise problems.

There are thousands of individual parts contained in the power trains of a rear-wheel or front-wheel-drive vehicle. Most parts emit noise when they fail. However, trying to put a finger on the problem area is frequently difficult because power-train noise is elusive.

For example, noise that seems to be coming from the rear-drive train of a rear-wheel-drive automobile may, in fact, be coming from the propeller shaft, transmission, tires or even the engine. Making snap judgments can lead to unnecessary, expensive repairs. Finding the source is the most important step in correcting a noise condition.

Troubleshooting power train noise is a Saturday mechanic's job and procedures outlined in this section are intended to help. However, repairs are another matter.

In some instances, you should be able to make repairs yourself, as you will see by reviewing the repair information outlined in this section. In other cases, repairs cannot be made without doing a major overhaul.

### Troubleshooting rear-drive train noise

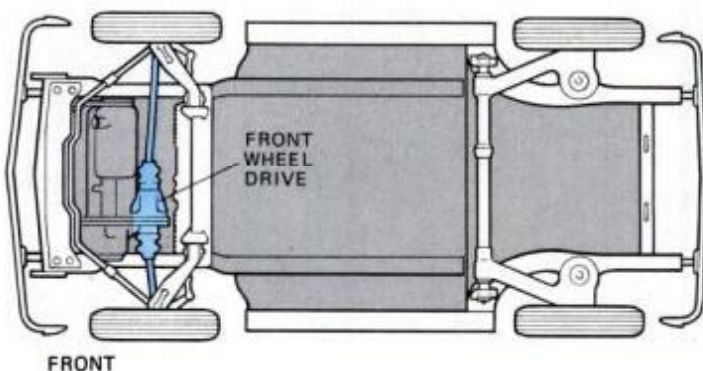
The majority of noise complaints received by *Car Clinic* in the last 10 years deals with suspected rear-drive train noise in rear-wheel-drive cars. The following procedure will help determine if the noise you hear is coming from the rear or elsewhere:

**1. Remove the rear axle** (differential) filler hole plug. If the plug is recessed, use a special wrench available from a parts and accessories dealer.

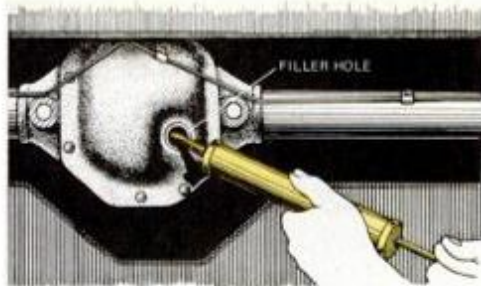
**2. Check the differential lubricant** level by inserting your pinkie. Lube should be no more than 1/2 inch below the filler hole. Add lubricant, if necessary.

Use only lubricant recommended by the manufacturer (consult the maintenance guide in the service manual). Recommendations differ according to climate (lighter-weight lubricants for colder climates) and the type of differential. Antispin (positraction) rear axles require an additive or special lubricant. A suction-type lubricating gun can be obtained to fill and drain differentials.

**3. Find a smooth tar or asphalt road**, and drive the car for 20 minutes to warm up the differential. Then start from a stop, increasing



Front-wheel drive cars lack drive-shaft; all power train components are up front.



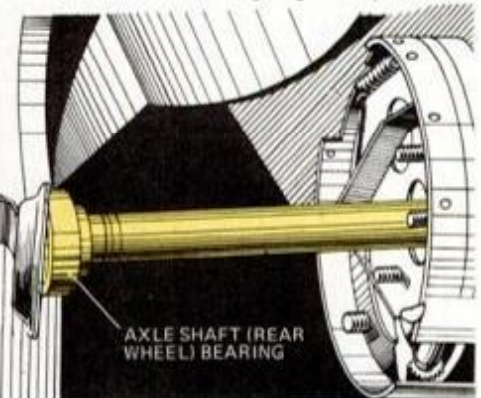
A suction-type lubricating gun is available for filling, draining differentials.

speed gradually. Note the speedometer or tachometer reading at which noise is loudest.

#### 4. Analyze the noise.

Differential gear noise is most pronounced when the car is accelerating, cruising or coasting 30-40 mph and 50-60 mph. If noise isn't heard at these speeds, dismiss malfunctioning rear-axle gears as the source.

Differentials make some noise, which automotive engineers call the "commercially acceptable noise level." This light sound—more like a tone than a noise—is normal. It occurs within a narrow band between 40 and 60 mph. If the tone is there, it's going to stay there.



To replace a bad axle-shaft bearing, unhook and slide shaft from differential.

Rear-axle shaft bearing noise is a growl or grating sound. However, a bad front-wheel bearing sounds the same.

To pinpoint the source of a bad bearing, accelerate the car to 60 mph, turn off the ignition and shift the transmission to neutral. Swerve the car from side to side, so the load on the rear switches from one wheel to the other. If the growling or grating noise becomes amplified, a bad rear-axle shaft bearing exists.

Confirm the existence of front-wheel bearing noise by jacking up the front wheels. Spin each wheel and listen for noise. Shake the wheels. A loose wheel indicates a loose (noisy) front-wheel bearing.

5. With the car standing still, and the transmission in neutral, increase engine speed until it reaches the range at which the noise was loudest during the road test. If you hear noise, look to the engine or exhaust system as the source.

6. To check the clutch, keep the transmission in neutral, run engine speed up to the noise range as you engage and disengage the clutch. If you hear noise, a bad clutch part probably exists.

7. To check on the transmission as a cause of noise, disconnect the propeller shaft from the transmission output shaft and increase engine speed to the noise range, with the transmission in high gear. Noise? Look in the transmission.

(Please turn to page 204)

### 5-Minute Motor Flush

... before every oil change!

Next time you change oil, take an extra five minutes and pre-clean your engine with 5 Minute Motor Flush. Pour it into the crankcase to clean out sludge, varnish and other harmful deposits. Then, your new oil can do its job better, protecting your car's engine for more driving miles.

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# CAR CARE GUIDE

## SECTION 4

**8. Noise made by tires** can be distinguished from rear-axle noise by driving the car on a different road surface. If the pitch changes, tires are the noisemakers. If the pitch stays the same, suspect the rear axle. You can also check tires by temporarily increasing tire pressure to 50 pounds. Noise made by tires will be noticeably altered, but rear-axle noise will continue as before.

### Rear-drive train repair

If lubricant level is low because of a leak around the differential cover, do not drive the car until repairs are made. Low lubricant is the main cause of differential failure.

To repair a leaking case caused by a bad gasket, do this:

**1. Disconnect the propeller shaft** from the differential universal-joint flange (see below, *Replacing A Universal Joint*).

**2. Remove the differential cover bolts.** Place a pan under the differential and snap the cover loose.

**3. Clean the flanges** of the differential case and cover. Remove all pieces of old gasket material and sealer. When flanges are clean, wipe them dry.

**4. Apply gasket sealer** to the flange of the differential case and press on the gasket. Then apply sealer to the face of the gasket. Install the cover and torque bolts to the specification in the service manual, which is probably 25-30 foot-pounds.

Rear-axle overhaul and replacement of axle bearings are jobs most people leave to a me-



**Apply sealer and press new gasket firmly into place; install and tighten cover.**

chanic. However, before having the mechanic replace ring and pinion gears, be certain rear axle noise isn't being made by a worn drive pinion bearing. Replacing the ring and pinion costs about \$150 more than replacing a drive pinion bearing.

If the mechanic replaces the ring and pinion, he should adjust ring-to-pinion backlash. Excessive, or insufficient backlash causes early failure. Generally, a ring-to-pinion backlash adjustment of .005 to .009 inch is called for. Backlash is adjusted by adding or subtracting shims, or by adjusting nuts.

### Propeller shaft, U-joints

A bad propeller shaft won't make noise, but causes vehicle vibration (see Section 5). Universal joints that are about to fail emit a clunking noise, which is apparent at low speeds.

To verify that a universal joint is going bad,

drive the car between 5 and 10 mph with the transmission in high gear. If clunking is pronounced, put the car on a lift and grasp the propeller shaft near each universal joint. Try rocking the shaft back and forth. It should not move.

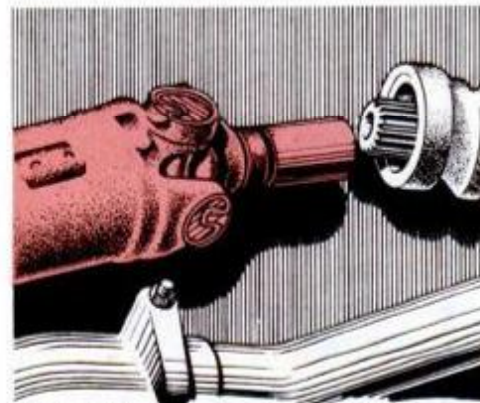
If there is play in the shaft, tighten the universal joint flange bolts and do another road test. If noise isn't caused by loose flange bolts, replace the universal joint. Driving a car with a bad universal joint will eventually cause the propeller shaft to break loose, possibly causing loss of control.

### Replacing a universal joint

**1. Raise the car.**

**2. Use a file to scribe a mark** across the rear universal joint flange and the differential companion flange. This is done to assure correct propeller shaft alignment when the shaft is reinstalled.

**3. Remove the propeller shaft** by removing the rear universal joint flange bolts and sliding the shaft off the transmission output shaft.



**Up front draw the propeller shaft to the rear, away from the transmission shaft.**

**4. Place the propeller shaft** on a workbench with the end possessing the suspected defective universal joint mounted in a vise. Do not tighten the vise forcefully, since you may damage the shaft. Use it to hold the shaft steady. Place the other end of the shaft on supports to keep the shaft level.

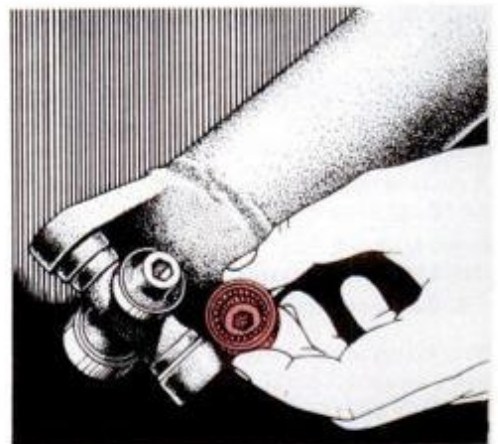
**5. If the universal joint bearing cap** has a snap-ring retainer, pull the retainer out with a pair of long-nose pliers. Tap around the outside of the bearing cap with a hammer until the



**Pull bearing cap snap-ring retainers, if present, to release hold on the U-joint.**

cap pops loose. Slide the universal joint from the propeller shaft yoke.

If the universal joint bearing cap does not have a snap-ring connector, get a piece of pipe



**Insides of the caps possess bearings that are the weak link of U-joint assemblies.**

large enough to encircle the cap. Place the pipe over the cap and hit the end of the pipe with a hammer. This breaks the bearing cap retainer loose, forcing the retainer and cap from the propeller shaft yoke. Rotate the propeller shaft and remove the other cap, using the same method. When the two bearing caps have been removed, slide the universal joint cross assembly from the propeller shaft yoke.

**6. Install the new universal joint** by sliding the cross assembly into the propeller shaft yoke. Press on the bearing caps. Then, seat the caps securely by tapping them in place with a soft-faced hammer.

**7. Install the propeller shaft,** seeing that the reference mark on the universal joint flange lines up with the reference mark on the differential companion flange. Install and tighten the universal joint flange bolts as tightly as possible.

### Noisy automatic transmission

Noise from an automatic transmission usually indicates the need for repair. However, as with differential gear noise, automatic transmissions emit a "commercially acceptable noise level." This noise is a low-key whine that increases in intensity as the car accelerates in first gear. Once the transmission shifts to a higher gear, the pitch of the whine drops.

Noise other than a low-pitch whine is not normal. This includes a click, knock, scrape or shrill whine. The noise may be coming from the vacuum modulator or torque converter.

### A Word About Modulators

If a vacuum modulator valve is present in your transmission, it is screwed into the transmission housing and connected to the carburetor by a vacuum tube. Most automatic transmissions use a vacuum modulator valve.

A modulator valve that fails causes the transmission to shift harshly or erratically and may produce noise. Since a modulator valve is relatively inexpensive, replace it at the first sign of transmission trouble. If you are lucky, no further repair will be necessary.

To replace the modulator valve, raise the car, remove the vacuum tube and unscrew the modulator valve and spring-and-pin assembly. Retain the spring-and-pin assembly to use with the new modulator valve. When the new valve has been installed, check the automatic trans-





# The men.

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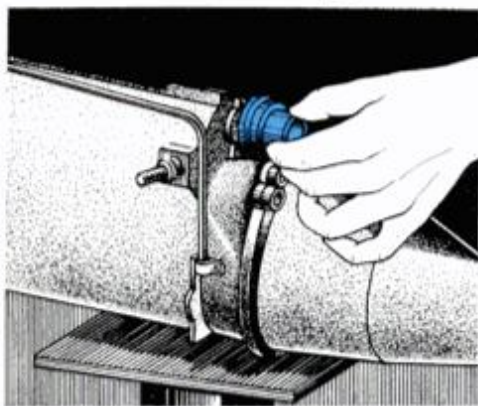


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# CAR CARE GUIDE

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**Transmission vacuum modulator valve is often cause for many shifting problems.**

mission fluid level, since some fluid may have been lost when you removed the old valve.

### Torque converters

A loose or cracked torque converter can make a knocking, clicking or scraping noise. Isolate noise to the converter by raising the car, placing the transmission in gear and having someone accelerate the engine to simulate the speed at which noise occurs. Place your ear at the torque converter and then at the transmission to pinpoint the source.

If it is the torque converter, remove the converter cover. Make sure converter plate bolts are tight. Rotate the converter plate and look for cracks in the plate. Replace a cracked one.

Noise inside the transmission indicates the unit will have to be overhauled.

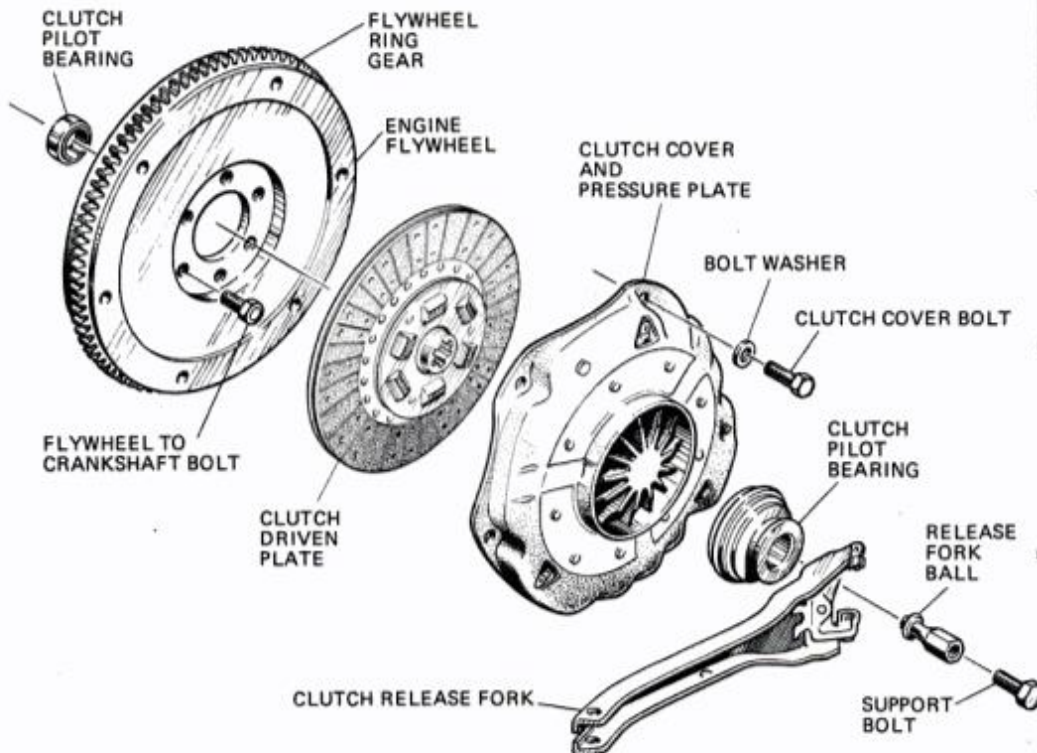
### Clutch noise

The purpose of a clutch is to disconnect the engine from the transmission as gears are being shifted, and to permit the engine to start and run. If an engine remained coupled to the transmission, it wouldn't attain starting speed because of resistance imposed by the transmission. A running engine in a stationary car must remain detached from the transmission, or the resistance imposed on the engine by the transmission will cause the engine to stall.

When the clutch is engaged and the car is put in motion, the clutch employs friction to drive the engine and transmission as a unit. A pressure plate and a clutch disc are the two main parts of a clutch assembly. The pressure plate is attached to the engine flywheel, while the clutch disc is located between the flywheel and pressure plate. The clutch disc drives the clutch shaft, also called the throwout bearing shaft. It couples the clutch and transmission.

The clutch disc is the key element. It possesses a layer of friction material on both sides. When the clutch is engaged, heavy torsion springs force the clutch disc, flywheel and pressure plate firmly together. The three parts act as one as they rotate. Engine torque is thus able to be transmitted from the flywheel, through the clutch, to the transmission.

When the clutch is disengaged (clutch pedal depressed), a part called the clutch fork applies pressure to a clutch release bearing, (also called the throwout bearing). This bearing rotates against, and puts pressure on, the clutch release levers. The clutch release levers, in turn, compress clutch springs. This action forces the pressure plate to the rear, dis-



engaging the pressure plate from the flywheel. The two then rotate independently, as the clutch disc and clutch shaft become stationary.

There are several different kinds of clutches, but all work pretty much the same. A major difference is whether they are dry or wet.

Dry clutches, which have graphite coatings that act as a lubricant, are used in cars and light trucks. Some dry clutches, especially those in imported vehicles, employ a hydraulic assist that acts similarly to the booster of a power braking system.

One type of hydraulic assist forces fluid from a master cylinder into the clutch housing. The oil presses against a piston, which applies pressure to a series of discs that are connected to the clutch disc. The disc turns and power is transmitted to the transmission.

Heavier vehicles generally use a wet clutch, which should not be confused with clutches employing hydraulic assist. Wet clutches supply oil to the clutch for lubrication.

### Clutch problems

Noise coming from the clutch usually warns of a broken or rough-running component, such as a pitted or chewed up throwout bearing, broken clutch lever or fork, broken torsion spring, cracked or loose clutch disc. To resolve clutch noise, and the problem it suggests, the assembly must be overhauled or replaced.

Most clutch problems involve a clutch that slips or drags. A clutch that slips is characterized by car speed that doesn't keep pace with engine speed. The car lacks power, especially when going uphill.

To determine if a clutch is slipping, park the car on level ground and let the engine idle. Set the parking brake, depress the clutch pedal and shift the transmission into first gear. Press down on the accelerator pedal gradually while you slowly release the clutch pedal. The engine should stall. If the engine doesn't stall, the clutch is slipping. A slipping clutch is caused by lack of clutch pedal free-play, worn clutch disc face, oil- or grease-contaminated clutch disc

face, weak clutch springs, or pressure plate or flywheel runout. Runout refers to a nonconcentric condition.

Clutch pedal free-play adjustment is the only service a clutch requires. Free play refers to the amount of movement in the clutch pedal before the clutch disc engages.

Wear of the clutch disc is normal. As a clutch disc wears, the amount of free play is reduced. If specified free play isn't maintained, wear will be hastened.

Free play should be adjusted periodically, as specified by the maker. The adjustment differs from car to car, so see your service manual.

A dragging clutch makes noise. To determine if a clutch is dragging, keep the clutch pedal pressed to the floor and press the accelerator pedal halfway. Shift into gear. If there is a grinding noise, the clutch is dragging.

Clutch drag is caused by excessive free play, weak or worn torsion springs, bad throwout bearing or a warped clutch disc.

### Noisy manual transmissions

A noisy manual transmission often signifies a problem requiring major overhaul. A gear or bearing may be broken, or the main shaft spline could be worn.

Manual transmission noise could also mean that there isn't enough lubricant in the gearbox. Many owners don't pay attention to the lubrication requirements of a manual transmission. This is a mistake. A manual transmission should be kept filled with lubricant of the correct viscosity to avert damage.

Consult the lubrication guide for your car to determine the recommended lubricant. Remove the filler plug of the transmission case. If lubricant level is below the bottom of the filler hole, add sufficient lubricant to bring the level to the bottom of the hole.

### Engine noise

Engine noise can be a click, rap, thump, whine, rattle, slap, chuck or thud. Noise can be loud, faint, sharp, dull, intermittent or constant.

*(Please turn to page 209)*



2349 in/lbs



2744 in/lbs



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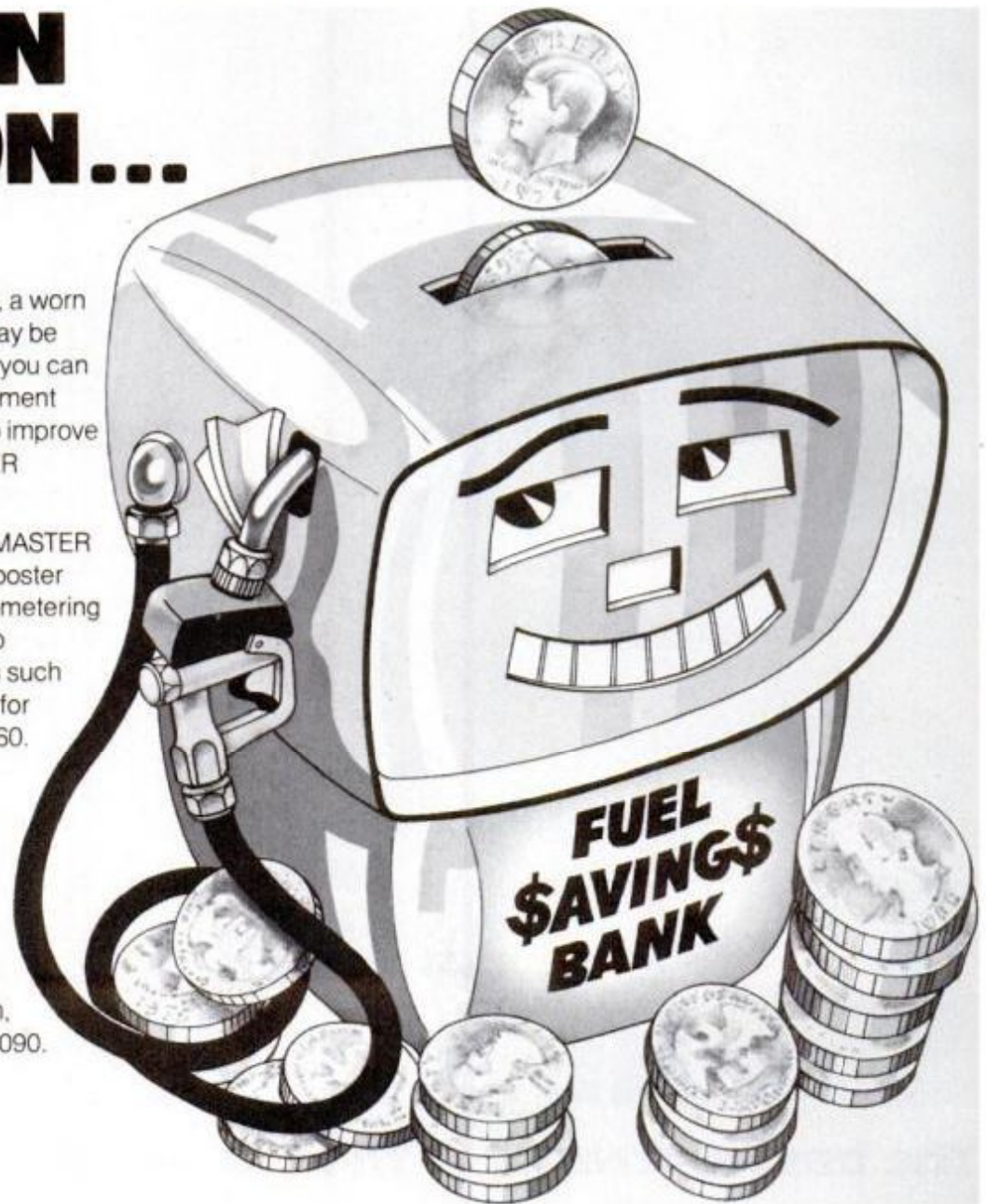
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# CAR CARE GUIDE

SECTION 4

It can occur when the engine is cold, warm, under load, on acceleration, or deceleration, at idle or when cruising.

The best way to analyze engine noise is by frequency. There are four categories.

1. Noise that occurs once every revolution.
2. Noise every cycle (two revolutions).
3. Noise that occurs intermittently, without apparent relation to engine revolutions.
4. Noise that occurs continuously.

Use a neon sparkplug tester to establish the frequency of engine noise. Be sure engine oil level is at the FULL mark on the dipstick. Warm the engine to operating temperature and connect the neon tester to one of the sparkplugs. With the engine idling, notice whether engine noise occurs once or twice for each flash of the tester or if there is no relationship.

If noise occurs twice for each flash (once every revolution), it is caused by some part driven by or driving the crankshaft, including pistons, piston rings, piston pins, crankpins and main journals.

If noise occurs once for each flash (once each cycle), it results from a part driven by the camshaft. In this category are valves, valve-related components (springs or stems), fuel pump, distributor or camshaft gear.

If the noise has no relationship to the flashing of the neon spark-plug tester, it is being caused by some component which has no relationship to the rotation of the crankshaft or camshaft. Included in this category are parts attached to the engine, such as the alternator, starter and distributor. You have a better chance of isolating noise to one of these components by using an engine stethoscope or a length of garden hose. Place the stethoscope or hose on the suspected parts and place the other end at your ear. Loud noise indicates the defective component.

Continuous noise is either a whine or rubbing sound that is caused by a rotating part. A constant whine is usually produced by a defective timing gear, oil pump drive or distributor drive. The flywheel may cause a rubbing sound.

To further isolate engine noise, short out each cylinder. With the engine idling, use a pair of insulated sparkplug cable pliers to pull the cable from each plug, in turn. If the noise stops, the problem is located in that cylinder.

## Front-wheel-drive noise

The presence of noise in the front axle of front-wheel-drive vehicles is normally confirmed by the presence of an instability and/or steering-wheel shimmy condition. Noises are usually grinding or grating sounds, which distinguish them from engine noise.

The most common causes of noise in the front axle assembly are as follows:

- Worn, loose or seized driveshaft ball joint.
- Worn, loose or seized wheel bearing.
- Too much play in the driveshaft and differential side gear serrations.
- Too much play in the driveshaft and hub serrations.

Noise and accompanying instability and/or steering-wheel shimmy normally mean the front axle has to be overhauled. However, before doing this make sure your mechanic determines that the noise is not the result of a front suspension problem. Lubricate the chassis. If this doesn't get rid of noise, check the strut suspension components (coil springs and bushings) for damage.

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## Poor roadability

This section of Car Care Guide discusses causes of vehicle vibration (shimmy) and poor handling. The two are referred to as poor roadability.

Poor handling refers to loose steering, hard steering, pulling and vehicle wander (instability). Usually, causes are located in the steering system.

Causes of vibration are usually found in places other than the steering system, although shimmy may be transmitted through the system so you feel the sensation in the steering wheel. You may also feel vibration coming from the floor or seat of the car.

Poor roadability should not be taken lightly. Vibration and poor handling frequently signify the existence of a hazardous condition, and quick action should be taken.

### The causes of vibration

Any of the malfunctions listed here can cause vibration:

- Incorrect tire pressure.
- Defective tires.
- Loose or missing wheel nuts.
- Defective shock absorbers.
- Defective or loose wheel bearings.
- Damaged or loose steering linkage.
- Worn suspension ball joints.
- Damaged or misaligned propeller shaft.
- Broken or loose engine mount.
- Unbalanced wheel/tire assembly.
- Misaligned front end.
- Tire runout.
- Wheel runout.

Troubleshooting most of these is within the capability of the Saturday mechanic. In fact, you can probably repair many of the defects that each of these suggests.

### Repairing tire and wheel causes

Check tire pressure first. Deviation in pressure from one tire to another can cause shimmy. So can low tire pressure.

Tires that aren't inflated to manufacturer specification will wear out faster than properly inflated tires. According to one survey, underinflated tires will give 25 to 50 percent less service.

Underinflated tires wear away more rapidly on the shoulders than in the center. In addition

to vibration and rapid wear, low pressure may cause tire squeal on turns, hard steering, bruised tires, broken tire cords, decreased fuel economy, and damage to the tire by wheel-rim impact.

Overinflated tires wear out faster in the center than on the shoulder. Furthermore, if pressure is higher than it should be, the vehicle rides harsher. Overinflated tires also bruise easily, and traction at the rear wheels may be reduced.

To keep tabs on tire pressure, buy a quality tire-pressure gauge from your auto parts and accessories dealer. Do not rely on service station gauges, especially those which are part of the air delivery system. Most are not accurate.

Check inflation when tires are cold. Cold tires are defined by the Rubber Manufacturers Assn. as those that have been stationary for at least three hours.

Examine each tire on the outside, inside and tread area for a bulge. If you can raise the car, so much the better. If not, get under the vehicle with a flashlight and make sure no bulge exists. A bulge indicates serious damage and a tire that will blow out. Do not drive the car before replacing the tire.

If your car has radial tires, you are probably familiar with radial-tire squat. Radial tires look squat where the tire contacts the ground. This is normal and does not signify tire damage.

The kind of bulge which is dangerous is a balloon or bubble caused by cords having ruptured. The bulge or balloon, which is the result of air leaking through the cord body, appears on the tread area or in the sidewall.

After checking for tire damage, look to see that all wheel nuts are present. Then, using a torque wrench, check wheel nut tightness to service manual specification.

This specification differs from manufacturer to manufacturer and also depends on the kind of wheels. For example, 1979 Chrysler Corp. Colt, Arrow, Challenger and Sapporo with steel wheels should have wheel nuts tightened to 51 to 58 foot-pounds. The same cars equipped with aluminum wheels should have wheel nuts tightened to 58 to 72 foot-pounds.

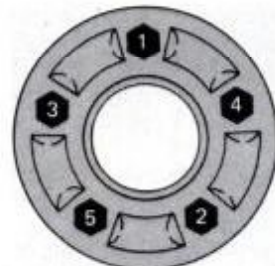
If you drive a 1977 Cadillac de Ville or Seville, wheel nuts should be torqued to 100 foot-

pounds. On the other hand, 130 foot-pounds is the torque needed for Eldorado wheel nuts.

The procedure to follow in tightening nuts is also important. Nuts should be tightened in crisscross fashion to equalize pressure around



WHEELS WITH FOUR NUTS



WHEELS WITH FIVE NUTS

### Wheel-nut tightening sequences.

the wheel. To begin with, tighten each nut to 50 percent of its torque value. Then return to the first nut you tightened and torque each nut, in turn, to its full value.

Never tighten wheel nuts with a pneumatic power wrench. After a few applications with a power wrench, wheel nut holes become enlarged. This frees wheel nuts, causing the wheel to wobble and the vehicle to vibrate. Furthermore, a pneumatic wrench can distort brake drums or rotors.

### The shock absorber story

The purpose of shock absorbers is to dampen the oscillations created by a suspension system. There are four shock absorbers in a car—one at each corner.

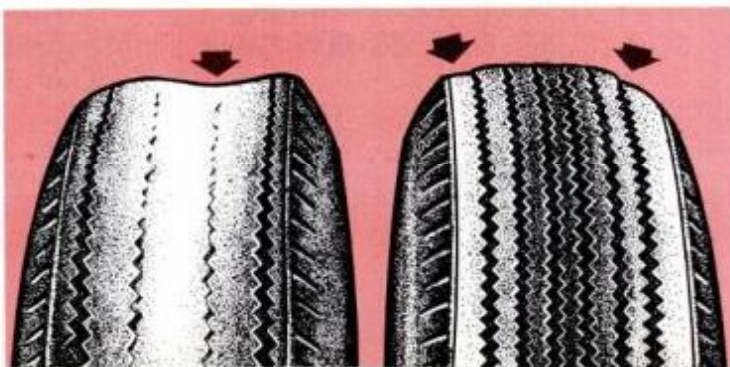
Weak shock absorbers often permit a vehicle to vibrate as the car hits a bump. In addition to vibration, worn or damaged shocks can also cause the following:

- Instability (wandering and weaving that has to be compensated for by oversteering).
- Vehicle pull to one side.
- Clunking sound from under the car during a turn or as the car hits a bump.

Shock absorbers fail in one of three ways, as follows:

- Mountings loosen or break, or bushings wear out. When this happens, the loose shock absorber shakes and frequently makes a clunking sound.
- Hydraulic fluid loss. Most shock absorbers are filled with hydraulic fluid, which is the me-

**Overinflated tires (left) wear rapidly in center, cause harsh ride and bruise easily. Underinflation (right) causes rapid tire wear, vibration, hard steering, high fuel bills.**



dium that absorbs oscillations. If the seal dries out and cracks, or is damaged in some other way, fluid is lost, and with it shock absorbing effectiveness.

Internal parts wear out. This form of damage rarely occurs, because shocks are frequently replaced for other reasons before pistons and springs loose effectiveness.

To test shock absorbers, park the car on a level surface. Turn off the engine. Stand at one corner of the vehicle and rock the car up and down by applying as much force as possible to the bumper or fender.

Pull your hands from the bumper or fender as the car is on a downward stroke. Watch the body. If it bounces up and down more than once, the shock absorber in that corner may be defective.

Defective shock absorbers can also be detected by a road test. Select a smooth roadway where traffic is light. Drive the car at 10 mph and tap the brake pedal lightly. If the front of the car dips and the rear rises, front shocks may be weak. Front shock absorbers usually wear before rear shocks.

There are two other indications of poor shock absorbers. Both necessitate raising the car. First, examine the lower case of each shock. Hydraulic fluid on the case indicates the shock absorber is bad.

Second, inspect the shock mountings. If the



**Damaged bottom and top bushings loosen shocks, causing loss of effective action.**

shock has separated from its mounting, or if bushings are dried out and crumbling, the shock should be replaced.

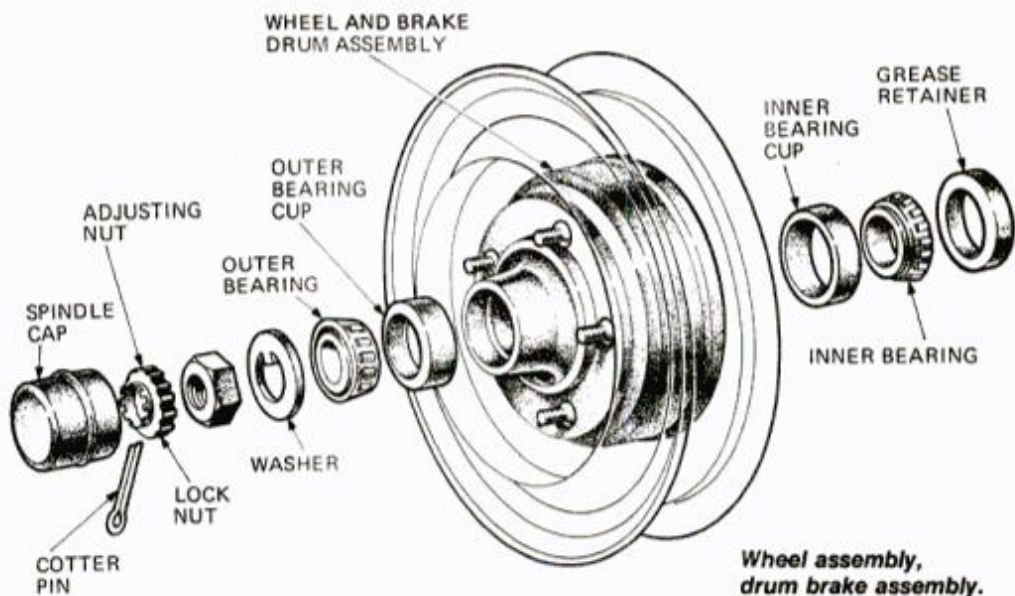
### Replacing shock absorbers

Front shock absorbers are mounted at the bottom and top. Bottom mountings are readily visible. To reach top mountings, you may have to work in the engine compartment. Some fasteners protrude through the hump made by the fender. To reach the fasteners in other models, remove the cover over the access hole in the fender.

Often, the most difficult part of the job is loosening bolts, which may be frozen. Treat bolts with a liberal amount of penetrating oil. Don't rush to remove them. Let the oil soak through for at least 10 minutes.

Raise the car, but be sure the vehicle is securely supported with jack stands. Put an automatic transmission in PARK and a manual transmission in gear. If the rear (or front) wheels remain on the ground, set the parking brake and chock the rear (or front) wheels.

In many models, front shock absorbers are mounted inside coil springs. It's not necessary to replace a coil spring unless the spring is damaged. When the shock is loosened from its top and bottom mountings, slide the shock down and out through the spring.



**Wheel assembly, drum brake assembly.**

If one front shock absorber has to be replaced, the other front shock absorber should also be replaced. This is necessary to equalize shock absorber damping action. However, rear shocks don't have to be replaced unless one is damaged.

Rear shock absorbers are also fastened at the top and bottom, but both fasteners can usually be reached from under the car. If a top fastener is not visible, look for the mounting in the trunk.

Place a jack under a part adjacent to the shock so that when the jack is lifted, tension on the shock is relieved. This makes it possible to get the shock loose.

If one rear shock absorber has to be replaced, the other rear shock absorber should also be replaced.

### Check out wheel bearings

Vibration may be caused by loose or worn wheel bearings. On a car having a rear differential, check the front wheel bearings. On a car having a transaxle (front-wheel drive), look to the rear wheel bearings.

This should not be taken to mean that bearings in the other wheels cannot fail. They can if lubrication is inadequate. However, wheel bearings in the rear of a car served by a rear

differential and in the front of a car having a transaxle are kept lubricated by grease splashed on them by rotating gears.

Signs of wheel-bearing failure, other than vibration, are a squealing, clicking or grinding noise from the wheel; loose steering or a jerk in the steering wheel; and pulling of the car to one side.

There are several ways to determine if wheel bearings have gone bad without taking wheels off.

**Raise the car and shake the wheels.** If they appear unusually loose, wheel-bearing service should be performed.

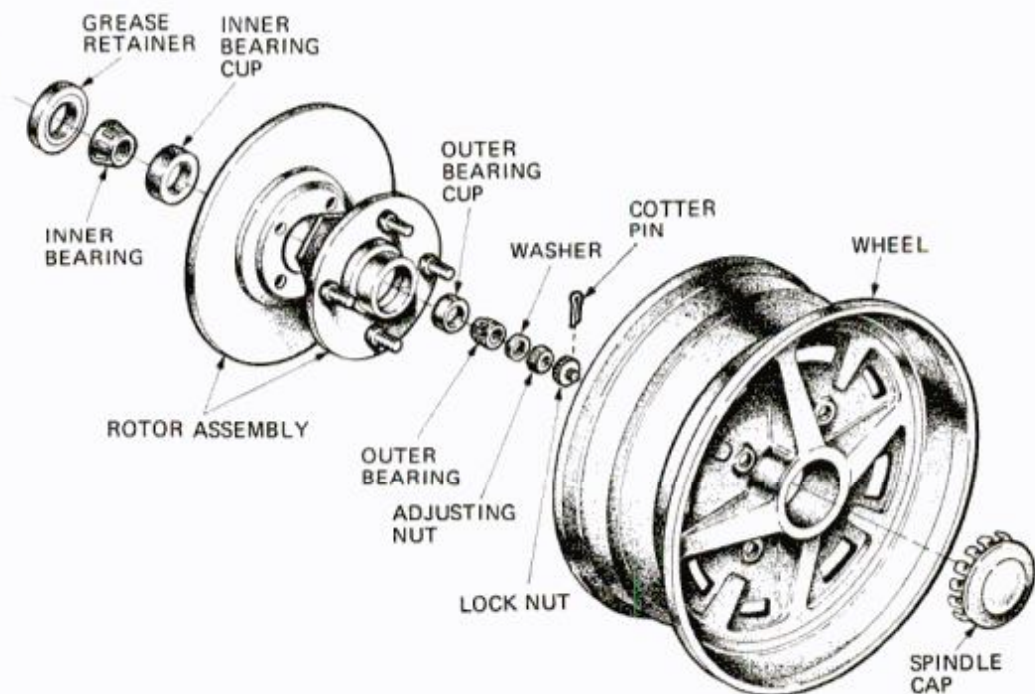
**Jack the car so wheels are free,** and spin wheels by hand. If noise (squeal, click, grinding) is heard, service the wheel bearings.

**Drive the car at least 10 miles,** remove the hub caps and feel the spindle caps. If a spindle cap is hot, there's a chance of a defective wheel bearing.

### Servicing wheel bearings

**1. A wheel has two bearings—outer and inner. Bearings should not be interchanged.** To prevent interchanging them, fill two containers with kerosene. Mark one container "outer" and the other container

*(Please turn to page 212)*



# CAR CARE **5** GUIDE

SECTION

"inner." As you remove each bearing, put it into its respective container. Accompanying hardware can be put into either container.

**2. Remove the hub cap or wheel cover.** If you are working on a wheel that has drum brakes, raise the front of the car. If you are working on a wheel that has disc brakes, loosen the wheel nuts, then raise the front of the car and remove the wheel.

**3. Remove the spindle cap,** whether the wheel is served by drum or disc brakes. Straighten the cotter pin, which is wrapped around the locknut, and pull it loose. Discard the cotter pin. Retain all other parts, if not defective.

**4. Remove the locknut,** adjusting nut and washer.

**5. Grasp the brake rotor** (disc) or wheel (drum brake) and draw it to you, but only slightly; then push it back. (Do not remove the rotor

or wheel.) The outer wheel bearing will fall on the wheel spindle. Slide the bearing off the spindle and place it in the "outer" can of kerosene.

**6. Thread the adjusting nut** back on the spindle.

**7. Remove the caliper retaining bolts** and hook the end of a piece of heavy-gauge wire through one of the bolt holes, if you are working on a wheel served by a disc brake. Fold a piece of cardboard in half. Slide the caliper off the disc and, as soon as you can, wedge the cardboard between the brake pads. This is done to make it easier to reinstall the caliper and also to prevent pads from touching one another, which may cause damage.

**8. Remove the caliper.** Bend the other end of the wire into a hook, and hang the caliper on a part of the chassis. The purpose is to make sure the caliper doesn't dangle, putting

strain on the hydraulic brake line and causing it to split.

**9. Grab the brake disc and pull it** toward you. The inner bearing and grease seal will be pushed from the disc by the adjusting nut and will fall on the spindle. Place the disc on a clean surface, unscrew the adjusting nut from the spindle, and remove the inner wheel bearing and grease seal. Discard the seal.

**10. Grab the wheel and pull it off,** if you are working on a wheel with a drum brake. The inner bearing and grease seal will be pushed from the wheel by the adjusting nut. Unscrew the adjusting nut, remove the inner wheel bearing and grease seal, and discard the seal.

**11. Parts must be thoroughly cleaned** to prevent dirt from damaging wheel bearings. Start by wiping the spindle with a kerosene-saturated cloth. Then, still using the



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cloth, clean the inside of the wheel or disc. This will remove dirt from the outer and inner bearing cups.

**12. Inspect the bearing cups** by shining a flashlight inside the wheel or disc. A scratched or pitted cup is cause to replace not only the cup, but also the wheel bearing. Knock the cup from the wheel or disc with a soft brass drift. Use the drift to tap a new cup in place.

**13. Coat the clean blade** of a screwdriver with wheel bearing grease (available from an auto-supply store), and spread grease around the inside of the wheel hub, coating bearing cups. You cannot use too much grease, so make sure parts are well coated.

**14. Remove each bearing**, in turn, from the kerosene container, handling it by the race. Do not wrap your hand around the bearing, since grime and perspiration will be transferred to rollers. Wipe the bearing with a lint-free cloth and inspect it for damage (cracks, nicks, pit marks). Replace a damaged bearing and its cup.

**15. Let the bearing air-dry.** Then, using a bearing packer, which is a tool you can buy from your auto-parts supplier, pack the bearing with grease. The bearing packer is a tool you fill with wheel-bearing grease. The bearing is placed inside the packer so grease will adequately coat the rollers.

If you don't have a bearing packer, don a pair of plastic gloves and scoop a quantity of grease into the palm of your hand. Grease one bearing and then the other, kneading each into the grease so grease gets between the rollers. Remember, you can't overgrease a wheel bearing.

**16. Insert the inner bearing**, narrow end first, into its cup in the wheel or disc. Apply a light film of grease to both sides of a new grease seal. Then, place a clean block of wood over the seal, and tap the wood gently with a hammer. Rotate the block after each tap. Continue to do this until the grease seal is level with the lip of the wheel or disc hub.

**17. Examine the seal for tears and splits** when it is in place. If damage was sustained during installation, remove the seal and try again with a new part. Do not use a damaged seal. Grease may leak onto braking parts, reducing effectiveness.

**18. Place the wheel or disc back on the spindle.** Slip the outer wheel bearing, narrow end first, over the spindle and into the wheel or disc hub. Install the metal washer and adjusting nut. Tighten the adjusting nut by hand.

**19. Wipe the disc clean**, if you are working on a wheel served by a disc brake, making sure no grime is left to score the disc. Place the cardboard-free edge of the caliper on the disc to keep pads apart, and pull the cardboard from between the pads. Reinstall and tighten caliper bolts to torque specification in the service manual. Install the wheel, and tighten wheel nuts by hand.

**20. Check your service manual** to determine the torque required to seat bearings when working on wheel bearings of a car with drum or disc brakes. Use a torque wrench to tighten the wheel-bearing adjusting nut to specification. Then loosen the adjusting nut one-half turn. Check the service manual to see if there's a second torque setting for wheel bearings. If there is, tighten the adjusting nut to this specification. If not, the job is done.

**21. Place the locknut into position**, turning it so its slots line up with the cotter-pin hole in the spindle. Insert a new cotter pin and bend its legs around the locknut. If the legs are too long, snip ends with wire-cutting pliers.



Align slots in the locknut with slots in the spindle and insert the cotter pin.

**22. Turn the wheel in both directions.** It should rotate smoothly and without noise. If it doesn't, go back and do the job again. You goofed somewhere along the line.

**23. Replace the spindle cap and lower the car** once you determine that everything is okay. If you've been working on a wheel served by disc brakes, don't forget to tighten wheel nuts.

**24. Pump the brake pedal a few times** to make sure brakes work before driving the car. If you've been working on a wheel with disc brakes, don't worry if the brake pedal goes to the floor the first time you press it—that is, not as long as it returns to normal after it's pumped two or three times.

### Troubleshooting the steering linkage

Steering linkage transfers steering movements from the steering wheel, steering column and steering gear to the wheels. The movement of the steering gear causes the pitman shaft and arm to rotate. The pitman arm is a steering linkage member. Its motion applies leverage to the relay rods or center link and tie rods—then to the steering knuckles that turn the wheels.

The steering linkage is duplicated on each side of the steering box; that is, there are two relay rods or one extending center link and two tie rods. However, there is only one pitman arm; a part called an idler arm duplicates pitman arm action on the right-hand side of the car. As the pitman arm is set into motion by the steering gear, it moves the right-hand relay rod or center link. This, in turn, activates the idler arm. Thus, motion started by the pitman arm is continued on the right side of the car by the idler arm.

In many cars, connections between various steering linkage rods are ball joints that resemble, but should not be confused with, suspension ball joints. Often, steering linkage ball joints are permanently lubricated. Unlike suspension ball joints, they do not sustain any of the vehicle's weight.

When steering linkage connections wear, linkage loosens. This may cause shimmy in the steering wheel. Other effects of worn steering linkage connections include loose steering,

jerky steering, noise, vehicle wander and tire squeal on turns.

The same conditions can occur if steering linkage is damaged. For example, a bent steering linkage shaft can cause shimmy, ineffective steering action, and so on.

When a problem occurs, see if the steering linkage in your car requires lubrication. Then examine each part for damage and wear (looseness). Grasp and try to shake each rod. If a rod moves, it is worn. Replace it.

### Troubleshooting suspension ball joints

A suspension ball joint is a flexible unit consisting of a ball and socket. It is used to connect suspension system control arms and is found in the front of a car—never in the rear.

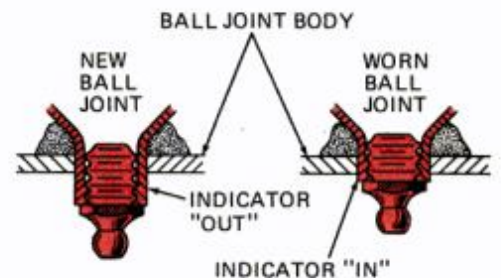
A great deal of the car's weight is concentrated on suspension ball joints. If a ball joint collapses and punches through the socket as the car is moving, the off-balance effect can cause loss of control.

A weak ball joint usually makes itself known in two ways. The first is vibration. The other is a crunching noise occurring when the car hits a bump. The noise is most audible at a crawling speed, often when the car hits the dip at the entrance to a driveway.

Since vibration and noise can indicate problems, test ball joints for looseness before having parts replaced. Although troubleshooting ball joints is not difficult, replacing ball joints is a job many car owners prefer leaving to mechanics.

Your car may have built-in ball-joint-wear indicators, which makes troubleshooting simple. Since 1972, GM-built cars have been best known for built-in ball-joint indicators. However, other makes (Ford Fairmont and Zephyr, for example) also have built-in indicators.

To check ball joints in cars with built-in indicators, get under the car. Do not raise the car, since load on ball joints should be maintained. Wipe a ball joint clean. The indicator is a round boss or nipple into which the grease fitting is threaded.



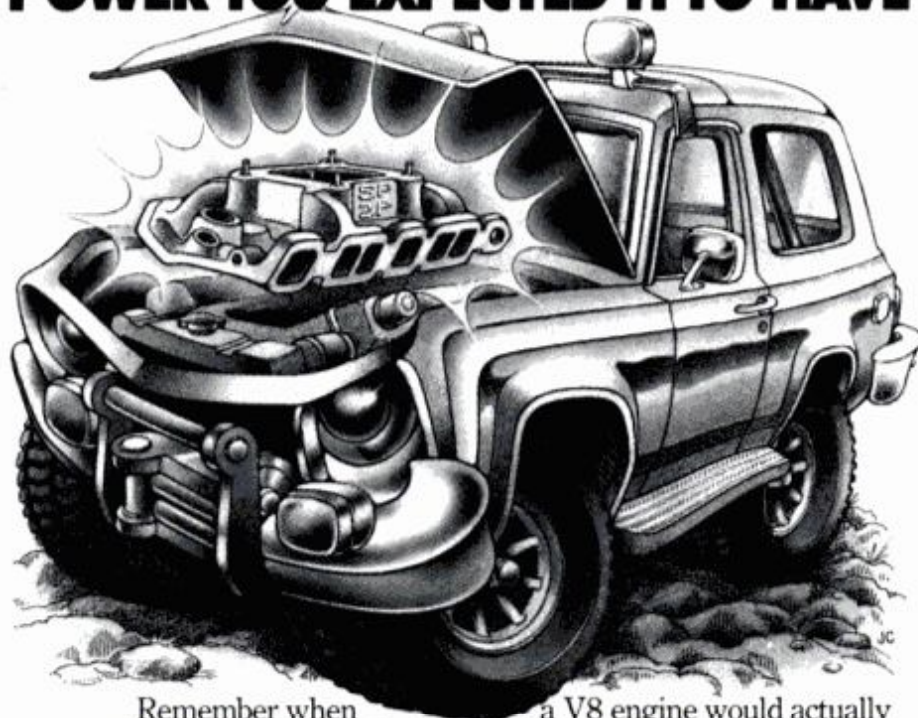
Replace ball joint when the ball-joint indicator recedes all the way into body.

If ball joints in your car lack built-in indicators, test for wear with a dial gauge. Load (weight) on ball joints is applied in one of two ways—by compression or tension. If a ball joint is compression-loaded, weight pushes the head of the ball against the socket. If a ball joint is tension-loaded, weight pulls the head of the ball away from the socket.

A car has four front-suspension ball joints—two on each side. There are ball joints between lower control arms and the bottoms of the spindles, and between upper control arms and the tops of the spindles.

(Please turn to page 214)

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Depending upon the type of suspension system the vehicle possesses, either the lower ball joints or upper ball joints absorb most of the weight (load). These are the ones that wear out. The other ball joints carry little weight and seldom wear.

(In cars having ball joints with built-in indicators, the lower ball joints are the weight-bearing members. These ball joints possess the wear indicators.)

Water that gets inside a ball-joint housing, diluting grease, is the chief enemy. As grease washes out, wear increases. Thus, space between the ball head and socket, which is practically nonexistent in a new ball joint, increases. This permits play between the ball and socket. As play increases, possibility of the ball punching through the socket also increases.

To test ball joints in your car, first identify the suspension system. You need to know this in order to release weight on the load-bearing ball joint so testing can be accurate. The following information may help:

- If the coil spring is on the lower control arm or the car has torsion-bar suspension, the lower ball joint is the weight carrier. To take pressure off this member, place a jack in line with the spring (if springs are used) or near the wheel. Raise the car so the tire is off the ground.

- If the coil spring is on the upper control arm, place a jack under the front cross member and put a support wedge (block of wood) between the upper control arm and front cross member. Raise the wheel.

Attach a dial gauge so the plunger rests against the wheel rim adjacent to the ball joint. Using the pry bar, move the wheel up and down. Check the reading on the gauge. It should not exceed the axial (up-and-down) play specified in the manual. Many experts contend that a reading in excess of 0.050 inch indicates a worn ball joint that should be replaced, notwithstanding what the manual may say.

Grab the tire at the top and bottom. Move it slowly in and out. Note the reading and check this against the radial (in-and-out) play specification in the manual. If the ball joint demonstrates more radial play than that specified, replace it.

## Troubleshooting the prop shaft

Vibration, particularly at slower speeds, can be caused by a propeller shaft that is out of alignment or loose. To check it, raise the car so wheels hang free and the prop shaft is not obstructed. If you use a hydraulic jack instead of a two-post lift, make sure the vehicle is firmly held. Chock front wheels and use jack stands. You'll be working under the car.

Have someone in the car start the engine, put the transmission in gear and slowly increase engine speed. Watch the propeller shaft. It should not seem blurred around the edges as it revolves. If it looks blurry, the propeller shaft is probably causing the vibration.

Turn off the engine and examine the shaft for dents. Replace a damaged shaft.

A propeller shaft which is out of alignment because of a factory installation error will cause vibration. Have prop-shaft alignment checked with an alignment gauge at a new-car service shop. If prop-shaft angle is not to specification, it can often be adjusted by installing



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shims under the rear engine mount or by readjusting the pitch of the differential.

Finally, the shaft may be loose because of worn universal joints. Refer to Section 4.

## Troubleshooting engine mounts

There are normally two mounts supporting an engine at the front and one mount in the rear at the transmission. If an engine mount loosens or breaks, the engine will vibrate. The situation is hazardous because the unsupported engine may shift and jam the throttle linkage and wedge the throttle valve open. The uncontrolled speed that results may startle a driver to the point where he could actually lose control of the car.

If your car has a manual transmission, determine if a loose or defective engine mount is causing vibration by letting the engine idle, with the parking brake engaged. While you watch the engine, have someone put the transmission in gear and let out the clutch, keeping a foot on the brake pedal. If an engine mount is loose or defective, the engine will jerk up sharply as it stalls.

If your car has an automatic transmission, jack up the engine with a hydraulic or hand jack placed under the oil pan. Put a block of 2x4 lumber between the jack and pan to avoid damaging the pan. Lift up slowly. If an engine mount is loose or defective, the engine will rise sufficiently for you to see daylight between the engine mount and engine.

If there is a questionable engine mount, tighten mount bolts to specification. If this doesn't help, replace the mount.

## Wheel balance and vibration

A wheel that isn't balanced can cause sufficient vibration to affect steering. Don't think that wheel balance isn't causing vibration because your car is new or you had wheels balanced recently.

A wheel can be damaged in going over a pothole or curb, affecting balance. Furthermore, a wheel loses balance when a balancing weight falls off the rim. Tire wear also affects balance.

The two types of balancing are called static and dynamic. Static balancing is done with the wheel almost stationary. Small lead weights are clipped to the rim of the wheel opposite the offsetting mass to counterbalance the heavy spot.

Dynamic balancing is done with the wheel and tire in motion. An unbalanced wheel wobbles. The mechanic uses special equipment to locate the heavy spot. Then he places weights on each side of the wheel, opposite the heavy spot, to offset the effects. Dynamic balancing is more effective than static balancing.

## A misaligned front end

The terms *front-end alignment* and *wheel alignment* are synonymous. They refer to the correct relative position of the front wheels to

obtain free-rolling movement over the road without slipping, scuffing or dragging.

Five different angles determine front-end alignment. They are caster, camber, toe-in, steering-axis inclination and turning radius.

The following conditions can result when any angle deviates from specification:

- Vibration. This occurs especially when caster is incorrect.
- Premature and unusual tire tread wear. Tread may wear more on one side than on the other; tread ribs might feather; and scuff marks and cups could develop over part or all of the tread surface.
- Pulling of the car toward one side of the road when you take your hands off the steering wheel. A slight pulling may be normal since many roads have a "crown" to facilitate drainage. However, you will have no problem discerning a pull brought about by misalignment. It is severe.
- Squealing tires.

See *Saturday Mechanic* (page 116, April '79 PM) for an explanation of the various alignment angles, how alignment is affected by road conditions and information on tire and wheel runout, which also causes vibration.

## The causes of poor handling

The chart below sums up causes of poor handling (loose steering, hard steering, pulling and vehicle wander) and what to do to correct them. [\(Please turn to page 217\)](#)

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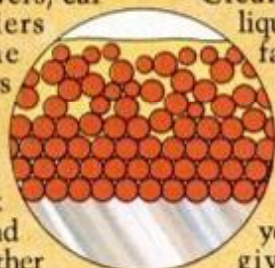


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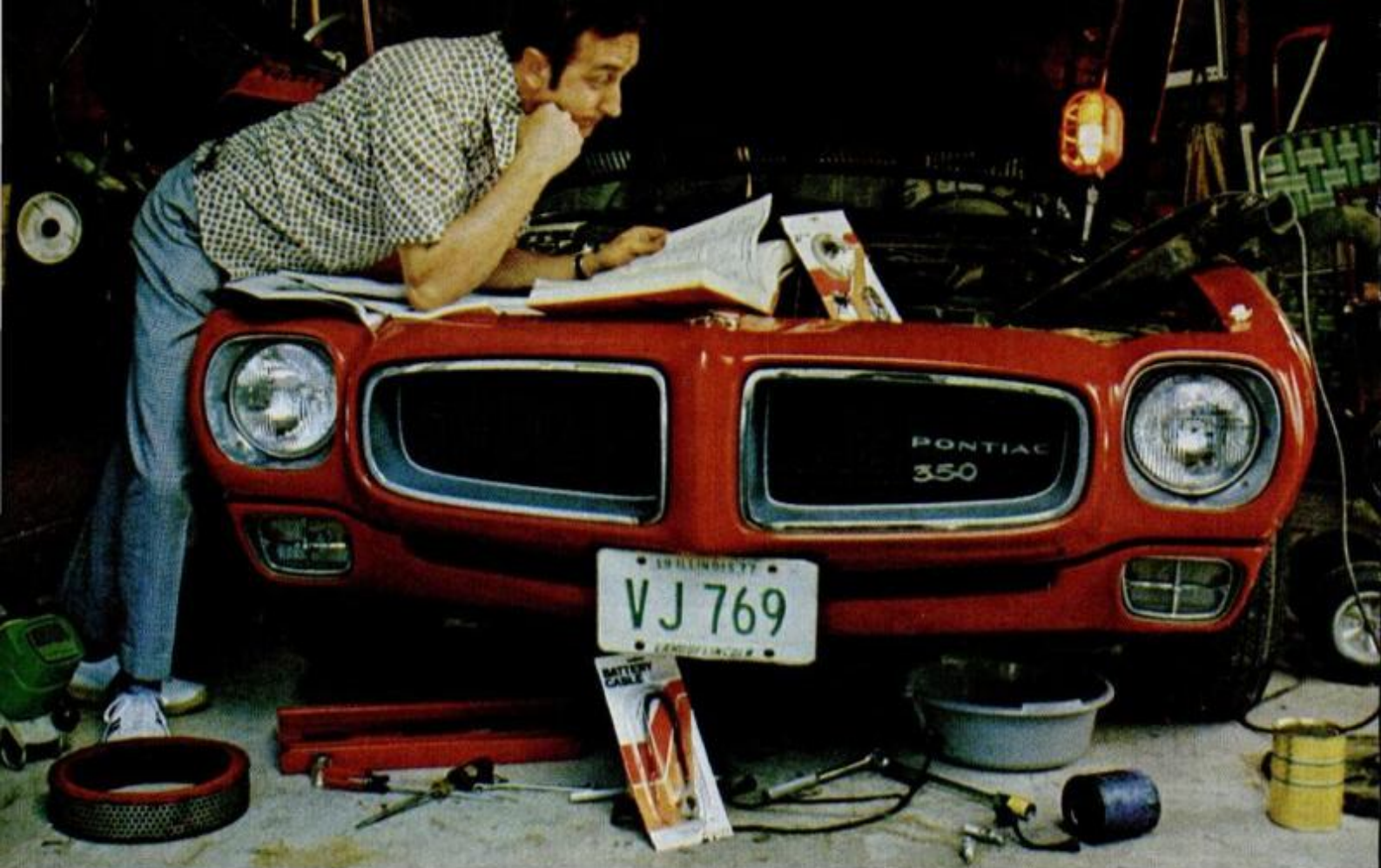
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# CAR CARE <sup>5</sup> GUIDE

SECTION

## Troubleshooting power steering

**1. Be sure the drive belt is not cut or glazed,** and that it's tight. A loose belt is the main cause of power-steering trouble.

**2. Check power-steering fluid.** The reservoir must be full to avert hard steering and noise. If the reservoir keeps losing fluid, check for a leak. First, wipe dirt from the pump reservoir and the power steering hoses. Let the engine idle. Then turn the steering wheel all the way to the right, and then all the way to the left. Do not hold the wheel at either extreme for longer than five seconds. If there is a leak, pressure will force fluid from the defective com-

ponent. Replace a defective component.

**3. Check for a defective power control valve** if hard steering exists at low speeds only. The valve provides maximum hydraulic-fluid pressure at low speed.

If the valve is sticking, rev the engine several times with the car standing still. The excessive hydraulic pressure this action sends through the power-steering system may free the control valve. If not, replace the valve.

If the above procedure fails to alleviate the problem, power steering should be tested with a power-steering pressure gauge. Most professional shops have this equipment.

## TROUBLESHOOTING POOR HANDLING

PROBLEM	CAUSES	ACTION TO TAKE	
Loose steering.	<input type="checkbox"/> Worn steering linkage.	Inspect; replace rods.	
	<input type="checkbox"/> Worn or improperly adjusted wheel bearing.	Inspect; replace bad bearings and adjust	
	<input type="checkbox"/> Loose steering-gear mounting.	Tighten	
	<input type="checkbox"/> Incorrectly adjusted or worn steering gear.	Adjust preload; overhaul steering gear if adjustment fails.	
Hard steering.	<input type="checkbox"/> Low or uneven tire pressure.	Inflate tires to correct pressure.	
	<input type="checkbox"/> Power steering problem.	See below.	
	<input type="checkbox"/> Steering gear, and steering and suspension ball joints, need lubricating.	Lubricate.	
	<input type="checkbox"/> Incorrect front-end alignment.	Check and adjust alignment.	
	<input type="checkbox"/> Steering gear adjusted too tightly.	Readjust preload.	
	<input type="checkbox"/> Damaged steering or suspension component.	Examine parts (steering knuckles, spindles, spindle arms, springs); replace damaged units.	
Car pulls to one side.	<input type="checkbox"/> Low or uneven tire pressure.	Inflate tires to correct pressure.	
	<input type="checkbox"/> Scuffed front tires.	Check alignment and rotate tires.	
	<input type="checkbox"/> Incorrect front-end alignment.	Check and adjust alignment.	
	<input type="checkbox"/> Damaged shock absorber.	Test shocks; replace bad units.	
	<input type="checkbox"/> Worn or damaged wheel bearings.	Inspect; replace bad bearings.	
	<input type="checkbox"/> Loose or worn steering-linkage rod on one side of car.	Inspect; replace worn rod.	
	<input type="checkbox"/> Front-spring sag.	Check vehicle height at fenders; if not to specification, replace spring or springs.	
	<input type="checkbox"/> If condition occurs when brakes are applied, look for improperly adjusted brakes and grease on brake linings.	Adjust brakes (determine if self-adjusting mechanisms work); replace contaminated linings.	
	Instability (wander).	<input type="checkbox"/> Improper tire pressure.	Inflate tires to correct pressure.
		<input type="checkbox"/> Unevenly worn tires.	Place best tires up front; discard tires worn beyond tread indicator limits.
<input type="checkbox"/> Incorrect front-end alignment.		Check and adjust alignment.	
<input type="checkbox"/> Steering gear, and steering and suspension ball joints, need lubricating.		Lubricate.	
<input type="checkbox"/> Loose steering gear.		Tighten.	
<input type="checkbox"/> Damaged steering knuckles, spindle, spindle support arm.		Replace.	

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Usual areas of engine oil leakage are pinpointed on this view of typical V8

## Oil loss

Automobile manufacturers state that no malfunction exists if there's loss of one quart of oil in 750 to 800 miles. Under terms of new-car warranties, if oil loss is no greater than this, no particular action will be taken by the manufacturers.

Most cases of excessive oil consumption are caused by conditions summarized in the accompanying chart.

### Knowing what engine work you need to do

Start by assessing the oil you are using. Is it the grade designated by the manufacturer of the car in the owner's manual? It should be.

You should make certain that the engine is equipped with the correct dipstick. It sometimes happens that the wrong dipstick is put into an engine on the production line. To check, ask a dealer to let you compare a dipstick from a comparable engine with the one in your engine.

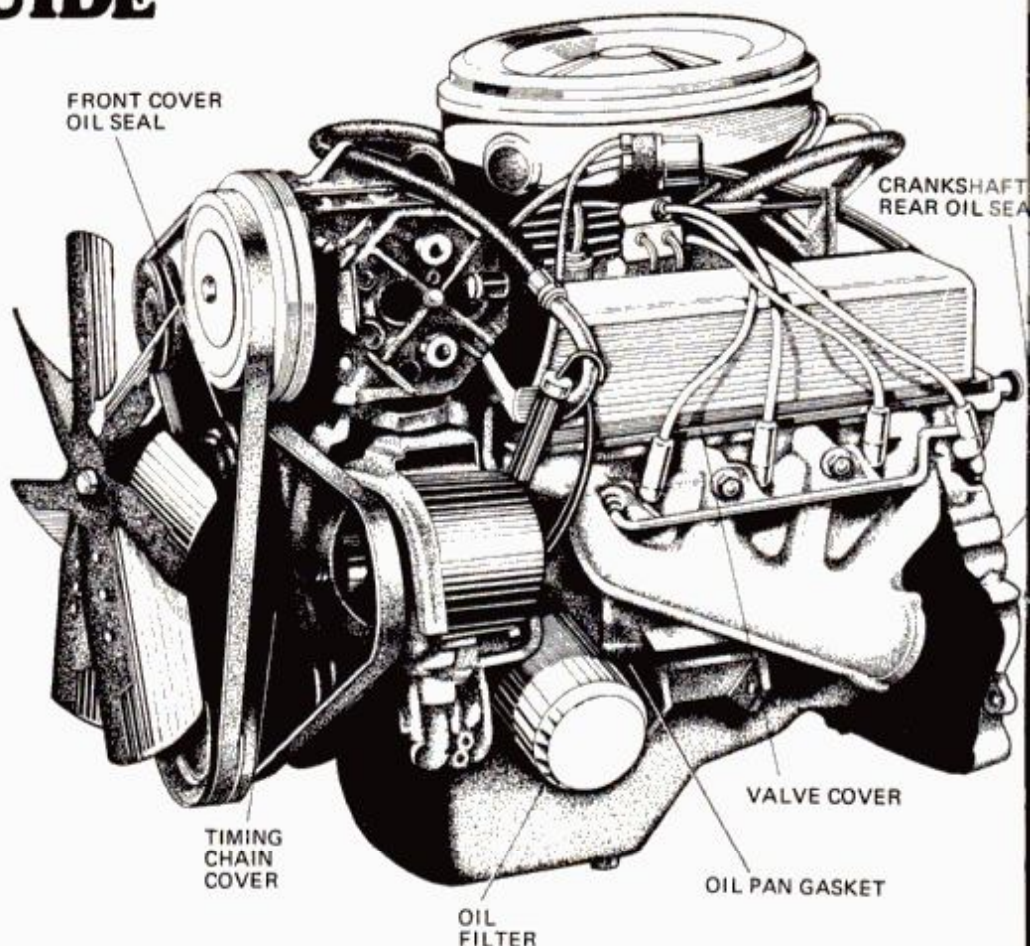
After spreading some clean paper on the floor underneath the engine and transmission, run the engine at between 1000 and 1250 rpm for a few minutes after it has attained a normal operating temperature. Then, accelerate to wide-open throttle from a fast-idle position about five times.

Check paper for spots of oil. The position of a spot on the paper will coincide with the location of a leak in the engine (consult the accompanying illustration to determine the most likely areas of leakage).

Accelerate the engine once again, checking for exhaust smoke. If smoke is blue or blue-gray, the engine is burning oil because of worn valve seals, worn valve guides or worn piston rings.

You can pinpoint the problem area by making a dry/wet compression test. Take a compression reading of all cylinders. Record the readings. Then, inject heavy oil through spark-plug ports into the cylinders. Do another compression test, recording the readings. If there is a rise in the "wet" compression readings, it means that the heavy oil you injected in the cylinders has formed a temporary seal around worn rings. Your engine is a candidate for overhaul.

If there is no, or an insignificant, rise in compression between "wet" and "dry" readings, it indicates that the oil burning problem is being caused by worn valve guides and/or seals. Install new valve seals and, if necessary, new valve guides.



If to this point you have not found the reason why your engine is losing oil, remove the carburetor air-cleaner cover and inspect the filter and inside of the housing. Oil on the filter or in the housing points to a clogged PCV system, which is causing pressure to build up inside the

crankcase. This pressure is allowing oil to back up into the carburetor air cleaner.

Replace the PCV valve and make certain that the PCV system hoses are not blocked. This procedure will solve the problem and prevent further oil loss.

### TROUBLESHOOTING OIL LOSS

CAUSES TO CHECK	CORRECTION
Incorrect reading of oil dipstick.	Check oil when your car is on a level surface, after allowing adequate time for oil to drain back into the crankcase if the engine has been running. (It is best to check the oil before running an engine.)
Incorrect oil viscosity.	Use the SAE viscosity for temperatures prevailing in your area as recommended in your owner's manual.
Continuous driving at high speed, or severe engine use such as that which occurs when you're towing a trailer.	No correction here. This type of operation causes higher oil consumption.
Defective PVC system.	An indication of this is when oil is present in the carburetor air filter housing. Check the PCV valve and hoses that lead from it. Replace if necessary.
Oil leaks.	Locate the leak and correct the condition by tightening or replacing the defective part. (Refer to the illustration above; it pinpoints the usual areas of leakage).
Worn valve stem.	Ream the valve guides; then install oversize valves and new valve seals.
Worn piston rings.	Install new rings.

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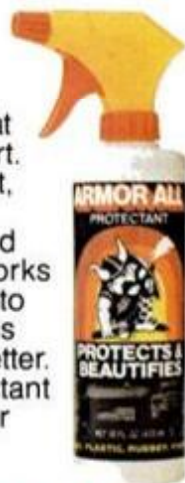


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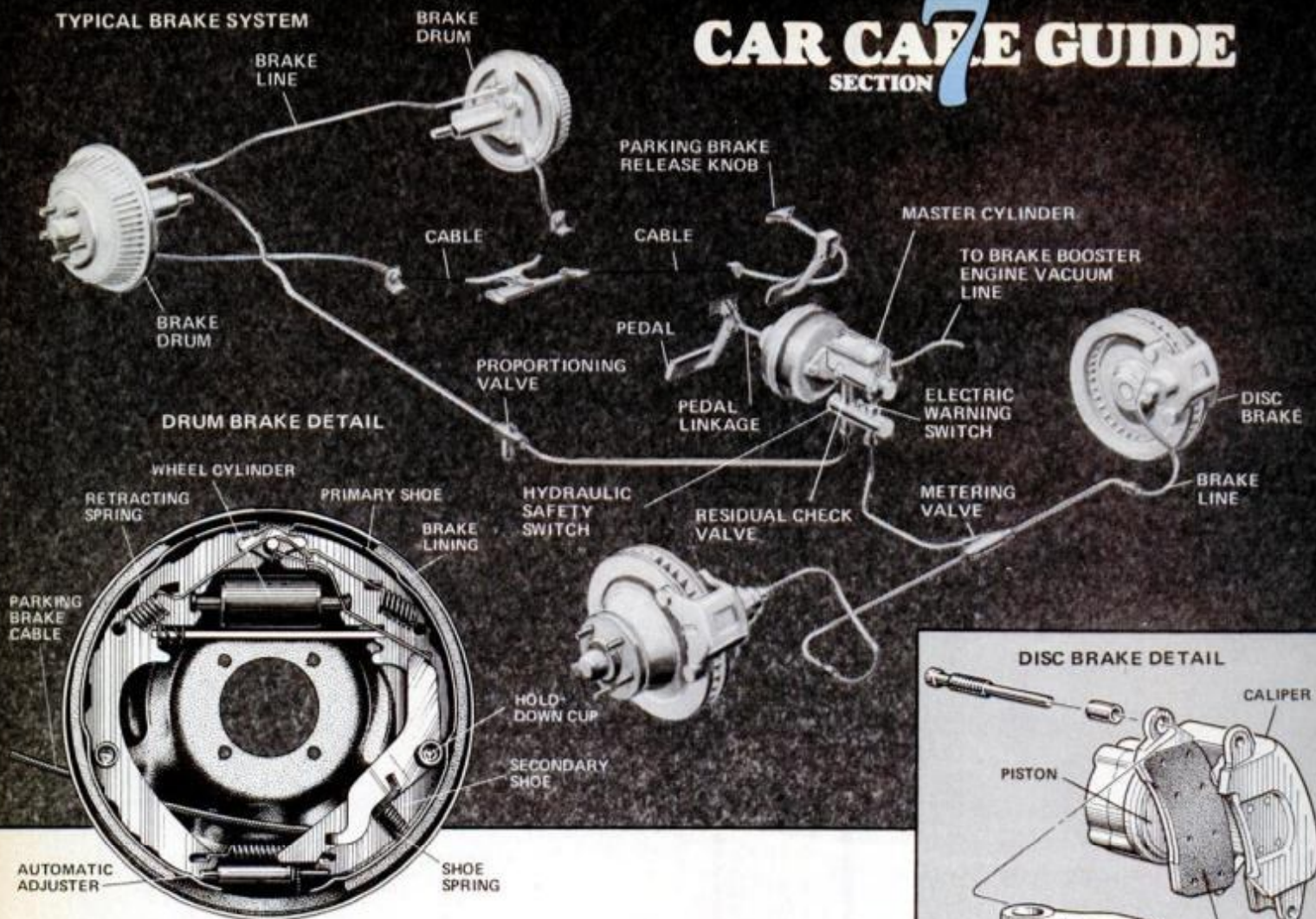


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# Brake trouble

The survey we did to prepare this Car Care Guide revealed that only 3.2 percent of 2000 representative letters sent Car Clinic involved brake trouble.

The troubleshooting chart on page 224, prepared with the cooperation of General Motors, matches brake problems with causes. It includes both disc and drum brakes.

Since some causes are more likely to create a problem than others, a double asterisk (\*\*) indicates probable cause, while a single asterisk (\*) signifies a less likely cause. Investigate the probable cause or causes first.

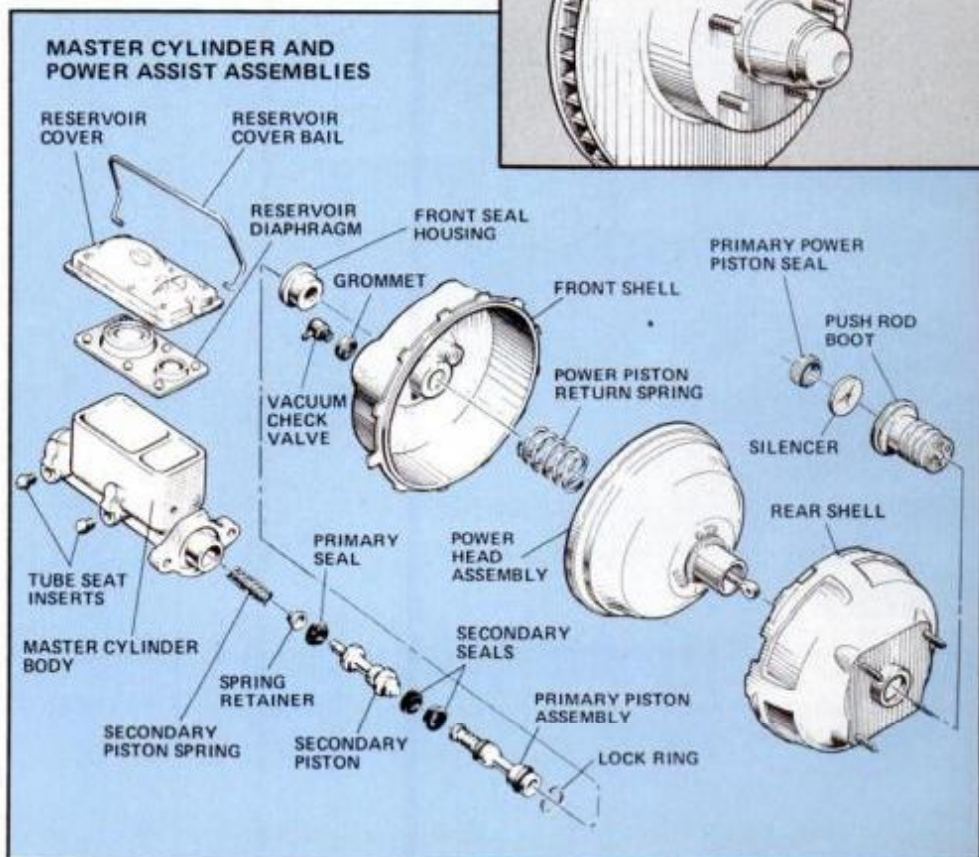
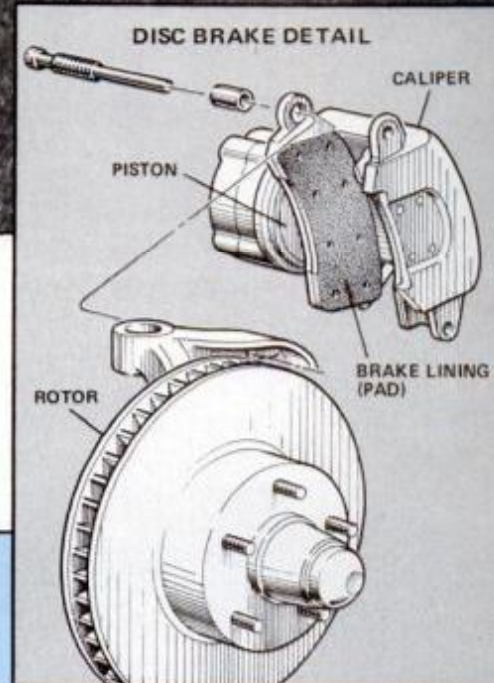
The illustration on this page identifies parts mentioned in the chart and will make it easier for you to troubleshoot the brake system.

It is imperative for safety that the warning signs of a defective braking system are recognized and acted upon at once. A braking system seldom fails suddenly. Rather, it emits a warning for several hundred miles before the situation becomes dangerous.

The most common warning signs are:

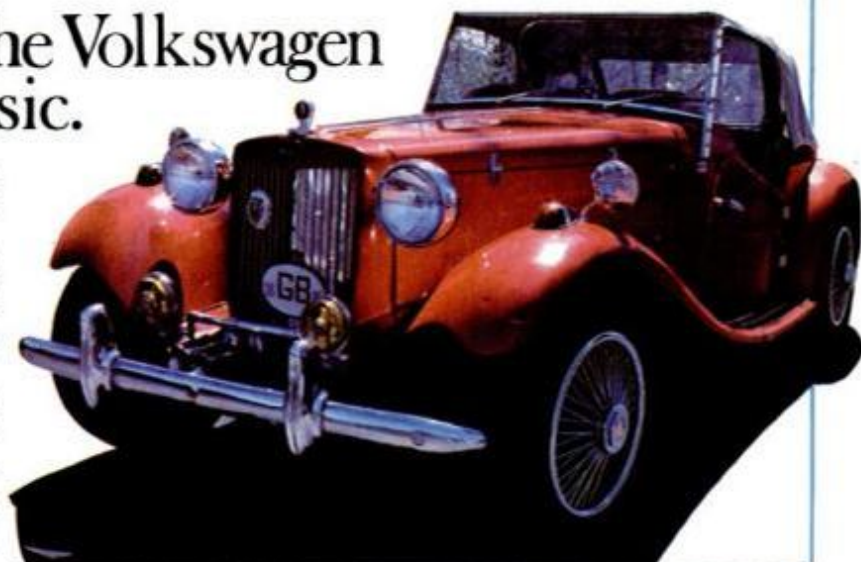
- Lighting of the dash brake warning light.
- Harsh noise (a low-pitched squeal on brake application is usually normal).
- Hard pedal.
- Pulsating pedal.
- A pedal that doesn't rise when the self-adjusting mechanism is activated (car moved in Reverse).
- Severe pull when brakes are applied.

*(Please turn to page 225)*



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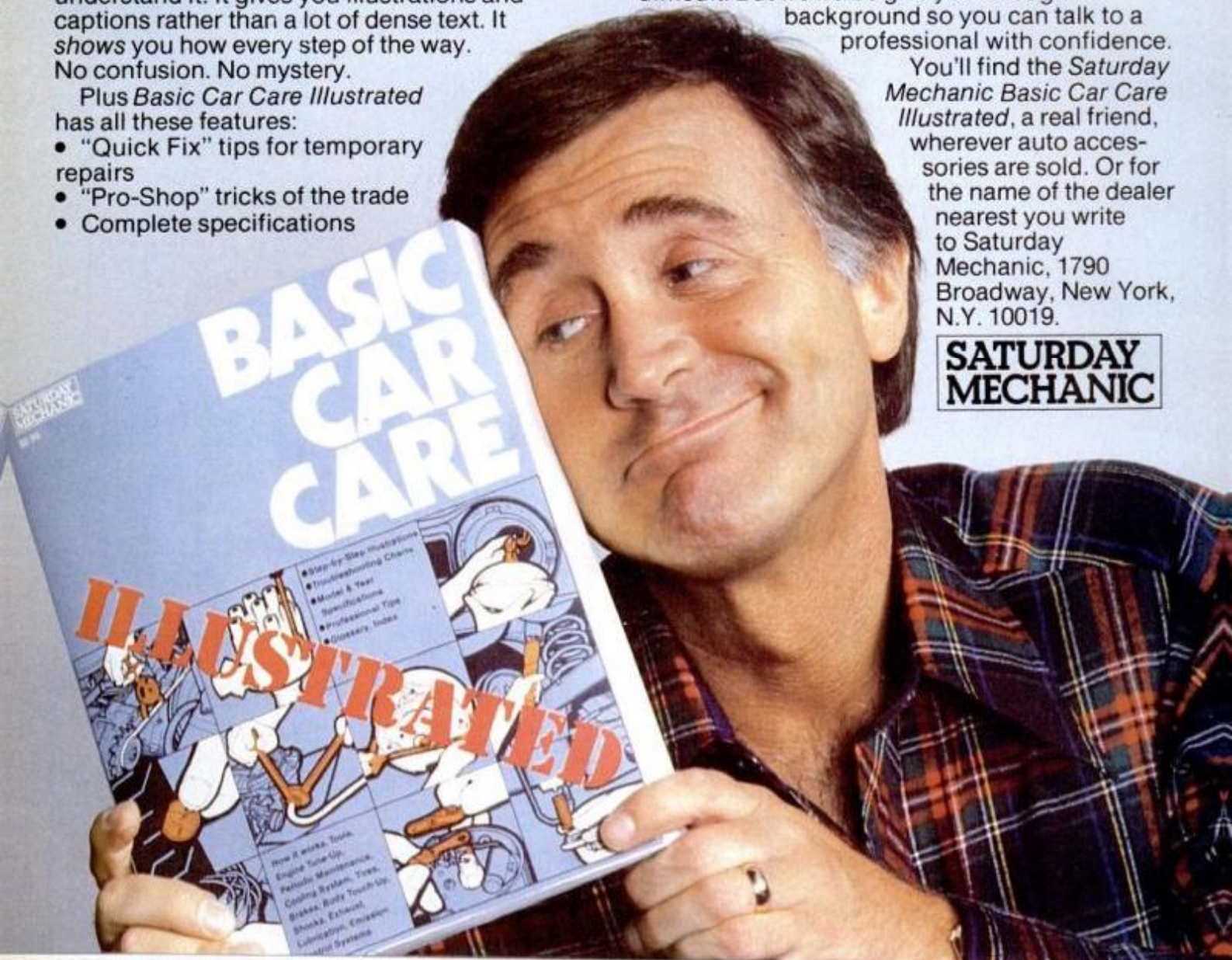
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# CAR CARE **7** GUIDE

SECTION

## TROUBLESHOOTING BRAKES

CAUSE	PROBLEM	Excessive pedal travel.	Pedal travel gradually increases.	Excessive pedal effort.	Brakes slow to respond.	Brakes slow to release.	Brakes drag.	Uneven (side to side pull) brake action.	Uneven (front to rear grab) brake action.	Scraping noise.	Brakes squeak when applied.	Brakes squeak during stop.	Brake chatter (roughness).	Brakes groan at end of stop.	Brake warning light glows during stop.
Leaking brake line or brake line connection.	*	**							*						**
Leaking wheel cylinder or master cylinder piston seal.	*	**						*							*
Leaking master cylinder.	*	**													*
Air trapped in brake system.	**								*						**
Contaminated or improper brake fluid.					*	*	*								*
Leaking brake booster vacuum system.			**		*	*									*
Restricted air passage in brake booster power head.			*	**	*	*									*
Damaged brake booster power head.			*	*	*	*	*								*
Improperly assembled brake booster power head valving.			*	*	*	*	**								*
Worn brake lining.			*	*	*	*	*	*	*	*	*	*	*	*	*
Uneven brake lining wear.	*							*	*	*	*	**	*	*	*
Glazed brake lining.			**	*				*	*	*	*	*	*	*	*
Incorrect lining.			*	*	*	*	*	*	*	*	*	*	*	*	*
Contaminated brake lining.							**	**	**	*	*	*	*	*	*
Too much brake lining dust.			*	*	*	*	**	**	*	*	*	*	*	*	*
Scored drum(s) or rotor(s).							*	*	*	*	*	*	**	*	*
Drums out of round.												*	*	**	*
Rotors out of parallel.													**	*	*
Excessive rotor run-out.													*	*	*
Damaged automatic adjusters.	*						*	*	*	*	*	*	*	*	*
Incorrect wheel cylinder size.			*				*	*	*	*	*	*	*	*	*
Weak or incorrect brake shoe springs.						*	**	*	*	**	*	**	*	*	*
Missing or loose brake-assembly fasteners (cups).	*					*	*	*	*	*	*	*	*	*	*
Brake-shoe guide insufficiently lubricated.					*	*	*	*	*	*	**	**	*	*	*
Restricted brake fluid passage or sticking wheel cylinder piston		*	*	*	*	*	*	*	*	*	*	*	*	*	*
Faulty metering valve.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Brake pedal linkage binding or being interfered with.			*	*	**	**									*
Improperly adjusted parking brake.						*									*
Tapered or threaded drums.										**					*
Incorrect front end alignment.							**								*
Incorrect tire pressure.							*	*	*	*	*	*	*	*	*
Incorrect wheel bearing adjustment.	*							*	*	*	*	*	*	*	*
Loose front suspension.							*	*	*	**	*	*	*	*	*
Out-of-balance wheels.													**	*	*
Driver rides brake pedal.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Improperly adjusted master cylinder push rod.	*				*	*	**	*	*	*	*	*	*	*	*
Sticking wheel cylinder or caliper piston.		*	*	*	*	*	*	*	*	*	*	*	*	*	*
Faulty proportioning valve.		*	*	*	*	*	*	*	*	*	*	*	*	*	*

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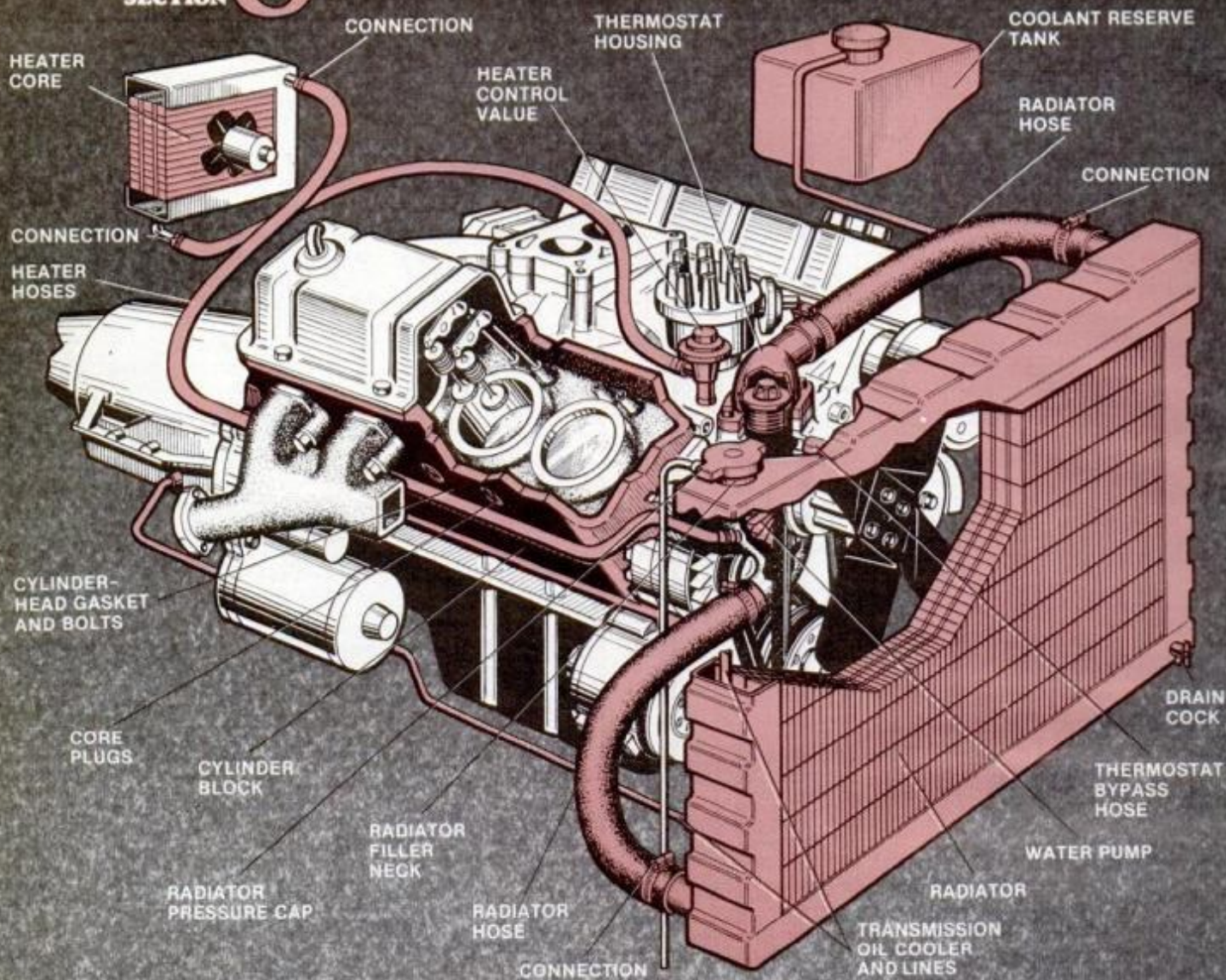


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# CAR CARE GUIDE

## SECTION 8



# Overheating

**F**requently, engine overheating occurs because the owner fails to maintain his car's cooling system. Maintenance requires draining and flushing the system at least once every two years, seeing that components (hoses, drive belt, radiator-pressure cap and thermostat) are operational, and filling the system with ethylene glycol coolant.

If the cause of overheating is centered in the cooling system, it is usually simple to identify. However, as the chart below shows, other malfunctions can cause overheating.

CAUSE	CORRECTION
System loses coolant.	Coolant loss is a result of several factors, summarized below.
Inadequate ethylene glycol coolant mixture.	Ethylene glycol protects engine against cold weather, also corrosion leading to curtailment of coolant flow, overheating.

System loses pressure.	Test radiator-pressure cap; Check loose hose connections.	Check solution with hydrometer. Protection between $-35^{\circ}\text{F}$ . and $-45^{\circ}\text{F}$ . is considered normal.
Obstructed radiator.	Clean bugs, debris from fins.	
Radiator tubes blocked by scale.	If flushing doesn't work, have radiator shop treat radiator chemically.	
Cooling-system passages blocked by scale.	Flush system; add fresh coolant.	
Loose drive belt.	Tighten.	
Inoperative thermal control fluid coupling fan.	Repair.	
Damaged water pump.	Repair.	
Lower radiator hose collapses due to weak internal spring.	Replace hose.	
Defective thermostat stuck in closed position.	Replace thermostat	
Incorrect ignition timing.	Set timing to spec; test vacuum advance for functioning.	
Restricted exhaust system.	See that muffler, exhaust system pipes haven't collapsed.	

### Areas of coolant loss

Check the following areas when coolant is being lost:

Areas of leakage	Corrective action
<input type="checkbox"/> Radiator.	Try sealer if leak is small, repair or replace radiator if leak is large.
<input type="checkbox"/> Radiator drain cock.	Tighten if loose; replace if defective.
<input type="checkbox"/> Transmission-oil cooler lines	Tighten connections.
<input type="checkbox"/> Coolant reserve tank and hose.	Repair or replace tank; replace hose.
<input type="checkbox"/> Hoses (radiator and heater), connections.	Tighten if loose; replace if defective.
<input type="checkbox"/> Water-pump seal.	Repair.
<input type="checkbox"/> Water-pump gasket.	Replace.
<input type="checkbox"/> Radiator pressure cap.	Tighten if loose, replace if defective.
<input type="checkbox"/> Radiator filler neck.	Reform if distorted; cut off and solder on new filler neck if repair fails.
<input type="checkbox"/> Thermostat housing gasket.	Replace.
<input type="checkbox"/> Heater core.	Repair or replace.
<input type="checkbox"/> Heater-water control valve.	Replace.
<input type="checkbox"/> Cylinder-head gasket.	Replace.
<input type="checkbox"/> Cylinder-head bolts.	Tighten to specification.
<input type="checkbox"/> Cylinder-block core plugs.	Replace.
<input type="checkbox"/> Warped cylinder head or blocked surface.	Resurface.
<input type="checkbox"/> Cracked cylinder head or block.	Replace.

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## Body rust

In our survey of Car Clinic problems, the number of questions about abnormal tire wear and body problems resulted in a dead heat. For a thorough discussion of the problems of tire wear, see page 119, April '79 PM. This section of Car Care Guide deals with the body, specifically body rust.

Washing and waxing the body periodically will help get rid of elements that cause rust. In washing a car, play a heavy stream on the underbody, especially inside fender wells and underneath rocker panels. This will wash away road salt, a leading cause of rust.

If rust appears, it should be eliminated as soon as possible to keep it from spreading. Sand it down and touch up the spot with matching paint. In the case of extreme rust, where metal is eaten away, one of three repair methods may be employed, as follows:

**1. Grind the rusted area** until the rust is eliminated. Cover the spot with aluminum tape, which comes in 4-inch widths. See that the tape extends at least 1 inch beyond the dam-



Aluminum tape and other material make possible body repair in the home garage.

age and that edges of the tape adhere to the body.

Using a piece of 100-grit sandpaper, roughen the tape. Apply plastic body filler as directed in the instructions accompanying the body repair kit. Kits may be obtained at auto supply and accessories counters.

Use a Surform tool to mold the plastic body filler into shape. Then, sand the spot with 40-grit sandpaper which is held in a sanding block. Follow by sanding with a 100-grit sandpaper, again using a sanding block. Continue the sanding until the plastic material is even with the surface of the car body.

Using a piece of 220 wet-or-dry sandpaper and sanding block, feather the repaired area;

that is, sand from the center of the area into the body. Keep the sandpaper wet and continue sanding until the repaired spot is just as smooth as the body. Paint the spot.

An auto supply and accessories dealer can help you match the color of the paint if you supply the correct code number. This number is included on the vehicle identification plate, which is attached to the firewall or door pillar.

This repair can be done by the home mechanic. It is effective, but not as long lasting as the other two methods.



Apply plastic body filler and use a Surform to mold materials and remove excess.

**2. Get a piece of sheet metal** that is of the same gauge as the metal of the body (usually 20 or 22-gauge). This piece should be large enough to extend 1 inch beyond the rust area.

Grind the rust area until rust is eliminated. Attach the piece of sheet metal to the body. This can be done with Pop rivets.

Roughen the sheet metal with a grinding disc. Then, use a plastic filler kit and paint to complete the repair. When applying the plastic repair material, pay careful attention to the edges of the sheet. Use enough filler and feather it into the body. Otherwise the lines of the sheet metal will show.

Most home mechanics are capable of performing this repair, which is more effective than applying aluminum tape, but less effective than the third method.

**3. Have a piece of sheet metal welded over the area** after grinding off rust. The metal should be the same gauge as the body. A machine shop or auto body shop can do this for you.

With the metal in place, complete the repair yourself using a plastic filler kit and paint.



Meticulous sanding is critical and you should use a block to prevent raggedness.

Use touch-up paint to cover any nicks as soon as you spot them, and keep a good protective coating of wax on your car's body and you'll minimize the time you have to spend on body repair!

This is the only way to stay ahead of the corrosion that shortens your car's life. You've got to become a fanatic about body care! Wash your car at least once a week to get off the surface dirt that holds pollutants against the finish. When you make it a habit to keep your car free of dirt, you'll find that it's easier to detect spots of tar, bird droppings, nicks and other road crud before they get their teeth into your finish.

Simply keeping your car clean will preserve its life, and preserve its appeal to you as the years go by. For some, washing is all the care they give the modern finishes on their automobiles. Others, however, use cleaners and waxes to take off the oxidized layer of paint, expose the car's true color and lay on a protective film that will shape those raindrops into big beautiful beads.

You've got your choice of various cleaners and waxes to do the job—from liquids, sprays and presoftened pastes to wax-impregnated cloths. Many car owners have tried all of these types at one time or another, looking for the best one to suit their needs. Many car buffs stock several different types of waxes so they can do a quick job or a real elbow-grease job depending on how much time they have.

You should polish one section at a time using a circular motion to apply the wax and making sure to overlap sufficiently. Your cloth will slowly become the color of your car as you rub off dead paint, so turn the cloth over frequently. When the wax is dry, it will haze on the surface and is then ready to be removed with a clean cloth and the surface buffed to a high shine. Again, fold the cloth frequently, as it becomes glazed with dead paint.

If you don't keep a clean machine with a regimen of "spit and polish" you'll soon find yourself driving a rust bucket.



## Recalls

**R**ecall campaign is the term given to action generally taken under the notification and remedy section of the Act (National Traffic and Motor Vehicle Safety Act) concerning safety-related defects and noncompliance. This is how the National Highway Traffic Safety Administration (NHTSA) defines the term, but we choose to define *recall* in terms of numbers:

From Sept. 9, 1966, through June 30, 1978, there were 2447 recalls of domestic and foreign vehicles. Involved were a total of 71.3 million vehicles, which is equal to the total U.S. car production for seven years.

The 71.3 million cars involved in recalls haven't been confined to GM, Ford, Chrysler, AMC, Toyota, Datsun, VW—the "biggies," that is. Not even the "smallies" familiar to the public (Jensen, Simca-Rootes, and others) make up the difference, because the total figure of 71.3 million takes into account all vehicles. This includes trucks, buses, motor homes, trailers and offbeat equipment. For example, did you ever hear of a CTK made by Dairy Equipment Co.?

In any event, the "biggies" account for most recalls from 1966 to 1978. So we'll confine ourselves to recalls involving Big Four cars—specifically, those recalls involving 100 or more cars made by AMC, Chrysler, Ford and GM.

"Why present this information?" you may ask. "After all, when there's a recall, it's announced in the newspaper and over TV and radio, and the car company involved sends notices."

To which we answer: Only "newsworthy" recalls make the newspapers or TV. You hear about a recall when Pinto gas tanks explode (1.4 million cars involved), Chrysler cars hesitate and stall (1.6 million involved) or GM cars have defective motor mounts (6.7 million). But for every one of these, there are many that don't receive news coverage.

For example, did TV or newspapers tell about defective rear-wheel mounting bolts on 4500 1978 GM cars that can fail and cause loss of a wheel? Or about the master cylinder defect on 16,000 1972 Jeeps which can cause loss of brakes? Or about incorrect ball joints accidentally installed on 2500 1973 Chrysler Corp. cars which could cause a driver to lose control of the car? Or about the improperly routed main wiring harness in 185,000 1978 Fairmonts and Zephyrs which could chafe, short and cause the car to lose electrical power?

As for notifications from car manufacturers, think about these points:

- Only original owners supposedly get notified. If you bought your car secondhand, how do you know if it was involved in a recall or, assuming it was, that the original owner had the defect corrected?
- I know a person who bought, new, a 1975 Pontiac LeMans and 1977 Pontiac Ventura.

He swears he never received notification that the 1975 LeMans was recalled for defective rear-axle shaft bearings or that the 1977 Ventura was recalled for defective rear-axle shafts.

There's another factor to consider. Although recalls concern safety-related defects, many point to "unsolvable" mechanical problems which *Car Clinic* hears about. Not long ago, for instance, we received a letter stating, "My mechanic hasn't been able to tell me why front tires wear so quickly on my 1973 Olds Cutlass." That's because his mechanic may not realize that 155,400 1973 GM cars were recalled because of a steering linkage overtravel problem. The remedy? Installation of an idler arm stop bracket.

The following chart is a guide to important recalls. What should you do if you find your car on it? Write the manufacturer, giving the vehicle identification number, or take your car to a dealer. Ask if the vehicle is included in the campaign. If you bought the car used, ask if the problem has been corrected. The manufacturer can tell by consulting the files. The dealer service shop can tell by inspecting the car.

### AMERICAN MOTORS CORP.

Year/Models Cars Involved	Description of Defect Corrective Action
1965-66: 174,857 V8s with automatic transmissions.	Throttle control stop on downshift valve cam may break, causing throttle linkage to stick. <i>Replace broken cam; install throttle linkage limit stop.</i>
1967: 428 Rebel, Ambassador, Marlin with V8 and Cruise Command.	Ball chain may catch beneath accelerator control-rod bracket and hold throttle open. <i>Replace rod, bracket and ball link chain.</i>
1967: 127 6710-80 series with 232-cu.-in. engine, 2-bbl. carburetor and Cruise Command.	Cruise Command bellows chain may interfere with carb. control shaft rod lever, holding throttle partly open. <i>Install Cruise Command bellows chain shield.</i>
1967: 9690 American, Rebel.	Improper installation of steering shaft, causing it to snap and loss of steering. <i>Replace with shaft of improved design.</i>
1968: 365 6800 series, all models.	Pipe plug in brake master cylinder improperly torqued, causing brake fluid loss. <i>Inspect and retorque.</i>
1968: 175 Rebel, Ambassador with V8 and Cruise Command.	Vacuum servo bellows contacting hood could cause wrong ball-chain adjustment, affect Cruise Command operation. <i>Modify vacuum servo assembly; install ball-chain guard.</i>
1968: 262 Javelin with manual transmission.	Clutch pedal rod may contact brake tubes. <i>Reroute brake tubes.</i>
1968: 2018 Javelin.	Body side sill spacer for steering upper idler arm bolt may be missing, cause wheel shimmy. <i>Install spacer.</i>
1968: 5259 American, Rebel, Ambassador sedans, station wagons.	Seat-back latches may not comply with federal standards. <i>Replace with improved latch.</i>
1968: 1048 Ambassador, Rebel.	Rear seat-belt retaining bolts may fail. <i>Replace bolts.</i>
1968: 7000 Rebel.	Light leakage around taillight may make it appear as if backup lights are lit. <i>Seal.</i>

Year/Models Cars Involved	Description of Defect Corrective Action
1969: 16,969 Ambassador.	Pitman and idler-arm studs may break. <i>Replace pitman, idler arms.</i>
1968-69: 27,242 AMX, Javelin with manual transmission.	Insufficient clearance between clutch-actuating rod and brake line may cause brake-line chafe and slow fluid leak. <i>Reposition brake line.</i>
1969: 3813 Rambler American, Rebel.	Under severe impact, reclining-seat mechanism can impair seat-belt webbing. <i>Install longer holster to prevent seat-belt contact with seat mechanism.</i>
1969: 25,409 6900 series.	Wrong heat treatment of seat-belt connectors. <i>Install new connectors.</i>
1968-69: 1704 6800, 6900 series	Certification plates omitted. <i>Install plates.</i>
1968-69: 405 6800, 6900 series	Shoulder belts omitted. <i>Install.</i>
1970: 14,396 Ambassador sedan and station wagon, Rebel station wagon.	Lift-hook pin may disengage from slot in jack rack bar, or lift hook may disengage from bumper. <i>Install new jack saddle.</i>
1970: 6184 All models.	Rear-view mirror backing plate may separate from mirror. <i>Install new mirror.</i>
1970: 3502 Hornet.	Hood latch does not align properly. <i>Repair.</i>
1970: 2498 Rebel, Ambassador, Gremlin, AMX, Javelin.	Locking pawl on bucket seat fails to meet federal standards. <i>Install new locking pawl.</i>
1970: 3581 Rebel.	Rear suspension lower-control arm may fail. <i>Replace arm and bushing.</i>
1970-71: 10,711 Jeep Commando.	Loose windshield may disengage from frame at high speed. <i>Add bracket.</i>
1971: 5704 Hornet Sportabout.	Rear auxiliary floor-pan support screws may penetrate gas tank. <i>Modify.</i>
1971: 5003 Javelin.	Improperly routed console wiring harness may interfere with accelerator pedal. <i>Reroute wiring harness.</i>
1971: 187 Matador, Ambassador.	Malformed jack-lift hook assembly may disengage from bumper. <i>Replace jack.</i>
1971: 6207 Jeep.	Cracks in front-axle spindle may break, causing loss of control. <i>Replace part.</i>
1971: 19,111 Hornet, Gremlin.	Door-latch assemblies may be defective. <i>Replace.</i>
1971: 1746 Javelin, AMX.	Front-turn-signal lamp fails to meet standards. <i>Replace.</i>
1971: 5029 Jeep Wagoneer.	Right rear brake line may rub on shock absorber and wear. <i>Reroute.</i>
1972: 380 Javelin with power brakes.	Rear and front brake hydraulic lines may be reversed at master cylinder. <i>Connect correctly.</i>
1972: 8572 Matador, Ambassador.	Omission of some rivets at rear suspension lower-control arm may result in drive train damage. <i>Replace rivets.</i>
1972: 264 Gremlin, Hornet.	Incorrect disc-brake caliper bolts may cause caliper to separate from steering knuckle. <i>Replace with proper bolts.</i>
1972: 6809 Javelin (except AMX)	Defective hood-latch assembly may exist. <i>Replace with new assembly.</i>
1972: 10,357 Jeep CJ5 and CJ6.	Dimmer switch may foul. <i>Modify switch position.</i>
1972: 15,819 Jeep CJ5 and CJ6.	Failure of master cylinder stop plate may cause brake loss. <i>Replace affected parts.</i>
1972: 3664 Gremlin.	Park and turn-signal lamp fails to meet standards. <i>Replace.</i>

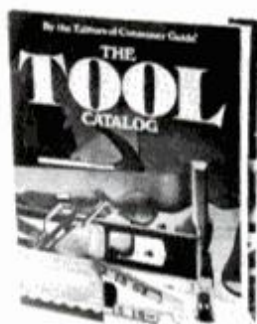
(Please turn to page 230)



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# CAR CARE GUIDE

## SECTION 10

Year/Models Cars Involved	Description of Defect Corrective Action
1972: 17,693 Matador, Ambassador.	Headrests fail to meet standards. <i>Modify headrests.</i>
1972-73: 270,815 Hornet, Matador, Gremlin, Javelin, Ambassador.	Brake-pedal link may separate from brake pedal, causing brake loss. <i>Attach using correct fastener.</i>
1973: 1040 Hornet, Gremlin, Javelin.	Master cylinder push-rod failure may cause brake loss. <i>Install snap ring correctly.</i>
1974: 325 Matador.	Tire air-pressure decal may be missing. <i>Install decal.</i>
1974: 8825 Jeep Cherokee, Wagoneer with power tailgate windows.	Connector in license plate lamp may short, causing loss of exterior lights. <i>Install new connector.</i>
1974: 13,822 Jeep Cherokee, Wagoneer with power brakes.	Defective power-brake booster may separate, causing brake loss. <i>Modify booster.</i>
1974: 1240 Matador, Ambassador	Incorrect capscrews may be in use on heavy-duty wheels. <i>Install new fasteners.</i>
1974: 19,088 Jeep CJ5, CJ6	Defective suspension spring locknuts may cause control problems. <i>Install new locknuts.</i>
1974: 4719 Hornet Sportabout	Possible erroneous tire inflation decal. <i>Replace Decal.</i>
1974-75-76: 11,333 Gremlin, Hornet, Pacer, Matador.	Connector failure of electronic control unit may cause ignition interruption and stalling. <i>Install new-type connector.</i>
1975: 13,676 Pacer.	Mispositioned fuel line may rub through, causing fuel leak. <i>Reposition line and retainer clip.</i>
1975: 1671 Jeep Cherokee, Wagoneer.	Throttle control may be lost by failure of throttle pedal ball-crank-to-cross shaft weld. <i>Install new assembly.</i>
1975: 5063 Matador and Jeep Cherokee, Wagoneer with 360/401-4V engine.	Carburetor fuel-inlet plug may become dislodged and cause loss of fuel; fire may result; incorrect secondary throttle-stop lever in carburetor may cause uncontrolled acceleration. <i>Install new plug and secondary throttle lockout lever.</i>
1975: 918 Hornet, Gremlin	Defective lower control-arm strut rod bushing retaining nuts may have been installed. <i>Install new nuts.</i>
1975: 909, Pacer, Hornet, Gremlin.	Jack assembly doesn't meet standards. <i>Replace jack.</i>
1975-76: 102,398 Jeep CJ5, CJ6, CJ7, Cherokee, Wagoneer.	Connector failure of electronic control unit may cause ignition interruption and stalling. <i>Inspect new-type connector.</i>
1975-76: 133,593 Gremlin, Hornet with power steering.	Power-steering hose may fail from heat given off by exhaust manifold. <i>Reroute hose.</i>
1976: 26,559 Matador V8 with heavy-duty cooling.	Blade separation of flexible-fan cooling fan may occur. <i>Install fan of different design.</i>
1976-77-78: 96,933 Jeep CJ5, CJ7 with three-speed manual transmission.	Displaced lubricant from transmission to transfer case may cause transmission failure. <i>Reposition rear oil seal.</i>
1977: 3085 Gremlin.	Accelerator cable may catch, keeping throttle open. <i>Install different cable.</i>
1978: 2041 Gremlin.	Instrument panel harness may chafe, causing electrical fire. <i>Eliminate interference between harness and clutch linkage.</i>
1978: 1995 Jeep Cherokee.	Accelerator control system may fail to close according to standard. <i>Install new spring.</i>
1978: 2726 Jeep CJ5 with manual steering.	Defective steering-shaft coupling may affect steering on turns. <i>Replace coupling.</i>

### CHRYSLER CORP.

Year/Models Cars Involved	Description of Defect Corrective Action
1966: 59,749 Belvedere, Satellite, Coronet, Charger with manual transmission	Interference of brake tube with clutch parts may cause brake fluid loss. <i>Reposition brake tube.</i>

Year/Models Cars Involved	Description of Defect Corrective Action
1966-67: 1101 Valiant, Dart with 10" brakes	Interference between wheel disc and brake drum may cause fatigue failure. <i>Replace all five wheels.</i>
1966-67: 6500 Belvedere, Satellite, Charger, Coronet with disc brakes	Water may enter brake-proportioning valve vent and affect braking. <i>Replace valve.</i>
1967: 6101 Chrysler, Imperial, Fury, Polara, Monaco with 440-cu.in. engine, 4V Holley carb.	Carburetor may lock in wide-open throttle position. <i>Replace carburetor.</i>
1967: 656 Fury, Polara, Monaco Canadian-built with column-mounted gear-shift lever and automatic transmission.	Defective shift lever gate mechanism may give inaccurate positioning of lever. <i>Install new retainers.</i>
1967: 41,953 Valiant, Dart.	Defective door latch striker may cause door to open. <i>Replace striker assembly.</i>
1967: 363 Valiant, Dart with disc brakes.	Disc-brake caliper crossover tube may be cut by brake rotor, causing loss of front brakes. <i>Reclamp tube.</i>
1967: 112,215 Fury, Polara, Monaco.	Inoperative wiper switch may have been installed. <i>Replace switch.</i>
1967: 9742 Chrysler, Imperial, Valiant, Barracuda, Dart.	Defective master cylinder push-rod bolt may lead to brake loss. <i>Replace bolt.</i>
1967: 670 Belvedere, Satellite, Coronet Charger with 426-cu.-in. hemi engine.	Interference between starter cable and steering-shaft lower-bearing collar setscrew may affect control or result in short circuit. <i>Correct mislocated starter cable fastener.</i>
1967: 6345 Chrysler, Imperial with autopilot.	Interference between instrument-panel wiring harness and autopilot brake release switch lever may cause loss of electricity. <i>Reroute harness.</i>
1967: 33,999 Chrysler, Imperial, Fury, Polara, Monaco with disc brakes.	Brake disc to front-wheel hub bolt torques may not meet specification. <i>Retorque bolts.</i>
1967: 33,999 Chrysler, Imperial, Fury, Polara, Monaco with autopilot.	Torque on autopilot linkage bolts may not meet specification; cotter pin may not be crimped, causing throttle to stick. <i>Retorque nuts and recrimp cotter pin.</i>
1967: 14,667 Imperial.	Interference between starter cable and steering shaft heat shield may cause short circuit or steering interference. <i>Reroute starter cable.</i>
1967: 47,036 Imperial, Chrysler with 11-in. brakes; Fury, Belvedere, Satellite, Polara, Monaco, Coronet.	Defective parking brake lever may cause cable to become disengaged. <i>Replace lever.</i>
1967: 24,062 Chrysler, Fury, Polara, Monaco station wagons.	Gas cap gasket may swell, restrict venting and cause fuel-tank damage. <i>Install new cap.</i>
1967: 7407 Barracuda, Dart two-door hardtops.	Interference of rear-center seat belts with seat supports may damage belts. <i>Install seat-belt protectors.</i>
1967: 159 Charger with chrome wheels.	Omission of front-wheel hub dust caps may cause wheel bearing damage. <i>Install dust caps.</i>
1967: 7189 Imperial with autopilot.	Snow, slush may hamper autopilot linkage, preventing throttle return to idle. <i>Install shield.</i>
1968: 2490 Chrysler, Fury, Polara, Monaco.	Propeller shaft with improper weld may fail. <i>Replace shaft.</i>
1968: 3032 Valiant, Barracuda, Dart with 6-cylinder engines and automatic transmissions.	Interference of floor pan with transmission kick-down rod may prevent throttle returning to idle. <i>Modify transmission lever.</i>
1968: 2478 Belvedere, Coronet, Charger with air-conditioning.	Interference of wiring harness with windshield wiper linkage may cause short and loss of electric service. <i>Reroute harness.</i>
1968: 1042 Belvedere, Coronet	Interference with power-steering hose may cause loss of fluid and

Year/Models Cars Involved	Description of Defect Corrective Action
with 273- or 318-cu.-in. engine and power steering.	loss of steering. <i>Replace hose assembly.</i>
1968: 2712 Charger.	Headlamp door vacuum-hose harness may fail, halting headlamp door operation. <i>Replace harness.</i>
1968: 40,767 Models with 340, 383, 440-cu.-in. engines, Carter 4V-AVS carbs.	Fast-idle cam lockout tab may break off and wedge cam to hold throttle open. <i>Replace fast-idle cam.</i>
1968: 475 Belvedere, Satellite, Fury, Coronet, Charger.	Rear-seat shoulder belts may not possess necessary reinforcing plate. <i>Install plate.</i>
1968: 598 Charger.	Defective bumper jack may have been installed. <i>Replace.</i>
1968: 8000 Chrysler, Polara, Fury, Monaco with speed control.	Kinked speed-control vacuum hose may prevent speed-control disengagement. <i>Reroute hose.</i>
1968: 201 Barracuda.	Incorrect control arm may prevent proper front-wheel alignment, cause damage to brakes, steering, front suspension parts. <i>Replace arm.</i>
1968: 100,080 Models with 340, 383, 440-cu.-in. engine and Carter 4V carb.	Presence of improper fast-idle cam may cause open-throttle condition. <i>Install new fast-idle cam.</i>
1968: 13,963 Chrysler, Coronet, Polara, Monaco, Belvedere, Satellite, Fury with standard steering.	Failure of steering-shaft lower bearing may cause shaft scoring, eventual breakage, loss of control. <i>Replace bearing.</i>
1969: 10,552 Models with 383 and 440-cu.-in. engine automatic trans.	Transmission oil cooler-tube damage may cause fluid loss that will prevent transmission operation. <i>Replace oil cooler tube.</i>
1969: 358 Coronet, Belvedere with 8 1/4-in. rear axle.	Inadequate rear axle-brake flange support weld may lead to brake loss. <i>Replace rear axle.</i>
1969: 18,905 Monaco, Polara, Fury.	Seat belts may fail to latch. <i>Replace belts.</i>
1969: 4981 C-type body with drum brakes.	Defective steering knuckle may lead to loss of wheel. <i>Replace defective parts.</i>
1970: 3034 Valiant, Dart.	Incorrect ball-joint stud nut may have been installed. <i>Install right nut.</i>
1970: 1544 Valiant, Barracuda, Belvedere, Dart, Challenger, Coronet, Charger.	Left-hand seat-back latch may fail to lock after repeated use. <i>Install new latch.</i>
1970: 754 Coronet, Challenger, Belvedere, Barracuda.	Inadequate wheel welds may cause wheel failure. <i>Replace wheels.</i>
1970: 437 Challenger, Barracuda.	Improper axle may result in wrong speedometer pinion application. <i>Install proper speedometer pinion gear to axle ratio.</i>
1970: 105 Challenger, Barracuda.	Incorrect axle may have been installed. <i>Install right axle.</i>
1970: 19,160 Dart, Valiant with drum brakes.	Front-brake or master-cylinder damage may have occurred in production. <i>Replace damaged parts.</i>
1970: 81,932 Polara, Monaco, Barracuda.	Defective bumper-jack hook may have been installed. <i>Replace hook.</i>
1970: 6366 Dart, Valiant with 10x2 1/4-in. front drum brakes.	Unmatched front-brake linings may have been installed, causing brake pull. <i>Install right linings.</i>
1970: 127,087 Barracuda, Challenger.	Folding front seat-back latch may not be suitable. <i>Modify.</i>
1970-71: 33,433 Polara, Monaco, Coronet, Satellite, Chrysler, Imperial, Charger, Fury with auto. speed control.	Malfunctioning automatic speed control may prevent throttle from returning to idle. <i>Install new cable.</i>
1971: 185 Charger.	Tire placard may not have tire pressure printout. <i>Replace placard.</i>
1971: 1307 Dart, Coronet.	Malfunctioning brake-proportioning tee may affect brake action. <i>Re-</i>

(Please turn to page 235)



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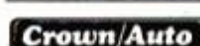
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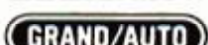
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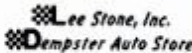



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	WI, OK, KS
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<b>Woolworth</b>	AL, ID, ME, MN, NC, VT, FL, IL, MI, MT, TX, WY
	OH, PA
	IL
	AL, CT, FL, GA, IL, IN, IA, KY, ME, MD, MA, MI, MN, MS, MO, NH, NJ, NY, NC, OH, PA, RI, TN, VT, VA, WI
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	Car-Freshner Deodorizers	<h2>Car Care Month</h2> <p>By Peter Noznesky Chairman of the Board, Automotive Parts &amp; Accessories Association</p> <p>"May is Car Care Month" has been sponsored by the Automotive Parts &amp; Accessories Association (APAA) and Popular Mechanics for seven succeeding, and successful, years. National recognition arrived in 1974, when the US Senate unanimously stipulated that May is National Car Care Month. Through the cooperation of several hundred newspapers, tens of millions of car owners and drivers have been learning how to save money, practice safety and fuel economy for the past several years. Primarily, the Car Care Programs are for you and everyone else who cares about their personal transportation.</p> <h3>MANUFACTURERS</h3>				Star Brite Car Polish, Star Brite Vinyl Shampoo, Vinyl Brite, Car Wash, Car Wax
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	Champion Spark Plugs					707 High Performance Metal Protector, Lubricant & Conditioner
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	The Hot One High Oil Temperature Filter, Purolator Import Car Filters, 15,000 Mile Dual Oil Filter					

Year/Models Cars Involved	Description of Defect Corrective Action
Charger, Valiant, Satellite with disc brakes.	piece tee.
1971: 10,969 Dart, Valiant.	Inadequately lubricated front-wheel inner bearings may exist. <i>Lube.</i>
1971: 1278 Colt.	Defective throttle linkage compo- nents may prevent maximum en- gine power. <i>Replace components.</i>
1971: 12,684 Coronet, Charger, Chrysler, Imperial, Satellite with split- back bench seats.	Weld failure at seat support may allow disengagement of seat back. <i>Reweld.</i>
1971: 5637 Barracuda, Satellite, Challenger, Coronet, Charger with front drum brakes.	Defective front brake shoe anchor pin may affect braking. <i>Install new pin.</i>
1971: 159 Satellite.	Omission of wheelhouse clip may cause right front brake line to chafe and fluid to leak. <i>Install clip; secure line.</i>
1971: 7544 Cricket.	Inadequate lubrication of front- wheel bearing may cause early fail- ure and loss of control. <i>Lubricate.</i>
1971: 485 Barracuda, Satellite, Challenger.	Short return hose on power steer- ing pump may pull loose, causing loss of steering. <i>Install new hose.</i>
1971: 2740 Dart, Valiant, Satellite.	Improper certification label (1972 instead of 1971) may be present. <i>Install proper label.</i>
1971: 4685 Colt station wagon.	Misrouted parking brake cable may cause cable wear. <i>Resecure cable.</i>
1971: 4685 Colt station wagon.	Plug cover for spare-tire release nut may be missing causing ex- haust gas to enter car through hole. <i>Install positive lock-type plug cover.</i>
1971-72: 42,000 Cricket.	Possibility that steering-gear rack bar may bend, resulting in steering loss. <i>Modify rack bar.</i>
1972: 5733 Dart, Valiant.	Insecure weld may result in struc- tural failure of front-seat assembly. <i>Reweld.</i>
1972: 52,729 Chrysler, Imperial, Demon, Coronet, Polara, Monaco, Fury, Duster, Satellite.	Loose transmission control-linkage bushing may result in improper transmission action. <i>Tighten the bushing.</i>
1972: 56,371 Fury.	Weak front bumper guard may not support jack. <i>Modify.</i>
1972: 129 Polara, Monaco, Fury.	1973 disc calipers may have been installed, causing ineffective brak- ing. <i>Install correct calipers.</i>
1972: 200 Cricket.	Windshield may not meet retention standards. <i>Reseal properly.</i>
1972-73: 149,056 Valiant, Satellite, Fury, Dart, Coronet, Charger, Polara with 6-cylinder engine.	Possibility of fuel-leakage and pas- senger-compartment fire because of metal fatigue and cracking at ex- truded fuel-pump outlet and/or seal of fuel-pump integral filter. <i>Modify.</i>
1972-73: 800,000 Fury, Polara, Monaco, Chrysler.	Main electrical power feed disrup- tion may cause loss of all electric systems. <i>Modify circuit.</i>
1973: 810 Charger, Coronet, Satellite with 400- and 440-cu.-in. en- gine, power steering.	Interference with power-steering hose may cause failure of hose and steering loss. <i>Install hose shield.</i>
1973: 1892 Charger, Coronet.	Loose idler arm to center-link ball- joint stud nuts may exist. <i>Torque to 40 ft.-lb.</i>
1973: 1985 Dart, Valiant.	Loose center link to steering-gear nut may exist. <i>Torque to 40 ft.-lb.</i>
1973: 14,000 Satellite, Coronet, Charger.	Front brake hose may chafe, caus- ing loss of fluid and brake loss. <i>Re- fasten hose.</i>
1973: 2560 Satellite, Coronet, Charger.	Incorrect ball-joint assembly may have been installed, causing ex- cessive wear and loss of control. <i>Install correct ball joints.</i>
1973: 149 Satellite.	Missing starter cable clip may let cable interfere with steering-column coupling. <i>Install clip.</i>
1973: 5500 Satellite, Charger, Coronet.	Defective lower control-arm pivot shaft may result in loss of steering. <i>Replace pivot shaft.</i>

(Please turn to page 237)

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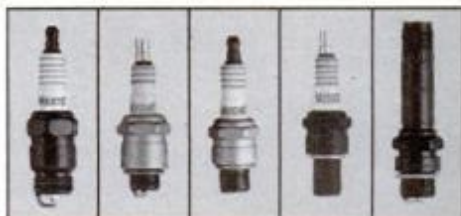
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## Tested Tough



Year/Models Cars Involved	Description of Defect Corrective Action
<b>1973: 1700</b> Polara, Monaco, Fury.	Automatic transmission throttle-linkage clip may loosen, leading to wide-open throttle. <i>Reseat clip properly.</i>
<b>1973: 500</b> Satellite, Coronet, Charger.	Brake warning lamp may not be connected properly. <i>Reconnect.</i>
<b>1973-74: 7028</b> Valiant, Dart.	Incorrect brake component may have been installed, causing ineffective brake action. <i>Install correct part.</i>
<b>1974: 60,000</b> Chrysler, Imperial, Plymouth, Dodge.	Ineffective heater and defroster capability may exist because of bad heater-hose water valve. <i>Replace valve.</i>
<b>1974: 179</b> Valiant, Dart.	Incorrect idler arm may have been installed, causing damage to steering linkage. <i>Install correct filter.</i>
<b>1974: 159,149</b> Chrysler, Imperial, Fury, Monaco, Polara.	Lower control arm may be fractured, permitting loss of control. <i>Reinforce lower control arm.</i>
<b>1974: 2391</b> Fury, Monaco.	Wrong brake tube may cause loss of rear brakes. <i>Install correct tube.</i>
<b>1974: 1537</b> Valiant, Satellite, Dart, Coronet, Charger.	Automatic transmission lever may separate from shift rod to cause improper shifting. <i>Replace lever.</i>
<b>1974: 8300</b> Chrysler, Imperial.	Seat-retainer pin may fail, causing seat disengagement. <i>Replace pin.</i>
<b>1974: 12,700</b> Imperial.	Parking brake shoe spring may fail. <i>Replace spring.</i>
<b>1974: 6037</b> Satellite, Coronet 4-door with 360, 400, 440-cu.-in. engine.	Possibility of exhaust-gume leak into passenger compartment. <i>Install special tailpipe extension.</i>
<b>1974: Fury, Morisco, Imperial, Chrysler.</b> <b>1975: Fury, Gran Fury, Coronet, Monaco, Chrysler, Imperial.</b> <b>Total: 33,500</b>	Power-brake booster diaphragm may fail because of heat, reducing brake power. <i>Install shield to protect booster from exhaust manifold.</i>
<b>1975: 55,862</b> Valiant, Dart.	Floor covering may interfere with accelerator. <i>Remove portion of dash liner to prevent interference.</i>
<b>1975: 65,000</b> Gran Fury, Monaco, Chrysler, Imperial.	Defective jack. <i>Modify jack.</i>
<b>1975: 450</b> Valiant, Dart.	Incorrect signal flashers may have been installed. <i>Replace with correct part.</i>
<b>1975: Valiant</b> <b>1976: Volare</b> <b>1977: Aspen, Dart</b> <b>Total: 1,300,000.</b>	Carburetor acceleration pump-seal distortion may cause persistent hesitation and stalling. <i>Modify carburetor and EGR system.</i>
<b>1975-76-77: 370,000</b> Fury, Gran Fury, Coronet, Charger, Monaco, Royal Monaco Cordoba.	Same carburetor problem and modification as above.
<b>1976: 2957</b> Volare, Aspen station wagon.	Incorrect front-tire pressure shown on placard. <i>Furnish correct placard.</i>
<b>1976-77-78: Aspen</b> <b>1976-77-78: Volare</b> <b>1977-78: LeBaron</b> <b>1977-78: Diplomat</b> <b>Total: 1,225,000.</b>	Defective brake components may cause loss of front brakes. <i>Replace affected parts, install brake-tube shield.</i>
<b>1978: Volare</b> <b>1977-78: Aspen, Diplomat</b> <b>1978: LeBaron</b> <b>Total: 1,207,458.</b>	Misaligned hood parts may result in hood not being restrained. <i>Readjust catch.</i>
<b>1976-77-78: 1,100,000</b> Volare, Aspen.	Failure of front-suspension pivot bar support plate may cause loss of control. <i>Install reinforcing brackets.</i>
<b>1977: 372</b> Cordoba, Charger.	Defective bucket-seat latch may result in seat not locking. <i>Replace latch.</i>
<b>1977: 1831</b> Fury, Monaco.	Transmission plastic shift linkage bushings subject to heat damage may result in incorrect shift position. <i>Replace with steel bushings.</i>
<b>1977: 1402</b> Arrow, Colt.	Front brake hose may fail. <i>Install new hose.</i>
<b>1978: 241</b> Volare, Aspen.	Incorrect fuel-supply tube may lead to fuel leakage. <i>Modify tube.</i>
<b>1978: 22,000</b>	Roll pin may slip in column, result-

Year/Models Cars Involved	Description of Defect Corrective Action
Volare, Fury, Aspen, Monaco, Charger, Diplomat, Cordoba, LeBaron with tilt steering.	ing in shaft disengagement and loss of steering. <i>Modify roll pin.</i>
<b>1978: 3000</b> Horizon, Omni.	Misrouted fuel tube may result in leak and fire. <i>Reroute tube.</i>
<b>1978: 3000</b> Horizon, Omni.	Lower control arm may crack, leading to loss of control. <i>Install new control arm.</i>
<b>1978: 3000</b> Horizon, Omni.	Improper installation of wheel hub nuts may result in wheel loss. <i>Reattach hub nuts securely.</i>
<b>1978: 42,000</b> Horizon, Omni.	Failure of ball-joint rivets may affect stability. <i>Reinforce area with bolt and nut.</i>
<b>1978: 14,000</b> Horizon, Omni.	Fuel hose may be interfered with and result in leak and fire. <i>Reroute hose.</i>
<b>1978: 30,000</b> Horizon, Omni.	Fuel tank may leak. <i>Replace it.</i>

## FORD MOTOR CO.

Year/Models Cars Involved	Description of Defect Corrective Action
<b>1966-67: 373,000</b> Falcon, Fairlane, Thunderbird, Mustang ('67 only).	Steering-wheel retaining nut may be improperly installed, causing steering wheel to loosen or come off. <i>Secure nut properly.</i>
<b>1967: 65,000</b> All models except Thunderbird.	Seat-belt attaching bolts may fail. <i>Replace with new bolts.</i>
<b>1967: 700</b> Thunderbird with power seats.	Seat-track assembly may fail to keep seat in place with full load on seat belt. <i>Install new track assembly.</i>
<b>1967: 842</b> Mustang with 289 or 390-cu.-in. engine; 7.35 x 14, 7.70 x 14 or 6.50/6.70 x 15 tires.	Under some conditions, tires may rub against front fenders, scuffing tires. <i>Modify fenders.</i>
<b>1967: 9074</b> Mustang, Cougar with manual steering.	Erroneous steering gear may result in steering-gear lockup. <i>Install new steering gear.</i>
<b>1967: 184</b> Ford, Falcon assembled at Oakville.	Improper front-wheel bearing torque may lead to vibration, wheel pull and bearing failure. <i>Retorque.</i>
<b>1967: 47,300</b> Models with V8 engines, 4V carburetors.	Secondary throttle plates may stick in open position. <i>Replace linkage.</i>
<b>1967: 217,000</b> Power-brake models.	Power-brake booster may malfunction. <i>Install new booster.</i>
<b>1967: 5900</b> Thunderbird with speed control.	Weld failures in steering hub retainer may cause steering loss. <i>Install new steering wheel.</i>
<b>1967: 28,570</b> Ford, Comet.	Faulty jack. <i>Replace.</i>
<b>1967: 85,000</b> Cougar.	Doors concealing headlamps may close with lights on. <i>Inspect and replace vacuum hoses.</i>
<b>1967: 447,000</b> Mustang.	Steering-wheel spoke breakage may affect steering control. <i>Replace steering wheel.</i>
<b>1968: 4034</b> Lincoln.	Faulty front suspension lower-control arm pivot bolts may fracture and cause steering loss. <i>Replace bolts.</i>
<b>1968: 248</b> Ford.	Improperly clamped tie-rod sleeves may cause premature tire wear. <i>Readjust, clamp tie-rod ends, sleeves.</i>
<b>1968: 39,000</b> Falcon, Fairlane, Montego.	Improper center link pin to steering idler arm may fail, cause steering loss.
<b>1968: 3400</b> LTD, XL, Country Squire.	Springs may have been omitted from vacuum-operated headlamp covers, allowing covers to close if there's a vacuum loss. <i>Install springs.</i>
<b>1968-69: 480,000</b> Mustang, Cougar.	Seat-back pivot pin of bucket seats may fail, result in injury. <i>Replace pin.</i>
<b>1969: 12,972</b> Mustang, Cougar.	Heater hose may be wedged between carburetor fast-idle lever and intake manifold, causing loss of control. <i>Reroute hose.</i>

Year/Models Cars Involved	Description of Defect Corrective Action
<b>1969: 75,000</b> Models with drum brakes.	Front-brake hoses may be wrongly routed, leading to fluid leak, loss of front brakes. <i>Reroute hoses.</i>
<b>1969: 12,985</b> Continental.	Improperly crimped power-steering pressure hose fittings may give way to cause fluid loss. <i>Replace hoses.</i>
<b>1969: 6823</b> Ford with 302 and 390-cu.-in. engine.	Improperly fabricated accelerator cable may hold accelerator open in cold weather. <i>Install new cable.</i>
<b>1969: 354,000</b> Ford, Cougar.	Hood latch mechanism failure may cause hood to open with car in motion. <i>Replace latch.</i>
<b>1969: 23,100</b> Mustang, Cougar.	Improperly fabricated front brake rotor may cause wheel bearing and/or spindle failure. <i>Replace parts.</i>
<b>1969: 110,000</b> Maverick.	Contaminated brake fluid may cause brake failure. <i>Drain, replace fluid.</i>
<b>1970: 3692</b> Fairlane, Mustang, Cougar, Montego.	Seat-belt retractor mechanism may be faulty. <i>Install new retractor.</i>
<b>1970: 86,300</b> Thunderbird, Ford, Fairlane, Mustang.	Seat-belt retractor may not lock. <i>Replace mechanism.</i>
<b>1970-71: 15,607</b> Cortina, Capri.	Faulty steering-wheel assembly may separate from steering column. <i>Reinforce wheel.</i>
<b>1970-71: 4,072,000</b> All models except 1970 Maverick and 1970-71 convertibles and imports.	Defective shoulder-belt pin connector sleeves may have been installed. <i>Install new fastener.</i>
<b>1971: 4188</b> Pinto.	Wrong certification label may have been installed. <i>Install correct one.</i>
<b>1971: 15,548</b> Mustang, Cougar.	Missed welds may cause separation of crossmember, lead to loss of front-wheel alignment, abnormal tire wear, more steering effort. <i>Weld missed spots.</i>
<b>1971: 4600</b> Mark III, Thunderbird.	Inadequate welding of seat-belt anchors may have occurred. <i>Reweld.</i>
<b>1971: 26,000</b> Pinto.	Accelerator linkage may bind, hold accelerator open on deceleration. <i>Modify.</i>
<b>1971: 215,823</b> Pinto.	Engine backfire may ignite fuel vapors in air cleaner assembly and cause fire. <i>Modify.</i>
<b>1971: 4414</b> Maverick, Pinto, Ford.	Contaminated brake fluid may cause braking malfunction. <i>Drain, refill brake system.</i>
<b>1971-76: Pinto</b> <b>1975-76: Bobcat</b> <b>Total: 1,400,000</b>	Fuel tanks and filler necks subject to failure when vehicles are struck from rear, causing fire. <i>Modify.</i>
<b>1972: 3176</b> Ford	Faulty jack. <i>Replace.</i>
<b>1972: 28,459</b> Ford, Pinto, Thunderbird.	Faulty seat belts and shoulder harness fasteners may exist. <i>Install new bolts.</i>
<b>1972: 2271</b> Ford.	Improper nut used to secure steering wheel may loosen, causing steering wheel to come off. <i>Install proper nut.</i>
<b>1972: 679</b> Mercury 4-door hardtop with 400-cu.-in. engine, air conditioner.	Erroneous information on tire placard. <i>Install correct placard.</i>
<b>1972: 471,535</b> Torino, Montego, Lincoln, Ranchero, with 302, 351, and 400-cu.-in. engines and air conditioning.	Flexible seven-blade cooling fan may fracture and result in personal injury. <i>Install new fan.</i>
<b>1972: 24,540</b> Mark IV.	Hood latch release lever may come in contact with curb and release. <i>Modify latch.</i>
<b>1972: 407,244</b> Torino, Ranchero, Montego.	Rear axle bearings may fail, cause loss of traction. <i>Install new assembly.</i>
<b>1972: 552</b> Thunderbird, Mark IV.	Incorrect rear seat belts may be present. <i>Install correct assembly.</i>
<b>1972: 157,623</b> Ford station wagon.	Blocked rear-bumper jacking slot may prevent jack engagement, cause vehicle to fail. <i>Remove obstruction.</i>

(Please turn to page 238)

# CAR CARE SECTION 10 GUIDE

Year/Models Cars Involved	Description of Defect Corrective Action
1972: 16,925 Torino, Montego.	Incorrect seat-belt assembly may be present. <i>Install correct assembly.</i>
1972: 178,000 Maverick, Comet.	Improper seat belts may have been installed. <i>Install correct belts.</i>
1972-73: 1,033,800 Torino, Thunderbird, Mercury, Mark IV with power steering.	Missing valve-assembly torsion-rod lock pin in power-steering gear may lead to steering loss. <i>Install lock pin.</i>
1973: 11,782 Torino, Ford, Montego, Thunderbird, with 429-4V engine.	Carburetor may leak fuel from around power-valve restrictor plug, causing hard starting and possible ignition of fumes. <i>Replace the affected units.</i>
1973: 76,670 Ford.	Interference between front brake tubes and fenders may result in brake loss. <i>Adjust to provide sufficient clearance.</i>
1973: 58,832 Torino.	Missing cotter pin in steering linkage may cause linkage to disengage from idler arm, affect control. <i>Install cotter pin.</i>
1973: 11,301 Pinto.	Faulty seat-belt bolts may fracture. <i>Install new bolts.</i>
1973: 13,475 Torino with 302-2V engine and power steering.	Loose power-steering gear assembly may result in free play, ultimate loss of steering. <i>Retorque bolts.</i>
1973: Thunderbird, Mark IV. 1974: Lincoln. Total: 59,283.	Improperly routed starter cable may wear through and cause electrical short. <i>Reroute cable.</i>
1973-74: 74,884 Torino, Maverick, Montego, Comet, Cougar with 302, 351, 400 2V engines.	Improperly aligned linkage may cause throttle to stick in open position. <i>Realign linkage.</i>

Year/Models Cars Involved	Description of Defect Corrective Action
1974: 362 Cougar with console shift.	Interference with lever may prevent engagement of transmission into Park. <i>Modify transmission.</i>
1974: 60,000 Pinto, Mustang.	Inadequate clamping of steering coupling flange onto manual steering-gear input shaft may cause loss of steering. <i>Replace steering coupling flange and clamp bolt.</i>
1974: 13,768 Capri.	Improperly fabricated wiring harness may wear through, causing loss of electrical power. <i>Modify harness.</i>
1974: 127,208 Torino, Ford, Thunderbird, Montego, Cougar, Continental, Mark IV with speed control.	Malfunctioning servo assembly may prevent release of speed-control device. <i>Replace assembly.</i>
1974: 281 Torino 2-door hardtop models.	Incorrect passenger seat belts may exist. <i>Install correct seat belts.</i>
1974: 914 Ford station wagon, Mercury station wagon.	Vehicles with Class 1 trailer-tow option may have received wrong hitch that could cause separation of the trailer from the vehicle. <i>Install correct hitch.</i>
1974: 2410 Lincoln.	Hydraulically powered brake-booster system may have improper pressure-relief valve that could result in personal injury, loss of brake fluid and steering. <i>Replace booster.</i>
1974: 105 Lincoln.	Incorrect steering-column flex coupling may have been installed, causing fracture of pitman arm stud. <i>Replace coupling.</i>
1974: Capri I	Brake hoses may split, causing

Year/Models Cars Involved	Description of Defect Corrective Action
1975: Capri II Total: 44,890	loss of front brakes. <i>Install new hoses.</i>
1975: 2027 Thunderbird, Continental, Mark IV with 460-4V engine.	Carburetor fuel-inlet seat may not be properly torqued, resulting in flooding and stalling of engine at idle. <i>Torque fuel-inlet seat.</i>
1975: 334 Mark IV.	Malfunctioning power-steering pressure-reapply valve may cause loss of power-steering fluid. <i>Install new valve.</i>
1975: 762 Mercury.	1974 rear seat belts may have been installed, which are not compatible. <i>Install proper belts.</i>
1975: 2280 Granada, Monarch with airconditioning.	Heater/defroster system may not respond to shift from Heat mode to Defog or Defrost. <i>Modify system.</i>
1975: 8460 Maverick, Granada, Comet, Monarch with 250-cu.-in. engine.	Incorrectly routed wiring harness may prevent throttle from closing. <i>Reroute and install restrainer.</i>
1975: 32,003 Granada, Monarch.	Unacceptable thickness of front suspension upper-control arm may cause arm to fracture and result in loss of control. <i>Install new arm.</i>
1975: 140,870 Torino, Thunderbird, Montego, Cougar, Mark IV with 460-cu.- in. engine and 4350- 4V carburetor.	O-ring on fuel inlet of carburetor may be lost, causing strong fuel odor and chance of fire. <i>Modify inlet with epoxy.</i>
1975: 140,870 Same as above.	Surface irregularity may impede secondary throttle lever, causing throttle plate to stick open, result in vehicle acceleration. <i>Install new secondary throttle stop lever.</i>

(Please turn to page 240)

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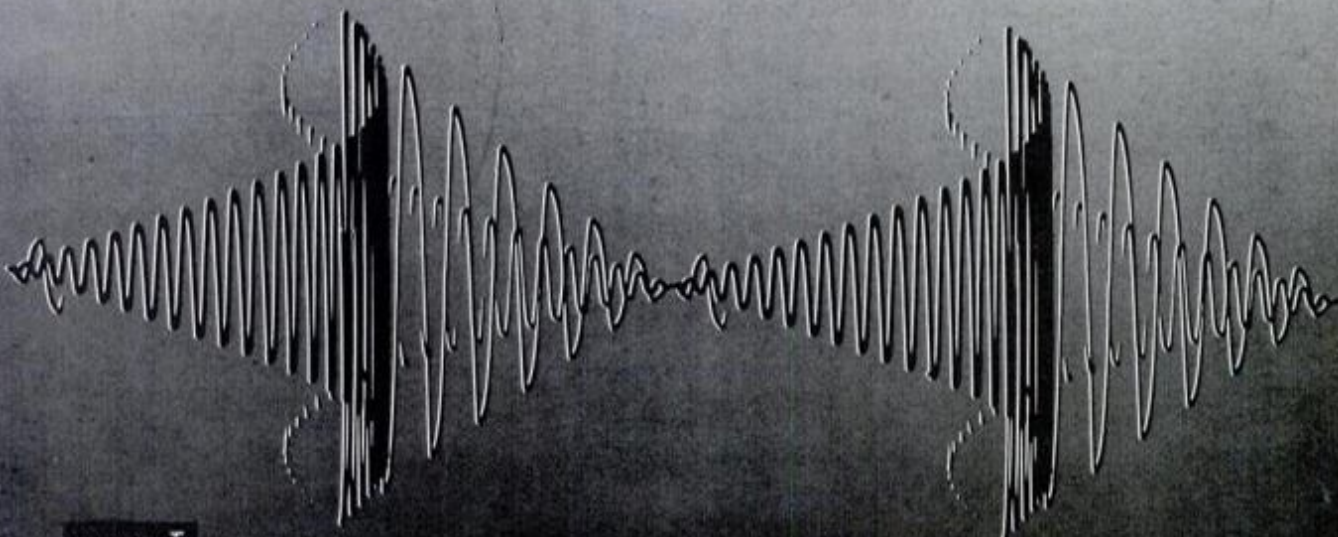
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# CAR CARE GUIDE

SECTION 10

Year/Models Cars Involved	Description of Defect Corrective Action
1976: 10,941: Capri.	Missing tire placard. <i>Install it.</i>
1976: 818 Torino, Montego.	Improperly tensioned parking-brake system may cause reduced rear-brake lining life. <i>Adjust cable tension.</i>
1976: 1000 Granada, Monarch.	Wrong right-hand front suspension struts may cause fracture resulting in steering-wheel pull and adversely affecting control. <i>Install correct strut.</i>
1976: 22,402 Maverick, Torino, Elite, Comet, Montego with airconditioning.	Defect in heater/defroster system may prevent defrost action. <i>Modify system.</i>
1976: 284,000 Pinto, Bobcat.	Vehicles may fail to meet 30-mph frontal-barrier impact test. <i>Install front-bumper bracket extension.</i>
1976: 2488 Montego.	Improper front park/turn-signal lamps may have been installed. <i>Install new lamp assembly.</i>
1976-77: 742,000 Ford, Mercury models with airconditioning: Lincoln with 400-cu.-in. engine.	Flexible five-blade cooling fan may fracture, resulting in personal injury. <i>Install new fan.</i>
1977: 2751 Maverick, Comet.	Inadequate left door-lock assembly may allow door to swing open. <i>Install new assembly.</i>
1977: 542 Pinto, Mustang, Bobcat.	Wrong rear-bumper fasteners may puncture fuel tank. <i>Replace the fasteners.</i>
1977: 9000 LTD II, Granada, Thunderbird, Cougar.	Wrong parts in tilt steering-wheel column may interfere with transmission selector and allow engine to

Year/Models Cars Involved	Description of Defect Corrective Action
Mercury, Monarch, Lincoln, Mark V, Versailles Ford.	start with transmission in Drive. <i>Install correct parts.</i>
1977: 60,000 Ford, LTD II, Thunderbird, Mercury, Cougar with 351 and 400 cu.-in. engine.	Fuel leakage at fuel inlet tube may take place, resulting in fire. <i>Install new clamp.</i>
1977: 290,000 Granada:	Vehicles may fail to meet fuel-spillage standards. <i>Install new filler cap.</i>
1977: 40,000 Comet, Monarch, Granada, Maverick.	Manual-steering gear may experience fracturing of steering-gear recirculating balls, causing steering loss. <i>Replace gear assembly.</i>
1978: 44,638 Fairmont, Zephyr.	Front-disc brake rotors may contain cracks, causing brake pull, affecting control. <i>Install new rotors.</i>
1978: 16,000 Models with 460-cu.-in. engine.	Secondary throttle lever may hang up, permitting vehicle to accelerate to high speed.
1978: 41,000 Fairmont, Zephyr with automatic trans. and steering-column mounted shift control.	Transmission parking pawl may not engage parking gear, allowing vehicle to roll free. <i>Adjust shift linkage.</i>
1978: 19,000 Mark V with C-6 automatic trans.	Park actuating cam support plate that engages parking pawl may fracture, causing no-park condition. <i>Repair transmission.</i>
1978: 154 Mustang.	Binding dust-tube portion of accelerator-cable assembly may reduce throttle-return rate or prevent throttle valve from closing. <i>Replace accelerator-cable assembly.</i>

Year/Models Cars Involved	Description of Defect Corrective Action
1978: 400 Thunderbird.	Cast aluminum wheels may have lug-nut counter bores out of specification, causing insufficient lug-nut thread engagement. <i>Replace defective wheels.</i>
1978: 2907 Versailles.	Misrouted electric engine-control wiring harness may cause malfunction of speed control. <i>Correct harness routing.</i>
1978: 6000 Fiesta with airconditioner.	Improperly located blower motor resistor wires may develop too much heat and ignite polypropylene blow housing. <i>Inspect temperature protective thermal limiter.</i>
1978: 185,000 Fairmont, Zephyr.	Improperly routed main wiring assembly may chafe and ground, causing loss of electric power. <i>Install wiring assembly shield.</i>
1978: 1956 Pinto, Mustang, Bobcat.	Rear seat-belt retractors may fail to lock. <i>Replace retractors.</i>
1978: 110,000 Ford 4-door and station wagon, Thunderbird, LTD II, Cougar.	Shoulder-harness retractors may not lock. <i>Replace seat-belt assembly.</i>
1978: 358 Fairmont, Zephyr with automatic trans. and steering-column shift control.	Erroneous transmission shift linkage parts may result in starting in gear or no-park mode. <i>Replace shift-linkage parts.</i>
1978: 180 Fairmont, Zephyr with automatic trans. and steering-column shift control.	Shift control may contact fuel hose, creating fire hazard. <i>Replace shift linkage parts.</i>

(Please turn to page 242)

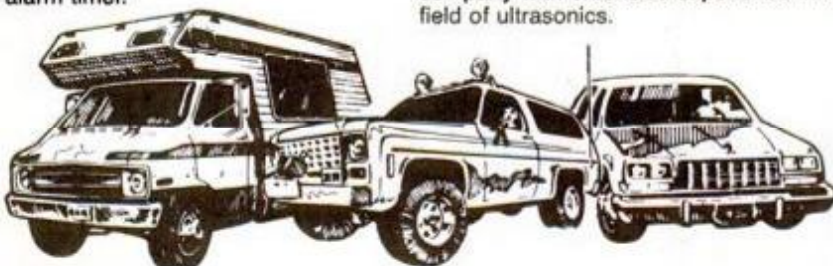
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# CAR CARE GUIDE

## GENERAL MOTORS CORP.

Year/Models Cars Involved	Description of Defect Corrective Action
1961-69: 679,900 Chevrolet Corvair.	Heating-system fumes containing carbon monoxide may enter passenger compartment and endanger occupants. <i>Inspect and repair.</i>
1965: Chevrolet Biscayne, Bel Air, Impala, Caprice.	Idler-arm assembly may separate to cause severe pulling to right. <i>Replace idler arm.</i>
1965-66: Pontiac Catalina, Star Chief, Grand Prix, Bonneville. Total: 1,143,000.	
1965-66: 830,000 Pontiac Catalina, Star Chief, Executive, Grand Prix, Bonneville.	Defective front-brake hoses may rupture, leading to brake loss. <i>Replace hoses.</i>
1965-69: 2,570,914 Chevrolet Biscayne, Bel Air, Impala, Caprice (excluding station wagon).	Possibility that exhaust may enter passenger compartment. <i>Reseal body openings.</i>
1965-69: 6,682,084 Chevrolet Standard, Chevy II, Nova, Camaro.	Defective motor mount may cause motor to lift and throttle to stick open. <i>Replace defective mount and install restraints to limit lift.</i>
1966-67: 6440 Oldsmobile 4-4-2 with automatic trans. and power brakes.	Throttle linkage may interfere with power-brake hose causing part throttle position when accelerator pedal is released. <i>Reroute hose.</i>
1967: 4950 Pontiac, all models with tilt steering wheel.	Insulation on turn signal and stop-light wiring harness may wear due to chafing, causing short that makes lights inoperative. <i>Add additional insulation.</i>
1967: 401,952 Chevrolet Chevelle, Corvair, El Camino; Pontiac GTO, Lemans, Tempest; Oldsmobile F-85, Cutlass, Cutlass Supreme, Vista Cruiser; Buick Special, Special Deluxe, Skylark, GS 400, Sportwagon.	Steering shaft may have been improperly installed, causing bind and possible shaft breakage. <i>Install new shaft.</i>
1967: 40,038 Pontiac with power brakes, except Tempest.	Insufficient seal may allow water to enter power-brake vacuum cylinder, reducing brake efficiency. <i>Reseal or replace cylinder.</i>
1967: 7573 Oldsmobile 88, 98	Defective steering-arm bolts may break, causing loss of control. <i>Replace bolts.</i>
1967: 6919. Buick LeSabre, Wildcat with manual brakes.	Master cylinder defect may cause pedal-linkage disengagement, loss of brakes. <i>Modify master cylinder.</i>
1967: 2484. Buick, Oldsmobile, Pontiac with 2-speed automatic transmission.	Defective shift detent lever may snap, causing vehicle to shift erratically. <i>Install new detent lever.</i>
1967: 577 Pontiac Firebird V8.	Heater blower motor wire may come in contact with exhaust manifold, melting insulation, causing a short leading to a fire. <i>Reroute wire.</i>
1967: 794 Chevrolet Chevy II.	Defective left front door lock may fail. <i>Install new assembly.</i>
1967-68: 4101. Olds Toronado with chromed wheels.	Defective rim may cause tire to lose air rapidly, affecting vehicle control. <i>Replace defective wheels.</i>
1968: 2781 Chevrolet Corvette.	Front brake line may rub against left front fender skirt, causing fluid leak and loss of front brakes. <i>Modify fender.</i>
1968: 1046 Chevrolet Corvair.	Defective front-compartment latch assembly may allow compartment lid to open while car is in operation. <i>Install new retainers.</i>
1968: 597 Chevrolet Corvair.	Defective rear-wheel studs may fail, causing loss of wheels. <i>Install new studs.</i>
1968: 382 Chevrolet Chevelle with power disc brakes.	Missing locknut in brake assembly may cause brake pedal to bottom before brakes are applied. <i>Install locknut.</i>
1968: 64,913	Misrouted brake line may chafe. <i>(Please turn to page 246)</i>



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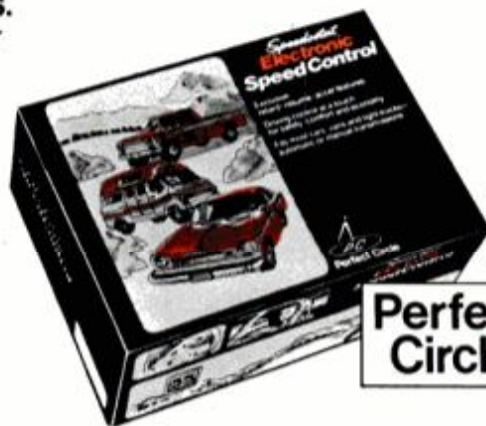
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# CAR CARE GUIDE

## SECTION 10

Year/Models Cars Involved	Description of Defect Corrective Action
Chevrolet Chevelle.	causing fluid leak and loss of front brakes. <i>Reroute line.</i>
1968: 28,639 Oldsmobile 88, 98	Misaligned transmission downshift switch actuating rod may permit throttle to stay open when accelerator is released. <i>Realign rod.</i>
1968: 355 Chevrolet with 327, 396-cu.-in. engine and 4V carburetor.	Cruise Master accelerator chain may catch, preventing throttle closing when accelerator pedal is released. <i>Repair accelerator chain.</i>
1968: 11,461 Oldsmobile 88, 98 with Cruise Control.	Improperly torqued Cruise Control stud nut may result in loss of nut and part-throttle condition when brakes are applied. <i>Install and torque nut correctly.</i>
1968: 310,290 Chevrolet Standard, Camaro, Chevy II, El Camino; Buick Special, Skylark; Pontiac Tempest, Firebird; Oldsmobile F-85; all with L-4 or L-6 engine, Monojet carb.	Interference of carburetor throttle lever with throttle retaining clip may prevent throttle closing when accelerator pedal is released. <i>Modify throttle lever assembly.</i>
1968: 12,164 Pontiac Tempest, Firebird with sport steering wheel.	Underweight steering wheel spokes may break and pull loose from retaining interlock ring, causing steering loss. <i>Install new wheel.</i>
1968-69: 2,966,979 All models with 4V Quadrajet carb.	Fast-idle cam may break apart, causing throttle to stick open. <i>Install new fast-idle cam.</i>
1968-69: 2057 Chevrolet Chevy II, Nova with 4-speed transmission and floor-mount console.	Wrong shift-pattern decal may be present. <i>Install correct decal.</i>
1969: 176 Chevrolet Standard.	Defective left rear door may have been installed. <i>Replace lock.</i>
1969: 4420 Chevrolet Corvette.	Seat belts may not latch securely and seat-belt locks may break. <i>Install new seat-belt assemblies and new seat-belt lock forks.</i>
1969: 24,017 Chevrolet full-size station wagon; Pontiac Bonneville, Catalina, Executive.	Missing left rear floor-pan filler plate may allow dust and exhaust fumes to enter car. <i>Install filler plate.</i>
1969: 129 Pontiac Firebird.	Incorrect rear brake hose may cause fluid loss and affect braking. <i>Install correct hose.</i>
1970: 1300 Pontiac Tempest with 8-cylinder engine and 2-speed trans.	Incorrect throttle-valve rod clip may keep throttle from returning to idle. <i>Install correct part.</i>
1970: 4527 Buick LeSabre, Wildcat, Electra, Riviera.	Wheels (15x6 in.) with defective welds may have been installed. <i>Install new wheels.</i>
1970: 1178 Buick LeSabre, Wildcat, Electra, Riviera.	Power front disc-brake hose may be chafed, causing fluid loss and affecting brake action. <i>Modify hose-frame area.</i>
1970: 2574 Pontiac Tempest, Grand Prix.	Defroster operation may be impaired by malfunction of electric circuit. <i>Modify electric circuit.</i>
1970: 19,917 Buick Skylark, Sport-wagon, GS	Bent carburetor throttle cable may prevent throttle closing. <i>Install new cable.</i>
1970: 16,712 Chevrolet Chevelle, Monte Carlo.	Incorrect tire decal. <i>Install correct decal.</i>
1970: 1406 Pontiac Firebird, Trans Am.	Idle-stop solenoid bracket nut may interfere with throttle closing. <i>Modify affected area.</i>
1970: 4000 Chevrolet wagon.	Defective jack pad may allow jack to slip. <i>Replace pad.</i>
1971: 12,600 Chevrolet Standard, Chevelle, Camaro, Nova, El Camino; Pontiac LeMans, Firebird; Buick Skylark; Oldsmobile F-85—models with L-6 engines.	Throttle rod to throttle lever retaining clip may be incorrectly installed, causing open throttle condition. <i>Install newly designed clip.</i>
1971: 6000 Chevrolet wagon.	Defective bumper jack may allow jack to slip. <i>Install new jack.</i>
1971: 15,000 Buick LeSabre, Cen-	Burr on heater-control support bracket may cut headlight wire, re-

Year/Models Cars Involved	Description of Defect Corrective Action
turion, Electra.	sulting in short circuit and fire. <i>Insulate wiring.</i>
1971: 30,885 Buick, Pontiac, Oldsmobile—regular-size cars with 15x6-in. wheels.	Wheels may crack at rim. <i>Replace wheels.</i>
1971-72: 350,000 Chevrolet Vega with Monojet carburetor.	Idle-stop solenoid bracket may break, causing piece to lodge and keep throttle in open position. <i>Install new bracket.</i>
1971-72: 526,000 Chevrolet Vega.	Rear-axle shaft defect may cause vehicle to bottom. <i>Replace axle.</i>
1971-72: 3,707,064 Chevrolet Biscayne, Bel Air, Impala, Caprice; Pontiac Catalina, Bonneville, Grandville; Buick LeSabre, Centurion, Electra, Riviera; Oldsmobile 88, 98.	Possibility that on unpaved road a stone may lodge between steering coupling and frame, interfering with steering. <i>Install protective shield.</i>
1971-74: 651,821 Cadillac C cars (except Eldorado).	Lack of steering-linkage idler lubricant may cause idler to break and affect control. <i>Install grease fitting and lubricate.</i>
1972: 475 Chevrolet, Pontiac, Buick wagon.	Third-seat lap belt may be too short. <i>Install correct length belt.</i>
1972: 149 Buick Riviera.	Incorrect steering-gear assembly may be present, causing steering loss. <i>Install right gear assembly.</i>
1972: 129,000 Chevrolet Vega with L-11 engine and 2V carburetor.	Frequent and severe exhaust-system backfire may weaken muffler, causing heat from muffler to expand fuel that may spill and ignite. <i>Install new muffler and other system components.</i>
1972: 309 Pontiac Firebird, Trans Am.	Incorrect tire identification label. <i>Install correct label.</i>
1972: 1082 Chevrolet Nova, Pontiac Ventura.	Defective rear-axle shaft may fail. <i>Replace shaft.</i>
1972: 41,711 Buick Electra, Riviera; Oldsmobile 88, 98.	Defective pitman arm may fail, causing steering loss. <i>Install correct pitman arm.</i>
1972: 1699 Oldsmobile, Pontiac, Chevrolet—standard size models.	Front-seat adjuster may not stay engaged. <i>Install new adjuster.</i>
1972: 7072 Chevrolet Vega.	Incorrect gross-vehicle-rating decal. <i>Install correct decal.</i>
1972: 42,689 Pontiac Grand Prix.	Loose retainer may allow battery to tip and cause short that can start a fire. <i>Install new retainer.</i>
1972: 37,500 Cadillac Calais, DeVille, Brougham.	Left rear-axle shaft may be too long, interfering with differential cross shaft and causing premature wear of rear wheel bearing. <i>Replace axle.</i>
1973: 688 Buick Riviera.	Incorrect carburetor throttle cable may prevent throttle closing. <i>Replace cable.</i>
1973: 544 Chevrolet Nova, Pontiac Ventura, Oldsmobile Omega.	Improperly torqued steering arm-to-caliper anchor bracket bolts may break and lodge in front brake rotor, causing wheel lockup. <i>Torque bolts properly.</i>
1973: 155,418 Chevrolet Chevelle, El Camino; Pontiac LeMans, Grand Prix; Buick Century; Oldsmobile Cutlass; GMC Sprint.	Steering linkage may overtravel, causing severe front-wheel toe-in that can wear out tires, damage inner tie-rod assembly and lead to loss of steering control. <i>Install idler-arm stop bracket.</i>
1973: 330 Chevrolet Nova, Pontiac Ventura, Oldsmobile Omega.	Improperly torqued left front upper control-arm nuts may break, causing loss of steering control. <i>Torque nuts properly.</i>
1973: 144 Pontiac Safari and Grand Safari wagon.	Incorrectly wired rear-window defogger could malfunction. <i>Rewire properly.</i>
1973: 693 Chevrolet Chevelle, Camaro; GMC Sprint.	Seat-belt warning system may become inoperative. <i>Modify.</i>
1973: 3083 Chevrolet Camaro.	Defective parking-brake pawl may break, affecting braking ability. <i>Replace pawl.</i>

(Please turn to page 248)



# CAR CARE SECTION 10 GUIDE

Year/Models Cars Involved	Description of Defect Corrective Action	Year/Models Cars Involved	Description of Defect Corrective Action	Year/Models Cars Involved	Description of Defect Corrective Action
<b>1973: 3225</b> Chevrolet Nova, Pontiac Ventura, Oldsmobile Omega.	Seat-belt warning system may malfunction. <i>Modify.</i>	<b>1974: 7380</b> Buick Estate Wagon.	Improperly positioned rear brake pipe may flex excessively and break to cause fluid leak and loss of rear brakes. <i>Reposition pipe.</i>	<b>1976: 18,676</b> Cadillac Seville.	Loose steering shaft may result in loss of steering. <i>Torque shaft to correct specification.</i>
<b>1973: 742</b> Buick Apollo.	Loose retention nuts on nonpower brake clevis may affect operation of master cylinder push-rod. <i>Adjust nuts to specification.</i>	<b>1975: 2562</b> Buick B, C, E series; Olds B, C, E series; Pontiac B series with Rochester 4V Quadrajel carbs.	Incorrect idle-cam follower lever may cause throttle to stick in wide-open position. <i>Replace carburetor.</i>	<b>1976: 39,278</b> Chevrolet Impala, Caprice, Monte Carlo; Pontiac LeMans, Grand Prix, Catalina, Bonneville; Oldsmobile 88; Buick Century, Regal, Electra, LeSabre, Riviera.	Defective brake combination valve may affect brake action during an abrupt stop. <i>Replace valve.</i>
<b>1973: 1112</b> Cadillac Eldorado, Oldsmobile Toronado.	Defective ball studs of pitman and idler arms may break, affecting control. <i>Install new ball studs.</i>	<b>1975: 1951</b> Oldsmobile Cutlass, 98, Delta with Cruise Control.	Defective servo relay rod may fail and wedge carburetor throttle open, resulting in loss of control. <i>Install new servo relay rod.</i>	<b>1976: 2,200,000</b> Chevrolet Chevelle, Nova, El Camino, Camaro, full-size (sedans and wagons); Pontiac LeMans, Firebird, Catalina, Bonneville, Ventura, Grand Prix; Oldsmobile Cutlass, 88, 98, Omega; Buick Skylark, LeSabre, Electra; Cadillac Calais, DeVille, Brougham (except fuel injection); GMC Sprint.	Gas vapors may enter power-brake booster, causing deterioration of diaphragm and loss of brake-power assist. <i>Install special charcoal filter in vacuum line to capture vapors.</i>
<b>1973: 3094</b> Chevrolet Chevelle, Malibu, Laguna, El Camino; Pontiac LeMans; Buick Century; GMC Sprint.	Master cylinder gasket may be missing, resulting in damage that can cause brake fluid loss and impaired braking. <i>Install gasket.</i>	<b>1975: 11,962</b> Chevrolet Nova, Pontiac Ventura, Buick Apollo, Oldsmobile Omega.	Defective front-suspension lower-control arm brackets may cause loss of steering. <i>Reweld affected area.</i>	<b>1977: 15,246</b> Chevrolet Camaro, Nova.	Defective wheel may fail, causing loss of control. <i>Replace wheel.</i>
<b>1973: 685,434</b> Pontiac, all models.	Fuel-line accumulator Welch plug may become dislodged, allowing fuel to spill on road when car is at standstill—a fire hazard. <i>Modify.</i>	<b>1975: 358</b> Chevrolet Nova, Pontiac Ventura, Buick Apollo, Oldsmobile Omega—2-door models with bucket seats.	Defective lock may prevent engagement of seat. <i>Install new seat lock.</i>	<b>1977: 15,484</b> Chevrolet Corvette.	Nonstandard horn-button cap may reflect sun into driver's eyes. <i>Replace cap.</i>
<b>1973: 75,010</b> Pontiac Grand Prix, Grand Am.	Short caused by wiring harness lamp circuit may cause fire in passenger compartment. <i>Ground circuit.</i>	<b>1975: 596</b> Chevrolet Vega, Pontiac Astre.	Incorrect tire pressure decal. <i>Install proper decal.</i>	<b>1977: 265,068</b> Chevrolet Monte Carlo, Malibu; Pontiac LeMans, Grand Prix; Oldsmobile Cutlass; Buick Century, Regal.	Defective rear-axle shaft may break, causing tire and wheel to come off. <i>Replace axle.</i>
<b>1973: 123,600</b> Chevrolet, GMC 4-wheel-drive models with power steering.	Steering-gear attachment bolts may loosen, causing erratic steering and possible loss of control. <i>Torque bolts.</i>	<b>1975: 2578</b> Buick LeSabre, Electra; Oldsmobile 88; Pontiac Grandville, Bonneville, Catalina.	Defective wheel may fail and cause loss of control. <i>Install new wheel.</i>	<b>1977: 31,979</b> Chevrolet Nova, Pontiac Ventura, Oldsmobile Omega, Buick Skylark.	Defective rear-axle shaft may break, allowing tire and wheel to come off. <i>Replace shaft.</i>
<b>1973-74: 1,218,387</b> Chevrolet A, B, F, X series; Pontiac A, F, X series; Buick A, X series; GMC A series.	Defective brake-vacuum power booster may separate, resulting in loss of brakes. <i>Reinforce booster to prevent separation.</i>	<b>1975: 220,982</b> Chevrolet Monte Carlo, Chevelle, El Camino; Pontiac LeMans, Grand Am; Buick Century, Regal; Oldsmobile Cutlass; GMC Sprint.	Defective rear-axle-shaft outer bearing could cause shifting of rear-axle shaft, affecting vehicle control. <i>Replace axle assemblies.</i>	<b>1978: 5146</b> Cadillac DeVille.	Defective windshield washer reservoir may not retain washing fluid. <i>Replace reservoir.</i>
<b>1974: 6149</b> Oldsmobile Cutlass Supreme.	Defective weld of front reclining-bucket seat may break, causing seat to collapse. <i>Install supporting bolt and nut.</i>	<b>1975: 31,073</b> Chevrolet Camaro with 350-cu.-in. engine and airconditioning.	Flexible fan blade may shatter, resulting in hazard to mechanics working under the hood with engine running. <i>Replace fan.</i>	<b>1978: 636</b> Chevrolet Malibu, Malibu Classic, Monte Carlo; Pontiac LeMans, Grand LeMans, Grand Am.	Rear-wheel cylinder may come loose, causing fluid loss and affecting rear-brake action. <i>Resecure cylinder.</i>
<b>1974: 22,215</b> Chevrolet Camaro, Pontiac Firebird.	Movement of driver seat may rub wiring ignition interlock and/or power-window wire harness, causing short and preventing engine starting or power-window operation. <i>Reroute wire harness.</i>	<b>1975: 3069</b> Chevrolet Camaro, Nova; Pontiac Firebird; Buick Skylark, Apollo.	Loose steering shaft may separate, resulting in steering loss. <i>Tighten connections.</i>	<b>1978: 4504</b> All GM models.	Defective rear-wheel mounting bolts may fail and cause loss of wheel. <i>Replace bolts.</i>
<b>1974: 9215</b> Chevrolet Bel Air, Impala, Caprice station wagon.	Improperly positioned rear-brake pipe may break, causing fluid leak and loss of rear brakes. <i>Reposition brake pipe.</i>	<b>1975: 16,098</b> Pontiac Ventura, Oldsmobile Omega, Buick Apollo.	Defective carburetor throttle-cable conduit may cause throttle to stick in open position. <i>Replace throttle cable.</i>	<b>1978: 575</b> Cadillac Seville.	Defective console latch may allow console to fly open in collision. <i>Install new console.</i>
<b>1974: 12,703</b> Chevrolet Nova, Pontiac Ventura, Oldsmobile Omega, Buick Apollo.	Broken rear spring U-bolt may allow rear spring to fall away from rear-axle assembly. <i>Install new U-bolt.</i>	<b>1975: 98,631</b> Chevrolet Monza 2+2; Buick Skylark hatchback; Oldsmobile Starfire.	Weak spare-tire fasteners may snap in a collision, causing spare tire to enter passenger compartment. <i>Replace with heavy-duty fasteners.</i>	<b>1978: 100</b> Buick Century, Regal.	Illegible tire decal. <i>Replace decal.</i>
<b>1974: 782,111</b> Chevrolet A, B, F, G series; Pontiac A, B, F, G series; Oldsmobile A, B, C series; Buick A, B, C, E series; GMC Sprint.	Front upper-control arm inner-bushing retainer nuts may loosen and fall off, causing control-arm cross shaft to break and loss of vehicle control. <i>Install new retainers.</i>	<b>1975: 1108</b> Pontiac Grandville, Bonneville.	Left turn signal may not comply with standards. <i>Replace lamp assembly.</i>	<b>1978: 22,268</b> Chevrolet Monza, Pontiac Sunbird, Oldsmobile Starfire, Buick Skyhawk.	Oversize steering-shaft coupling may prevent proper coupling and could result in steering loss. <i>Replace coupling.</i>
<b>1974: 260</b> Chevrolet Nova, Pontiac Ventura, Oldsmobile Omega.	Loose steering-arm attaching bolts may break and lodge in front brake rotor, causing brake lockup. <i>Tighten bolts.</i>	<b>1975: 687</b> Buick LeSabre, Electra, Riviera, Estate Wagon; Pontiac Catalina, Catalina wagon, Bonneville, Grandville, Grandville wagon.	Defective wheel may fail, causing loss of control. <i>Replace wheel.</i>	<b>1978: 1643</b> Chevrolet Malibu, Monte Carlo, Pontiac LeMans, Grand LeMans, Grand Am.	Front headrests may not conform to standard. <i>Install correct headrests.</i>
<b>1974: 2937</b> Chevrolet Corvette.	Defective fuel line may fail, allowing gas to leak on tailpipe. <i>Replace fuel line.</i>	<b>1975: 1293</b> Cadillac (except series 75 and Eldorado convertible); Buick Riviera, Electra, LeSabre; Oldsmobile 88, 98 and Toronado.	Defect in air-cushion restraint system may prevent air cushion from functioning properly in a crash. <i>Replace defective module.</i>	<b>1978: 333,619</b> Chevrolet Malibu, Monte Carlo; Pontiac Firebird, Catalina, Bonneville, LeMans, Phoenix; Oldsmobile 88, Cutlass, Omega; Buick LeSabre, Electra, Century, Regal, Skylark; GMC Sprint.	Defective fan may break. <i>Replace fan.</i>
<b>1974: 3458</b> Chevrolet Chevelle, Laguna.	Hood latch may not engage securely, allowing hood to fly open. <i>Modify latch assembly.</i>	<b>1975-78: 133,419</b> Cadillac models with fuel injection.	Fuel hose may deteriorate and leak, leading to fire. <i>Install new and stronger fuel connections.</i>		
<b>1974: 5128</b> Cadillac Calais, DeVille, Brougham.	Defective wheel could fail, leading to loss of control. <i>Replace wheel.</i>	<b>1976: 4107</b> Chevrolet Chevette.	Loose rear-brake pipe may fail, allowing fluid loss and affecting brake action. <i>Add pipe restraints.</i>		
<b>1974: 234,278</b> Cadillac, all.	Hood latch may not engage securely, allowing hood to fly open. <i>Readjust latch assembly.</i>				
<b>1974-75: 2005</b> Cadillac, all except series 75.	Underhood wiring harness that controls air-cushion restraint system may rub through, causing short, inadvertent deployment of restraint. <i>Reroute harness.</i>				

# TASTE WINSTON LIGHTS



**Best taste.  
Low tar.**

13 mg. "tar", 0.9 mg. nicotine av. per cigarette, FTC Report MAY '78.

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

first night out, but finally the whisper of the current and night chorus of frogs lull us to sleep.

Breakfast commenced at dawn but was a leisurely affair. Once packed and underway, we fished as we floated, catching and releasing small panfish. At noon we paused for sandwiches and cold beer at the mouth of a spring branch. After an eight-mile trip and well before sundown we found another suitable campsite.

During the day's float, we navigated several rough stretches but found only one that looked mean enough for us to send someone ahead along the shore to scout a whitewater chute, note the obstacles and chart the best way to run the stretch by canoe.

Early evening of the third day, we reached our haul-out point, and Doc and Charlie immediately drove the waiting car back up to pick up the other one at our launching spot. Although we floated 18 miles by river, the two points were less than ten miles apart by road and the two cars were back in half an hour. By then Lloyd and I had the canoes unloaded and gear laid out.

The three-day adventure had cost us \$16 each, including ribs, steaks and other food, plastic tableware, beer, liquor, ice—everything. We didn't include gas for the cars or the fishing licenses and equipment we already had. But even if we'd rented the canoes, the tab would still have been less than \$25 each.

### How to do it

You can do the same thing on any one of a dozen streams in your own state. Get a local map and look for a stretch of river which does not parallel a road, or one which highways don't bisect too often. Try to select areas of hilly terrain; streams there have sharper gradients and are more interesting to float than slower rivers.

Find several possibilities? Note the counties these streams flow through, and write your state highway department for the proper county maps. For 10 cents or 25 cents (and some are free), they show all roads, bridges, villages, creeks, even some farm houses. At a scale of two miles to the inch, they're ideal for figuring float trips and measuring river and highway distances.

### Which boat?

Three types of craft are recommended for floating: johnboats, ca-

noes and rafts. Light, flat-bottomed johnboats are popular in the Ozarks where riffles are shallow gravel chutes. These boats displace little water, carry a lot of weight and are safe for calm conditions.

A canoe is better for streams with such obstacles as root wads, boulders, fallen trees, rapids with brushy undercut banks or fast water. A canoe is very maneuverable and, contrary to some opinions, actually is the safest craft for such conditions.

Firms like Old Town, Grumman, Alumacraft, Lowe and a number of others make excellent canoes for floating. Aluminum models are ideal because they're light and easy to unload from a cartop carrier. They are rugged enough to withstand impact from rocks.

Fiberglass canoes are also rugged, but some are too heavy. Beware of those with molded bucket seats. Many are too low and difficult to get out of in an emergency. New plastic canoes, like those of Royalex, are light, unsinkable, and can survive an impact that might puncture aluminum or shatter fiberglass. And regardless of your choice, consider one without a keel. It will turn more easily and is less likely to overturn in fast water.

Only specially designed rafts can handle some of our western rivers with big, rough rapids. Two years ago we took a several-day float on the Green River in Utah, and our raft proved perfect for the conditions. A raft is difficult to maneuver, however, and should only be used on large rivers.

### Your gear

Float-trip equipment is simple and easy to obtain. You'll need two paddles per canoe, a pair of life jackets, and long nylon lines attached to bow and stern. I prefer a good-quality spruce or ash paddle with 8-inch blade and 5½-foot length for use in shallow water and riffles.

River nights can be cool so get a sleeping bag plus an air mattress or foam pad that doesn't require inflating. If the gals are with you, a light nylon two-man tent offers privacy and protection from an occasional bug. Otherwise, a light tarp spread over a rope between two trees will ward off dew and rain-showers. Spread another tarp beneath the sleeping bags, and bring along a trenching shovel to dig a drainage ditch around the sleeping area. I always carry a couple of

plastic garbage bags to pull over my sleeping bag if a blowing rain comes up during the night. In a water-repellent ditty bag (an airline flight bag works fine), carry a flashlight, insect repellent, your roll of toilet paper and miscellaneous personal items.

### Camp equipment

Essential for a float trip is a grub box. Doc Holsman built his of plywood and painted it red. This "magic red box" holds everything a party of six or eight needs for cooking. Make one like it or use an old footlocker. Into this put a wire grill, two large frying pans, steel rotisserie rod, metal coffee pot, two aluminum pots with bails, long-handled forks and spoons, tableware, paper or plastic plates, plastic glasses, Styrofoam cups, paper towels, napkins, condiments and all foods which don't require refrigeration. Remember to add a flashlight, mantle-type lantern, candles, a bag of charcoal, fire starter, camp ax and saw.

A folding campstool, folded flat in the bottom of a canoe, can keep gear up, out of bilge water. Carry ice chests or coolers for vegetables and frozen meats. Gear should be stowed in the middle of the canoe but not lashed down; in case of a capsized it should float free to be retrieved downstream. A full load, tied in, will make it nearly impossible to salvage a swamped canoe. Always distribute the load with weight low and in the center or behind it. A bow-heavy canoe is much harder to steer; a top-heavy one is extremely unstable.

### Where to go

In California, The Russian River is beautiful but can be difficult. The American and Feather Rivers are also popular. Certain stretches of the West's Salmon, Colorado and Green are canoe-float waters, but most are better suited to rafts and kayaks. In Mexico, try the Balsa. The Rio Grande, flowing through the Texas Big Bend country is scenic. In Tennessee, the Hiwassee is both rough and smooth. Michigan, Minnesota and Wisconsin are loaded with fine float-and-fish streams. So are West Virginia, Pennsylvania, Illinois and most of New England. Or for an off-season winter wonderland when the water is high, try Florida's moss-decked Suwannee.

Better yet, take a good look at the streams nearest your home. They might surprise you. **PM**

Chickweed, matchweed, dollarweed, Florida pusley. There are some 20 weeds you can get just by having a lawn anywhere in the South.

Some of these are just a pain in the neck. Others like chickweed and dollarweed are downright aggressive.

They creep out and drop new roots wherever they touch the ground and form dense ugly-looking weed patches that choke out your good grass.

If you remember weeding when you were a kid, you probably hated it. All that kneeling and tugging. It isn't like that anymore. We can't say it will be fun, but at least it will be a lot easier.

## If you don't like the job this does on your weeds, we don't want to keep your money.

First, don't try digging or pulling your weeds up, you'll just get an aching back and you'll still have weeds.

There are just two things to do and you can do them both at the same time. The first is simply to put down something that gets rid of weeds. And the second is to build up your good grass so it's hard for any new weeds to grow. Our Turf Builder Plus 2\* and Bonus\* S weed and feed products do both jobs. Use Turf Builder Plus 2 on bahia, bermuda, fescue or bluegrass lawns. Use Bonus S

One pass with your spreader and goodbye chickweed.

on St. Augustine and carpetgrass lawns. Use either one on zoysia or centipede lawns. One pass with your spreader will finish off more than 20 different kinds of common weeds. And at the same time, you are putting down our special slow-release fertilizer. For up to two months, your lawn will get a steady feeding for healthier, greener turf.

Turf Builder Plus 2 and Bonus S are specially formulated for use in the South and we sell them with the plainest guarantee we can think of. "If for any reason you are not satisfied with the results after using this product, you are entitled to your money back. Simply send us evidence of purchase and we will mail you a refund check promptly."

We also make it easy to get advice on how to keep your lawn looking good. Just call toll-free from Tennessee and Alabama east, 800-543-1415; from Mississippi west, call 800-543-0091. You may also like to get our publication *Lawn Care*. Just write to us here in Marysville, Ohio 43040. It's full of hints on how to get a better lawn.



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CITY \_\_\_\_\_

STATE \_\_\_\_\_ ZIP \_\_\_\_\_

**GM'S 1980 FWD COMPACTS**

(Continued from page 110)

into this car and feel it and drive it, you'll see that there's no way you could call it a Nova—as good as the Nova was."

Chevy offers three Citation body styles: three-door and five-door hatchbacks and an exclusive slant-back coupe for those who prefer a conventional trunk. A traditional Chevy grille and a large air dam dominate the frontal styling, and Impala-like rectangular taillamps bring up the rear. A sporty "X-11" chassis and trim performance package is available on two-door and three-door models.

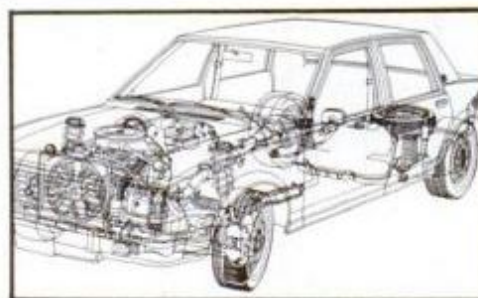
Inside, the standard instrument



Pontiac Phoenix Coupe, like all the new GM compacts, is on a 104.9-in. wheelbase.



Olds Omega Brougham, in the four-door notchback sedan style, is 183 in. overall.



Buick Skylark four-door is ghosted to show the fwd layout and other components.

panel is plain and austere, but a dress-up custom panel adds attractive round dials, and the X-11 package has full instrumentation and a nice sport steering wheel. Citation gets high marks for its optional swing-out rear quarter windows with remote controls, but, incredibly, is the only '80 "X" without an available fatigue-relieving adjustable seatback for the driver's side. Also the odd, vertically-mounted radio seems designed to discourage

customers from installing aftermarket stereos.

**Pontiac Phoenix**

Phoenix for 1980 comes in five-door hatchback and two-door notchback body styles—the former for maximum utility, the latter for a handsome "mini-Grand-Prix" formal appearance. Front and rear styling is basically scaled-down Catalina, with a split-egg-crate grille and ribbed rectangular taillamps. The hatchback, a bit dumpy-looking in base form, looks better in luxury "LJ" clothing and downright beautiful with the sporty "SJ" two-tone and black-out-trim treatment.

There is no "performance-image" package equivalent to Chevy's X-11 (although a "GTO" version is due next year), but the "SJ" option does include a "Rally RTS" suspension and other functional sporting equipment. The Phoenix instrument panel, sporting lots of Grand-Prix-style round gauges and air vents, is perhaps the most attractive of the '80 "Xs," and Pontiac's is the only X-car with damage-resistant soft-face front and rear ends and integral body-colored bumpers.

**Oldsmobile Omega and Buick Skylark**

No champions in the small-car arena, Olds and Buick Divisions are counting on their X-car offerings to draw increasing numbers of luxury compact buyers into their showrooms. Both have two-door and four-door notchback versions, with Olds Cutlass-like styling for Omega and a Buick LeSabre look on the Skylark.

Both are designed to be as much like their larger divisional relatives in driving comfort and character as possible, and the amount of big-car feel the chassis design achieves with such an externally small and lightweight package is positively uncanny, partly due to a vibration-dampening shock absorber between the V6 engine and its cradle.

Interiors, too, are in keeping with the big Olds and Buick themes, right down to the Skylark's large, round, "hood-lit" instruments. Most luxurious are the Omega Brougham and Skylark Limited versions, while sporty small-car shoppers are treated to a choice of Skylark Sport Coupe or Omega SX. Buick's Sport Coupe, with six-slot, body-colored nose, side stripe and blacked-out trim and taillamps may be the best-looking X-car of all—but its high-

(Please turn to page 254)





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## GM'S 1980 FWD COMPACTS

(Continued from page 252)

speed handling is not as precise as that of Chevy's X-11 or Pontiac's SJ, its all-black interior and instrument panel need some contrasting color, and it does not have an available tachometer. Olds' SX, with black waterfall grilles, tricolor side stripes and awkward extra-high rear spoiler, seems at first glance to be as overdone as the Buick Sport Coupe is clean and refined. But you can get the heavy-duty cornering suspension and other goodies without the visual package.

### These cars do everything well

Based on three days of test driving at GM's Desert Proving Ground, plus a fast mountain run and 1000 cross-country miles (see below), we came away extremely impressed. These first new cars for the '80s do everything well and nothing poorly. They're roomy and unbelievably quiet and stable, even at high

speeds. They corner like slot cars, ride better than any small car in memory, perform like pre-emissions fun cars and sip gas with the best of similar-size imports. You can nit-pick: Window cranks operate backwards, the bench seat backs are too laid-back for some peoples' tastes, but finding major fault with these cars is nearly impossible.

### Most tested GM cars ever

According to GM, the '80 X-cars are the most tested and developed new models in the corporation's history, with almost 2.5 million total test miles and 341 preproduction cars produced and tested in several separate prototype and "lead-unit-build" programs. "These are the highest-quality automobiles ever built at GM," says executive vice president Jim MacDonald. We've heard that before. But time will tell. **PM**

## Two hours through the mountains (with Chevy) and two days on the road (with Pontiac)

Brake for the turn... downshift... dial in some steering... accelerate smoothly and quickly toward the next turn... brake and downshift again... wind it up through the gears coming out.

The scene was five V6-powered Chevy Citations (four X-11s and a standard-suspension five-door hatchback), four hard-driving auto writers and a handful of top Chevrolet engineers and technicians playing follow-the-leader on nasty, narrow, little-used roads through some rugged Arizona mountains.

Few ordinary automobiles could best these cars' performance on such roads, and there was no trace of brake fade, little of the evil power understeer and power-off oversteer often found in nose-heavy front-drive cars, and not a whimper of protest from overworked engines and transmissions. The base sedan was good, the X-11 coupes fantastic. Stability and road-holding, even on bumpy surfaces, were outstanding in the tradition of very expensive imported sport sedans. My only complaint was the slightly notchy cable-type manual shift linkage, but even it was good compared to some other front-drive cars.

Never have I enjoyed a test trip more, or learned more about a car in less time. It was over much too soon, but the end result was four very impressed writers and a group of proud and broadly smiling Chevy folks. They've certainly done one hell of a job on this one!

### Flight of the Phoenix

Phoenix-to-Tucson-to-El Paso-to-San Antonio is not the most exciting route to

travel, but it did provide an excellent cross-country test of an '80 Pontiac Phoenix. "Comfort isn't the five-minute drive, it's the five-hour drive," says Pontiac general manager Bob Stempel. So PM put one of his new cars to the test for more than 1000 miles—and, once again, came up smiling.

Five minutes, five hours or five days, there are few more pleasant places to spend it than in a 1980 Phoenix, in this case a lovely silver and charcoal five-door SJ hatchback with the Pontiac four-cylinder and automatic transmission. In freeway and major two-lane-highway driving at 60 to 65 mph, with two aboard, plus luggage, the Phoenix averaged 26.2 mpg, and it was easily the best four-cylinder/automatic combination I've ever driven. It started and drove away with no stumbling or hesitation on cold mornings, had plenty of smooth acceleration and passing performance and never missed a beat in the two-day test. It was hard to believe that the Four and not the V6 was tucked under the hood.

### Roomy cabin, restful seats

The spacious cabin was roomy even for a long-armed, long-legged driver, and was almost concert-hall quiet. After a day of driving, I was no more fatigued than if I had been sitting home in front of the TV, thanks to the extra-long seat travel and adjustment seat back (other U.S. small-car makers take note!). Endless desert freeways aren't my idea of enjoyable motoring, but the next time I have to make such a trip, I'm going to do it in a 1980 Phoenix.—G.W.

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**FREE CATALOG**

# Ohio Man Discovers The Secret of How to Escape The American Rat Race

**7 Simple Rules Net This Working Man Without Any Money or Experience \$145,000 in First Year**

By John Whitehead, Special Features Writer (Canton, OH) The secret to making a quick fortune in America has been reduced to a simple 7 step system by an entrepreneur from Canton, Ohio. It requires little or no money, a minimum of time and no elaborate plant or equipment. In fact, you can do it in your home or anywhere.

The man who did it is Ben Swarez from Canton, Ohio, the Pro Football Hall of Fame city. There are hundreds of rags to riches stories each year in America. However, his is very unique. Ben's system is geared to the working man who is living from pay to pay, no savings or assets, working an 8 hour a day job for a big company, no experience and no rich relatives.

For the secret of how he achieved his workingman's way to riches, I held the following interview with Ben.

My interview with Ben was very lengthy and detailed, and I could never come close to fitting it on this page. The most interesting part was towards the end. At the beginning of the interview Ben related how he arrived at the 7 steps to generate net wealth. He calls these 7 steps a Net Profit Generator System, or N.P.G.S. for short. The story on how he arrived at the N.P.G.S. system is lengthy and also incredible. It was no easy task. I will try to summarize.

It all started when he was typical of a majority of Americans, working for a large corporation and being unable to make ends meet. One day the last straw came in a string of frustrations which made him decide to go into something for himself.

He started out by trying to start orthodox businesses, but soon found himself, as all starting businessmen do, heavily in debt. Then one day while exercising, of all things, he had what he calls a tremendous insight on how to make money quickly.

As he put it, "the idea rolled out of my head like a computer printout." It was the 7 step method, the N.P.G.S. system. But even that didn't come easy. The first N.P.G.S. systems failed miserably. But, Ben could see that his concept was valid and only needed to be perfected. He finally did perfect the system and his first successful system was called N.P.G.S.-4. Within a few weeks N.P.G.S.-4 netted him enough money to pay off all his back debts and have \$80,000 left over for profit. It was such a glorious day that I wanted to pick up on the interview at this point.

**QUESTION: That is incredible. Within a few weeks N.P.G.S.-4 netted you enough money to pay off all your back debts. You had in your hand \$80,000 in cash as net profit. I can't even imagine getting that much money all at once. What was it like?**

**ANSWER:** It's almost impossible to verbalize. My wife and I just stared at the check for a long time. We had a two day celebration with a dinner and party. It's a fantastic experience to go into work and tell them you quit. The chance to say what you truly feel to people who have had you under their thumb for 10 years is truly a pleasant release of frustration.

The first thing I did was pay off all my bills. Then I paid off my house. I took the money to the savings and loan company who held the mortgage personally to see the looks on their faces. After, we had a "burn the mortgage" party. Next I went to the showroom of the local Lincoln-Mercury dealer and laid down the cash for a brand new Mark.

My wife and I went on a shopping spree for clothes. We had been making do with old clothes for so long they had become worn out. She always had to shop for clothes with very little money. I always joked with her that "If I gave you \$5,000 to spend on clothes could you do it in one day?" She used to say "I could do it in a

couple hours." So that's what I did. I gave her \$5,000 to go out and buy clothes.

We then took a long vacation. In New York I bought her a large diamond at Tiffany's — another thing we always dreamed about.

But, what money really does is give you precious time. Time to be with your wife and children before they grow up before you know it — and time to do things you really want to do. Another priceless thing you gain is your self respect. The words of Frank Sinatra's song "My Way" says it all.

**QUESTION: This definitely could be a movie script. How did things go after that?**

**ANSWER:** Excellent. The same year I assembled two more systems and made a total of \$145,000.

**QUESTION: You've been at it for 3½ years now. Were the succeeding years as good?**

**ANSWER:** Better. Here are the results by year: The 1st year as mentioned I made \$145,000; the 2nd year I made \$205,000; and 3rd year \$309,000. And already in the first half of this year I have made \$200,000. I have audited financial statements from certified public accountants and income tax returns to verify this to any agency or investigator of any kind who wishes to challenge me on this.

**QUESTION: That's quite a system. I understand you're now ready to tell everyone how you did it.**

**ANSWER:** I don't know if I'll tell everyone. But, I have put it all into a set of step-by-step instructions. It contains the complete simple to understand details on how to assemble an N.P.G.S. system which I finally reduced to just 7 simple steps. Here are some highlights of the qualities of the system:

- The system requires a minimum of time and money to start.
- You don't need special experience or skills to do it, and it's not a salesman's job.
- You don't need to buy or rent buildings, buy or rent equipment and you don't have to hire people.
- You can do it anywhere — in your house, while you travel or a favorite vacation spot or retreat.
- With the system you can earn \$10,000 to \$500,000 in a matter of months and even within two days depending on which system you assemble.
- The money you make is all earned income which is subject to one of the lowest tax bites.

**QUESTION: Did you say you can make big money within days?**

**ANSWER:** No, that's an understatement. You can actually do it within hours in some cases. You can compile a system in an afternoon one day and start having spendable money in your hands produced by the system the very next morning!

**QUESTION: How much money do you average on a system?**

**ANSWER:** I'd say the average is \$200,000. That's the type I usually stick to. I'll tell you this, doing a system to make \$10,000 to \$20,000 is literally duck soup. I have these available all the time but don't even use them.

**QUESTION: You said you need no special talent or experience. Who all can do it?**

**ANSWER:** You only need to follow directions. All you need is common sense, a sense of pride in your work and the ability to see a job through to completion. This system is also perfect for people who are confined at home, such as housewives.

**QUESTION: O.K. So, why do you want to reveal your system to other people when it's obvious you're making loads of money with it?**

**ANSWER:** Everyone likes to brag when they accomplish something; and, I'm no different. Second, I am in the position now to completely

**Says you can do it anywhere. He does it while traveling in his motor home.**



Swarez does his system in his motor home while his wife, Nancy, drives and his two daughters, Sharon and Michele, play and sight-see. That's the family's pet shetland sheepdog on a favorite perch.

retire. I have put all my money into a diversified portfolio of blue chip investments that no one can touch, including myself. So, I'm protected from losing my money myself or someone taking it away from me.

**QUESTION: I shudder to ask, how much does your system cost?**

**ANSWER:** Would you like to guess? I'll give you a hint. Keep in mind this is a system designed for the working man like I was, and must be affordable to him.

**QUESTION: Well, I know proven money making systems such as hamburger franchises cost \$100,000 to \$250,000 plus overrides, and all you get for your money is their name and a handbook. But with your hint, and, also I know you've been chastised by other entrepreneurs for giving away the store, I'll say \$500.00 to \$1,000.00.**

**ANSWER:** No, I've made it a very token price, just enough to keep away insincere people. I've done it for reasons I don't care to discuss, but, it has something to do with the unwritten law of when you take something out of the land, you have to put something back. The price is only \$20.00. I don't want to sound like a philanthropist, though, the fact is that I will still make money at that price. However, I could have made much more.

**QUESTION: That's an unrefuseable deal. I am looking at the system. It's incredible. You could not get this money making information if you spent \$30,000.00 for a Ph.D. from Harvard. Thank you for a most interesting interview.**

For those who wish to obtain a copy of Ben's N.P.G.S. system, it's called "7 Steps to Freedom". Here's how to order:

To order: 1) Get a blank piece of paper; 2) At the top of the paper, print the words "7 Steps to Freedom"; 3) Print your name and address; 4) Mail this along with \$20.00 in cash, check or money order to Quality Consumer; Dept. G-120 4626 Cleveland Avenue N.; Canton, Ohio 44767.

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## SERVICING GM'S FWD COMPACTS

(Continued from page 111)

pivots while the pawl rides over the quadrant teeth. When you step on the clutch pedal, however, the pawl locks into the quadrant. When additional free play is needed, the cable pulls on the quadrant some more, the pawl rides past more teeth, and a new adjustment position is established.

The automatic has an oil pump built into the valve body and driven off the torque converter by a shaft, instead of directly off the converter. The indirect drive permits placing the pump where it can be removed easily (just take off a cover on the back of the transaxle and there's the valve body). Pump failure on a conventional automatic entails an expensive replacement job you've got to leave to a pro, who must pull and partly disassemble the transmission. On the new GM line, pump replacement is a do-it-yourself proposition.

### Removing the power train

What may become a do-it-yourself proposition, too, as advanced Saturday mechanics gain familiarity with the cars, is removing the power train. The engine and transaxle sit in a rectangular cradle (actually two right-angle members bolted together) that is attached through cushions to body rails. It's not as simple as dropping the power train on the old VW Beetle, but if you know how, in less than a couple of hours you can lower the cradle, complete with engine and transaxle, to the ground. Or you can take off the left side of the cradle and gain room to remove just the transaxle.

The cradle concept is not new—one of the early transverse cars, the British MG-1100, had it, and so does the Lancia today. You'll also find a U-shaped support on the VW Dasher and Audi Fox. The GM cradle, however, is the first we've ever seen that comes apart on the car.

We're not going to give you complete power-train removal instructions here, but some of the things that are involved (in addition to the usual cooling-system, electrical and fuel-system disconnections) include the following:

- First, you must support the power train at the top. If you don't have a chain hoist, you can do it with an adjustable hook or short chain suspended from a bar resting across the engine compartment. VW has such a tool for the Fox and Dasher, or you can make one yourself.

- Unless you want to drop the complete suspension, take the caliper off the disc and disconnect the strut and the tie-rod end from the knuckle. The camber adjustment is at the strut joint, so wheel alignment must be reset after reassembly.

- Remove the axle shaft nut and separate the knuckle and wheel hub from the axle shaft. As on the GM luxury fwds, the wheel bearings are in a sealed hub, so there's no readjustment necessary after you put everything together.

- Separate the axle shaft from the transaxle by driving a tuning-fork-shaped tool between transaxle and shaft. Then pull out the shaft. There are different forks for manual and automatic transaxles. To reinstall later, drive them in, and they'll snap into retainers.

- Unbolt the stabilizer bar completely if

you're taking off only the left side of the cradle.

- Disconnect the exhaust pipe at the manifold for a half-cradle pull, or at both ends, and remove for a full-cradle drop.

- Unbolt the cradle at its mounting cushions, and if you're taking off only the left half, remove the bolts that hold the cradle sections together. There's a lot of them and some are accessible through holes in body rails.

- Disconnect the engine from the torque reaction mount at the top front of the engine compartment.

### Suspension

Although disconnecting the front strut at the knuckle affects camber, this setup (also used by Rabbit and Omni-Horizon) beats the integral strut-knuckle design for two reasons: 1. A camber adjustment can be made so that the ride and handling can be tuned to compensate for the variations in tolerances in all suspensions. 2. The strut can be more easily removed for service. There's no need to separate the knuckle at the ball joint to get it out.

The GM strut (essentially the same as one its Delco Div. makes for Omni-Horizon) should not need service that often, however. It's a superpremium design with a rated life of 50,000 miles and, except in severe service, can be expected to last 100,000 miles, according to GM engineers.

The rear shocks are outside the coil springs and present no service problems.

Dashboard service on the new line should be every bit as good as on GM full-size cars. The dash is completely front-serviced—just remove a single bezel for access to cluster gauges and controls.

### Body care

Body care also should be easier. The lower end on each side (from about the wheel opening down, front to rear) is sprayed with Plastisol before painting. This plastic adhesive makes the paint highly resistant to chipping, so very little touchup painting should be necessary. Plastisol has been in limited use on a few GM cars at the rear quarter panels for the last four years, but on the new models the application will be the greatest ever.

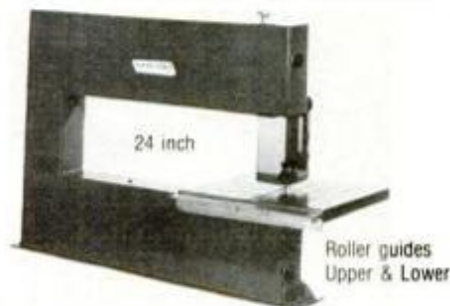
The Plastisol treatment results in a paint finish that is not as smooth as paint alone, so don't confuse it with orange peel or some other defect. That's as good a finish as the process provides to this date.

If the front end gets racked up, the sheet metal can be unbolted from the unit body, another service plus even if you don't do it yourself.

### Good engineering

One engineering appeal of the transverse-engine fwd is that it permits a very short engine compartment, so the truly open-access-to-everything car probably is unrealistic to expect with this design. GM has, however, done a lot of good engineering outside the engine compartment, too, and by figuring such popular options as airconditioning and power steering in the basic underhood layout, has produced an "as-equipped" package the Saturday mechanic can handle. **PM**

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## MODERN SEARCH AND RESCUE

(Continued from page 106)

airport to set up a command post. The first spotter plane was in the air at 6:45. Then, a snag: The spotter, flying over the position marked by the computer, was unable to see McLatchy's plane. The C.A.P. pilot was picking up a distress signal from an emergency locator transmitter. But McLatchy's Cherokee had nestled into a kind of gully, preventing the signal from going out in all directions. Furthermore, the mountains made the signal echo. The pilot of the twin-engine spotter was unable to see the wreckage, or pin down the transmitter signal.

He returned to Bennington.

Down on the ground, McLatchy and his passenger had passed a difficult night. The sleeping bag hadn't been enough to protect them from cold air knifing into the cockpit. Both men in the back seat of the plane suffered constantly from muscle cramps. At dawn, Richardson brushed snow off the maroon top. McLatchy found it difficult to move.

### Spotted at last

Then the survivors heard the distinct whine of an approaching aircraft. It was a single-engine spotter this time, slow enough to draw a bead on the emergency transmitter signal. The engine noise grew louder and the plane appeared above. As it crisscrossed the air over the wreck, Richardson waved.

A short time later, a twin-engine Sikorsky chopper from Otis Air Force Base on Cape Cod hovered in the 30-knot wind spilling over the top of the mountain. The countryside was too rugged to haul the survivors out by snow vehicle, so now a cable pulled McLatchy and Richardson, one by one, about 85 feet up into the warm belly of the helicopter.

"You okay?" the hoist operator asked as McLatchy swung in the door. McLatchy made an OK sign with his thumb and finger. Within minutes, the men were in hospital rooms. Both had survived.

The story might have ended differently if a chain of fortuitous events had broken at any point: If the Piper's heating system had worked well, and if McLatchy had not chucked a sleeping bag in the back seat . . . If the plane had crashed a hundred feet higher up the mountain where, Dawson said, trees were much thicker. . . And if Malcolm Dodge, working a desk job in another state, had not been able to call on a computer to find a needle in a snow-capped haystack.

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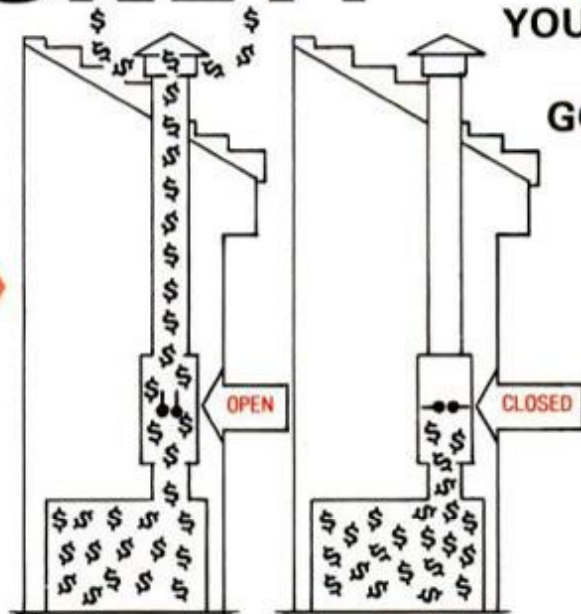
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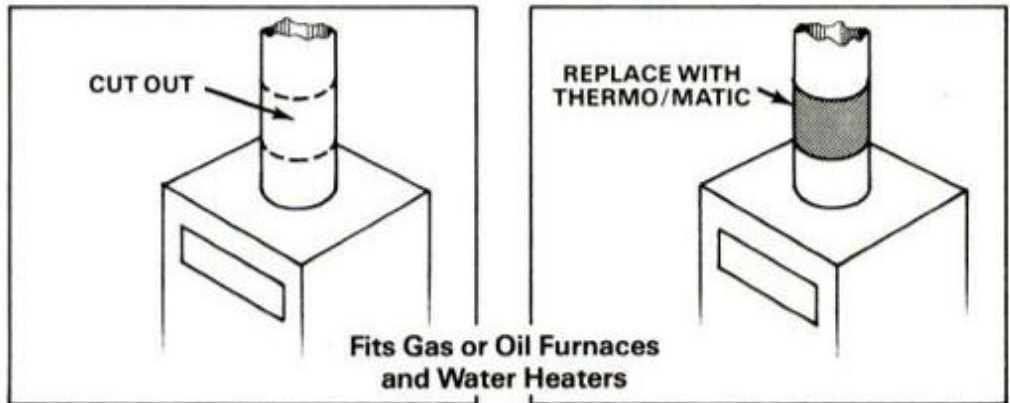
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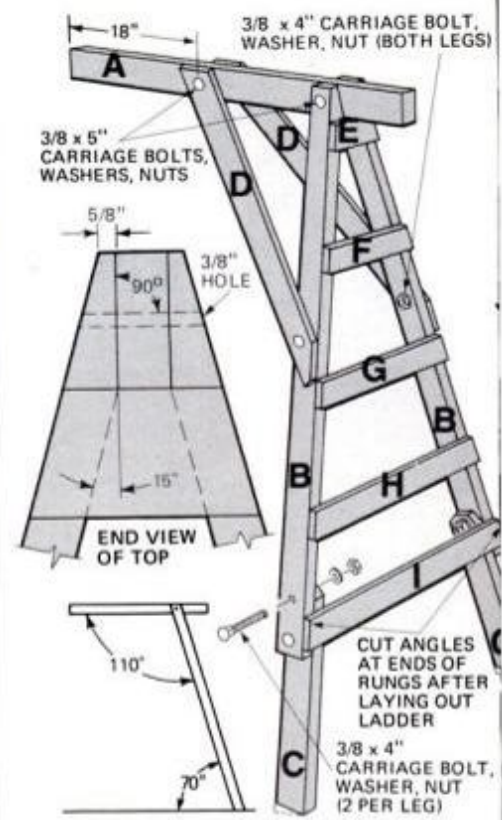
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## SCAFFOLD YOU BUILD

(Continued from page 139)



### MATERIALS LIST—SCAFFOLD LADDERS

Key	Pcs.	Size and description (use)
A	2	1 1/2 x 3 1/2 x 48" pine (top pieces)
B	4	1 1/2 x 3 1/2 x 72" pine (uprights)
C	4	1 1/2 x 3 1/2 x 24" pine (leg extensions)
D	4	3/4 x 3 1/2 x 48" pine (braces)
E	2	3/4 x 3 1/2 x 8" pine (crosspiece)
F	2	3/4 x 3 1/2 x 15" pine (crosspiece)
G	2	3/4 x 3 1/2 x 22" pine (crosspiece)
H	2	3/4 x 3 1/2 x 29" pine (crosspiece)
I	2	3/4 x 3 1/2 x 35" pine (crosspiece)

Misc.: 8, 3/8 x 5" carriage bolts; 24, 3/8 x 4" carriage bolts, nuts and washers for carriage bolts; 10d nails.

crosspiece (I) in position 3 in. from the bottom of the uprights. Saw protruding ends of the crosspieces off flush with the uprights.

Position top piece (A) and diagonal braces (D) so that the angle formed where they meet is 110° (see drawing, above). Temporarily tack-nail diagonal braces to the uprights and top piece and saw protruding ends of the braces flush with the edges of the top piece and uprights. Sand off all sharp edges.

Drill holes for carriage bolts as shown in the drawing. Keep additional holes for leg-height adjustment 1 1/2 in. apart. Then remove temporary nails, insert carriage bolts and fasten with washers and nuts.

Saw off the corners of the upper ends of the leg extensions so they clear the lowest crosspiece when the extensions are in folded position. To fold in top piece, remove bolts holding lower ends of braces, loosen bolts holding uprights and braces to top piece, and swing top piece down. Replace hardware in original holes for safe keeping.



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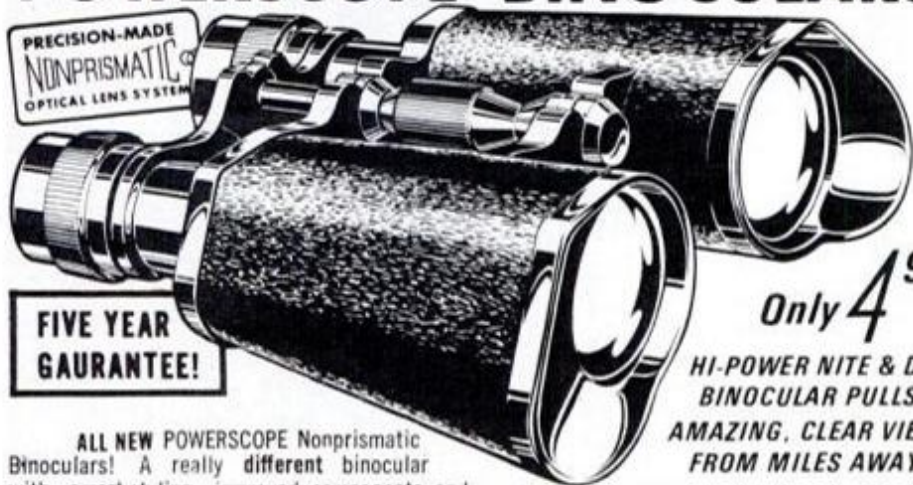
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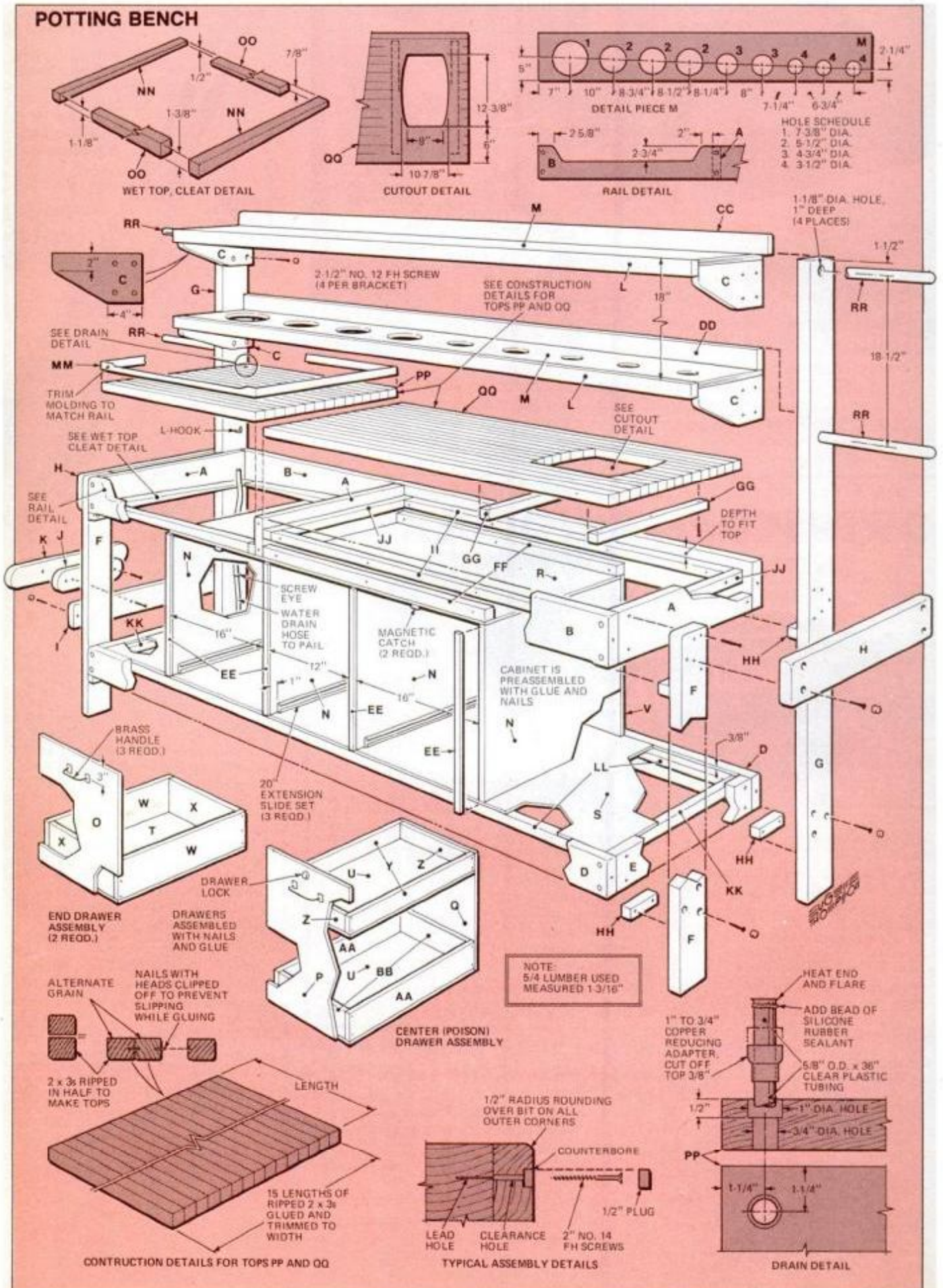
# BUILD PM'S POTTING BENCH

(Continued from page 141)

the top to keep the assembly true. Face the boards with kitchen wax

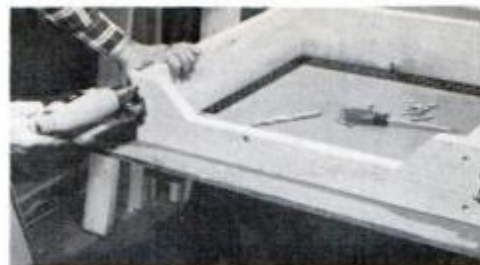
paper to prevent them from sticking to the work. Mix glue and brush it onto mating surfaces as quickly as possible. When all pieces are coated, apply light pressure with bar clamps

to bring the pieces together. Then clamp alignment boards so they're snug. Apply full pressure with the bar clamps; add more clamps and let glue set about 12 hours.

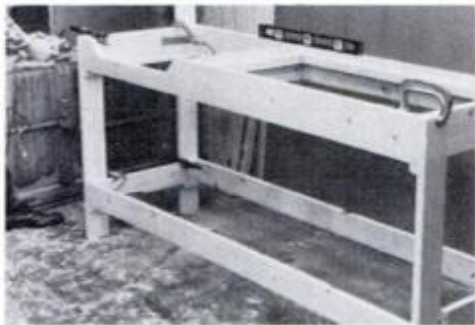




**1** Bore 1-in.-dia. holes in slop sink's front to form corners when cutting contour. On straight cuts, use a clamped-on guide.



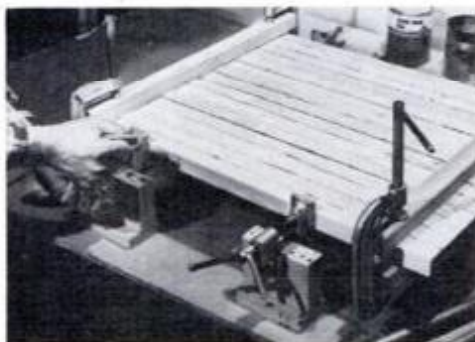
**2** Clamp frame together before boring pilot holes for screws. Drill three holes, one each for pilot, shank and plug.



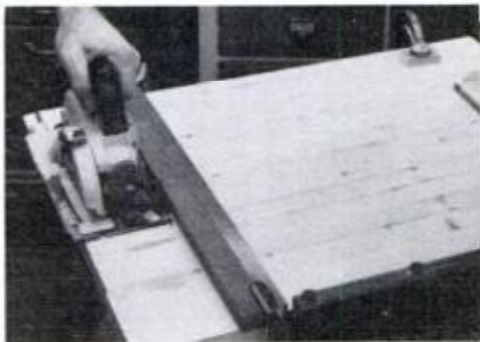
**3** Frame should be level when boring holes for screws. Since floors are seldom level, use shims under legs if needed.



**4** Nail "pins" are used to align the boards for edge gluing. Number pieces in order to make final assembly easier.



**5** Use wax paper, boards clamped on surfaces to keep assembly from buckling as pressure is used with bar clamps.



**6** Tops are too bulky to crosscut on table saw. Instead, clamp a guide and use a portable circular saw to trim off the ends.



**7** Belt sander is only way to quickly true-up surface. First, shave off the glue beads with a sharp chisel.

Use a belt sander to remove all glue lumps and saw ripples. Then trim off the excess stock at ends and sides so the top will fit the opening formed by upper rails.

(Please turn to page 264)

#### MATERIALS LIST—POTTING BENCH

Key	Pcs.	Size and description
A	3	1 1/8" x 5 1/2" x 22" pine
B	2	1 1/8" x 5 1/2" x 75" pine
C	4	1 1/8" x 5 1/2" x 10 3/4" pine
D	2	1 1/8" x 4" x 75" pine
E	2	1 1/8" x 4" x 22" pine
F	2	1 1/8" x 4" x 36" pine
G	2	1 1/8" x 4" x 72" pine
H	2	1 1/8" x 4" x 24 1/2" pine

I	1	1 1/8" x 3 1/4" x 24 1/2" pine
J	1	1 1/8" x 3 1/4" x 9 1/2" pine
K	1	1 1/8" x 3 1/4" x 17 1/2" pine
L	2	1 1/8" x 1 1/2" x 75" pine
M	2	3/4" x 10 1/4" x 75" plywood
N	4	3/4" x 19 1/4" x 21 1/4" plywood
O	2	1/2" x 15 1/4" x 19 1/2" plywood
P	1	1/2" x 11 1/4" x 19 1/2" plywood
Q	1	1/2" x 10 1/4" x 16" plywood
R	1	3/4" x 21 1/4" x 47" plywood
S	1	3/4" x 22" x 72 1/4" plywood
T	1	3/4" x 14 1/8" x 21" plywood
U	2	3/4" x 10 1/4" x 20 1/2" plywood
V	1	1/4" x 20" x 47" plywood
W	2	3/4" x 5 1/4" x 21" pine
X	2	3/4" x 5 1/4" x 13 7/8" pine
Y	2	3/4" x 2 1/2" x 20 1/2" pine
Z	2	3/4" x 2 1/2" x 9 3/4" pine
AA	2	3/4" x 3" x 20 1/2" pine
BB	2	3/4" x 3" x 9 3/4" pine
CC	1	3/4" x 2 1/2" x 77 1/4" pine
DD	1	3/4" x 2 1/2" x 75" pine
EE	4	3/4" x 3/4" x 19 1/4" pine
FF	2	1 1/4" x 1 1/2" x 30" cleat
GG	2	1 1/4" x 1 1/2" x 19" cleat
HH	8	1 1/4" x 1 1/4" x 4" cleat
II	2	1 1/4" x 1 1/2" x 40 1/2" cleat (rip from 2 x 3)
JJ	2	1 1/4" x 1 1/2" x 22" cleat (rip from 2 x 3)
KK	2	1 x 1 x 22" cleat
LL	2	1 x 1 x 70 1/4" cleat
MM	4	1 1/2" x 8" doorstop molding (cut to fit)
NN	2	1 1/2" x 1 1/2" x 22" fir
OO	2	1 1/2" x 1 1/2" x 25" fir
PP	15	2 1 1/8" x 27 1/4" (2 x 3s ripped in half)
QQ	15	22 x 43 1/2" (2 x 3s ripped in half)
RR	4	1 1/2"-dia. x 12" closet pole

Misc.: 20" Full-extension slides, Grant No. 328; 1" to 3/4" copper reducing adapter; 3/4" O.D. x 36" plastic tubing; silicone rubber sealant; drawer lock; 3 drawer pulls; plastic dishpan.

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## GUARD YOUR BATTERY

(Continued from page 86)

wires to the cigaret-lighter plug, that the ground lead (which connects the side or shell contact, not the tip) is the lead attached to the long outside row of connection points (marked "Y" on the breadboard). The LEDs will not light when plugged in backward. They can be indexed by a flat on one side, which should point toward R-1.

All resistors used are 1/4-watt types. The LEDs must be small to fit as shown, about 0.1-inch diameter. The hookup jumpers are simply No. 22 AWG solid hookup wire; we used

several colors to help make the connections more easily identifiable. You'll find small molded numbers (1-23) and letters (A-J, X and Y) on the solderless breadboard. They should help you duplicate our layout.

### Finding the components

Your local parts store should have all of the resistors, as well as the capacitor, the zener diode and probably the LEDs. Since the LM3914N is a new IC, you may have a bit more trouble locating it. Parts suppliers that handle National Semiconductor ICs can probably get the IC for you; suggested retail price for the LM3914N is \$3.75. **PM**

### Breadboarding from the inside out

Modern solderless breadboards, which are sometimes called plugboards or solderless sockets, depend on a specially designed flat, folded spring-metal clip to make contact. The clip is slotted into pairs of spring fingers, which permit it to independently grasp a number of wires, pins or leads of varying sizes and hold them firmly.

Each of these clips, called a terminal, has five pairs of these spring fingers, each spaced 0.1 inch apart. The solderless breadboard itself is an array of these terminals placed behind a matrix pattern of access holes in the face of an insulating plastic carrier, arranged in flanks which are also spaced 0.1 inch apart.

So the matrix of holes is spaced on 0.1-inch centers in each direction, which happens to be an industry standard for lead spacing in integrated circuits and many other components. As a result, most components simply plug into the breadboard directly, without bending leads.

The metal chosen for these terminal spring clips is generally nickel-silver. It is not only a good conductor itself; its oxides are also good conductors. So even an old spring clip terminal can still provide excellent electrical contact.

The plastic molded into the insulating carrier is most often an acetal copolymer—the stuff "unbreakable" combs are made of. It will bend or give a little rather than chip, which helps lengthen the life of the breadboard assembly.

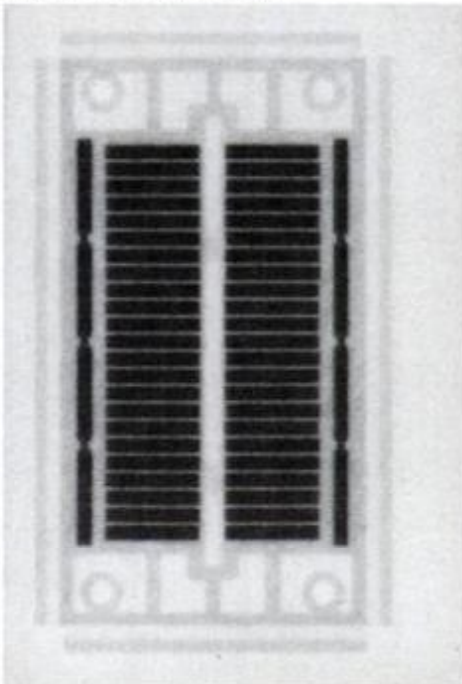
Components can be plugged into the board easily, or unplugged just as easily, too, and small lengths of insulated solid hookup wire do the job handily. AWG (American Wire Gauge) 22 is probably optimum, but the breadboard can easily accommodate wire two or three sizes bigger or smaller. The center channel between the flanks of terminals provides the appropriate spacing between sides of integrated circuits. So when an IC is plugged into the bread-

board, each lead plugs into the end of a terminal, leaving four contact points (pairs of fingers) unused.

Outside the twin flanks of terminals on each side of the breadboard is a long row of terminals, connected end-to-end. These are perfect for bussing power supply or signal voltages. The tongue-and-groove feature molded into the edges of the breadboard allows them to be mechanically interlocked into larger arrays to make more area available.

These ingenious and versatile electronic circuit building blocks are being used more and more by both professional designers and hobbyists. They're quick and simple to use, very dependable, completely reusable and delightfully inexpensive.

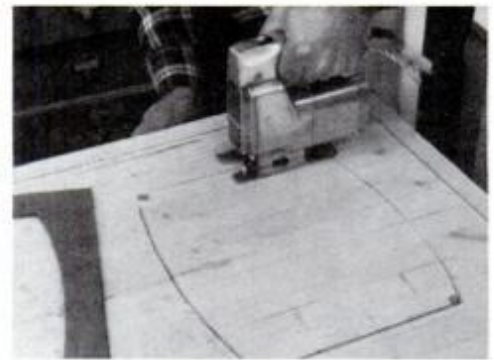
One other point breadboard users make, both because of the ease of using these boards and because no soldering is necessary, is that breadboards save energy. This project is your chance to evaluate these new electronic building blocks for yourself.



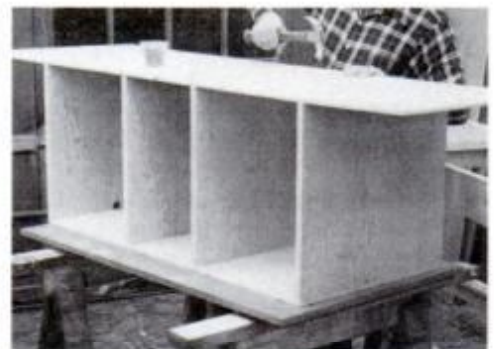
X-ray view of a plastic breadboard, showing placement of the clips.

## BUILD PM'S POTTING BENCH

(Continued from page 86)



**8** Use sabre saw with a coarse-tooth blade to make opening in top. Note the test cutout in scrap paneling at left.



**9** Nails and glue are used to assemble cabinet case. Exposed plywood edges are finished with wood strips later.



**10** Cabinet case and lower rails are installed as single unit during final assembly. Cleats work as extra hands.

Straight cleats are used to support the large tabletop while the small top requires tapered cleats to achieve the necessary pitch so water will drain. Tack-nail the cleats in place and test the two tops for fit before gluing-in the cleats. Do not glue-in the tops until the cabinet has been installed. Also, before gluing-in the sink surface, bore and counterbore the hole for the drain—a copper pipe reducing adapter and a piece of clear plastic tubing.

The adapter is too long as is, so 3/8 in. must be cut off the top with a hacksaw. Use silicone rubber sealant to seat it firmly in the counter-bored hole. To flare the tubing end, use a heat gun or hair dryer to soft-

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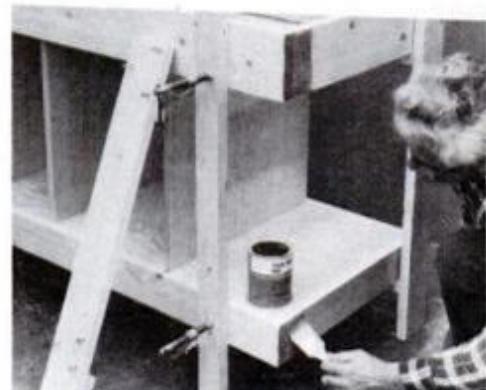
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## BUILD PM'S POTTING BENCH

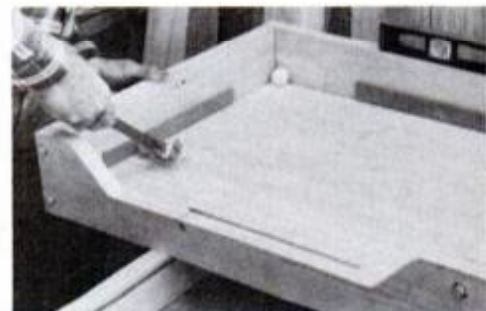
(Continued from page 264)

en the plastic. Press the edges outward by twirling the end of your thumb in it. When cool, the tube end will retain the shape. Apply sealant on the adapter shoulder, then slide the tube in.

The cabinet is made as a completed unit and slipped into place



**11** Temporary 2 x 3 leg, clamped to rails, permits removal of true leg for applying glue. Repeat at each corner.



**12** To accurately position cleats under sink, temporarily prop bottom into position and tack guide strips to sink sides. Ball shows where water will drain.



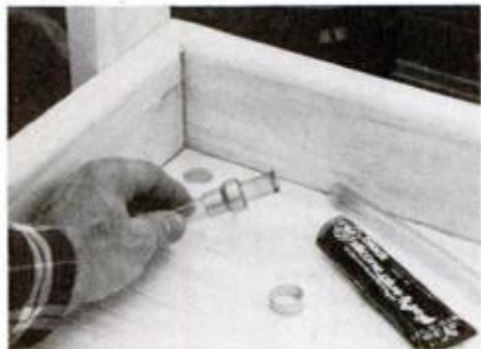
**13** Coping saw cuts off excess molding after it's installed—after you mark it in position and clamp to bench.

on 1 x 1 cleats which are glued to the insides of the lower rails. The back panel should not be attached until after the drawers have been installed. This allows access from the rear and makes it easier to install and adjust drawer-slide hardware.

To install the cabinet, unscrew the lower rail assembly and place it on the floor. Drop the base of the cabi-

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net onto the cleats then secure with nails and glue. Lift the unit onto the lower leg cleats and push it into place. A pair of cleats glued to the top of the cabinet and to the inside of the upper frame will add rigidity. Now the legs can be permanently attached.



**14** Plumbing consists of sawed-off reducing adapter, clear plastic tube. Flare tube end to obtain watertight fit.



**15** Keyed lock is fitted into a 7/8-in.-dia. hole. The sliding drawer hardware is designed to sustain heavy loads.



**16** Outside drawers each accommodate two plastic bins. Full-extension drawer slides mounted on each side permit easy access.

Make the drawers and then attach the slides before adding the plywood drawer fronts. To position the fronts accurately, drive two nails through the front of the drawer. Then shim the drawer front so it rests perfectly centered. Next, with a helper, push the drawer from the back so the nail

(Please turn to page 270)

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## BUILD PM'S POTTING BENCH

(Continued from page 269)

points make their marks on the 3/4-in. pine front. Remove the drawer, apply glue, align the nail holes and drive them home. Add a few more nails. Use a 1/2-in.-radius rounding-over router bit to round the edges.

To cut the opening for the plastic dishpan in the larger top use a sabre



**17** To size holes for pots with diameters other than those shown, make a simple caliper using wood scraps.



**18** Use a fly cutter in a drill press only; clamp work firmly on both sides. Or, make cutouts with a sabre saw.



**19** Apply three coats of quality exterior varnish to the work surfaces. The other parts need only two coats.

saw. If the pan you use is different from the one indicated, change the dimensions. Cut a dummy hole in scrap wood first to check the fit.

Doorstop molding is used to seal the joint line around the sink top. Miter the corners and attach with silicone sealant and brads.

Pot rack holes can be cut with a fly circle cutter on a drill press or a sabre saw with pivot guide attachment.

For a tough finish, apply three coats of clear varnish such as Flecto Varathane and exterior paint. **PM**



## INDY 500 MECHANICS

(Continued from page 125)

Olson, however, there were dozens who rode in terrified anonymity.

The second two-man car period was a result of a Speedway effort to cut the cost of racing after the '29 stock market crash, and to attract auto manufacturers. Engine displacement limits went from 91½ cubic inches to 366, superchargers were effectively outlawed, and other restrictions were placed on nonstock engines. To keep big stockers from dominating things, a weight minimum of 7½ pounds per cubic inch, with an absolute minimum of 1750 pounds, was set.

The new rules also called for a body width of 31 inches, up from less than 20 inches of typical Miller and Duesenberg racers, with provision for mechanic and driver.

The change in the rules *did* attract many stock-based cars, but the first seven places went to the pure racing cars—Millers and Duesenbergs given wider bodies to meet the new regulations. Billy Arnold's winning car weighed in at just six pounds over the minimum and carried a 151-inch Miller Eight for power. His riding mechanic, Spider Matlock, however, couldn't have been as comfortable as the unknown daredevil who rode with tenth-place finisher, L.L. Corum: Winner of the 1924 race with Joe Boyer, Corum drove an absolutely stock Stutz, doors, cigar lighter, and all. Prepared for the race by the removal of fenders, running boards and the windshield, and the doubling of shock absorbers, the car had a wheelbase of 134½ inches (compared to Arnold's 100) and weighed 4030 pounds. No one ever had a plusher ride at Indy.

Russ Snowberger drove a modified Studebaker to eighth place in that race, sixth in 1931. His performance so fired up Studebaker management that they entered an eight-car team in the 1932 race and finished five in the first 15 places.

One entrant on the Studebaker team was Zeke Meyer, a Philadelphian who typified the era of the "gentleman driver" which was fast disappearing from the Indy scene. In a classic 1937 photo, he is shown about to hop into his Studebaker, which he'd driven to ninth place the year before. Topped by one of the hard leather soup-bowl helmets of the period, his driving outfit included white shirt, a tie, a shetland sweater tucked into trousers from a business suit, a watch chain hooked to the belt, and wing-tipped shoes. Best of all, one pant leg is rolled up

and we can see that Zeke is wearing silk socks and garters. Match that, A.J.! His son, in polo shirt and white duck pants, was riding mechanic.

By 1938, it was obvious that Detroit wasn't planning to "go racing." The pure racing engines continued to dominate the 500 and, as the day of the four-cylinder Offy (an off-spring of the Miller) dawned, Speedway management changed specs. The two-man car was finished.

And nobody really minded. Other than a few die-hards (no pun intended), most mechanics felt no desire to ride the track at speeds the cars were reaching, with someone else's hands on the wheel and foot on the throttle.

Drivers who'd started as riding mechanics, or with riding mechanics at their sides, retired and a new breed took over.

## The modern mechanic

Meantime, emphasis shifted to better and more thorough preparation for the annual 200-lap grind around the Speedway. Although California had been, next to Indianapolis itself, the center of auto racing equipment development before World War II, it virtually had the field to itself afterward. As the nation's major producer of aircraft, the area developed hundreds of young mechanics, trained in the precise engineering approach to speed. They had a new appreciation of close tolerances, light weight, and the full utilization of the latest in metallurgical and technological advances.

The hot-rod movement getting its start at the time also made its contributions, both in the development of hardware and ideas and in the communications it spawned. New approaches, new tricks, and the results of unsuccessful experiments quickly became common knowledge, raising the sophistication level of the whole racing fraternity.

With all this came a change in the image of the Indianapolis mechanic. No longer a hell-bent-for-leather blacksmith who'd ride with his driver through the jaws of death, he became a studious technician, getting the job done "by the numbers."

Other numbers have entered the picture, too—the big numbers of major corporate sponsorship. As late as the 1950s, it was possible to acquire a race car, a reasonably good engine, enough spares to shade the odds, and to put together a team to enter the Indy 500, all for as little as \$25,000. The winner usually had to spend far more, but that investment—with a little luck and some careful corner cutting—would give


(Please turn to page 272)

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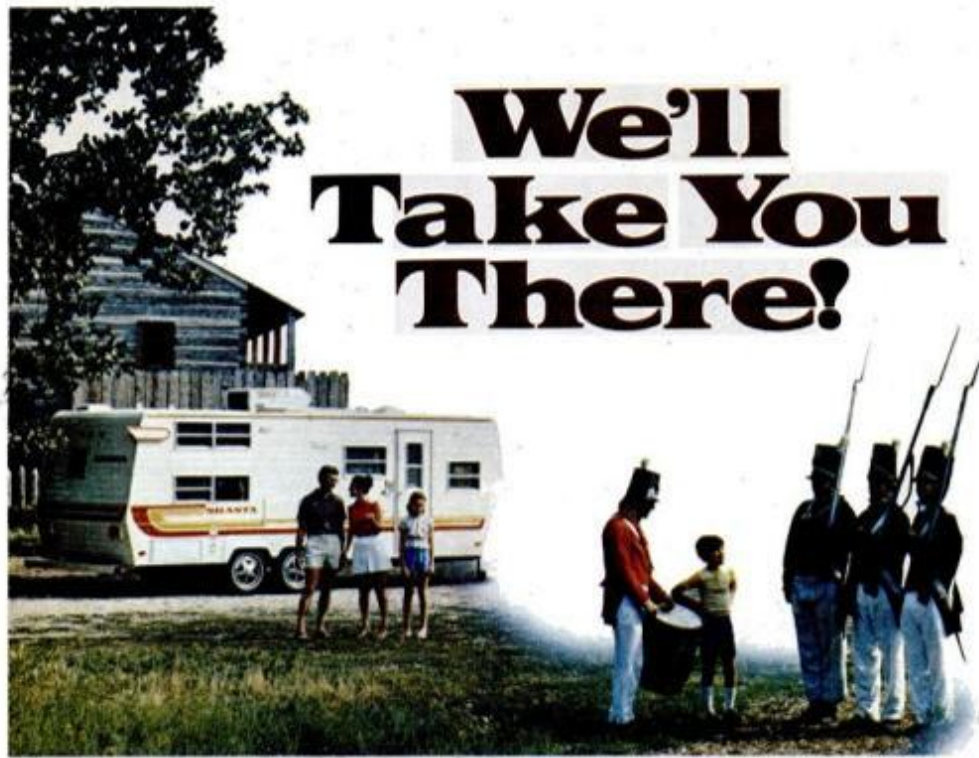
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## INDY 500 MECHANICS

(Continued from page 271)

you a better than even shot at qualifying and finishing in the first 10.

Today, that won't even buy a new engine—at least not one of the Ford-based Cosworths that may finally have put the long-dominant Offy out to pasture. It just *might* make the down payment on one of the transporters the superteams use to move their cars and crews to races.

Representing an investment of at least \$100,000, a transporter begins life as a standard 40-ft. drop-frame highway trailer. In the step-up above the king-pin is a full machine shop including a lathe, a milling machine, a bandsaw, a stationary belt sander and a power hacksaw.

Stainless-covered benches run the full length of both sides, with removable portions cut out for a side door. Spaced at predetermined intervals along their surfaces are inset tie-down rings—the benches also serve as the shelves on which a team's two cars ride from race to race.

A heavy duty diesel-powered generator, located outside where the refrigeration unit is customarily mounted, provides power for a high-capacity electric arc welder, full fluorescent lighting, at least one air-conditioner, a refrigerator, and enough outlets to permit the use of half a dozen drills and sabre saws.

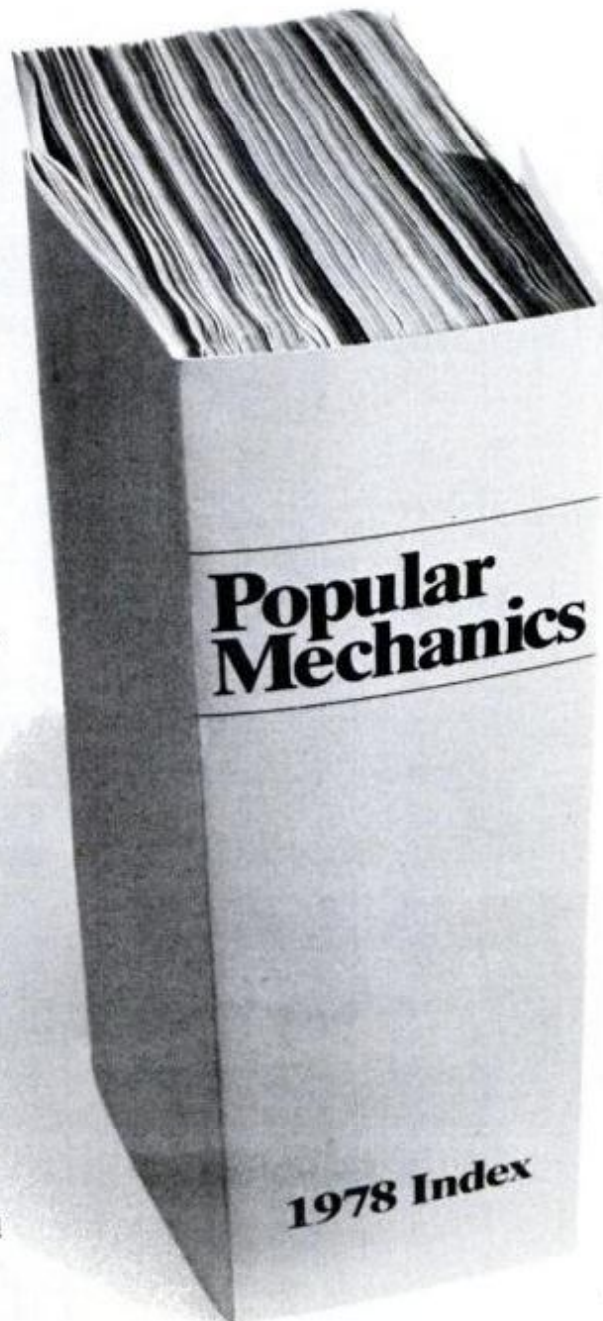
Unless the roof is translucent fiberglass, for lighting during the day, it may be strengthened and decked so that the team's owners, sponsors and family will have a comfortable place, near the pits (everywhere but at Indianapolis), from which to watch a race.

Stored in myriad lockers, cabinets and bins are enough nuts, bolts, parts and tools to do everything but build a new car. Spare nose cones, wings, wheels and tires make up the rest of the cargo manifest in the "essential" category, but there's usually enough room left over for half a dozen folding deck chairs, an awning, several cases of beer, and the team's luggage. Pulling this is a high-speed Pete or Kenny with sleeper cab, itself worth \$25,000.

Going racing today is a far cry from loading the race car on an open two-wheel trailer and towing into the sunset with a pickup or a modified sedan and the mechanics at Indy, circa 1979, are a new breed of professionals.

The mechanics who work the pits today may not have to face the terror of the wall at Indy, but they may face a different terror—the challenge of rebuilding a damaged car the night before an Indy 500! **PM**

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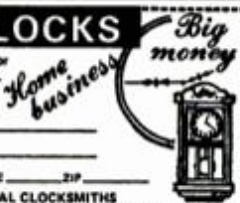
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So, with Patio Protector you get the best as well as the least expensive model by far. In the late afternoon or early evening you'll be able to relax in the shade, linger over your barbecue, stay by the pool, play tennis while it's cool—without being bothered by mosquitoes. Even after it rains you can forget about sprays, throw away those smelly citronella candles.

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Patio protector mounts in minutes, virtually anywhere. On a tree, any kind of fence, the side of your house, even a brick wall. Set it up about 25 feet from where you generally stay. Fifty feet may be even better. Then plug it in. Ordinary house current is all that's needed, though you may have to use an extension cord. The operating cost is less than 30 cents a month.

The ultraviolet light, with the exact frequency for maximum effectiveness, is produced by a unique, fluorescent-type bulb constructed of special glass and housed in scintillating reflectors. Often called "black light" because it's invisible to the human eye, it seems to compel the insects to come ever closer. Actually capturing them because they can't—or won't—fly away.

Just why it works no one knows. Not the scientists who discovered it, not the entomologists who tested and confirmed the phenomena. They do suspect, however, that the light's effectiveness is somehow connected with the constant early evening and night time propagation activity (sex) of these insects.

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Captured, unable to escape or fly away, the mosquitoes, moths, gnats and other insects are caught in a down-draft (created by a small electric fan) and plunged into the water in the pan below where they're drowned. All you do is change the water about once a week, emptying the tray in the bushes where the birds eat all the bugs. It's a clean, simple, seconds-a-week procedure.

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## OLDSMOBILE TORONADO OWNERS REPORT

(Continued from page 133)

formance a person could want, but even so, it's too high-priced."

### Praise for comfort

The Toronado's riding qualities and general comfort came in for high praise, the following being representative and typical:

"Here's a comfortable car at last," says a Wisconsin CPA, "and the first GM two-door I can sit in wearing a hat!"

A Michigan domestic engineer: "Rear passengers feel that the individually contoured seats greatly improve comfort."

"Quietest car I've ever driven," purrs a retired farm-equipment manufacturer. A Michigan teacher observes, "This car really has good legroom, but remember, it only seats four."

An Ohio real estate salesman: "I've never had so many compliments about the comfort of a car." And a Michigan property manager: "Everything is in its proper place, and the seating is fantastic."

Despite teething problems of a new car on a new assembly line, nearly 74 percent of the owners we surveyed judged the Toro's workmanship *good to excellent*. "No complaints on that score," declares

an Iowa nurse, "and I'm one to voice them if so deemed." An Ohio steelworker: "I believe it's the best of any car we've ever owned." A Michigan manufacturer's rep: "Generally excellent. There are a few trim pieces out of alignment, but it's still the best-put-together car I've owned in a long time."

One thing that bothered a few owners (6.1 percent) was the design on the radiator grille. A New York insurance exec suggested, "The plastic grille is too flimsy, and I'd also like to see it restyled to dress up the front end." An Ohio housewife agrees: "The front grille is rather nondescript." And a Brooklyn day-care director: "Why let the grille spoil the looks of an otherwise fine-looking car?"

### Some improvements suggested

The grille comments came in a section where we asked owners to list changes they'd like to see in their Toronados. Nearly 25 percent suggested leaving the car as is, but we did get quite a few recommended improvements to wit:

"Better gas mileage," proposed a Michigan physician, and he was echoed by 8.1 percent of the Toronado population.

"Styling is too boxy," quoth an Ohio salesman. A Minnesota labor official: "Larger glove compartment. They put a huge door on it and then have a tiny bin. It's ridiculous." An Illinois physician: "The rear license bracket is inconvenient to pull down for getting at the gas filler. How about a little handle? I'd also like no-draft vent windows in the front and the fuel gauge needs brighter illumination at night. You almost need a flashlight to see how much gas there is/isn't in the tank."

A Wisconsin diemaker: "We don't like the radio antenna that goes up and down whenever you turn the radio on and off. It freezes in wintertime and will burn out the motor."

Quite a few owners didn't care for the temporary spare tire. "Spare tire is for the birds," chirps a New York physical-fitness director. "My husband insists we get a regular spare, but then were will we put the luggage?" And an Omaha postal clerk laments, "I'd like to have normal wheels for mounting snow tires and for use as a conventional spare."

More owners experienced early mechanical problems than didn't—a ratio of 54.5 to 45.5 percent. The most common

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involved transmission leaks and linkage adjustments—aggravating but not serious. "I've been back to the dealer five times for leaks in the automatic transmission, and it's not fixed yet," grumbled an Ohio estimator.

Misadjusted heater controls, noisy speedometer cables, balky carburetors and deranged electrical systems were

also mentioned. Yet nearly 70 percent of complaints were taken care of by dealers, usually after just one visit to the shop.

The dealers themselves constitute a well-liked group, by and large, with 71.1 percent garnering votes of *good to excellent* for their service departments.

Ninety-three percent of our Toronado owners said they'd buy another Toro next

time—a very high figure and far above norm. Repeat customers are legion, and as a Michigan supervisor put it, "I am sold on front-wheel drive. This is my 10th Toronado."

A salesman from Michigan averred, "It's the same quality car as the Eldorado for about \$4000 less, with better styling than the Riviera and a super ride." **PM**

## SUMMARY OF 1979 OLDSMOBILE TORONADO OWNERS REPORTS\*

<b>Total miles driven:</b> 570,530	<b>What changes would you like?</b>	Poor . . . . . 0.7	Average . . . . . 12.1
<b>Average miles per gallon</b> (350-cu.-in V8, gas-powered, EPA 16 mpg)	No changes . . . . . 24.3%	<b>Had any mechanical trouble?</b>	Fair . . . . . 10.7
In town . . . . . 14.2	Better gas mileage . . . . . 8.1	Yes . . . . . 54.5%	Poor . . . . . 6.0
Long trips . . . . . 17.8	Normal spare tire . . . . . 6.1	No . . . . . 45.5	<b>Number of vehicles owned:</b>
<b>Why did you choose the Toronado?</b>	Different grille styling . . . . . 6.1	<b>What type of trouble?</b>	Toronado only . . . . . 32.5%
Front-wheel drive . . . . . 53.3%	Better quality materials . . . . . 4.7	Transmission . . . . . 22.2%	Two cars . . . . . 52.1
Styling . . . . . 48.7	<b>Workmanship opinion:</b>	Oil leaks . . . . . 11.1	Three cars . . . . . 13.0
Past experience . . . . . 10.9	Excellent . . . . . 33.7%	Heater . . . . . 10.0	Four or more cars . . . . . 2.4
Size . . . . . 9.1	Good . . . . . 40.2	Speedometer cable . . . . . 8.9	<b>Make of other vehicles owned:</b>
<b>Specific likes:</b>	Average . . . . . 13.6	Carburetor . . . . . 7.8	Oldsmobile . . . . . 28.9%
Handling . . . . . 50.9%	Fair . . . . . 7.7	Electrical . . . . . 7.8	Chevrolet . . . . . 22.8
Styling . . . . . 45.5	Poor . . . . . 4.7	<b>Did you repair it yourself?</b>	Ford . . . . . 14.0
Ride . . . . . 35.2	<b>Comfort opinion (front seats):</b>	No . . . . . 95.6%	Cadillac . . . . . 7.9
Front-wheel drive . . . . . 30.9	Excellent . . . . . 73.2%	Yes . . . . . 4.4	Buick . . . . . 7.0
Comfort . . . . . 30.9	Very good . . . . . 17.9	<b>Dealer repairs satisfactory?</b>	<b>Age distribution of owners:</b>
<b>Specific dislikes</b>	Good . . . . . 8.3	Yes . . . . . 69.2	15-29 years . . . . . 6.2%
No complaints . . . . . 28.1%	Fair . . . . . 0.6	No . . . . . 30.8	30-49 years . . . . . 35.6
Poor workmanship . . . . . 9.8	Poor . . . . . 0.0	<b>Dealer service opinion:</b>	50-plus . . . . . 58.2
Lower-than-expected mpg . . . . . 8.5	<b>Comfort opinion (rear seats):</b>	Excellent . . . . . 41.6%	<b>Would you buy another Toronado?</b>
Price too high . . . . . 7.8	Excellent . . . . . 49.3%	Good . . . . . 29.5	Yes . . . . . 93.0%
Unhandy seat shape . . . . . 5.2	Very good . . . . . 28.9		No . . . . . 7.0
	Good . . . . . 16.4		
	Fair . . . . . 4.6		

\*Percentages might not equal 100% due to rounding or insufficient data.

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## THE ETERNAL FLEET

(Continued from page 115)

all, is to bring honor to the old ships and the men who served in them. The Navy doesn't want to be embarrassed by bankruptcies or great warships going to rust in the public eye. In the 20-plus years of the Naval Historic Ships Program this has not happened.

One of the first ships to be turned over to a citizen's group under the Navy program in 1957 was not a World War II vessel, but the cruiser *Olympia*, flagship of Commodore George Dewey, when he sailed into Manila Bay in 1898 and told *Olympia's* captain, "You may fire when ready, Gridley!"

*Olympia*, which was scheduled to be cut up for scrap in 1954, is now berthed in the Delaware River at Philadelphia. It is the oldest remaining steel warship of the U.S. Navy. Built and launched in 1892 at San Francisco, it sailed in Asia for a number of years, came home via the Panama Canal in 1899 to duty in the Atlantic and Mediterranean. It was aboard the *Olympia*, in 1921, that the body of the Unknown Soldier was brought home to rest in Arlington National Cemetery.

### Combination displays

It is not unusual for submarines to be on display in conjunction with larger ships in the memorial fleet: *Lionfish* is with the battleship *Massachusetts*; *Drum* with the battleship *Alabama*; *Marlin* with the minesweeper *Hazard*, for example. Several of these undersea boats have distinguished records.

The *USS Cavalla* was one. She spotted units of the Japanese Fleet heading for Saipan in 1944 and passed the information to the U.S. forces, which would ultimately win the Battle of the Philippine Sea. Two days later, her intelligence work complete, *Cavalla* found a Japanese carrier of the *Shokaku* class (one of the Pearl Harbor attackers) and sent it to the bottom with six torpedo hits. *Cavalla* may be seen, along with the destroyer escort *Steward*, in Galveston, Tex.

At Manitowoc, Wis., where 28 World War II submarines were built by the Manitowoc Shipbuilding Co., and where townspeople remember submariners affectionately, civic leaders yearned to have one of their vessels returned by the Navy as a memorial to all submariners. Alas, not one of these inland-built subs, born on the shores of Lake Michigan, was available, but the *USS Cobia*, a small submarine built by Electric Boat Co. in Groton, Conn., was

offered instead. It is the centerpiece of Manitowoc's Maritime Museum today, even though built by a "rival" company.

Another submarine memorial association and museum is, quite naturally, at Groton, the so-called submarine capital of the world. Oddly, it wasn't possible until 1977 that visitors to Groton could see anything but the outside of a submarine. Then the *USS Croaker*, built at Groton in 1943, was acquired from the Navy. *Croaker* may prove to be merely a temporary stand-in for the glamor submarine that the Groton group is now eyeing, however—none other than *Nautilus*, the world's first nuclear submarine, now scheduled for decommissioning this year. Groton will have to compete for the famous boat, however—among other interested parties is the U.S. Naval Academy.

### Open to the public

Yet another submarine memorial association was responsible for rescuing the *USS Ling* from the scrapheap in 1972. This fleet-type sub, launched at the end of World War II, earned no combat record, but a group of prominent New Jerseyites thought she would make a worthy addition to Borg Park in Hackensack, N.J., all the same. Tours of the *Ling* are now conducted seven days a week, complete with realistic sound effects and the opportunity to actually lay hands on the vessel's controls. The *Ling* is also available as a site for children's birthday parties—cake and punch in the torpedo room!

Other submarines open to the public as memorials include the *USS Cod* on the lakefront in downtown Cleveland, Ohio; the *USS Requin* in Tampa, Fla.; the *USS Batfish* at Muskogee, Oklahoma; the *USS Silverfish* at Chicago; the *USS Torsk* at Baltimore; the *USS Pampanito* (temporarily closed) at San Francisco; the *USS Roncador* (once painted pink for a Hollywood filming) at Redondo Beach, Calif.

Although not a memorial, the World War II German submarine, *U-505*, has been a popular exhibit at the Museum of Science and Industry in Chicago since 1954. It is the only enemy ship to be captured by the United States since the War of 1812. Attacked and damaged by a U.S. carrier task force off Africa in 1944, *U-505* was abandoned on the surface by her crew, then taken as a prize by an American boarding party. The boat yielded important infor-



mation about codes in use by German submarines operating in the Atlantic. Towed to Bermuda, *U-505* sat out the rest of the war under camouflage, then made a tour of eastern port cities, ending up at Portsmouth, N.H.

For a time it appeared that *U-505* would be cut up for scrap, but a Chicago civic group went to Congress to secure title to the prize and then raised \$250,000 to finance the costs of towing the submarine 3000 miles from New Hampshire, around Nova Scotia, into the St. Lawrence River, through three of the Great Lakes and eventually to Chicago.

### Most desirable prizes

Although these many Silent Service boats have a special emotional appeal as memorials to the 52 U.S. submarines which never returned from World War II patrols, bigger ships with bigger guns are undeniably the prize showpieces for civilian groups to acquire. For example, in Buffalo, N.Y., a citizens' committee has acquired not one, but two well-known Navy ships—the destroyer *USS The Sullivans* (named for five Iowa brothers who lost their lives when the cruiser *Juneau* was sunk early in World War II), and the guided missile cruiser *Little Rock*. The latter is the first cruiser to be awarded under the Naval Historic Ships Program. The vessels are now moored stern to stern at a waterfront Naval and Servicemen's Park under construction in the Port of Buffalo, and have just been opened to the public.

Another mini-navy—actually, the largest naval ships exhibit anywhere—has been assembled at Fall River, Mass., where the submarine *Lionfish*; a patrol gunboat, *USS Asheville*; a motor torpedo boat, *PT 796*; and the destroyer *Joseph P. Kennedy* all huddle under the big guns of the battleship *Massachusetts*. These mighty naval rifles are credited with firing both the first and last United States 16-inch salvos of World War II—in the invasion of North Africa in 1942 and the bombardment of Japan in 1945. A marine museum rounds out this exhibit.

Three other great old Navy battle-wagons are also available to the public: The *Texas*, commissioned in 1914 and in action in both World Wars is at San Jacinto Battleground Park, near Houston. The *North Carolina*, rescued from the scrapper's torch by contributions from 700,000 North Carolinians, may be found in the Cape Fear River, in Wilmington, N.C. The *Alabama* is at Mobile, Ala.

(Please turn to page 282)



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## THE ETERNAL FLEET

(Continued from page 281)

Yet another famous battleship, the Mighty Mo, USS *Missouri*, is not a designated memorial, but an inactive or reserve ship of the Navy. She is stationed at the Puget Sound Naval Shipyard, Bremerton, Wash., and could be put back into active service if a need arose. Because of *Missouri's* historical significance as the ship on which Japan surrendered in World War II, portions of her quarterdeck, forecastle and wardroom are open to the public free of charge.

### An impressive giant

Nothing, say Navy buffs, can match the awesome power of a battleship—nothing, say *other* Navy buffs, save the awesome size of an aircraft carrier. Only one of these giants has so far been turned into a memorial, the *Yorktown*, at Patriot's Point, in Charleston, S.C. Three football fields long, with 15 battle stars to her credit and over 1000 enemy aircraft destroyed, *Yorktown* is an impressive ship which attracted nearly a half million visitors in the first two years following its opening in 1976.

### Distinguished history

If an ambitious group of New Yorkers and aviation enthusiasts is successful in its plans, another famous carrier will soon join this historic memorial fleet—*Intrepid*. This World War II veteran was hit four times by Japanese suicide attacks at Iwo and Okinawa, but survived them all. In mothballs for five years, *Intrepid* was recommissioned for the Korean War, saw action off Vietnam, recovered astronauts from the Pacific, then retired again to the Philadelphia Navy Yard. Now a non-profit group called Odysseys in Flight proposes to bring *Intrepid* to a berth in the Hudson River at New York City, where she would become a floating museum dedicated to the history of aviation.

### Worthwhile investment

Inevitably, many great old ships are still cut up for scrap once they are stricken from the Navy's register. Indeed, more are lost than are saved because rescuing a warship is an expensive undertaking; the *Intrepid* project, for example, will require over \$3 million. For many Americans, however, the investment is worth it and donations are gladly made. They see the ships of our memorial fleet not simply as a collection of nostalgia, but as milestones of history. **PM**

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Challenger 10 were the standout players with Challenger winning the top honors. Just to be sure, we ran a series of games pitting Boris against Chess Challenger again. These scores were even more decisive: Chess Challenger won five out of six games and drew the last one.

Though considered "adult toys" the performance of these computers led us to have more than a grudging respect for them—and we're not alone. Several experts think that Chess Challenger 10 merits a U.S. Federation rating (playing at its Level III) of between 1150 and 1350—which means it could beat approximately 15 percent of America's 30,000 rated chess players. In my opinion, Chess Challenger 10 easily plays better than 90 percent of the

40 million Americans (excluding the tournament players) who know the chess moves.

Though the machines are often touted as challenging to even an experienced player, it is as teaching devices that they excel the most. Through a process of intimidation and punishment, these computers will often improve a human player's tactical ability—at least the novice player will have an opponent who is adept at seeing targets, making sharp attacking moves and defending against obvious "threats." Of course, the machines will make some bloopers but even the weakest of them may be a useful teacher.

I recall a year ago when the parents of a prodigal four-year-old boy bought him a CompuChess I (the

predecessor of the current model). The child, like most children, tended to concentrate on his own moves and overlook his opponent's threats. Though his chess aptitude was high, his practical playing strength needed development. CompuChess provided a good, stable opponent for him. Incidentally, the boy always insisted on another person being in the room with him whenever he played CompuChess!

One of my other chess students purchased a Chess Challenger III for his father (that game also ancestral to the one we tested). "In the beginning," the student told me, "my father had no offense. He made many mistakes and lost every game. But he quickly learned to coordinate his play, often using two or three pieces together in an attack. In two months he was able to win two out of ten games from the computer."

The student himself used his dad's computer: "Though I could beat it eight out of ten games," he explained, "I still enjoyed playing it and it really sharpened my game. I sometimes intentionally give up a few pieces to give it an advantage. You can improve your game by giving it such an advantage as will force you to be resourceful to beat it."

### Helping you choose your move

While all these computers have some similarities they also have many distinguishing characteristics. They are all easy to operate—if you want to move a pawn from D2 to D4 you simply key in D2D4 and hit *play* or *enter*. All of them can accomplish the chess moves of castling, pawn promotion and capturing *en passant*, although such moves are a shade harder to enter into CompuChess and Chess Champion than Boris or Chess Challenger.

Chess Champion has a large, easily read display, but will accept an illegal move if the human makes a mistake. This can lead to impossible game situations.

Chess Challenger and Boris will play either Black or White with equal facility—CompuChess can be made to play White, but only after an awkward session of keyboard entry. Chess Champion has no instructions given to play White.

All the computers have different levels of skill. Higher levels offer better games, but longer "think" times. CompuChess and Chess Challenger have ten levels. Chess Champion has six. Boris, however, is unique in that he has a timer. You

(Please turn to page 286)

### HOW CHESS COMPUTERS THINK

Teaching a computer to play chess—to many computer programmers—is more than a game. Many consider such research and development to be the first step toward realization of machine intelligence.

But it is still a long, uncertain road from machines such as Boris and Chess Challen-

ger to *Star Wars* droids like C3PO and R2D2. Before we can make a machine think, we have to know how a human does it.

The game of chess is a prime example of how a computer can be far outclassed—right now—by an ordinary human. When the idea to program a chess-playing computer was first pursued it seemed a deceptively simple chore. Just have the computer evaluate all the possible board positions and pick the best one.

As it turns out, there are so many different board positions that even the fastest, most modern of computers would take a programmer's lifetime to search through them all. Obviously, a way had to be found to cut down the search to a manageable level.

One way, still the way that computers such as Boris and Challenger do it, is to only look a few *plies* ahead (a move being one *ply* or piece moved by Black and another ply by White). So, we can now see why these home

chess computers have different levels of play and why the better-playing levels take longer to move. The more plies ahead the computer looks, the longer it takes to sort the possibilities. Also, we see why the giant computers can usually trounce the little home ones; they are often faster machines with giant memories.

As computers look ahead to evaluate a move they assign various scores to possible board positions. Obviously, a position that loses a knight will be assigned a lower score than one that wins a pawn. The trouble lies in the quiet areas—of deciding the score for controlling the center of the board, for centralizing the king in the end game, for literally dozens of situations where no pieces are lost or exchanged and yet there is a subtle shift in advantage.

Many authorities agree now that human chess Masters look ahead only four moves in a normal game. Surprisingly, novice chess players also look ahead about the same amount. But a chess Master will tend to make the right move and a novice to foul up. The answer seems to lie in something called pattern recognition. A chess Master has mental "snapshots" of the various board positions he may come up against. The right move springs to mind; he does not have to fumble. Unlike most chess computers, or novice humans, he quickly recognizes what to do.

Herein seems to lie the answer to programming a metallic world chess champion. Pattern recognition is a tough nut to crack and the best programmers in the world are trying.

Chess Challenger 10, our tourney winner, uses a very primitive form of pattern recognition in the openings. It has been programmed so that—for the first 10 moves or so—it just needs to "look up" the right move.

Future computers may take pattern recognition to the same heights as Bobby Fischer or Anatoly Karpov. Then again, they may not. One thing is sure, computer chess will stay in the forefront of programming and computer development.—Neil Shapiro



Home computers can get in on the action. This is the Apple II display of Personal Software's Microchess program also available for Pet and TRS-80 computers.

ger to *Star Wars* droids like C3PO and R2D2. Before we can make a machine think, we have to know how a human does it.

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## USE THE SUN TO HEAT YOUR POOL

(Continued from page 138)

tice run. Many dealers not only can call on their own experience, but also have access to computer-stored data of thousands of other installations. Fafco and Grumman distributors, for instance, will feed pool size, shading, climate, desired pool temperatures, length of swimming season, etc. to their computers. The printout reveals feasibility, optimum system design, panel area required and estimated dollar savings over conventional fuels.

A contractor-installed system also means you'll have someone to turn to if the system develops problems. Should you decide to have the work done, get as many references as possible—and check them out. Read the warranty carefully. Some warranties may extend 10 to 15 years—but not cover much except part replacement on a prorated basis. Other warranties, such as the one from Grumman for five years, not only cover materials and workmanship, but also the costs for part removal, reinstallation, labor and shipping.

If you decide to attempt the job yourself, ask to see the installation manual before you buy. Is it clearly written, with easy-to-follow illustrations? I found Fafco and Solex manuals easy to follow.

A 32-page booklet entitled *Solar Pool Heaters and Other Ways to Cut Your Pool Heating Bills*, is a worthwhile investment for the do-it-yourselfer. It's \$2 from Horizon Industries, 12606 Burton St., North Hollywood, Calif. 91605. **PM**

### MANUFACTURER'S LIST

- Ac-cello Products, Inc., 30 Alabama Ave., Island Park, N.Y., 11558; Thermo/globes (plastic-ball pool covering)
- Andray Products, Inc., 23 Centerway, East Orange, N.J., 07017; solar pool cover
- Bio-energy Systems, Inc., Mountindale Rd., Spring Glen, N.Y., 12483; SolaRoll extrusions, solar pool heating systems
- Fafco Solar, 235 Constitution Drive, Menlo Park, Calif., 94025; active solar pool heating system
- Grumman Energy Systems, Inc., 4175 Veterans Memorial Highway, Ronkonkoma, N.Y., 11779; active solar pool heating system
- Heliotope General, 3733 Kenora Dr., Spring Valley, Calif., 92077; solar pool electronic control, automatic valve
- Lof Bros. Solar Appliances, Inc., 1615 Seventeenth St., Denver Colo., 80202, solar pool cover
- Sealed Air Corp., 2015 Saybrook Ave., Commerce, Calif., 90040; solar pool cover and active solar pool heating system
- Solar Industries, Inc., Monmouth Airport Industrial Park, Farmingdale, N.J. 07727; solar pool heating system
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(DEALER INQUIRIES INVITED)

## COMPUTER CHESS CHAMP

(Continued from page 285)

can play Boris at a wide range of levels by setting his timer from one second to one hundred hours. (There is also a \$400 Boris which runs off rechargeable batteries and has a memory to recall games.)

CompuChess has a special feature called "Survival." The machine will randomly select one out of 1500 possible middle-game positions and play it at whichever level the human asks for with the White pieces.

Boris is especially flexible and easy to use for position verification and position modification because of its "rank display" feature. It will actually show you little pictures of the chessmen and where each is supposed to be on the board.

And let's not forget that, of them all, Chess Challenger is the most gentlemanly opponent. When it is your move he will notify you with a pleasant beeping sound.

### But is it a buddy?

Many humans, myself included, seem to vacillate between calling one of these machines "he" or "it." You tend to assign human characteristics to the machine—after all, it is your playing partner.

By naming their machine Boris (after a programmer's puppy, we are told), its manufacturer is obviously capitalizing on this human tendency to personify a machine. Boris also talks to you—by displaying about 80 remarks, ranging from "Hooray" and "Ready to resign?" to "I need help" and "Ah, ruthless!"

Human responses to these remarks vary. Some find them delightful, others a nuisance after a few dozen games.

One seven-year-old came to me after bearing the brunt of several jibes by Boris and lamented that "Boris doesn't like me!"

There will be rapid developments in these games and—as programs change and are redeveloped—today's losers may be tomorrow's champs. In fact, new versions of these machines may be offered soon.

One thing for sure—it will be a very long time indeed before any of them can hope to match the play of a human world champion (though one manufacturer's ads imply just that outrageous possibility). What they offer you is entertaining and instructive chess. And, though they may forget themselves and beat you on some occasions (when you have set the play level too high), they can be trusted to keep the distasteful record of your losses a confidential secret!

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## So, why let yourself deteriorate?

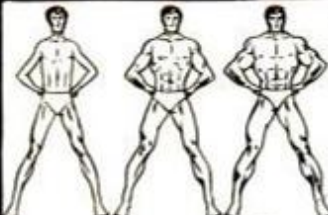
Face it, unless you do something about it, your body gets worse, day by day it gets uglier! Your body and your health are your most important possessions and they deserve your attention. With progressive body building you get better, day by day, with results you can see and feel!

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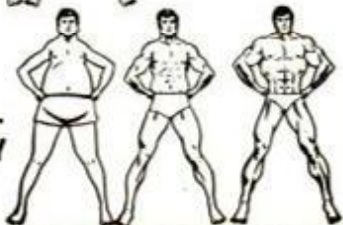
## As for sports ...

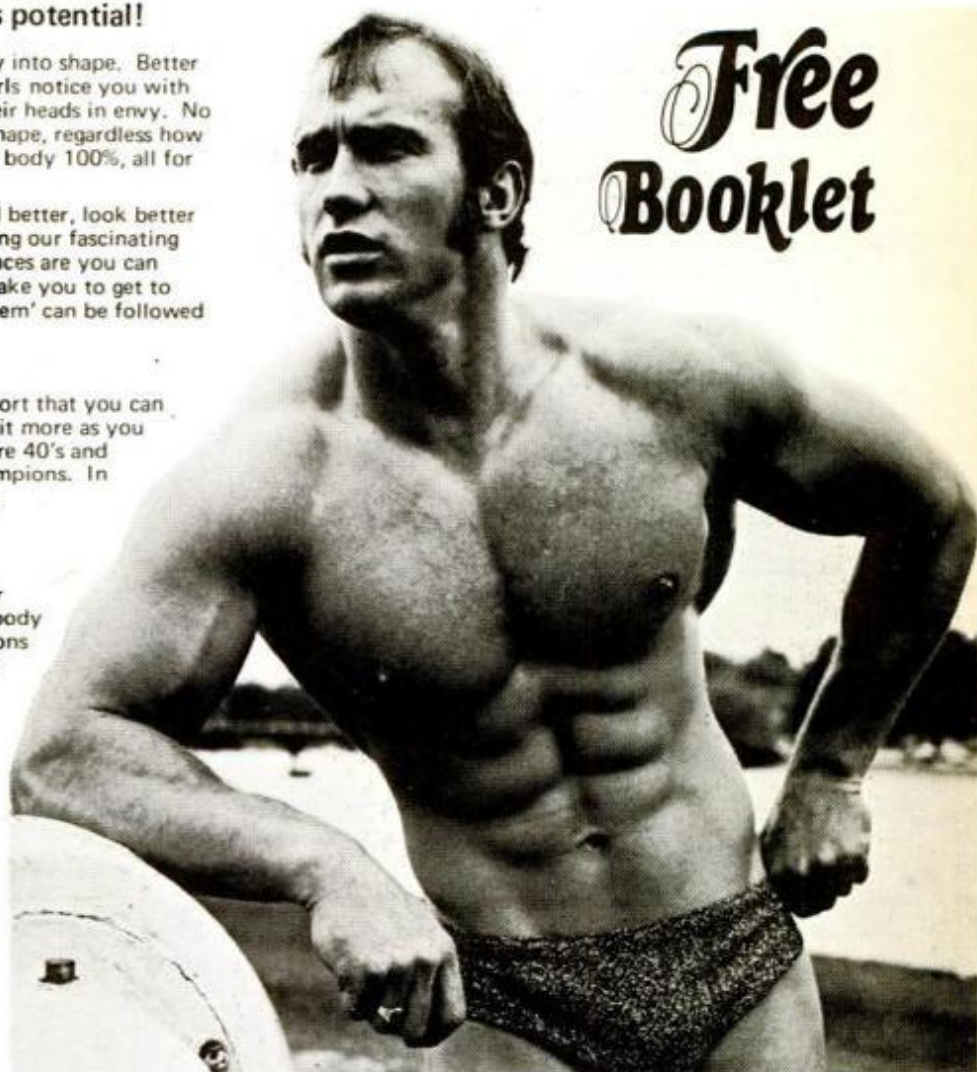
It's a fact; all factors being the same, the stronger person can always outperform! This applies to all endeavors that require strength and endurance.



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## PATIO TABLE AND CHAIR SET

(Continued from page 143)

60°. To insure accuracy, use a sharp point on your pencil to mark all cuts—square, angled, beveled or whatever—and make certain your saw blade is on the waste side of the line when you cut. Should your saw wander slightly, you can usually make corrections to get tight-fitting joints. Use either a sanding block or

Surform plane, or a file, rasp or belt sander—whichever will do the particular job best.

### Table layout

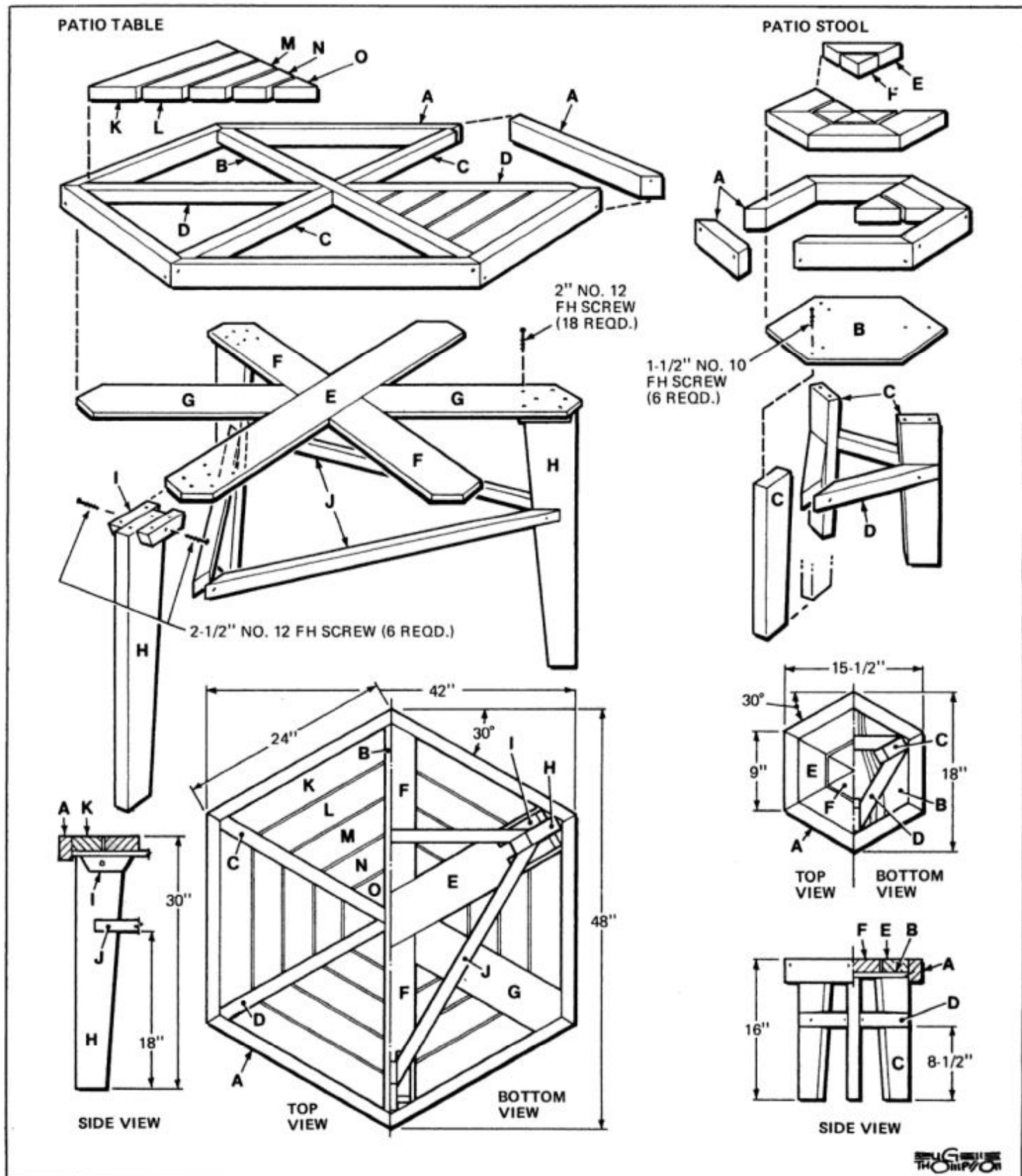
To give you a working surface for both drafting and assembly, lay a 4×4-ft. piece of plywood on a pair of sawhorses. Using a ruler, protractor, pencil and straightedge, lay out the tabletop outline on the plywood and draw in the parts that form the

top. You can then take the dimensions and angles for the various pieces right from the drawing on the plywood panel.

To facilitate assembly, do it right on the plywood. Install each piece of wood with its best surface down against the plywood.

### Assembling the table

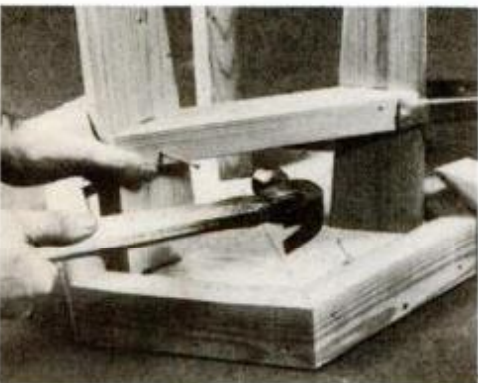
Start by cutting the six table edges (A in the illustration below)





edges (A in the drawing, page 288) and beveling their ends. Use your combination square to locate the nail holes for both ends and keep nail locations aligned on all edge pieces. Pre-drill nail holes with a 1/8-in. drill bit, then line up the edge parts on the plywood pattern and glue them together to form the table rim. When all parts are joined, countersink all nail heads slightly below the surface. Make certain the work-piece is well supported as you set the nails, so the parts do not rack and fall apart.

Next, cut the divider strips (B, C and D) to fit. Notice that one strip spans the entire top, running from one point to the point opposite. The other four strips meet in the middle. Bore pilot holes and nail and glue at



**15** Invert the stool, cut leg braces to 30° angles and, using glue and nails, fasten the leg braces to the legs.



**16** Cut a 2x4 block to suitable length and use it for support beneath each leg when you are setting the nail heads.

the center and through the outside edge points.

Rough-cut the tabletop sections (K,L,M,N,O) that fit between the dividers. Set the outside piece (K) flush against the table edge and leave a 3/16 to 1/4-in. gap between the inner pieces. Number sets by the triangular section of the top into which they will fit, remembering to keep the better side down against

(Please turn to page 290)

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## PATIO TABLE AND CHAIR SET

(Continued from page 289)

the plywood. Mark the tabletop pieces, turn them good side up and miter the ends to fit, using a block plane or belt sander.

Cut top support pieces (E, F and G in drawing) for a tight fit and position the tapered legs (H) on them. Add the blocks (I). Using at least two screws for each radius section, fasten the supports (E, F and G) to the dividers (B, C and D).

Turn table right side up, spread glue on support pieces and the lower edges of the dividers and drop all of the mitered tabletop sections (K, L, M, N, O) into place. When top is dry, invert table on sawhorses, trim leg braces (J) to 30° angles, and position them on the legs 18 in. up from the floor—so stools can slide underneath them. Nail and glue braces to inside edges of the legs.

### Finishing the table

Fill all nail holes and defects with a matching wood putty. Then give the table two good sandings—the first with 80 to 100 medium-grit paper and the second with 150 or 180-grit paper on a belt sander.

Dust the table and finish with two coats of exterior-grade varnish. For a finer finish, sand lightly between coats, and dust and wipe with a tack rag carefully before applying the second coat.

Use the same construction techniques for the stools that you used for the table. Flop the piece of plywood and use the back side to draw a pattern for the stool tops.

Once satisfied with your design, cut the parts for all six stools at one time. Lightly label each part with a pencil (A, B, C or 1, 2, 3 and so on), and make up a separate stack for each stool. The best method is to build all six stools on a Saturday, and put the first coat of finish on them Sunday. If you're a fast woodworker, you will probably get to put the first coat of varnish on Saturday. **PM**

### MATERIALS LIST—PATIO TABLE

Key	Pcs.	Size and description (use)
A	6	1½ × 1½ × 24" (table edge)
B, C, D	5	1½ × 1½" to fit (divider strips)
E, F, G	5	¾ × 5½" to fit (supports)
H	3	1½ × 5½ × 27¼" (legs)
I	6	1½ × 1½ × 5½" (cleats)
J	3	1½ × 1½" to fit (leg braces)
K	6	1½ × 3½ × 20½" (top)
L	6	1½ × 3½ × 16" (top)
M	6	1½ × 3½ × 12" (top)
N	6	1½ × 3½ × 8" (top)
O	6	1½ × 3½ × 4" (top)

### PATIO STOOLS

A	36	1½ × 2½ × 9" (edges)
B	6	½" plywood cut to fit (seat bottoms)
C	18	1½ × 3½ × 14" (legs)
D	18	1½ × 1½" to fit (leg braces)
E	36	1½ × 3½ × 7½ approx. (top)
F	36	1½ × 3½ × 3" approx. (top)

## WOOD LATHE (Continued from page 147)



Use the skew with a light shearing cut to turn the cylinder smooth. See text.



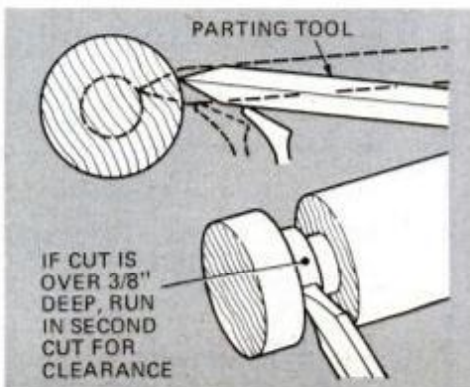
Or, make smoothing cut using skew in scraping position (better for beginners).



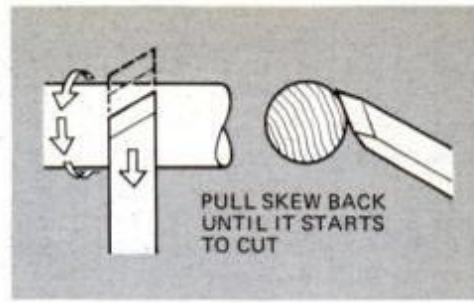
Cut a template and use it to lay out the basic shape on the smoothed cylinder.



Cut various segments to correct diameter using the parting tool fed straight in.



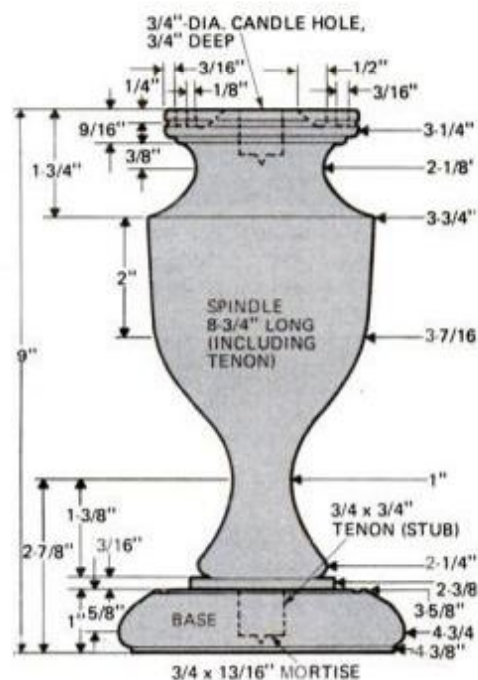
Hold parting tool 90° to work, raise handle slightly as you push tool into work.



To use skew, place it over the work, draw it back until skew's bevel rides work.



Use a try square to check cylinder flatness; remove extra stock as required.



Use this pattern to make the candleholder shown in photos B and C on page 144.

its outside edge. You can shape the face with whatever chisel best fits the shape you want. Work from the center toward the edge. Remember, the outer edge is spinning much faster than the center. Thus, it is good practice to take light cuts only when working on the face.

### Turning a spindle

Work turned between centers is called spindle turning. Make it your practice to square the wood you will use for a spindle turning; this makes

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it easier to rough-round a cylinder with a deep gouge. Steps for spindle turning are illustrated on these pages. It is important to determine the centers of both ends in order to mount the workpiece in the lathe properly. Other key points include:

- Always cut saw kerfs for the drive center, as shown on page 147. Use a wooden mallet to seat the drive center well into the wood. (A metal hammer will damage the center.)



Lay out and cut groove for chimney using a small round-nose chisel with slow feed.



Periodically check globe in the groove. Stop lathe and back off tailstock to do it.



Next, shape the surface between the groove and the candle hole.

- Apply a lubricant to the cup center to reduce friction. You can use light machine oil. I prefer a candle stub—which won't stain wood.

When mounting a piece to be spindle-turned, insert the spur center into the spindle and support the out-board end of the workpiece with your left hand. Move the tailstock within an inch of the work and

(Please turn to page 292)

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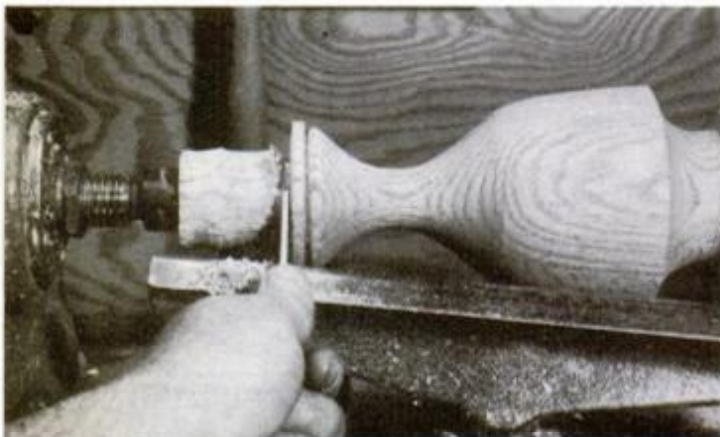
Shape cove portion by working from both shoulders down to the cove's center.



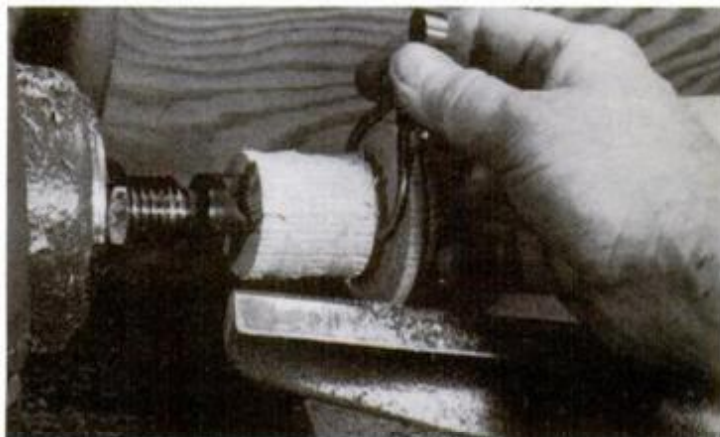
Skew in scraping attitude is an effective way to control shape on spinning work.



Sharp gouge with shearing cut produced desirable results on upper shoulder.



Using the parting tool, make a cut to desired tenon depth. Bottom surface of spindle can be dressed later with a skew.



Stop lathe, check stub diameter with outside caliper. When satisfied, turn balance of stub to initial cut.

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clamp it. Advance the cup center by turning the handwheel; make certain its point enters the pre-punched center. Continue to advance the center while slowly rotating the work with your left hand until the work is difficult to turn. Then back off the wheel  $\frac{1}{8}$  to  $\frac{1}{4}$  turn and lock the tailstock spindle. Set the toolrest, rotate the work by hand to clear the rest and turn lathe on.

Turn the work to a rough cylinder using the gouge and a slow speed. To smooth the cylinder, use the skew, a tool that requires effort and practice to master. Here's the easiest way for leaning how: With the work spinning in the lathe, rest the skew on the toolrest so its point is well over the cylinder. Grip its handle with your right hand and the blade—close to toolrest—with your left hand. Curl your fingers over the blade so your thumb is toward you. (See photo top left, page 290.) Slowly lower the skew until its bevel rides on work and shearing cut is made at blade's center. Maintain blade position as you move skew across the cylinder.

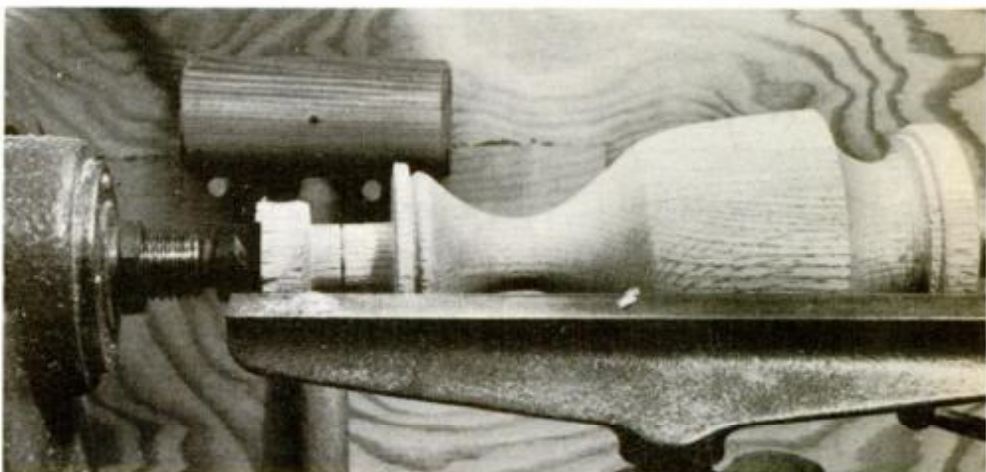
In the next installment, we'll discuss some of the more advanced techniques. **FM**



File, supported by toolrest, is an excellent way to start the smoothing step.



For final smoothing, use 220-grit paper (or fine emery cloth) shoeshine fashion.



To finish, bore candle hole and cut off the tenon at desired length on bandsaw.

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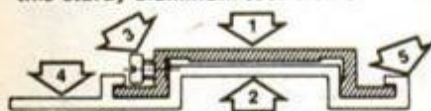
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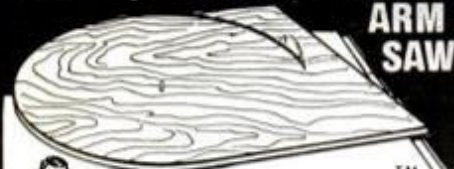
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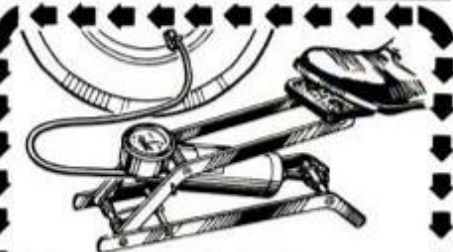
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# YOU SAY YOU'RE FED UP WITH HAULING ICE?

Read about THE electronic breakthrough that has made the portable ice chest as obsolete as grandma's kitchen ice-box.

Does your family groan when it's time to empty all that yucky water out of the cooler? Are you getting tired of paying for food that goes bad? When somebody even mentions the word "ice" - do your back and shoulders ache a little?

## YOU'VE COME TO THE RIGHT PAGE.

There's good news here: The Aerospace Program has spun off a portable refrigeration breakthrough!

### Big Research Discovery

Space scientists at Cape Canaveral had to keep critical components in rockets and satellites cool. They needed something small and light...something that used very little power but was absolutely reliable...something that wouldn't konk out if it were tipped up, down, or sideways. The result? Solid state thermoelectric refrigeration modules that went to the Moon.

### Enter Koolatron

Koolatron was quick to see the civilian-use possibilities of these modules for portable refrigeration. They worked until they developed Koolatron - a 12 volt portable electronic refrigerator that uses the same powerful solid state thermoelectric refrigeration modules used in rockets and satellites.

### Saves Inconvenience

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Model F1A shown.

The new Koolatron keeps 40 lbs. of food at household refrigeration temperature but weighs only 15 lbs. Only 21" x 16" x 16" ext.

### Saves Shopping Trips

Koolatron holds more - so you spend less time shopping. Although it measures no larger than most ice chests, its 36 quart capacity is not half-filled with ice and sloshing water. So there's more room for food - 40 pounds of it, or 40 large cans of soda pop!

### Saves Food

This is *dry* cooling we're talking about. Not the *damp* kind that breeds mold and can turn perfectly good food bad overnight - exposing the whole family to needless risk. Koolatron keeps your food cold and dry. With food prices so high, it's a shame to let any more meat and milk or sandwiches spoil!

### Saves Money

Ice is expensive these days. So is the gasoline you use in looking for it. Don't waste another dollar this way! Get yourself a new Koolatron 12 volt portable electronic refrigerator and LET IT PAY FOR ITSELF. That's right. The money thrown away on ice and gasoline and spoiled food - not to mention what your own time is worth - will MORE THAN PAY for your new Koolatron in a single year!

Proof: A recent survey of Koolatron owners revealed their average saving was \$156.03

in just nine months. Some claimed they had saved over \$500.00 on ice, gasoline, spoiled foods, and the restaurant meals made necessary when the ice ran out.

### No Toy

Koolatron is built to last. The rugged case is filled with the best insulation available - rigid urethane foam. Its heavy-duty handle can take loads of 150 pounds or more. Hinges and latches are made of non-rusting polypropylene. The exterior is a handsome harvest gold with a white, easy-to-keep-clean interior. Four non-slip rubber feet keep it from marring boat or camper surfaces.

### No Hassle - Ever

Koolatron was designed by engineers who are also boatowners and campers. They know you want something simple that doesn't break down and is easy to service. So they designed Koolatron to be as trouble-free as possible. A small, quiet fan is the only moving part and it and the thermostat can be replaced by you with only a screwdriver!

### So Reliable It's Guaranteed For One Full Year

Your new Koolatron comes with a written one year guarantee plus complete instructions and helpful information. If you need additional help or advice anytime, you can call or write for a personal reply.

### 21 Day Money-Back Trial Period

Use your Koolatron for 21 days after you receive it. If for any reason you are not totally satisfied, return it for a prompt refund in full.

### Buy now at our new low price

Good news. Our increased sales have overcome mounting material costs. So for now we can pass on a saving of \$10.00 per unit. Formerly \$169.00. Now \$159.00 + \$7.00 handling and shipping (\$179.00 in Canada).

### Adjustable Thermostat Option

For an additional \$10 you can order the Koolatron with an adjustable thermostat in place of the standard fixed temperature thermostat - order model F1A.

Phone your order in collect now to (705) 737-0842

Or use this handy order coupon.



SOUND FAMILIAR?... "Mary, where do you want this 50 pounds of ice?"... "Wait George, I'm not through draining the ice chest!"... "Dad-dy - you're dripping more water where I've mopped the floor!"... "Hey, Mom, these tuna salad sandwiches are soaking wet - and (pew!) they smell bad."... "Mary, quick, I'm going to drop this @#!%& ice on my toes!"... "George -!"

**Koolatron**  
INDUSTRIES  
LIMITED

Dept. 496

56 Harvester Avenue, Batavia, New York 14020  
Canada: 230 Bayview Drive, Barrie, Ontario  
LAN 4Y8

Send me - Koolatron F1 @ \$159 (\$179 in Canada) + \$7 each for handling and delivery in USA or Canada (N.Y., Quebec and Ontario residents add sales tax).

-I want model F1A and have added \$10.

I understand that if I am not satisfied, I may return it undamaged within 21 days and get a full refund.

I enclose my  check  money order for \$ \_\_\_\_\_ or please charge my  Visa  Master Charge  American Express

Acct. No. \_\_\_\_\_ Expiry date \_\_\_\_\_

Please send colour brochure only.

Signature \_\_\_\_\_  
(necessary to ship merchandise)

Name \_\_\_\_\_

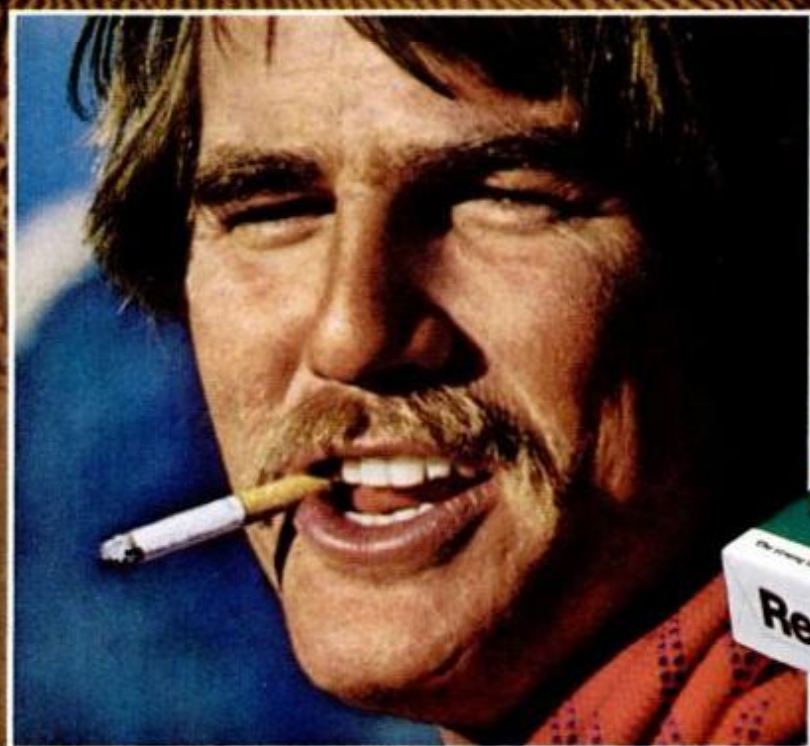
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MENTHOL: 8 mg. "tar", 0.6 mg. nicotine, FILTER: 9 mg. "tar", 0.7 mg. nicotine, av. per cigarette, FTC Report MAY '78.

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Only  
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***"Real's got dynamite taste!  
Strong...more like a high tar."***

***The strong tasting low tar.***

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# THERE ARE TIMES WHEN GOING SLOW BEATS GOING FAST.

Going fast gets you there first, ahead of the crowd.

But trolling slow is what fills the stringer.

The problem is: trolling slow doesn't come naturally to a high-performance outboard motor. It takes a lot of engineering to keep the spark strong and the fuel mix uniform at dead-slow speed when magneto output is low and the air stream is lazy.

Evinrude engineers met these problems with two ingenious solutions. The first is Firepower ignition that uses sophisticated solid state electronics to generate a super-power spark at trolling speeds—a higher voltage spark than



older systems delivered at wide open throttle.

The second is Evinrude Air Lift Carburetion, which introduces air into the carburetor jet ahead of the jet orifice. Aerating the fuel makes it lighter. It pulls more easily through the jet, mixes more readily, and disperses more thoroughly into the intake air.

This aerated, atomized fuel emulsion gets into the engine quicker and stays mixed longer. So the engine starts easier and runs smoother. And it trolls slower.

As any walleye fisherman can tell you, there are times when going slow is the only way to come out ahead.



**EVINRUDE**   
PRODUCT OF OUTBOARD MARINE CORPORATION *first in outboards*