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MAY 1982 \$1.25

Popular Mechanics

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**14 NEW
ULTRALIGHT
SPORTS PLANES YOU
BUILD FROM KITS**

POPULAR MECHANICS MAG.
EDITORIAL PROD. DEPT.
224 WEST 57th STREET
NEW YORK, N.Y. 10019

**STEP-BY-STEP
GUIDE TO
A SMOOTH-
RUNNING
CAR**



'67 CAMARO
Proper Care Pays Off!

**INGENIOUS WAYS TO
MASTER 11 TOUGH
SHOP PROBLEMS**

**PM's DREAM GARAGE:
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16 mg "tar," 1.1 mg nicotine av. per cigarette. FTC Report Mar '81



On the cover

The handsome 1967 Chevrolet Camaro Rally Sport convertible is the proud possession of Pete Tomaini of Belmar, N.J. If you value your car, too, you'll appreciate the step-by-step look at the problems any car faces—and how to solve them. The information is in PM's 10th annual Car Care Guide, starting on page 123.
—PM photo by Jerry Abramowitz

Popular Mechanics®

MAY 1982

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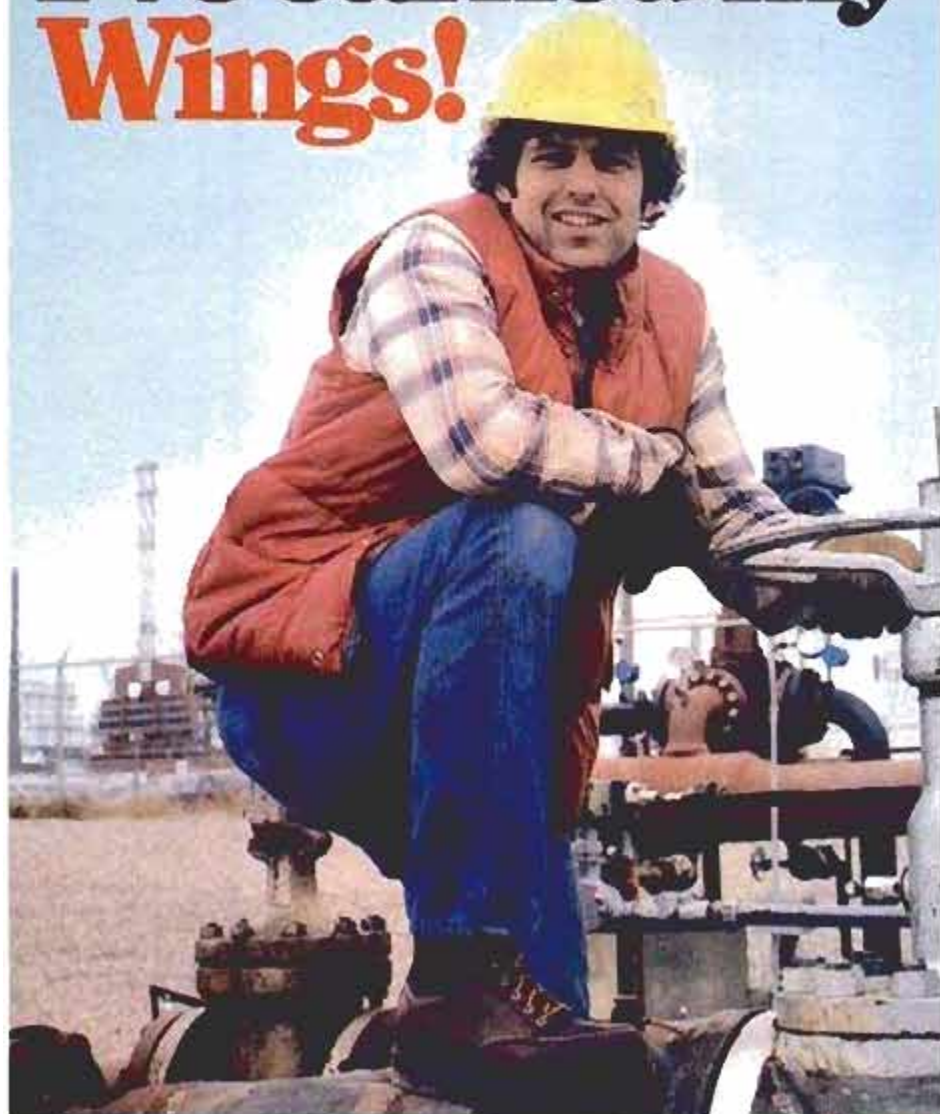
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How to pick a pocket.

To prove a point, we stitched together half a pair of the best-selling jeans and half a pair of JCPenney Plain Pockets.

The point is, both feel great, fit great. They even look alike.

Till you look at the pockets. The best sellers have a little extra stitching. And that can cost you extra.

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JCPenney

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LETTERS TO THE EDITOR

One man's meat . . .

In the many years I've been reading PM, I thought it was an American magazine. Now I'm beginning to think it belongs to the Japanese. Your *PM Owners Report: Datsun 810 Maxima* (page 32, March '82) positively glows with enthusiasm. But when it comes to an American car, you say the Cimarron is sluggish (*PM Owners Report: Cadillac Cimarron*, page 86, Feb. '82). The whole article reeks of negativism.

In my travels, I've driven many Japanese cars and have found them to be uncomfortable and extremely sluggish. On the other hand, I've owned many excellent American cars, some topping 100,000 miles with only minor repairs.

If we could shut off the flood of Japanese cars and other products, our recession and unemployment would cease overnight.

PAUL TONSING
FORT WORTH, TEX.

I've never owned a foreign car because I felt it was patriotic to "Buy American." But something has to be done about the poor quality and high cost of American cars.

MARVEL FELTS
MALDEN, MO.

Your editors consistently take a pro-Japanese, anti-American view. My friends and I think it's good business to "Buy American." Sell your magazines to the Japanese.

EDWARD L. WATKINS
PONTIAC, MICH.

I was the extremely unhappy owner of a 1978 Chevette, the sorriest set of wheels ever. After 16 trips to the dealer, I turned it in for a Scirocco, absolutely the most satisfying auto I've ever owned.

Why did I buy a Chevette? No imports for me. I wanted to "Buy American." What a pity!

JOEL L. CLARK
TUCKER, GA.

Opinions expressed in Owners Reports are those of Americans who must live with the cars they've purchased. No one gains by ignoring the complaints.

65 runs, 1 error

We very much appreciated your story on "beep baseball" for the blind (*Science Worldwide*, page 8, Jan. '82).

There was just one tiny discrepancy that has nine Albuquerque Tru-Sighters, three Seeing Eye dogs and the water boy upset.

Contrary to your source in Dallas, it was the Albuquerque Tru-Sight team, not the Dallas Bandits, that won the World Series game by a score of 33 to 32.

BILL McLAIN
TELEPHONE PIONEERS OF AMERICA
ALBUQUERQUE, N.M.

Actually, it was an official in New York who dropped the ball—but we should have caught it. Thanks for the assist.

Can tanker subs survive?

Your article *The Ice Above, the Giant Below* (page 118, March '82) doesn't mention the obvious Achilles' heel of these submarine natural-gas tankers—military vulnerability. In a war, the huge vessels could be easily picked off by enemy killer subs.

W. E. CHAPLINE
SAN CLEMENTE, CALIF.

We agree they'd be somewhat vulnerable, but certainly much less so than surface tankers or overland pipelines. Also, the enemy would be more intent on trying to knock out our missile subs.

Fun with PM's funny banks

Many thanks for your article *Old-fashioned Banks You Can Make* (page 94, Jan '81). We made three of



Three of PM's Funny-Face Man banks, made by W. E. Bergfield and Pam Hager.

the Funny-Face Man banks (photo, above). Congratulations on these great, fun-filled projects.

W. E. BERGFELD
PAM HAGER
HANFORD, CALIF.

We're glad you liked them. For others who may be interested, photocopies

of the article are available for \$1.50 from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Depends on how you count

The Sperry Univac ARTS IIIA computers installed at the New York TRACON air traffic control facility were not purchased nine years ago, as stated in your article *Hit or Miss? The Computers of Air Traffic Control* (page 96, Dec. '81). The contract for their procurement is dated August 5, 1976.

The computers, while procured at that time, represent an architecture and processor speed fully competitive with currently available state-of-the-art systems.

DONALD R. BRUUN
SPERRY CORP.
ST. PAUL, MINN.

While the contract was, indeed, signed six years ago, our interviews with representatives of the FAA and air traffic controllers indicated that the equipment's planning and development stages actually began at least three years earlier.

Spokesmen for both the FAA and PATCO (as then constituted) independently cited "nine years" as the effective age of the current computer system.

Would you believe? . . .

I very much enjoyed your article *High-Tech Treasure Divers Rob Davy Jones* (page 84, Feb. '82). I must point out, however, that the H.M.S. *Edinburgh*, sunk during World War II, was not a battle cruiser, as stated. She was a light cruiser of the *Southampton* class.

G. DE WITT MORGAN JR.
PORTLAND, ORE.

Technically, you're right, but there's an interesting historical twist to the story. The Edinburgh, along with her sister ship Belfast, was originally designed to carry quadruple 6-inch gun turrets, which would have put both vessels in the battle-cruiser class. Prototype trials were unsatisfactory, however, and the design was subsequently downgraded to match the triple turrets of the Southampton class.

In this respect, you could say that the Edinburgh was a battle cruiser "modified" as a Southampton-class light cruiser.

PM

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on the farm,
you can cut it in
the city.

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PM WORKBENCH

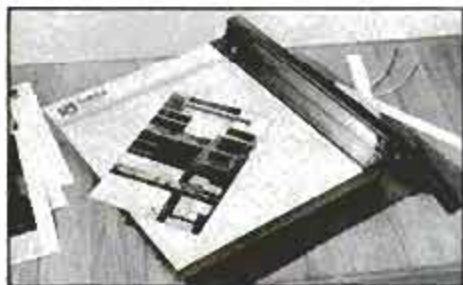
PM EXAMINES PRODUCTS AND SERVICES

Cutting up

For a high-quality paper cutter that's built to last, look at Dahle Premium Cutters. Available in three sizes (12-in. for \$45, 15-in. for \$68 and 18-in. for \$90), each has a plastic laminate surface, self-sharpening blade, transparent paper clamp and safety



Accurately calibrated board and clear plastic guard make for precise and safe cuts.



Self-sharpening blade operates smoothly and is adjusted easily to desired tension.

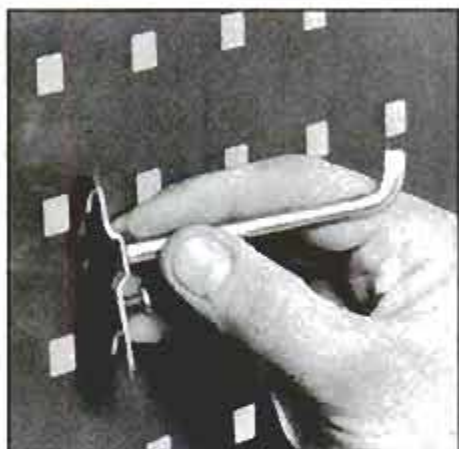
shield, and a ruler calibrated in both inches and centimeters. Sold in art and department stores, they're made by Dahle U.S.A., 6 Benson Rd., Oxford, Conn. 06483.—H.W.

Sure-grip toolboard

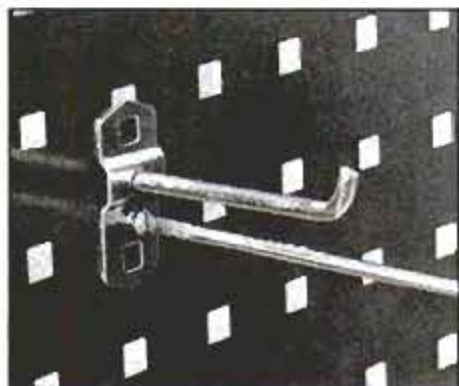
This sturdy tool organizer, dubbed Lockpanel, consists of 20-gauge steel perforated panels and fool-



New steel panel holds heavy shop tools without the brackets bending or pulling out.



To install, slide clips on bracket back into panel holes (above) and pull down. Then tighten screw with screwdriver (below).



proof tool holders. I installed the one shown in my shop and it is up to stay. Best feature: Both tools and fixtures stay put. Available in 24x24, 18x36 and 24x48-in. sizes for \$22, \$24 and \$41, respectively. From Lockpanel Systems Inc., 86 Elinor Ave., Akron, Ohio 44305. Write for catalog before ordering.—H.W.

New stud finder

The Stud Sensor represents a new concept for finding framing members inside walls: It electronically



To locate stud or joist, move sensor over wall or ceiling surface until bulb lights.

measures the change in the density of wall materials. When it passes across a stud or joist behind plaster or dry wall, it lights up. One great advantage of this tool over the magnetic type of stud finder is that the Sensor will precisely indicate both sides of any framing member, not



Unit detects actual wood framing members, not just nails like magnetic stud finders.



Sensor is of high-impact plastic, weighs 5 ounces, is powered by a 9-volt battery.

just the position of a nail which may or may not be centered. The tool costs \$19.95 plus shipping and is available from the maker: Zircon International Inc., 475 Vandell Way, Campbell, Calif. 95008.—S.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.



**"I get Pennzoil protection
in all my cars."**

"Driving the Pennzoil Chaparral for the past two years has made a Pennzoil believer out of me. A national championship, a win at Indy and thousands of race miles and never an oil-



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Johnny Rutherford

Quality in every extra mile.



Quality is Job 1



**"A quality
die finish can
take at least
40 hours
of hand
polishing."**

Peter Collins
Tool & Die Maker
Cleveland, Ohio Stamping Plant

Seat belts save lives... Buckle up.

Everybody talks about quality, Ford people make it happen.

Take our attention to craftsmanship, for example. There are still some things that the human hand can do better than a machine, like the final polishing of a die. A detail which can take from 40 to 120 work hours, and is done so that the sheet metal in doors and body panels is not blemished during the stamping process.

This dedication to quality at Ford Motor Company is paying off. Latest results show a 48% average improvement in quality over 1980 models as reported by new car owners.

Visit a Ford or Lincoln-Mercury dealer and take a close look at what total employee, management, union and supplier involvement can achieve.

At Ford Motor Company,
Quality is Job 1!



Ford
Mercury
Lincoln
Ford Trucks
Ford Tractors

SCIENCE WORLDWIDE

In a world of atom smashers and deep-space telescopes, scientists still use a time-honored standby to communicate hot news—they hold a meeting. There was plenty to communicate at the annual American Association for the Advancement of Science (AAAS) meeting, held earlier this year in Washington, D.C. Some of the highlights follow.

holding facility. There, specially designed canisters would be stored in chambers which would hold the radiation for thousands of years.

Other waste disposal methods, including deep-sea and deep-space dumping of nuclear fuel, have been proposed. But there's ecological opposition to the sea dumping and opponents say space dumping would

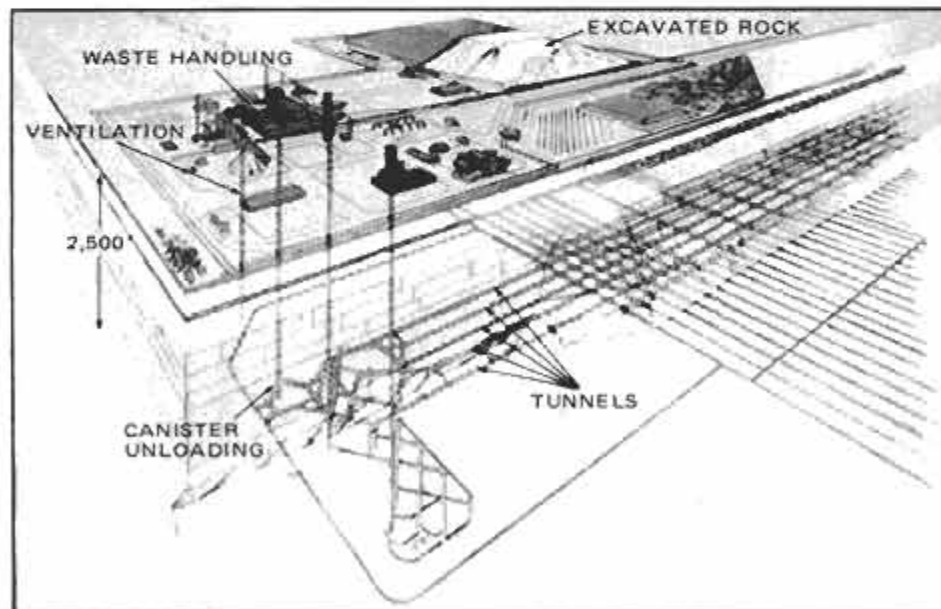
will become maps with scales of one inch for each $\frac{1}{10}$ of a mile.

The project, started in 1980, is scheduled to conclude in 1986, when the federal government will have its most detailed map ever of the entire nation. It will be used for everything from planning-and-zoning surveys to wetlands classification.

Science as child's play

Science policy makers are worried about the future supply of scientists in America, because children are showing less interest in math and science. The National Council of Teachers of Mathematics used the AAAS meeting to call for a national school math agenda, including a shift in elementary math education from drills to problem solving.

Meanwhile, a researcher at London's Royal College of Art, not present at the AAAS meeting, has originated a way to teach geometry



Specially designed nuclear waste canisters would be stored one-half mile below bedrock.

Down in the (nuke) dumps

An estimated 100 million pounds of spent nuclear fuel, the product of mostly military and some commercial uses, is currently packed in metallic containers that are submerged in deep-water tanks throughout the nation.

Nuclear waste, critics point out, poses a major threat to the environment, because the containers that hold it will deteriorate long before the radioactive matter loses its health-threatening potency.

It could be reprocessed for use in special reactors, but the reprocessed fuel could conceivably become diverted to a foreign government that wants to manufacture atomic weapons.

However, Department of Energy scientists are studying several practical disposal techniques. The most promising seems to be the creation of a national underground nuclear-waste repository.

The site would be located on a 400-acre reserve above a solid formation—probably bedded rock salt. A shaft about 2,000 to 4,000 feet below the surface would shield a 2,000-acre

be expensive and possibly dangerous if a waste canister re-entered Earth's atmosphere accidentally.

Surf's up

The sun's core temperature is millions of degrees Fahrenheit, while the surface is in the thousands. But the temperature rises to over one million in the bright corona that surrounds the solar surface. Now, a University of Arizona research team thinks it may know why.

The team, with help from the Sacramento Peak Observatory in New Mexico, has discovered "gravity waves" that ripple through the sun at about 4,500 mph. The waves are detected by a shimmering of the solar spectrum—the rainbow of light seen through a prism pointed at the sun. The waves may explain the ups and downs of solar temperatures: More heat is generated as gravity creates wave peaks.

On the map

By the end of this year, U.S. geological-survey aircraft will have flown over 20 states at 40,000 feet to get high-resolution photos. These



Play box acquaints child with geometry.

at the lowest grade levels. Jim Sanhu has designed rectangular boxes covered with sliding tops that contain variously arranged shapes. These are used to provide kindergarten children with an early introduction to geometric forms. **PM**



Ultra Kings, 2 mg. "tar", 0.3 mg. nicotine, Lights Kings, 9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method, Filter Kings, 16 mg. "tar", 1.1 mg. nicotine av. per cigarette, FTC Report Dec. '81.

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

A black and white photograph of a man with a beard and a plaid shirt, playing a trumpet. He is looking down at the instrument with a focused expression. The background is dark, making the man and his trumpet stand out.

There's only one way to play it...

Wherever the music is hot,
the taste is Kool. At any 'tar' level, there's
only one sensation this refreshing.



Original



Low 'tar'



2 mg.

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

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

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

Choice of Specialized Training

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

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

recorder and NRI's exclusive Action Video servicing lessons on videotape.

State-of-the-Art VCR

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

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

Learn at Home at Your Convenience

No need to quit your job or tie up your evenings at night school. NRI comes to you. You are a class of one, getting both theory and practical hands-on training backed up by our staff of experienced educators.

NRI the Pro's Choice

More than 67 years and a million and a half students later, NRI is still the first choice in home-study schools. A national survey of successful TV repairmen shows that more than half have had home-study training, and among them, it's NRI 3 to 1 over any other school.

That's because you can't beat the training and value. Only NRI combines exclusive fast-track training techniques with modern state-of-the-art equipment to give you the skills you need for success quickly



and easily. Only NRI offers such complete training with so many timely options for specialized bench experience.

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- Digital Electronics
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- Industrial Electronics
- Basic Electronics
- Small Engine Servicing
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The Ducks of North America

William J. Koelpin, dean of American wood carvers, creates a definitive collection of hand-painted miniatures—the first ever to portray every species of duck in North America.

Thirty-six intricately detailed miniatures in all—available by subscription only.

Hand-painted duck decoys have a beauty and fascination all their own. Crafted according to traditional skills passed down from generation to generation, decoys today are admired and sought after by collectors as unique expressions of American folk art. Yet never has there been a collection portraying *all* the species of North America's ducks—until now.

For now, the dean of American wood carvers, William J. Koelpin, has accepted a commission from The Franklin Gallery to create just such a collection. A collection of *miniature decoys* portraying all of the 36 different kinds of wild ducks native to North America. Each decoy will be superbly detailed—hand-painted in its full natural colors. Together, they will form an unprecedented display of sporting art in a uniquely American collecting tradition.

Classics—by an acknowledged master



The art of William J. "Bill" Koelpin has won numerous awards and can be seen in major museums and private collections throughout the country. In 1974, Koelpin was chosen "Best in World" at the World Championship Wild Fowl Carving Competition in Salisbury, Maryland. He has been named "Master of the

Guild" by the International Wood Carving Guild. And our nation's most prestigious wildlife museum—the Lehigh-Yawkey-Woodson Art Museum in Wausau, Wisconsin—has called him "one of America's premier artists."

Bill Koelpin's enormous talent—his artistic mastery, his accuracy and complete authenticity—will be in evidence throughout The Ducks of North America Miniature Decoy Collection.

Working directly in miniature, he has hand-carved an original master for each species of duck. From these master models, expert craftsmen take special molds, so incredibly detailed that they capture every line and curve of the sculptor's art. Each decoy in the collection is then crafted from these molds in a blend of resins and wood to create a perfect miniature. A



work so lifelike, in every respect, that you will actually be able to see the *attitude* of the bird . . . the *texture* of its wing plumage . . . and the true-to-scale *proportion* of each species—from the majestic Mallard and King Eider to the compact Surf Scoter.

The rich colors and shadings of nature

To add to the life-like realism of the collection, each miniature decoy is then individually hand-painted in as many as twelve colors. These colors are carefully chosen and painstakingly applied to accurately define the rich hues and subtle shadings found in nature.

The iridescent green hood of the Mallard, for example. The steel-blue head and muted speckled breast of the Blue-winged Teal. And the brilliant plumage of the Wood Duck—a rainbow of purple,



green, burgundy and bronze. Indeed, this individual hand painting of each miniature is the only way to achieve the *authenticity* that distinguishes the most desirable decoys. The result of all this

Miniature Decoy Collection

BY 



will provide a dramatic accent for the walls of a study, den or office. Its design allows ample room for the collection to be arranged in any of several ways.

Enter your subscription by June 30th

The Ducks of North America Miniature Decoy Collection will be crafted exclusively for subscribers. It is available only by direct subscription from The Franklin Gallery. It will not be sold through stores.

If you appreciate the beauty of nature's most spectacular waterfowl . . . and its expression in the uniquely American tradition of finely crafted decoys . . . this collection of hand-painted miniatures will provide you with rich and lasting satisfaction.

To subscribe, please reply by June 30, 1982.



Decoys, at left, shown reduced. Average length is 3 inches. The base of each decoy will bear the name of the species portrayed, the signature of the artist, and the copyright of The Franklin Gallery.

© 1982 FG

meticulous craftsmanship is a collection of 36 miniature decoys that represents a truly remarkable achievement. For each one is faithful to nature. Crafted with the precision and detail that would do credit to a full-size decoy—in a miniature that rests comfortably in the palm of your hand.

To complete the presentation, the base of each decoy will bear the signature of William J. Koelpin, together with the name of the waterfowl portrayed. And each decoy will be accompanied by a specially written commentary, describing the duck, its seasonal markings and its habitat.

A dramatic display to showcase the collection

So that these superb hand-painted miniatures may be displayed to their best advantage, a handsome display rack will be included as part of the collection.



This fine hardwood rack

The Ducks of North America MINIATURE DECOY COLLECTION

Please mail by June 30, 1982

The Franklin Gallery
Franklin Center, Pennsylvania 19091

Please enter my subscription for **The Ducks of North America Miniature Decoy Collection** by William J. Koelpin, consisting of 36 hand-painted miniature decoys, to be issued to me at the rate of one per month.

I understand that the original issue price is \$27.50* for each miniature decoy and that this price will be guaranteed to me for the entire collection. The hardwood display rack will be sent to me at no additional charge.

I need send no money now. I will be billed for each decoy in advance of its shipment.

**Plus my state sales tax and \$1. for shipping and handling.*

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48

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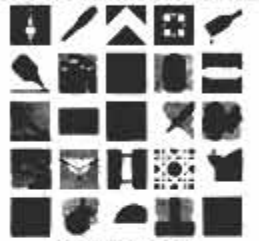
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Right now I'm having to eat my words because I told my partner that his new T-shirt would never sell. I was wrong. You can read for yourself what it says... black shirt with white lettering. It's 50% cotton-50% polyester, and we think you'll have some fun wearing it around. Order S, M, L and XL. \$7.50 delivered.

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Sure-footed and swift



Turbocharged, 4wd Audi Quattro GT hits 0 to 60 mph in 7.5 seconds, 128-mph top speed.

Let's hear it for those enthusiasts who willingly pay the price of superlative performance and make the world so much more interesting. In the world of cars, appreciative drivers will put down about \$38,000 each for all the Quattros Audi can make this year—about 500 of them. After



Quattro's full-time 4wd is powered by 156-hp, sohc, fuel-injected, turbocharged Five.

a year of rallying in Europe, the four-wheel-drive racer has gone into limited production. It will hit our streets this month. Its full-time 4wd isn't meant for the dirt. It should make the Quattro nothing short of the ultimate road car—fast and safe under any road conditions. We're going to try our darndest to hang out the tail, and we'll have a full report soon.

Back on the track

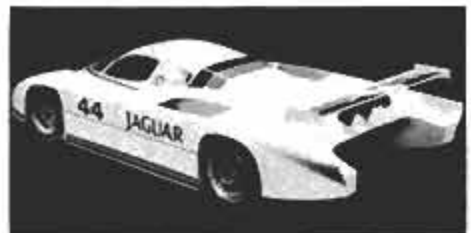
If you came of age—driving age, that is—in the '50s, you probably wished that whatever you were driving was a Jag. That was a glorious



Jaguar GTP car, shown in one-quarter scale model, is made for endurance racing.

decade for Jaguars, with one win after another. They made a tea party of LeMans, winning in '51, '53, '55, '56 and '57. Whoops, getting nostalgic.

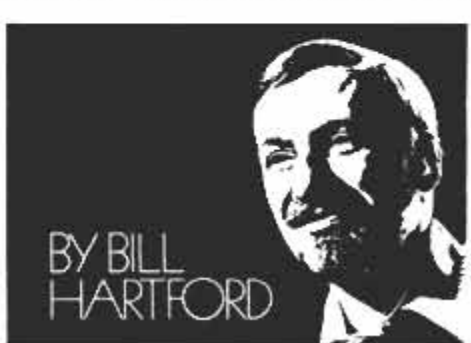
It's *this* year, 1982, that the modern-day Jaguar chaps want to be a glorious one. They're going racing again with a new V12-powered, Grand Touring Prototype (GTP) car, designed for endurance racing. Jaguar Rover Triumph Inc. considers 1982 a development year for the new racer which will be campaigned by Bob Tullius. The Camel GT series of the International Motor Sports Assn. (IMSA) is home base for the V12, but we could see it at LeMans



V12 Jag, pure racing car in 1,000-kilogram GTP class of IMSA, is good for 230 mph.

next month if all goes well—and go well we hope it does.

Indy 500: If it's May, it must be time for all good race fans' pilgrimage to Indiana. The 66th running of the 500-mile classic at the Indianapolis Motor Speedway is set for May



BY BILL HARTFORD

30. We hope there's a clear-cut winner this year! This year's pace car is Chevy's Z28 Camaro, specially prepared in silver and blue. Even if you don't see it at Indy, you'll catch it at dealerships, where commemorative editions will be on sale.



Camaro will pace this month's Indy 500.

There's another special version of the Camaro, the Z28-E, which is General Motors' first model to be prepared exclusively for sale overseas. It'll have a realistic speedometer (instead of our 85-mph would-be governor) that tops out at 240 kilometers per hour.

Off-road Championship Gran Prix: Mickey Thompson's got a new venue for his off-road series (see *How They Bring Baja To The 50-Yard Line*, page 80, Aug. '81). They'll be rolling at the Los Angeles County Fairgrounds May 23 and July 11.

On the pole

Here's some input to help you with your new-car buying decision, or just to help you stay out in front of the pack.

Nissan: For the first time, Nissan is offering an automatic transmission on its front-wheel-drive cars. Stanzas and 310 GX models get the



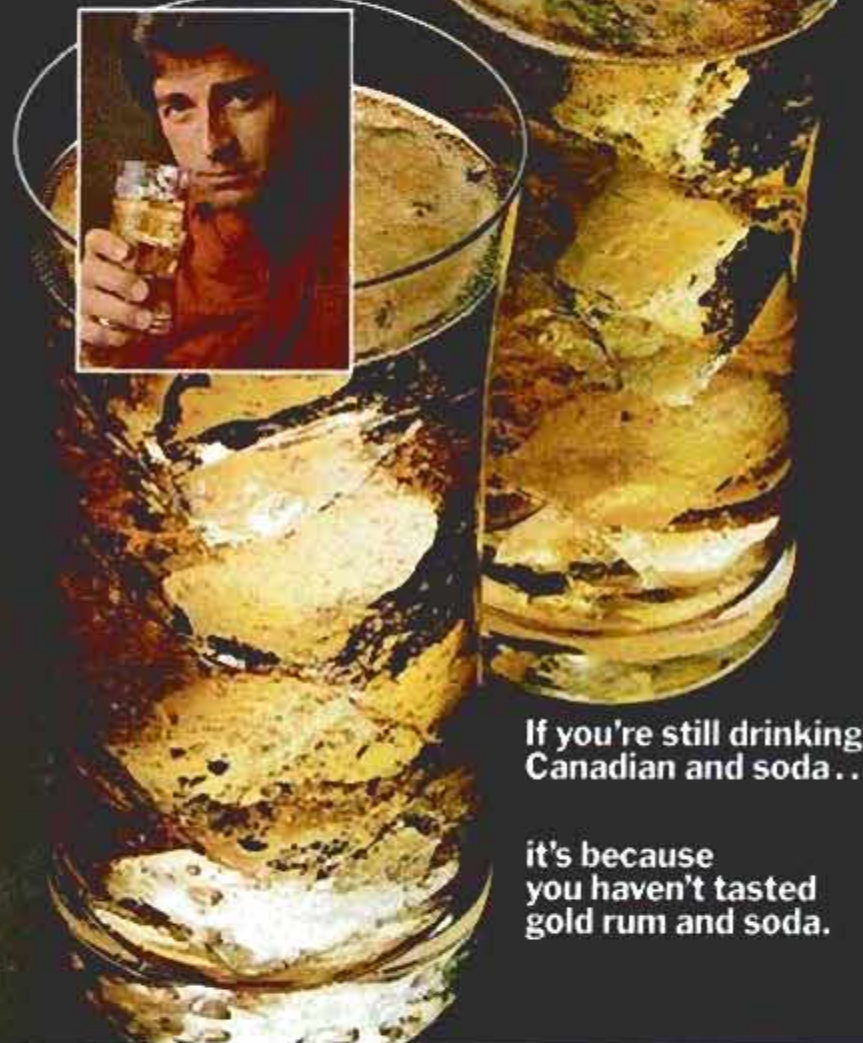
Celica GT-S for '82 gets Supra handling.

option, which will cost you \$280.

Toyota: Celica gets a GT-S package for '82, which makes the economical four-cylinder handle like its dohc, six-cylinder big brother, the Supra.

European delivery: Don't overlook the fact that many import car manufacturers offer good deals on European delivery of a new car—enough to finance that vacation abroad. Top savings on a Saab, for example, is \$2,660 for the 900 Turbo. On Mercedes-Benz's 300SD you can net a *wunderbar* \$6,221: If you journey to Stuttgart, you can pick up your car for \$30,609 instead of \$36,830. Nice work if you can get it. **PM**

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Canadian and soda...

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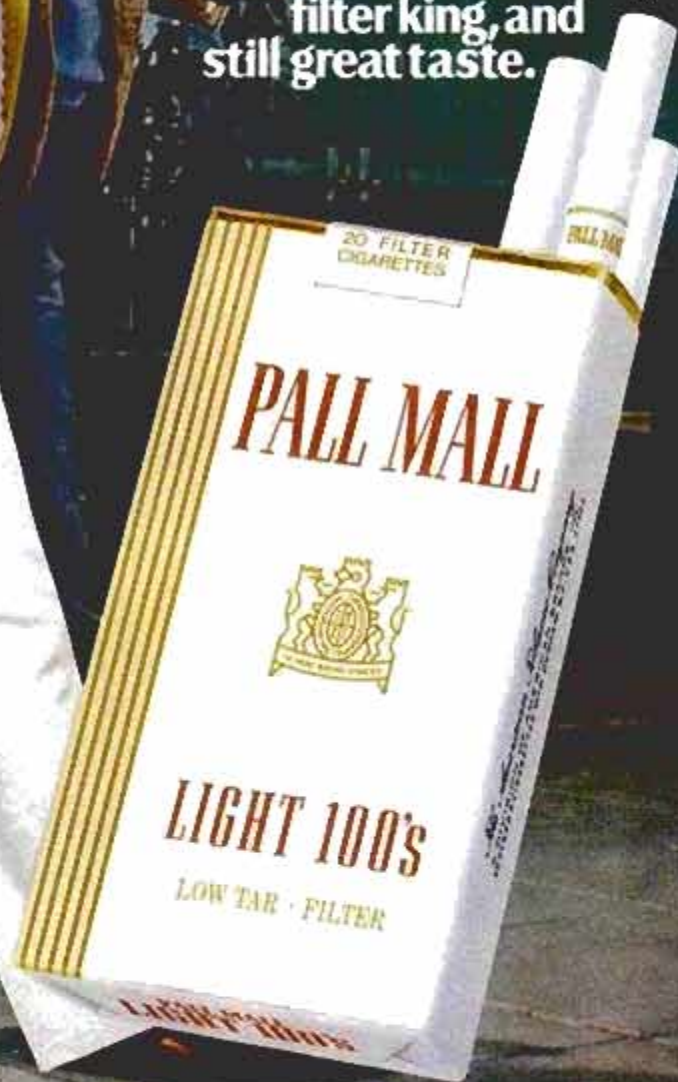
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than the leading
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less than 0.01mg. tar. 0.002mg. nic.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette, FTC Report Dec. '81.

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

Don't write off alcohol

Last month, mention was made of a multifuel engine that can be run on alcohol, as well as on gasoline or diesel fuel (*A Burnt-Out Case*, page 206), and a cross-country trip in an alcohol-fueled car (*Eight Days On Straight Alcohol*, page 89). People who equate the well-publicized collapse of the Gasohol-marketing complex, as a result of the world oil surplus, with the final demise of alcohol as a fuel are wrong.

As energy costs continue to rise, the outlook for any number of hydrocarbons as substitutes for or supplements to conventional petroleum-based fuels can only get better. But when the gasoline crunch was at its peak several years ago, the wish on the part of practically everyone that alcohol could somehow quickly be mustered as a no-strain, no-pain replacement resulted in two specific areas of widespread misinformation: First, you were going to be able to whip it up in your back yard, eliminating OPEC and service stations in one fell swoop; second, with a few minor adjustments, today's automobiles would take to alcohol like cats to cream.

Recent reading on alcohol: Most literature on alcohol fuels tends to overstate the immediate practicalities and understate possible problems. The following are not entirely excepted, but are good overall introductions: *Fuel Alcohol—How to Make It, How to Use It*, by James R. Ross (St. Martin's Press), and *The Alcohol Fuel Book*, by Rodger and Virginia Seratt (Box 1291, Fayetteville, Ark. 72701).

As many people have found out, it just isn't so. The economical production of anhydrous (200 proof) ethyl alcohol by distillation is far from simple; one company, Archer Daniels Midland, holds the lion's share of the industrial market and is not threatened by back-yard operations. PM recently visited a smaller-scale fuel alcohol distillation plant run by Smith Bowman Co. in northern Virginia. For decades the company has made a bourbon-connoisseur's whiskey under the Virginia Gentleman brand. The production of anhydrous fuel alcohol, however, while involving the same raw materials, added critical steps to the distillation process that require microprocessor control. Much of the output comes from "finishing" lower-proof alcohols bought from yet smaller producers—who are simply not able to achieve the final 10 to 20 degrees of proof (eliminating the water) with limited, small-scale equipment. In other words, it takes nearly as much extra know-how, technology and resources to get ethanol from 190 to 200 proof as it does to make a good bourbon in the first place.

As far as automotive performance goes, the Brazilian

experience is often cited as both a triumph and a disaster. It's true that the country converted more than a third of its automotive population to run on alcohol in less than five years. It's also true that performance and maintenance problems have accrued well out of proportion to what was anticipated. Pure alcohol is corrosive and will not readily vaporize at under 65° F. These facts must be taken into account by anyone who expects to run alcohol long-term through a conventional carburetor (with larger jets) and who will have to start the car in cold weather.

The Brazilians are not backing away; commercial alcohol-powered auto and truck fleets are operating with good results in the United States, primarily in California. Gasohol is still being sold in most Midwestern and Western states; a methanol-based variant called Petrohol is also being tried at blends up to 12 percent (at which point some car manufacturers don't recommend it). Here and there, new techniques and materials are being applied which show promise of overcoming the adverse side-effects of straight alcohol fuels.

It is as an octane-booster that alcohol shows the most immediate utility. There are plenty of American cars knocking, pinging and dieseling on low-octane gasolines these days. Some motorists blend their own alcohol, in very small amounts, right into gasoline and find the knocking stops. A La Jolla, Calif., firm, D.A. Smith En-

(Please turn to page 24)



Smith Bowman distillery: From bourbon to ethanol with computerized process controls required for the higher fraction.



Alco-Charge unit: Looking for ways to boost low-octane gasoline, it injects alcohol vapor directly into the carburetor.

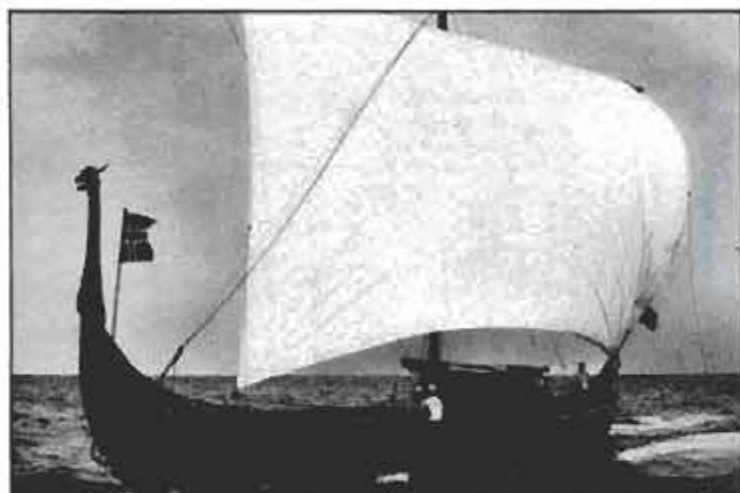
gineering (Box 301), is bringing out a device called Alco-Charge that feeds minute quantities of alcohol vapor directly into the carburetor (at normal engine operating temperatures). It sells for \$10, postpaid, and can be mounted with a single screw.

With advanced technologies such as genetic engineering being applied to fermentation, the economics of alcohol fuel can only improve. In one way or another, it's here to stay.—Robin Nelson

Viking, go home

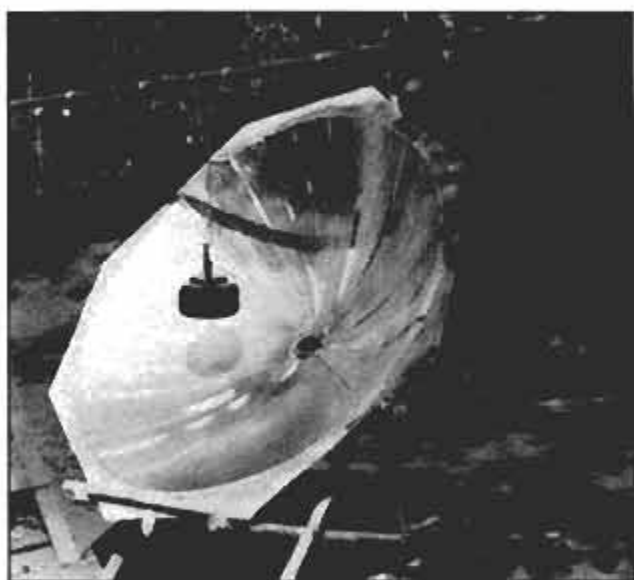
For a good deal of his adult life, Robert Asp of Moorhead, Minn., had one obsession: He dreamed of building a replica of an 11th-century Viking longship on Lake Superior, then sailing it to Norway and back, thereby adding credibility to the idea that Norsemen could have travelled as far as our upper Midwest centuries before Columbus.

Asp began working on such a vessel in 1971, but he died of leukemia two years ago. His family and a group of friends rallied to continue the project. The ship, named the *Hjemkomst* ("Homecoming") will sail from Duluth in May for Norway. In 1983, a return voyage is planned, but as of now underfunded. A crew of 12 will man the open vessel. The project was afforded nonprofit foundation status last year; tax-deductible contributions can be sent to *Hjemkomst Viking Inc.*, Box 127, Moorhead, Minn. 56560.



Replica of 11th-century Viking ship tests sails and gear on Lake Superior.

Ship's forefoot showing elaborate and painstaking detail of lapped planking.



Solartary confinement

Camera at hand, PM reader Charles King of Milpitas, Calif., advanced through the jungle near Karnchanaburi, Thailand, and came upon a teapot hanging from a bamboo pole over a reflecting paraboloid. The site is on the banks of the River Kwai where, 40 years ago, solar energy was employed in less palatable ways.

Saving energy—it adds up

With all the admonishments to save energy in every way you can, you sometimes get to the point where, like an overpunished child, you don't believe you can do anything right. In case you're looking for a little positive reinforcement, consider the fact that oil imports in the year 1990 are now projected at 1.3 million fewer barrels per day than they were in 1980.

The figures come from the economics braintrust at Conoco, one of the major oil companies that puts a lot of stock in its forecasting ability—and tends more than some others to make the data public. Even by the year 2,000, says Conoco, oil imports, at 5.8 million barrels per day, will still be less than the 6.2 million figure notched in 1980 (1981's daily total is estimated at 5.2 million, a drop of a million barrels per day in one year).

Automobile downsizing, more efficient home heating and insulation and other energy-saving technology will account for much of the savings, but so will the turn to other energy sources, primarily coal.

Interestingly, Conoco sees world oil prices rising no faster than general inflation rates for the next several years—as the sharp decline in U.S. import requirements sets in. As that decline bottoms out about eight years ahead, however, oil prices will begin to run 2 to 3 percent above inflation annually.

Our pre-embargo demand for oil in the United States was increasing at an average 4 percent annual rate; since the embargo, we've reduced it dramatically, and it should average about 1.5 percent per year through the end of the century.

So take time out for congratulations, but remember that the projections all assume we're going to keep on finding new ways to save energy.



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ALL OUTDOORS

Survival signal

One of the best signaling devices if you're in trouble is the flare pistol. Fire a bright rocket high in the sky any day or night—except July 4th—and there's a good chance you'll attract attention and aid. Ever since naval ordnance expert E.W. Very invented it in the late 1800s, this pyrotechnic pistol has been shooting up balls of fire to call for help around the world.

It's known as a "Very pistol" to a few million armed service veterans, but is it also a "firearm"? In 1981, when Coast Guard regulations started requiring approved visual distress signals aboard all boats on Great Lakes and coastal waters at night and any craft over 16 feet during the day, many boatmen wondered if playing it safe was going to get them in trouble. While a flare gun has been used on occasion to scare off marauders, it isn't designed as a deadly weapon. Shotgun shells can't be chambered in it, and anyone trying to fit them is looking for trouble and a possible explosion in his hand. But it looks like a pistol and fires like one, even though manufacturers and the Coast Guard call it a "flare launcher." Though legally you can wave an approved orange distress flag during the day or blink out an S.O.S. with an emergency flashlight at night instead, a rocket flare is a lot more likely to get results. When the regulation was passed, Olin Chemicals was the first to perfect a reliable and inexpensive "flare launcher" for carrying on any boat.

New York State has some of the strictest firearm laws, and now Robert Abrams, New York State attorney general, has given the legal opinion that "flare launchers approved by the Coast Guard and not capable of firing conventional ammunition are not firearms as defined in the penal law." Hopefully, this ruling will establish a precedent for other states, as well. When a boatman needs to signal for help, he wants to have at hand the strongest, brightest, most effective attention-getter he can find.

Scope picture

For the selective trophy hunter, and for most others, as well, there are thousands of sights he remembers between the few moments when he actually has a chance to shoot. Red-



Snap Shot, a new, little 110 Instamatic camera from Redfield, turns a telescopic sight into a true telephoto or zoom lens.



field, the well-known telescopic sight manufacturer in Denver, has come up with the newest aid to record distant scenes afield. They call it the Snap Shot, and it's a pocket-sized Instamatic camera that takes 110 film, comes with a belt-loop carrying case and fits neatly onto telescopic sights with its scope adapter. The scope becomes a bargain telephoto lens, and a variable-power model serves as a very powerful zoom. A cable release makes snapping easy, and pictures taken with it that we saw at this year's SHOT show in Atlanta were of remarkable quality. And for photos around camp, it slips easily off the scope. Price is under \$60; Redfield dealers should have Snap Shots in stock by now.

Boatmen's mecca

Cruising off to a tropic island surrounded by sheltered waters full of

(Please turn to page 28)





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Frank Jartin
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ALL OUTDOORS

(Continued from page 26)

fish and edged with white sand beaches is the goal of skippers across the country. The answer is Florida, and the expert who tells how and where is Red Marston, in his new book, *Cruising Florida*. Much more than just a directory, the book gives routes, stop-offs and sights to see, plus history, color and Red's personal observations, after covering every watery mile of Florida's Gulf and Atlantic coasts and keys. For sail and power boatmen who are going, who might go or who wish they could, this \$14.95 volume from McGraw-Hill is the satisfying answer.

For travelers ashore, Windward Publishing, Box 371005, Miami, Fla. 33137, has issued *Guide To Florida Campgrounds*. It's \$4.60 postpaid from the publisher.

Pack photography

Eastman Kodak's new Disc camera—there are three models—



Kodak's new Disc camera, wallet-thin, slips with ease into a backpack or pocket.

should appeal to almost every picture taker who enjoys photos without fuss, but it's particularly adaptable to outdoorsmen on the go. Automatic exposure, automatic motorized film advance, automatic flash if needed, make possible one-hand shooting while you're climbing up a mountain or skiing down it. A slide cover protects the tiny lens from dust or mist when not in use.

Automatic cameras have been available before, but these Disc cameras are so thin and compact that they slide easily in almost any backpack or pants pocket. For a peek at their innards, see *Technology Update*, page 35.



“Exxon motor oil appeals to one’s sense of thrift.”

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DETROIT LISTENING POST

'83 Ford development

Ford has been making a lot of news for its return to exciting, performance-oriented vehicles on the street and serious, openly supported racing cars on the track. But lest we forget that there's more to America's No. 2 automaker than burning rubber, the nice folks over at Ford's Dearborn Technical Center invited us over for an intensive, two-day show and tell.

They marched us through reliability laboratories, emissions laboratories, engine-dynamometer cells and computer centers. They showed us real crash tests and filmed wind-tunnel tests, every mile of the Dearborn Proving Ground, and even the pilot plant where early examples of '83 cars and trucks were being carefully bolted together and checked for fits and buildability.

As if that weren't enough, they talked our ears off on manufacturing technology, employee involvement and other quality-improvement programs; then actually *listened* to find out what we thought! Finally, for dessert, they showed us the year's most beautiful new show car, the Continental Concept 90.

When it was all over, we were footsore but suitably impressed—not only by what we perceive as a dramatic change in attitude toward the building and marketing of automobiles, but also by the future Ford automobiles themselves.

As you're aware, the fall cars—facelifted Mustangs and Cougars and downsized LTDs and Marquis, the latter Fairmont/Zephyr-based—have not dazzled buyers, but wait'll you see the mid-'83 small sedans (Ford Tempo, Mercury Topaz) and Thunderbird! The former, on a stretched fwd Escort platform, are smooth, rounded, aerodynamically clean and among the best looking family-type cars we've ever seen.

The latter retains its rear-drive mechanicals, but takes on a startling new look so gorgeous you'll never believe it's designed by the same company that turned out the current, overly-chromed shoebox T-bird and XR-7 a few short years ago. Visualize a Mercedes 500SEC coupe—now squash it down, round the corners and clean up the details, and you'll have some idea what we're talking about. The Mercury XR-7 version is just as nice below the belt

Continental Concept 90



Is this the shape that will beautify the roads of the country? It seems to be. From what we saw in the pilot plant, next-generation Continentals and T-Birds will look like this show car.

but spoiled by a truly ugly roofline that's formal square in back and reverse-curved on the quarter window side. Ugh!

The Continental Concept 90 show car is the basis for the future T-Bird and Continental—sort of a two-door Continental with its subtly modernized grille and rear deck.

Ford aerodynamics

While we loved the soft and swept-back look of those future Fords from an aesthetic standpoint—and believe it will displace GM's thin-pillar formal look as state-of-the-art among U.S. carmakers in the next two years—we also appreciate its aerodynamic benefits. The coming T-Bird, for example, parts wind-tunnel air with a very clean .35 coefficient of drag. The Tempo/Topaz sedans boast an excellent .36. The '83 Mustang fastback rates .37. And even the new LTD/Marquis scores a respectable .38 Cd.

But these numbers don't mean a whole lot without Cds of competitive products, measured in the same (Lockheed) tunnel under identical conditions.

Exactly how would the new Toyota Celica or the Pontiac Firebird compare, for example; or the Mazda RX-7, or the Porsche 924 Turbo?

The Ford aero folks say they test competitive cars for their own information, both at Lockheed and in Europe, but they won't release the numbers. Don't want to open that can of worms, they say. Yet they advertise their current Mercury/LN-7 has "the best aerodynamic rating of any standard-equipped car made in America." Are we supposed to take their word without supporting evidence?

Not to pick on Ford alone. Most

everyone's touting aero efficiency and throwing Cd numbers around now, but we've seen no hard comparisons.

We've checked GM, too, and come up empty. We know they know where they stand vs. the competition, but they won't tell us.

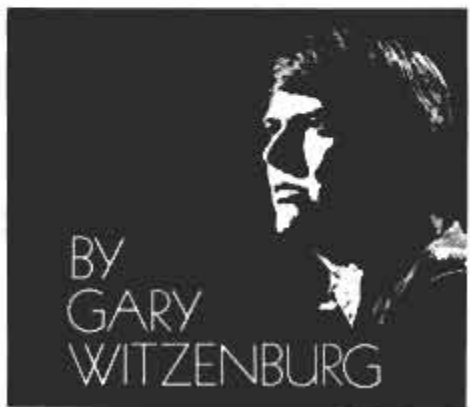
If Cd is really such an important selling point, maybe what's needed is a standard third-party test program—participated in, and supported by, whichever manufacturers choose to advertise their products' aero prowess. Voluntary, mind you, not a regulation. But until statistically comparable numbers are available, we'll have to take Ford's—and everyone else's—antidrag claims with a big grain of salt.

Future GM powertrains

General Motors researchers and engineers have taken a hard look at what will likely motivate purchase of our personal vehicles in the next decade and here's what they've concluded:

Gasoline engines are viable far into the future because they'll get continuous efficiency improvements, but direct-injection turbodies-

(Please turn to page 32)



"It's the wagon that made us love wagons!"



"We really needed a wagon. But we wanted more than just room. Glad we discovered this Oldsmobile Custom Cruiser. Lots of space, sure. Over 87 cubic feet for cargo, with the rear seat folded down. But so luxurious it feels more like a big, comfortable sedan. Smooth. And quiet. Economical, too, with the optional diesel V8 and automatic overdrive transmission. Put it all together, and our new Oldsmobile

is terrific. It's the wagon that made us really love wagons!"



First it's an Olds.



Then it's a wagon.

Custom Cruiser.
Even today,
there's still room to
do it with style.

Oldsmobile

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AVAILABLE
OPTIONAL

36

MPG CITY

22

MPG HIGHWAY

Use estimated mpg for comparison. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Highway estimate lower in California. Some Oldsmobiles are equipped with engines produced by other GM divisions, subsidiaries or affiliated companies worldwide. See your dealer for details.

(Continued from page 30)

sels are the best fuel economy bet—about 40-percent thrifter than gasoline with comparable performance—if they can meet emissions requirements. Forget Stirling engines for passenger cars, and don't look for automotive gas turbines until at least the 1990s. Direct-injection stratified-charge is a possibility and under development.

Electronic engine/emission controls will be simplified compared to current systems and expand in us-

age and capabilities. Electric cars, probably combined with a flywheel to stretch range, will have a role as soon as battery technology improves. Flywheel/heat-engine hybrids show promise under certain conditions. And belt-driven continuously variable transmissions (CVTs) look good for future front-drives.

Buick sports car

It looks like Buick's high-performance luxury sports car may be ready by the '84 model year. Powered by a fuel-injected, possibly turbocharged, V6 engine driving the

front wheels, the 2,000-pound two-seater will use a lot of J-car chassis components with its own highly aerodynamic body on a 94-in. wheelbase. Production will be about 20,000 a year, price well over \$20,000, and a later targa-top or full convertible version is a good possibility. Cadillac is also said to be considering such a car, obviously aiming to take on the Mercedes 380SL and Porsche 928.

AMC/Renault Car of the Year

A panel of 52 top European auto journalists has named the new Renault 9 European Car of the Year for 1982. This is significant to U.S. buyers because, as you may know, an Americanized version of the 9 (expected to be called the Renault Alliance) will soon be produced by American Motors and sold through U.S. AMC and Renault dealers. Available this fall in two-door and four-door sedan styles, the car impressed us, too (see *Detroit Listening Post*, page 60, Mar. '82).

Now, natural gas?

Despite the stabilization of gas prices and the current glut of crude oil, Ford is still hard at work exploring alternate fuels. The philosophy is: Whenever a new fuel becomes widely available, they'll have cars that run on it. Hence the factory propane-powered Fords already being sold here and in Canada, the alcohol test-fleet Fords in California, and now—a compressed natural gas (CNG) powered Ford.

The slick little AFV (Alternate Fuel Vehicle) is still just a prototype, since there's no distribution system in place yet for fueling motor vehicles with natural gas. There's a heck of a system already distributing it to most every home in the country for heating and appliances, though, so all that's needed is a natural gas compressor in every garage.

Natural gas (or methane) is cheaper today than gasoline, but contains only 23% of the energy in a given volume. Fuel tanks have to be rather expensive spun-aluminum cylinders (to handle CNG's high pressures), and range is cut about a third (to 210 miles in the AFV) even with a fairly large (4.3 cu. ft.) tank. But conversion of the engine is simple and inexpensive, emissions almost nil, and performance (based on a CNG Ford Escort) at least as good.

Ford says there are no potential safety problems that can't be handled (about 250,000 vehicles are already running on CNG in Italy) and that the car, while more expensive initially, could pay for itself with operating savings in about a year of normal driving. **FME**

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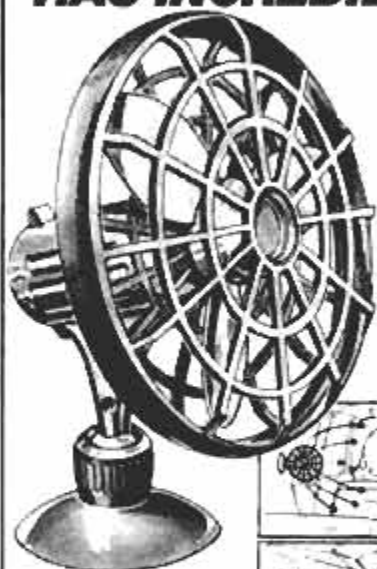
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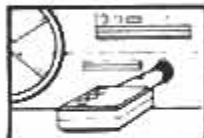
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TECHNOLOGY UPDATE

Kodak debuts new disc technology

Photography

The word is "disc" and Eastman Kodak is hoping it will soon become a national obsession—at least among shutterbugs. According to Kodak, its new disc photography system will allow amateur picture-taking to take a "substantial leap forward."

Three new cameras all share the same, calculator-thin appearance and use Kodak's new disc film cartridges. The cameras are incredibly simple to use. Electronic circuitry analyzes the picture possibilities of a scene and sets the proper exposure automatically. It decides if the built-in flash is needed, takes the shot, advances the film to the next frame and recharges the flash—all in less than a second. But this new disc film isn't just a gimmick; it really should enhance many amateur photographers' results.

Kodak has developed a new concept in lens optics: The small but carefully polished and coated lens in the camera (F/2.8 aperture) has an extremely short focal length, which gives these cameras astonishing depth of field. This means that sub-



Kodak's new disc camera (above) uses cartridges (right) that hold 15 color-print negatives. Everything from flash to winding to new exposure is fully automatic.



jects positioned close to the camera will be in focus and so will distant subjects.

But the short focal length of the lens also puts only a tiny image on the film. So Kodak developed a new

form of Kodacolor film with almost twice the resolution of previous types.

These tiny negatives couldn't be carried on normal, thin film, so thicker emulsions were developed. Soon, the disc idea was born as a way to carry that thick-emulsion film.

The disc also brought about the automatic film advance. It's much easier to spin a disc a notch than to advance roll film automatically.

This space-age camera also features one of the first portable power supplies based on lithium chemistry. The camera—batteries and all—is warranted for five years. No flash bulbs, no batteries—just shoot, and shoot and shoot.

Our first test with the camera showed it was capable of far better quality than an Instamatic and, in some instances, took shots that were almost indistinguishable from a good SLR.

Three models of the camera will be available beginning May 17. They range in list price from \$67.95 to \$142.95. PM will run an extensive test on this new system in an upcoming issue.

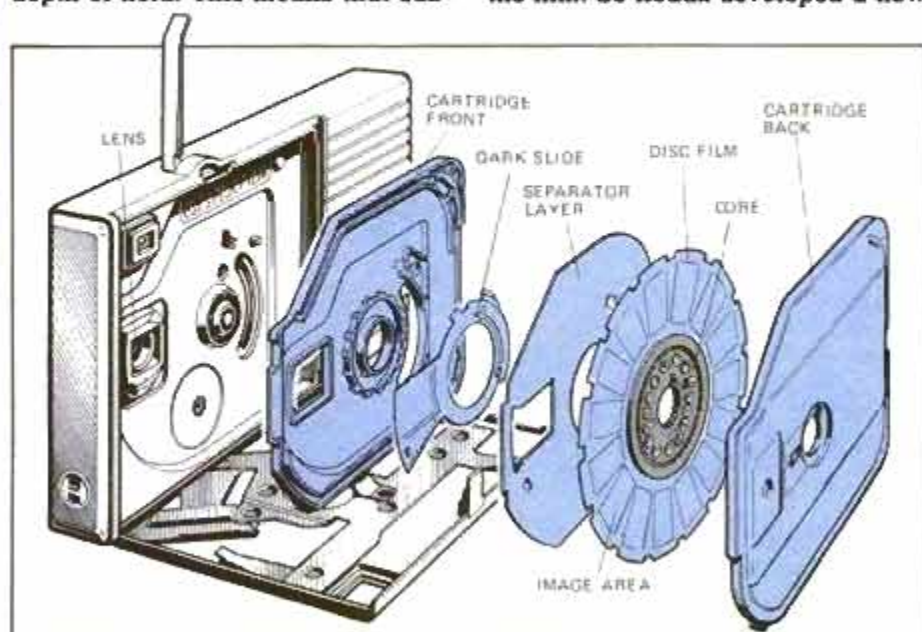


Image area on film (above) is tiny. Film emulsion allows the small image to be enlarged to normal prints. Short distance from lens to film allows great depth of field.

Transportation

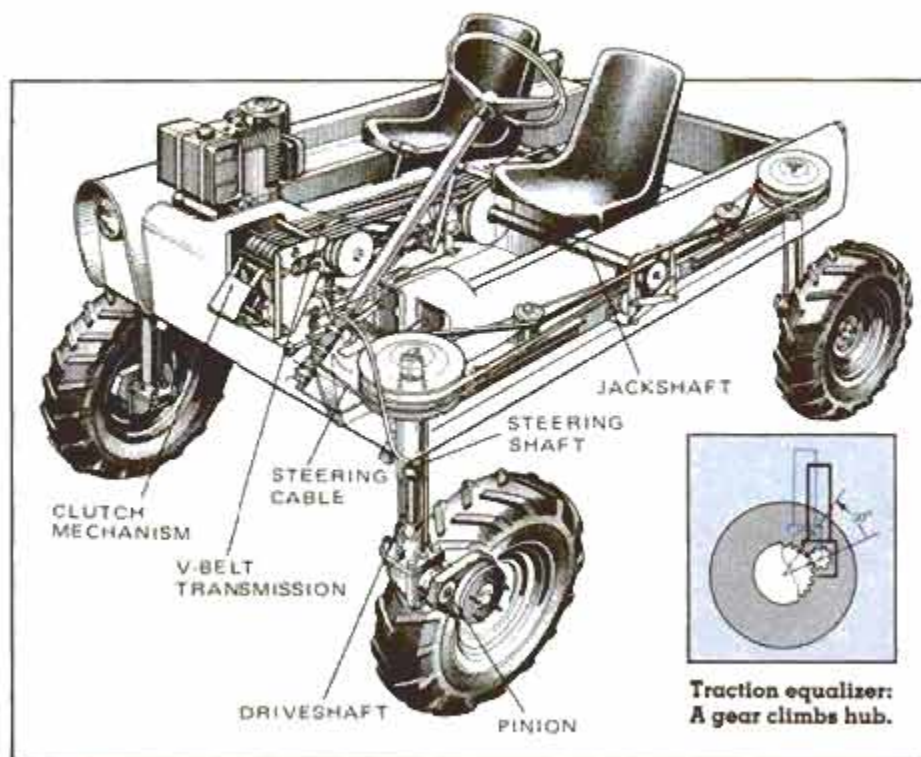
Four for the chore

Vermont inventor William George Spence first began toting up registered patents involving "ongoing developments in tractor technology" a decade ago. Several years later, they culminated in a prototype called the Quadtractor.

In addition to four-wheel drive and four-wheel steering, the tractor offers over 30 inches of unobstructed ground clearance. This allows a drag load to be suspended; as a result, its 8-hp Briggs and Stratton engine has a load-pulling capability of nearly two tons.

There is a final-drive reduction of 72 to 1 at each wheel, providing the requisite torque for this high-traction geometry. The vehicle itself weighs 900 pounds.

Of particular interest (see drawing) is a powered suspension at each vertical axis, using no springs or shocks; a small gear tries to "climb" a larger one, transferring extra power over irregular terrain.



For a base price of a little over \$3,500, the Quadtractor comes with its air-cooled engine, electric starter, tires, off-road lights and padded seats. A whole raft of ingenious options is available, including drawbar, electric winch, skid plates,

scraper blades, plow and cultivator. Its traction and independent wheel action make it ideal for light logging applications in rugged terrain. The manufacturer, Traction Inc., can be reached at North Troy, Vt. 05859 (phone: 802-988-4411).

Recreation

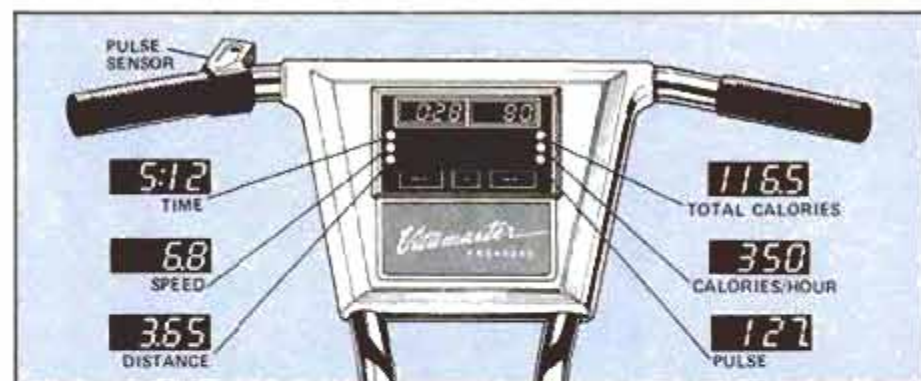
Life cycle

The melding of microprocessors with exercise equipment is soon to revolutionize multipurpose resistance devices (see *Physical Fitness And The Machine Age*, page 91). To some extent, it's already here in more specific apparatus, like the Vitamaster Pro-1000 station-

ary cycle.

While it has a heavy flywheel and variable resistance features of standard exercise cycles, the Vitamaster unit adds a console between the handlebars that provides the fol-

Vitamaster cycle offers variable resistance and total exercise data system on a console.



Vitamaster panel (above) reads out exercise parameters in sequence unless the user selects specific information. Calorie figure relates to the total effort expended. The speed and distance figures are calculated as bicycle equivalents.

lowing digital data: time, speed and distance (simulating bicycle equivalents), calories expended and pulse rate.

The company insists calorie expenditures won't vary significantly with body weight or type; researchers might quibble with that, but the average readings provided for a standard cycling exercise are probably close enough. Pro-1000 retails for about \$639.

In the oncoming generation of resistance machines, electronics will be used to set "weight" (resistance) levels, as well as provide readouts. One design problem: What happens if there's a power failure when someone's in the thrust phase of a heavy exercise? Because of that consideration, most of the devices that are ready for near-future marketing use 12-volt batteries as a power source.



Aviation

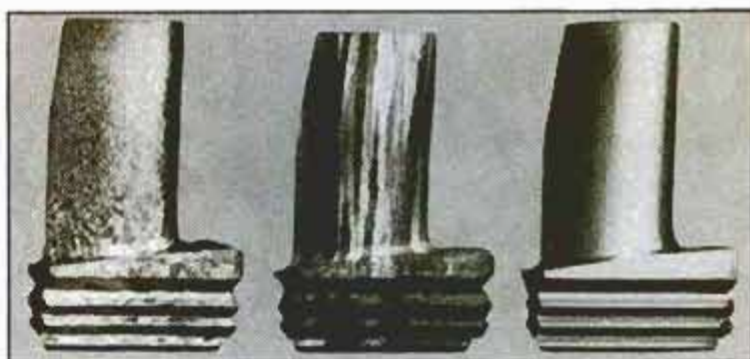
Central casting

Turbine blades are the Achilles' heels of jet-age aircraft. When one fails, it tends instantly to become a foreign object capable of destroying other engine components. The metallurgical processes for producing turbine blades have always been fairly critical, but now Pratt & Whitney Aircraft believes a refinement in casting has produced the strongest turbine blade yet possible.

Cast metals are likely to fracture along natural crystalline boundaries. As far back as the '60s, Pratt & Whitney was using a directional solidification process in which the grain (crystal) boundaries were aligned parallel to the blade axis. These blades had superior strength at high temperature. By fur-

ther modifying this casting technique, Pratt & Whitney has produced a "single-crystal" turbine blade, fabricated from an alloy known as PWA 1480. In the new casting process, grain boundaries—fracture points—are completely eliminated.

If the blade proves out, current limits on jet thrust could be extended.



CONVENTIONAL CASTING COLUMNAR GRAIN SINGLE CRYSTAL

Evolution (left to right) of turbine metallurgy from the weakest to the strongest cast; blades are etched to show crystal structure.

A helicopter that isn't a 'chopper'

Up until recently, nobody who manufactures or flies helicopters had a much better explanation for the audible phenomenon known as "blade slap" than the man in the street.

Obviously, everybody would profit from quieter helicopters; but researchers had been in a quandary about what really causes the "wop-wop-wop" of the whirlybird. By setting up

pressure and airflow measurements within the 1/30,000-of-an-inch boundary layer on a scale-model whirling blade, Massachusetts Institute of Technology scientists have been able to draw some conclusions about blade slap.

A pressure differential causes a vortex to form at the tip of each rotor blade as it whirls. It is vortex-induced stalling within the

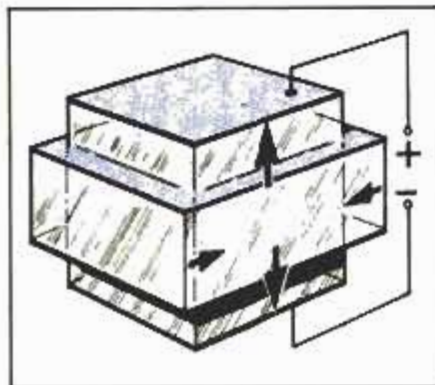
boundary layer of the following blade, the MIT researchers say, that causes blade slap. The vortex causes air to separate, then to reattach itself violently to the blade, creating the sound. The MIT project was also able to construct a slap-damped, scale-model blade. Production versions may someday be mounted on aircraft called "slicers."

Electronics

Son of piezoelectricity

Perhaps because the name is such a mouthful—and some people mistake it for an automated Italian fast-food chain—the phenomenon known as piezoelectricity keeps resurfacing in various forms. First described in 1880, it's the property of certain crystalline materials which convert mechanical energy to electrical, and vice versa. Applications of this have been as common as the quartz crystals used to fix radio frequencies or as the central element in electronic watches.

But now, a Cambridge, Mass., firm, Piezo Electric Products Inc., is aiming to put piezoelectricity on the map for good. The company plans to manufacture synthetic piezoelectric materials which can replace expensive magnetic devices in items such



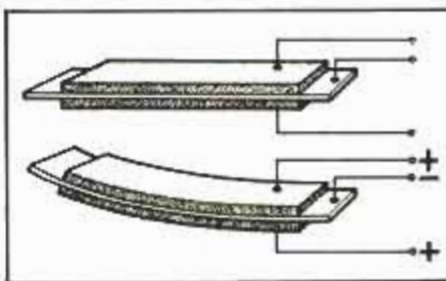
Quartz crystal distorts along one plane (exaggerated in sketch) in response to current at silvered faces. Conversely, strain on plane produces electricity. The natural frequency of these changes regulates quartz watches and radio tuners.

as watches and relays. The substitute devices would be cheaper to produce, but wouldn't waste as much energy through heat and wouldn't produce magnetic "noise" to interfere with other solid-state devices.

The basic element in the substitute devices is the "bender" (see drawing) which sandwiches ceramic mater-

ials in a manner very similar to a thermostat element. Application of an electric field causes one layer to expand while the other contracts; likewise, mechanical bending of the sandwich (oscillation, vibration and so on) would create an alternating electrical potential through attached electrodes.

This simple, long-known principle, plus modern manufacturing techniques, could combine to make you-know-what a household word at last.



Piezoelectric "bender" technology being applied to switches, relays; ceramic-metal sandwich reacts to applied current like bimetallic thermostat reacts to heat.

Energy

Home is where the heat is

Wouldn't it be a fantastic boon to the homebuilder—if homebuilding ever again becomes affordable—if you could balance future energy costs against available design options? It would, and you can. Through a combination of computer modeling and extensive testing of energy-containing (structural) building components, a system has been developed which can predict the energy consumption of residential structures.

Owens-Corning Fiberglas Corp. developed the software, known as the Energy Performance Design System, in both workbook form, to permit manual calculations, and as a computer program. It is through the latter, now being offered to builders, that such design options as sliding doors and skylights can be fed into a basic plan and the effect on energy consumption predicted.

Owens-Corning spokesmen caution that the predicted amounts are essentially a guide, much as the government's gasoline-mileage figures apply to cars in the real world. How a house actually performs, in terms of its energy consumption, depends a good deal on how the people who occupy it "drive" it.

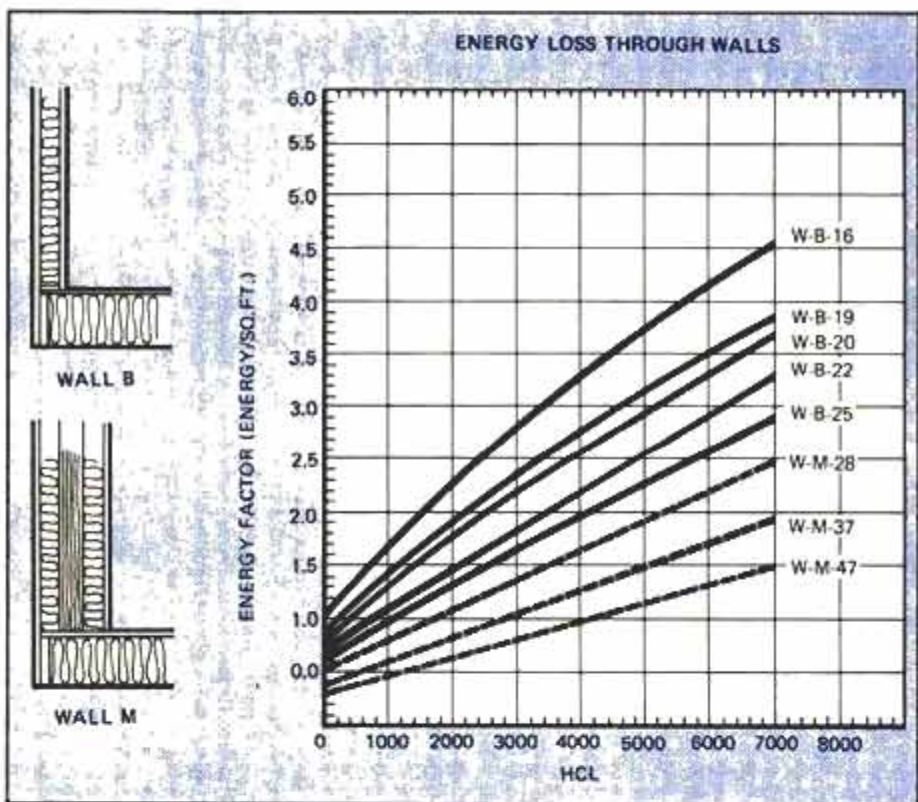
Yet the EPDS model is the first, according to its developers, to combine extensive testing of individual



This calibrated "hot box" tests wall structures by applying heat on one side and measuring the transfer over time.



Test homes were built near Madison, Wis., to furnish data for Owens-Corning's EPDS program. Full-scale tests showed advantages of double-stud wall construction.



Graph shows energy loss through various walls in different climates (vertical scale) and with different insulation R-values.

Wall B is standard 2x4 construction (solid lines); Wall M is a double-stud version. Loss is shown in calories.

components—walls, ceilings and windows—with thermal testing of complete, typical dwellings. Dynamic testing of wall sections in a "hot box" (see photo and chart), in which temperature changes are induced on one side and the degree of transference noted, was one method. Others included a huge, climate-controlled chamber to test vertical heat transfer through typical residential structures.

Three full-scale, ranch-type homes were also constructed in conjunction

with an on-site weather station that provided necessary data.

A builder can thus feed all relevant architectural data into the computer—or do the 250-page workbook entries manually—and then plug any number of design options into the mix. The results are "dynamic" in that they incorporate the effects of constant climatic changes, hour by hour, rather than a simple average based on degree days. Owens-Corning is at Fiberglas Tower, Toledo, Ohio 43659.

How to make home improvements without a home improvement loan.

More than a quarter of a million people like you have already chosen the Shopsmith MARK V for their home workshops.

And in today's tight money market, it's no wonder. People just can't afford professional help to maintain and upgrade their homes. Or the high interest on home improvement loans.

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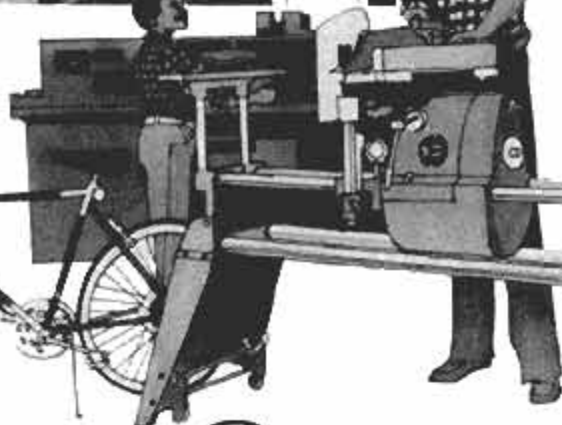
That's because the MARK V is more than a power tool. It's the complete home workshop that gives you the five power tools you need most in a single unit that takes no more space than a bicycle.

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What's more, the MARK V lets you "borrow" functions from one operation to make another more productive.



Shopsmith Inc.

The Home Workshop Company
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Send in the coupon today!



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CAR CLINIC

SOLUTIONS
FOR MECHANICAL
HEADACHES

BY
MORT SCHULTZ



'Relayer' from Decatur

My 1981 Pontiac Phoenix lacked power when I accelerated from a standstill with the air conditioner on. To give it more power on acceleration, I've wired a relay into the air conditioner compressor circuit that I operate manually by means of a dash-mounted switch to interrupt compressor operation. The result is satisfactory, but I'm wondering whether the air conditioner, electronic control module or related circuitry will suffer damage over the long term.—Robert G. Adams, Decatur, Ill.

Not likely. In fact, you preempted General Motors. Beginning with 1982 models, GM four-cylinder engines having airconditioning systems are equipped with a wide-open-throttle relay that shuts the compressor down momentarily during acceleration to reduce load and give the engine added power. The relay coil grounds itself through the electronic control module to deactivate the air conditioner compressor.

My advice to someone driving a 1981 model is to turn the car over to a Pontiac dealer unless he's sure he knows what he's doing. Either of the two relays being put on 1982 models can be installed in the circuit between the compressor and electronic control module of a 1981 model. These relays carry part No. 10022616 for 2.5-liter fuel-injected four-cylinder engines and part No. 14036279 for nonfuel-injected engines.

Life in the fast lane

My 1981 Dodge Aries, equipped with the optional 2.6-liter engine made by Mitsubishi, has a problem the dealer can't resolve. The engine idles at a speed approximating 30 mph for about five minutes in warm weather—longer in cold. My fuel economy is suffering. Can you tell me what to tell the dealer to do?—Delbert Callahan, Porter, Ind.

Unlike its little brother, the 2.2-liter Chrysler-built engine that is standard for the Aries, Reliant and

1982 Dodge 400 and Chrysler LeBaron), the 2.6-liter Mitsubishi engine has no way to adjust the fast idle. Holley carburetors on 1981 2.2-liter engines have fast-idle cams and screws—also a fast-idle speed specification. The Mikuni carburetor of the 2.6-liter engine doesn't have a fast-idle screw or, for that matter, a fast-idle speed specification. What it does have is a fast-idle lever that automatically controls the throttle valve when the automatic choke is closed, which is where the cause of your trouble may lie—with the choke, that is.

This choke is not the conventional bimetal electrically controlled element found on most engines, including the 2.2-liter. The element in the 2.6-liter engine is a thermo-wax, nonelectric unit controlled by engine coolant. As long as the coolant temperature is low, the thermo-wax element holds the choke plate closed. As coolant temperature rises, heat causes the thermo-wax element to release its grip on the choke plate.

This thermo-wax element is also "hooked" into a fast-idle cam that operates the fast-idle lever. As long as the engine is cold, a "plunger" exerts pressure on the fast-idle cam, and this cam exerts pressure on the fast-idle lever, which, in turn, holds the throttle valve partially open to

allow the engine to run at fast idle.

If your engine is idling too fast for too long a period, air trapped in the choke thermo-wax element housing may be forcing the element to keep the choke engaged longer than normal, which would also keep the fast idle "engaged" longer than normal. On the chance that this is happening, do the following:

1. Loosen the radiator cap. This is important, because what you're about to do can cause excessive pressure in the cooling system that may burst a hose. Loosening the cap releases pressure.

2. Start the engine, which must be cold.

3. At choke housing, loosen the clamp of the coolant outlet hose and pull the hose off the housing until coolant flows from the housing. This action will purge air from the choke system.

4. As soon as coolant comes from the housing, shove the hose back onto its fitting and tighten the clamp.

If this doesn't solve the problem, get in touch with the Chrysler Corp. zone office. It now becomes a matter of determining if the carburetor has a manufacturing defect. If so, you should be entitled to a new carburetor free of charge. You sure don't want to pay for one. A Mikuni costs \$375.

Time on his hands

I recently bought a 1980 Datsun 210 with the A-15 engine and five-speed gearbox. In attempting to time the engine because of some ping, I found this:

- The decal under the hood says to set timing at 11° BTDC.
- The owner's manual says to set timing at 7° BTDC.
- A shop manual published by a company other than Datsun says to set timing at 5° BTDC.

The only point they all agree upon

(Please turn to page 44)



This month's tip, which comes to us from the Automotive Information Council, tells us how to prevent that vinyl top, for which you must pay extra, from acquiring the look of a faded pair of jeans.

The Council says:

- Don't apply ordinary car wax to vinyl. Use a coating formulated for vinyl tops. It's available at auto-parts and accessories stores.

- Apply the coating when the vinyl top is still new—before dirt and grime have become firmly embedded.

- Wash the top when you wash the car.

- Treat the top with a fresh coating when water fails to bead on the surface. However, first remove the old coating with a vinyl-top

cleaner, which you can also buy at an auto-parts and accessories store.

- Never use an abrasive, such as a kitchen cleanser, on a vinyl top.

Top of the day



Now you can shrink a \$600 car repair down to \$25.

Everywhere you look these days, it's \$600 for a transmission job here, \$400 for engine repairs there.

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Ask for Ford Motor Company's Extended Service Plan by name.

Ford Extended Service Plan



CAR CLINIC

(Continued from page 42)

is to remove the vacuum advance line. What's going on?—Bill Parente, Coram, N.Y.

You ain't heard nothin' yet. The correct timing specification for this engine is 8° BTDC. Remember to plug the end of the distributor vacuum hose after disconnecting it to be sure of setting timing properly.

Picking on a pickup

Can you please help solve a problem I'm having with a 1981 Chevrolet pickup equipped with a 305-cu.-in. V8 engine and overdrive transmission. Numerous complaints to the dealer and GM regional representative have led nowhere, although they've tried. The problem is surging and/or missing on easy acceleration, spark knocking and burned-out sparkplugs in only 12,000 miles. The dealer replaced the electronic spark timing module and I've tried premium no-lead gas (92 octane).—Bill Fillwock, St. Johns, Mich.

All your troubles are probably being caused by using the wrong sparkplugs. The original plugs—AC R45TS—are too hot for the way this engine and overdrive transmission

combination operates. The plugs overheat, causing fuel to detonate and the engine to knock. The detonation sensor picks up the knock and signals the electronic spark timing module to prematurely ease off on spark advance, thus causing a lull in ignition and an engine miss.

Chevrolet recently authorized a switch to AC R44TS sparkplugs, which operate at a colder heat range. Since this switch wasn't printed in a service bulletin, your

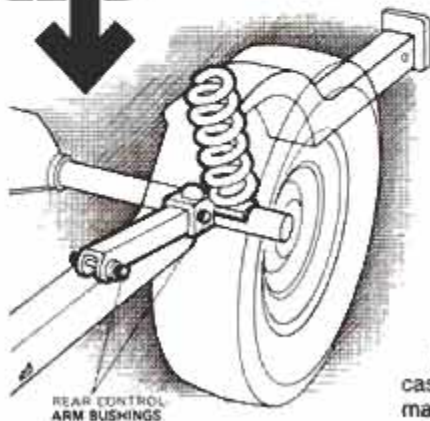
dealer and GM regional representative may not be aware it exists.

Dirty deal

With only 1,000 miles on my 1981 Pontiac Grand Prix with the 5.7-liter diesel engine, I'm getting soot inside the car. I don't know where it's coming from. The dealer is at a loss, too. Can you help us?—Kermit Olstad, Moorhead, Minn.

Sure. The soot is an oily residue the diesel engine produces during

PM CAR CARE
TIP



Bush league advice

In searching for the cause of a handling problem, such as excessive steering play and pulling of the car to one side, or tire cupping, don't overlook the possibility that the rubber bushings are shot.

This advice applies to bushings in the rear of the car, as well as those up front. For example, if your car has a strut rod and needs wheel alignment often for no apparent reason, maybe the strut-rod bushings are bad. If control-arm bushings are worn, wheel caster may be affected, which could cause the vehicle to pull when brakes are applied. This illustration will help you locate bushings in your car. Look for cracking, hardness and general deterioration. In any case, if all else fails to alleviate a handling condition, it may be worth a try to replace aged bushings.

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A&C GRENADIERS—THE TASTE LEADER

city driving and prolonged idling. You can replace the engine-oil breather cap to try to stop it, but chances are it will continue. However, you can keep the residue from messing up the inside of the car.

Residue enters the passenger compartment because of a poor seal at the cowl and hood or at the evaporator case and dash. So, tell your dealer he can find instructions on how to reseal these "leaking" areas in Pontiac service bulletin 81-I-41 (Jan. 1981).

Curve ball from Big Bend

My problem started the first day I bought a new 1981 Oldsmobile Cutlass Supreme with a V6 engine. The valves have been tapping ever since. The Olds dealer tells me it's the gasoline I'm using, which happens to be the highest octane I can buy. He retarded the timing, which cut down on the clattering some, but the engine still sounds like a diesel and hardly has any power. Now, an independent certified mechanic tells me that this car is equipped with a computer, and it's bad. Is he right?—Jimmie Bernard, Big Bend, La.

I'm confused, Jimmie. On the one hand, you say engine valves are tapping. On the other hand, mechanics

are treating the engine for spark knocking. Which is it?

If it's engine valves, which aren't load-sensitive, noise should be heard at idle, under acceleration, while cruising—in other words, all the time. The engine should be disassembled to get at the valve train.

However, if the noise occurs only when the engine is under a load, then it is probably a spark knock, and one of two conditions is probably causing it—either the exhaust gas recirculating (EGR) valve is stuck closed or the computer PROM (Programmable Read Only Memory) is not the correct one.

In any case, Jimmie, repairs shouldn't cost you a cent. All emissions control units in your car, including the EGR valve and computer, are covered by warranty for five years or 50,000 miles, whichever comes first. If the trouble is engine valves, you're on record as having reported it before the engine warranty expired. So hang tough.

GOT A PROBLEM WITH YOUR CAR?

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

SERVICE TIPS

■ You can get rid of a shudder in the power steering of a 1981 Oldsmobile Omega when the steering gear is near the end of its travel, either to the left or right. A new return power-steering hose kit will do the job—part No. 7841445 for the 2.5-liter L4 engine and part No. 7841446 for the 2.8-liter V6 engine. Tell your dealer to consult service bulletin 82-T-5.

■ If your Ford airconditioning expert can find no reason why the system in your 1980-82 Bronco or F-series pickup isn't cooling, remind him that there's a filter (part No. 19B958) in the condenser outlet tube that may be blocked. Ford airconditioning systems in passenger cars don't have this filter. You can gain access to the filter by discharging the system and then disconnecting the liquid line from the condenser.

■ Gear noise at 40 to 60 mph from the automatic transaxle of a 1981 or 1982 Omni, Horizon or Reliant, or 1982 LeBaron or Dodge 400 may be eliminated by installing a rubber shift cable sleeve (part No. 4269881) on the gear-shift selector cable. Service bulletin 21-04-82 tells your dealer how to do the job.

■ GM reminds us that a kinked or restricted vacuum hose is the main cause of surging when a speed (cruise) control is engaged. Don't blame the speed-control transducer before the vacuum hose to the transducer is inspected to see that it's correctly routed and isn't clogged or bent. This advice holds true for all models—not just GM's.

APPLIANCE CLINIC

QUESTIONS ANSWERED

No-spin washer

My Sears washer, Model 1106305802, serial No. 16857C337, is having a problem in the spin cycle. At times, it completes all cycles and works as it should; but every so often on the rinse cycle, it fills with water and agitates, but doesn't go into the spin cycle. I reset it to spin, sometimes two or three times, before it will spin and complete the wash. What seems to be the problem?—Mrs. Joseph Seliga, Ely, Minn.

Sounds like your problem is in the timer assembly. Apparently the timer is sticking in the rinse cycle. I suggest you have a service technician replace the timer (or, possibly, you might want to replace it yourself). The part is available through any Sears parts department. It is No. 84062 and it costs approximately \$50 plus tax. The timer comes with installation instructions.

Burned-out burner

We have a Sears gas clothes dryer, Model 110-6207704, that is not generating any heat. The burner won't light. The glow coil is lighting; it also has a pilot. My dad and I suspect a faulty solenoid that controls the gas flow, since we don't smell any gas. How do you suggest that we repair the unit?—Nathan Obuch, Downers Grove, Ill.

Your problem may be either in the main burner coil or the pilot switch. To check which one is at fault, turn on the dryer. Set the controls for heat. Check the burner assembly. The glow coil should light along with the pilot flame. Watch the glow coil. If it goes out and the pilot flame stays lit, your main burner coil is bad. If the glow coil doesn't go out and both the pilot flame and the glow coil stay on, your problem is in the pilot switch. Lastly, check the pilot orifice and make sure it's clean.

Both parts are still available from Sears. When ordering the parts, be sure to give the burner assembly number along with the model and serial numbers. I'm sure, between you and your dad, the machine will be working fine in no time.

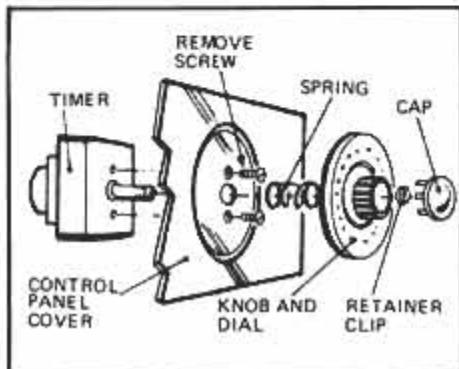
Dryer keeps drying

We have a Maytag electric dryer, Model DE 306, serial No. 671062. It works fine, except that it won't shut off by itself. Can you help? Thank you.—Chris Marbach, Drake, N.D.

Sounds like you, too, have a timer problem. My advice would be to replace the entire timer as one unit. If you want to tackle the job yourself, it's not difficult.

The timer is readily available from any Maytag authorized parts dealer (check your classified directory). The timer is part No. 3-24-54. The suggested list price is \$31.90 plus tax and postage.

To replace the timer, first disconnect the dryer from the electrical supply. (Turn the circuit breaker off or pull the fuses.) Next, remove the control-panel cover. It is held on by two screws. Pull the control cover



To reach the timer, first remove the cap, retainer clip, knob, dial, spring and the screws which hold the timer in place.

off. Now you're ready to remove the timer.

Pry the cap from the timer knob. Remove the retainer clip which holds the dial and knob to the timer shaft. Pull off the knob, dial and spring. Next, remove the two screws which hold the timer to the control panel. Remove the timer. Put the new timer next to the old timer; remove one wire at a time from the old timer and connect it to the new timer.

The wires going to the timer are numbered or color-coded to correspond to the terminals on the timer. Replace the timer by reversing the removal procedure.

Warmed-over gasket

I have an International Harvester refrigerator, Model HA-92, serial No. 0116191B1. The gasket around the door is worn. I would like to know if I

can purchase this gasket; if so, where? I will be looking for your answer in the column.—Mary Catalano, Elizabeth, N.J.

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

can purchase this gasket; if so, where? I will be looking for your answer in the column.—Mary Catalano, Elizabeth, N.J.

Your model number indicates that your refrigerator is a 1951 vintage. I checked with International Harvester; the company assured me that the door gasket is still available through any International Harvester dealer, whether truck, construction or farm-equipment dealer.

The closest dealer to you is located at 525 Linden Ave. W., Linden, N.J. The part number for the gasket is 418066R1. It costs \$15.77 plus tax. Once ordered, the gasket should arrive within one week.

Puffing dragon

I have a Tappan gas range model No. 30-0355-05, serial No. 04066-2610-2584. Several years ago, we moved to a location without natural gas. The range was converted to use LP gas. The oven burner has started to puff when it's turned on and the flame is lighted.

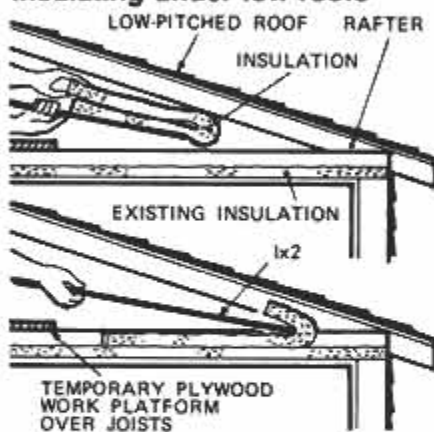
Can you give me any information as to what the cause could be and what repairs must be made? We have had a service man here twice, but the oven burner continues to puff. I don't think that the .022 heater pilot orifice was changed. Could it be possible that this is the problem now?—Mrs. John E. Paulick, Tony, Wis.

Sometimes dirt or dust inside the oven burner causes the problem that you mention. You can wash the burner with a mild dishwashing detergent and water. Rinse it well and allow it to dry thoroughly. Do not adjust the air shutter on the burner. Contact your LP gas supplier and have them check for proper gas pressure to the range. Also make sure that the oven pilot isn't dirty. Finally, have your supplier check to make sure that the proper orifices have been installed on the range for your type of gas.



HINTS FROM READERS

Insulating under low roofs



Even under ideal conditions, laying additional fiberglass attic insulation is no picnic. Under low-pitched roofs, it's very difficult to work batts out to the eaves; there isn't any headroom, fiberglass won't slide on fiberglass and you can't push the batts because they buckle. Here's how you can do it:

Put down a temporary work platform of two 2x4-ft. plywood panels side by side, bridging joists (assuming 24-in. on-center joists), where headroom is sufficient for you to sit. Cut 8-ft. lengths of insulation. Fold one length in half and use a 1x2 to position the insulation between joists; the fold should be 4 ft. from the eave (top drawing). Use the 1x2 to lift the top fold and push it toward the eave until the piece is fully extended and flat (bottom drawing). If there are breather holes under the eaves, do not block them.

Leapfrog the plywood panels as you work the length of your house, so you'll have a constant work platform. Cross over to the other side of the attic and insulate under that eave. Filling in the middle is duck soup.

—Kenneth Brooks

Reducing static electricity

To reduce or eliminate the static electricity that often occurs when you're operating a mimeograph or other printing machine, suspend a strand of Christmas tinsel from the frame of the machine in such a way that each freshly printed sheet brushes the end of the dangling tinsel.

—Lane Olinghouse

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L. Hannah, Moberly, MO

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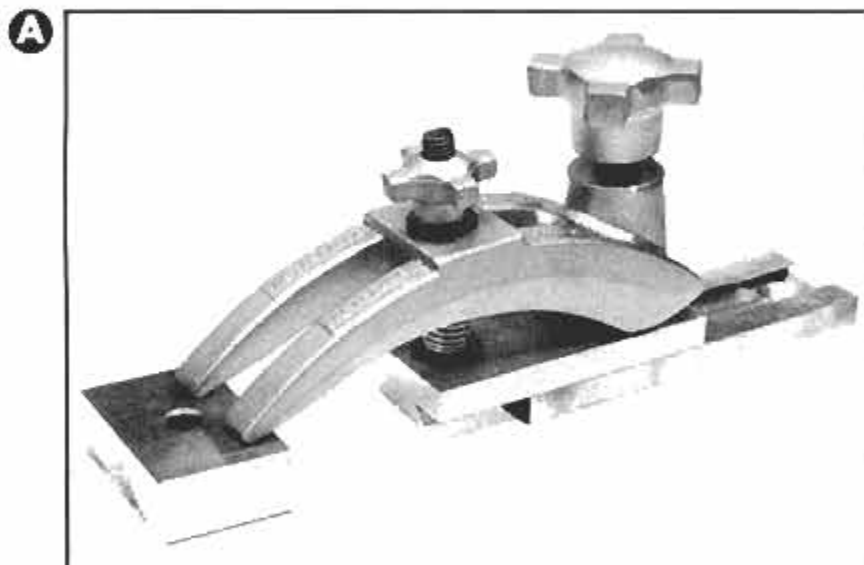
The HR-17 features a rugged, dependable Honda engine, easy-start system, automatic choke and a clutch that stops the blade from turning within a few seconds after the handle is released.

If lawn jobs are getting the best of you, cut them down to size with the HR-17. Check your local Yellow Pages for the closest Honda Lawn and Garden dealer or call toll-free 1-800-447-4400. And in Illinois 1-800-322-4400.

**IT'S A
HONDA**

©1982 American Honda Motor Co., Inc. For optimum performance and safety, we recommend that you read the owner's manual before operating your Honda Power Product.

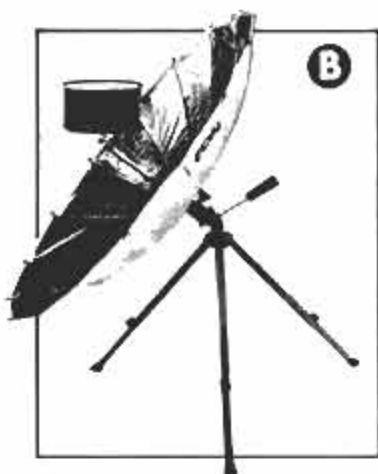
NEW NOW for home and shop



A The Magicclamp is a new, easy-to-mount, drill-press hold-down clamp designed to accommodate stock up to 2 1/4 in. thick. The smaller knob adjusts the clamp height, while the larger one secures the workpiece firmly. Two models are available, both with pivoting clamping heads: The Zoom, shown here, has a two-piece dovetailed base which allows the clamp to slide along the table; the standard model has a single base and cannot slide. The former sells for \$80 and the latter for \$65 plus shipping from Insta-clamp Co., 11902 West Dakota Dr., Lakewood, Colo. 80228.

B The Eon is a 3-pound portable solar powered stove that consists of a reflector, griddle plate, tracking stand, tie-down assembly (for use in the wind), tote bag and instruction manual. According to the manufacturer, the stove works well anywhere the sun is shining. The parabolic configuration of the reflective umbrella concentrates heat on the griddle plate only; the rest of the unit remains cool to the touch. Designed to boil a quart of water in 20 minutes and fry eggs in 5 minutes, it's \$99.95 postpaid from the maker: Redshift Ltd., 959 East Colorado Blvd., Suite 1, Pasadena, Calif. 91106.

D The digital Touch Code Lock is an electronic garage-door lock that mounts on the outside of the building and operates the door only when its control panel is touched in the proper sequence of letters and numbers. The four-digit code can be changed whenever the homeowner desires by simply reprogramming the codebox: 20,000 different combinations are possible. Made of high-impact plastic, the unit is wired directly into the door opener and sells for \$49.95 through the Sears home-improvement catalog. From Sears Roebuck and Co., Dept. 703, Sears Tower, Chicago, Ill. 60684. **FM**

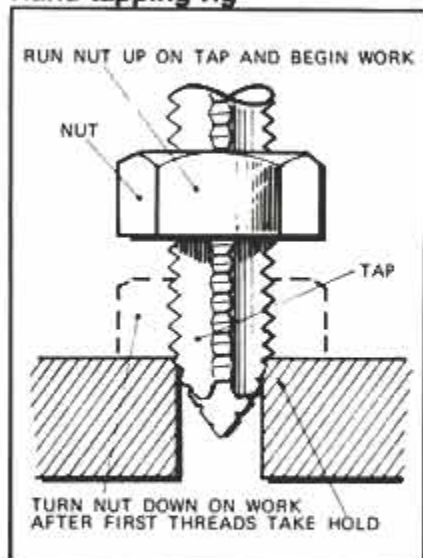


C Tappan's new Centennial electric range (model No. 31-2542) features a lift-off oven door; easy-to-remove, 2,600-watt surface burner elements and a 9x23x28-in. storage drawer under the oven. An automatic clock control can start and stop cooking in your absence, while the black glass door and canopy-style backguard add to the modern appearance of this range. Available in white, coffee, almond, harvest wheat and fresh avocado colors, the unit is available for approximately \$800 at dealers nationwide. It's made by the Tappan Co., Tappan Park, Mansfield, Ohio 44901.



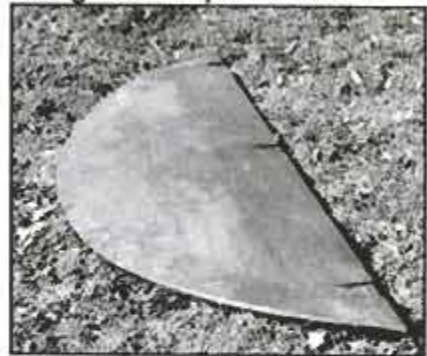
HINTS FROM READERS

Hand-tapping rig



This arrangement keeps a hand tap at a right angle to the work. Clamp the workpiece to the table; run a nut (same thread size as the tap) up the tap. Start the hole, until the first threads take hold. Then, keeping the tap engaged, turn the nut down on the work surface with a wrench. As it bottoms, nut draws tap straight. Continue, keeping nut against work.—*Edward Mayover*

Straighten warped tables



You can straighten a warped table leaf this way: On a warm, sunny day, weight the warped piece with bricks—concave side down—on the lawn for a few hours. The leaf may gather enough moisture to straighten itself. To keep it straight, place two 2x4s across the width of the table leaf and clamp them with cushioned C-clamps for several days indoors. Or cut three spaced saw kerfs on the underside, the length of the leaf, to a depth two-thirds table thickness; nail permanent cleats across the cuts.

—*Ralph S. Wilkes*

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The EM-500 is perfect for battery charging, camping, boating or emergency use. It gives you all the comforts of home even if you're going miles away. Check your local Yellow Pages for the closest Honda Generator dealer or call toll-free 1-800-447-4700. And in Illinois 1-800-322-4400.

IT'S A HONDA

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PM ELECTRONICS MONITOR

Going in circles

The videodisc laser system took center stage in a blaze of light when it made its solo appearance more than a year ago. Then the RCA system—called CED or Capacitance Effect Disc—became a player in this ongoing drama. Now, at long last, the VHD system (from JVC and others) has arrived.

The new VHD system (see *VHD Makes A Promising Debut*) offers a long-lasting stylus, as well as the type of quick searching now found only in the laser systems. But the purpose here is neither to praise it, nor to speak of it ignominiously (such musings will be featured in a later article once I get my hands on a working model).

Rather, it is to point out that all this activity on stage has led to less than rave reviews in the one place it counts—the marketplace. If success is measured by the applause of the cash register, then the videodisc is the Fatty Arbuckle of 20th-century technology.

Oh, they loved the act when it first appeared—but, later on, it just wouldn't play in Peoria.

Three competing systems that are totally incompatible have led to a great deal of consumer confusion. The question is not, simply, which videodisc system is better, but which will even be here in five years.

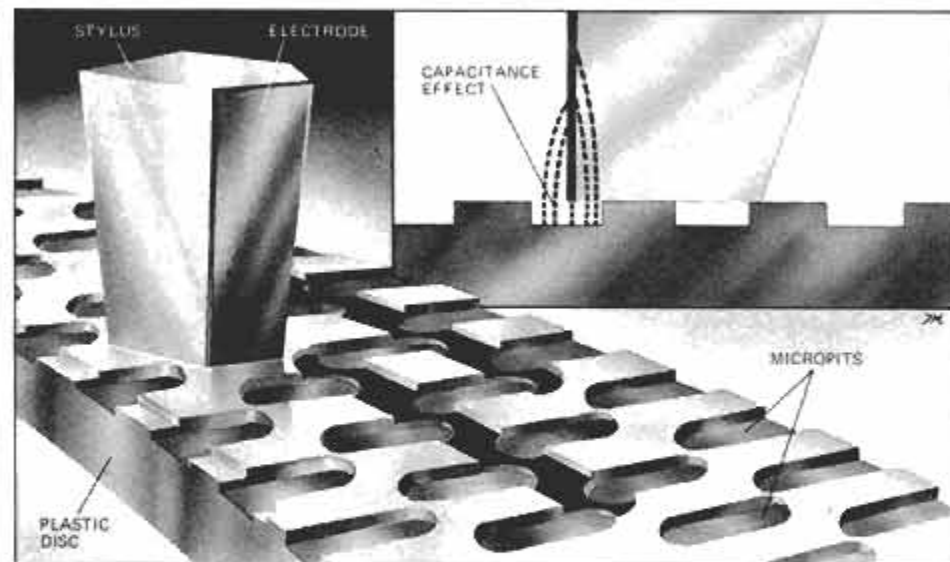
Today's videodiscs of *Smokey And The Bandit* could easily wind up being tomorrow's Frisbees.

Most people just won't put down a \$500 to \$1,000 "bet" unless all the cards are showing. And right now, the cards are all wild.

Contrast all of this with the upcoming audiodisc market, which seems as certain of success and prosperity as the videodisc market is unsure. The reason is that there is, as yet, only one announced audiodisc system that anyone seems to be taking at all seriously.

The system, developed by Phillips (a company based in The Netherlands), at first seems similar to the videodisc laser devices. Like them, it uses a very shiny, plastic-encased disc, covered with reflective, microscopic "pits." The laser light is reflected in a digital manner by the pits and music is produced. But the pits are even smaller than their video counterparts—and the discs are smaller in diameter. Quality control, still an unknown, is the one area to be proven.

At the Consumer Electronics



VHD Makes A Promising Debut

The new videodisc system pictured here is called the VHD or Video High Density system. Its proponents claim that it's the system of the future. A stylus-electrode combination rides smoothly atop a plastic disc. On the disc itself are thousands of information-containing "micropits." As the stylus's electrode passes over

these pits, it senses the information in a "capacitance effect," which can be thought of as a digitally encoded message.

The main advantage of this new system is that the flat stylus just barely skims the disc. This means that wear is minimal and fast searching is easy.

Show, recently held in Chicago, we had the opportunity to hear several versions of the audiodisc system from Sansui, Marantz, Sony and other companies. All sounded as fabulous as a convention floor would allow. But more importantly, the buyers and distributors at the show were excited by the audiodisc, though turned off by its video counterpart.

Why? Because of the one system. There is no doubt which system to stock—just which brand. And on top of that, dealers know customers won't be stuck with something totally outmoded in a year or two.

The audiodisc system will hook up much like a turntable to any of today's amplifiers. And the sound? Superb! There's no doubt that anyone interested in audio should plan on buying one. But if you're into video, maybe you should wait and see.

Warning signals

The cost of audio recording tape in England may be on the verge of doubling in retail cost. It's not that it's becoming more expensive to manufacture—it's due to a campaign being waged by the British Phonographic Industry (BPI).

The blokes at BPI are of the opinion that the record industry there is losing millions of pounds (the monetary variety) as people buy blank tapes and "pirate" records from

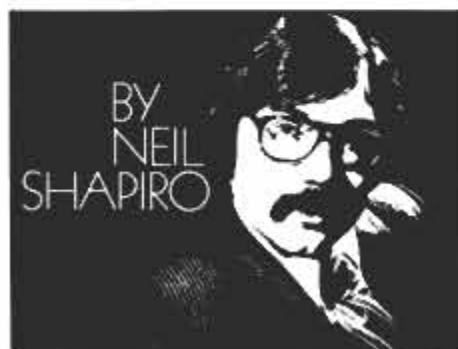
friends' libraries by taping them. So far, the British government has blocked BPI's attempts to have a tax imposed on the cost of each blank tape sold—revenues from the tax to go to British record companies.

But bulldog-tenacious BPI intends a long and drawn-out fight. Already, a spokesman has been quoted (in Britain's *New Scientist* magazine) as saying: "If we can find some sneaky way of getting our levy [tax] going, by . . . shoving it into a subclause no one bothers to vote on . . . we will do it!"

You can bet that people in our own audio industry—as well as people concerned with videotaping—are watching these transatlantic events with great interest. The question is: Even if the English face up to a new tax with stiff upper lips, would Americans do likewise?

After all, the tax on tea never got far here.

PM



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HINTS FROM READERS

String on electrical cord

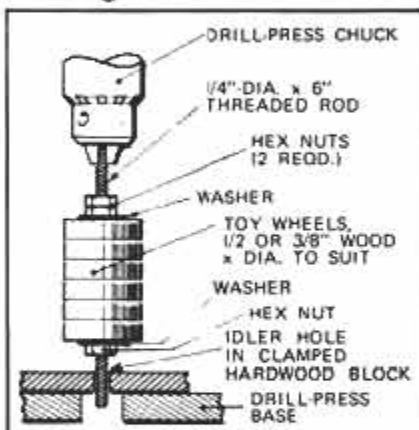


A short piece of rawhide or heavy twine tied to the end of a lead or extension cord (above) neatly secures the cord when it is rolled up and not in use (below). You can then hang the cord in a handy spot until you need it again.

—Howard E. Moody



Sanding discs



After cutting discs with a hole saw, I smooth them with the set-up shown to make toy wheels. Chuck a threaded rod in a drill press; steady the free end in an idler hole. Sandwich the discs between hex nuts and washers. Use rasps and sandpaper as the discs turn.

—Russell F. Schleicher



STAY SHIP SHAPE.

Honda's BF-75 outboard motor will really keep your head above water. With 7.5 hp, it's powered by a smooth, quiet Honda four-stroke engine. For quick response, powerful acceleration, and maximum fuel economy.

There's even a built-in 60 W charging coil for recharging boat or RV batteries.

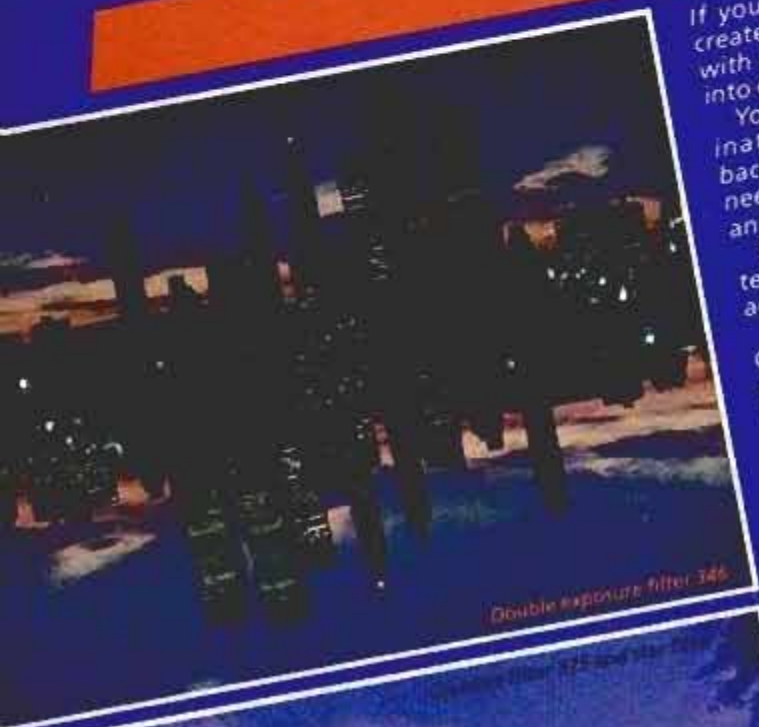
The BF-75 outboard motor. For smooth sailing on small craft or auxiliary power on larger ones. Check your local Yellow Pages for the closest Honda Outboard dealer or call toll-free 1-800-447-4400. And in Illinois 1-800-322-4400.

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Replace only the element, not the whole filter.

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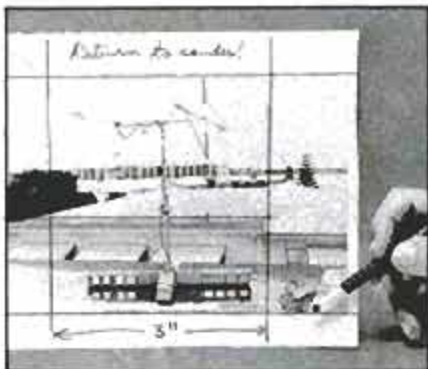
PHOTO HINTS

Flop-free filtering



Filtering chemicals can be a very messy chore. But if you use a laboratory-style ring stand, you'll be able to work spill-free. The heavy iron base prevents sloppy tipping.—*Bob Hertzberg*

No-scratch marker



When you crop a photo (mark the area to be enlarged), *don't* use an emulsion-damaging pen. Use a "negative pencil"—a form of erasable grease crayon, available at photo stores.—*Bob Hertzberg*

Sock them away



Delicate and expensive camera lenses shouldn't be left to "clink" together at the bottom of your gadget bag. Protect them with woolen socks, secured with rubber bands.—*Bob Hertzberg*



ANOTHER HONDA FOR THE ROAD.

Now you can have all the comforts of home away from home. With Honda's new 4000-watt RV generator.

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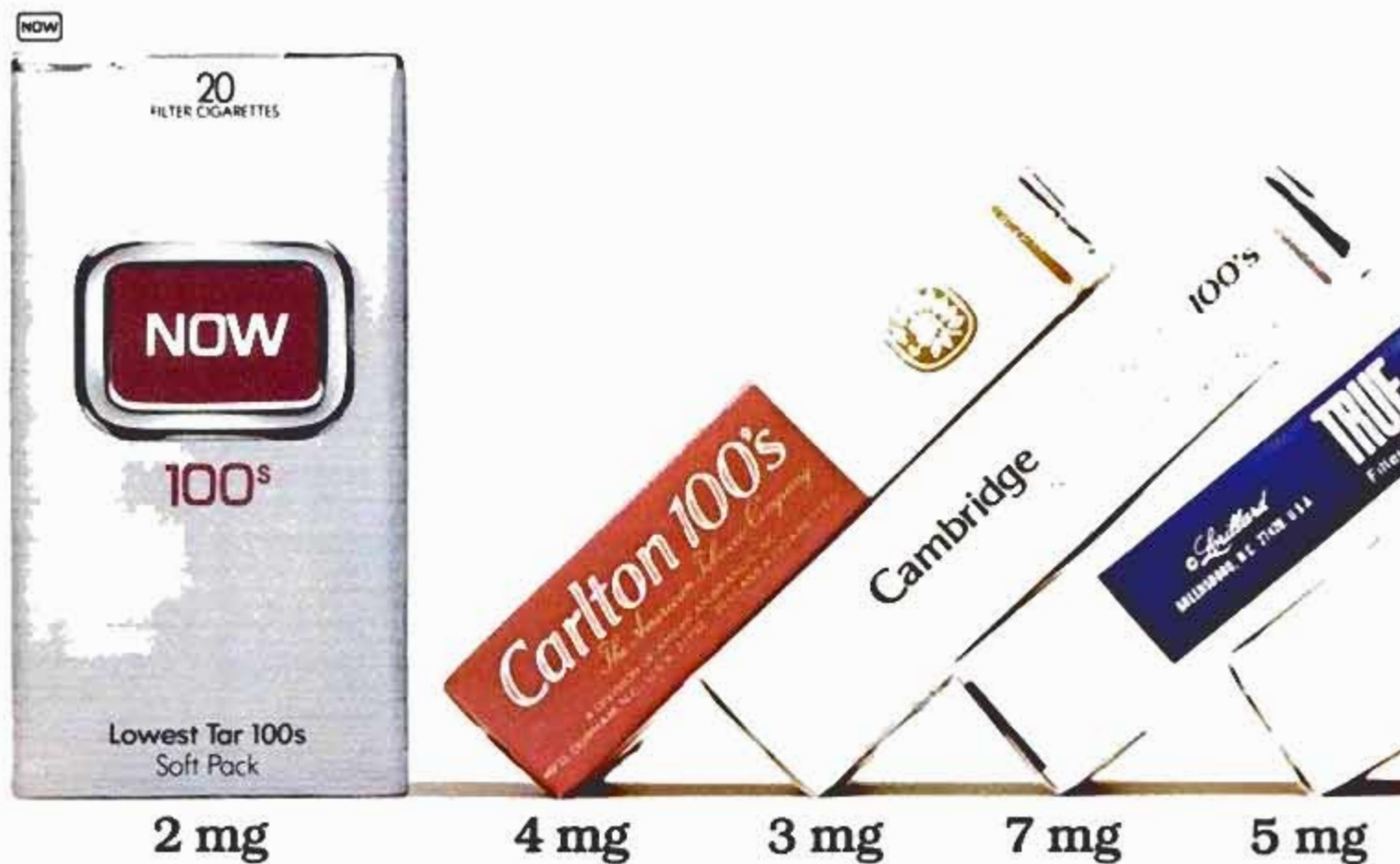
The EV 4000 is compact, and has just the right dimensions to fit an RV compartment. It gives you more than enough power to run all your household appliances even when you're in the middle of nowhere.

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HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Tin cans clean chimney?

I've heard of an old southern remedy of burning tin cans in a fireplace to reduce the buildup of creosote in the chimney. Care to comment on its effectiveness?—E.R. Hawes (address not given)

I'm afraid that remedy is an old wives' tale. Burning tin may create a chemical reaction in the smoke going up the chimney. This would be similar to the reaction of so-called chemical chimney cleaners which, incidentally, aren't given much credence by authorities. The long-range effect of the salts in the chemicals on all types of chimneys (masonry, galvanized steel or stainless steel) is corrosive, and its overall harmful effect is unknown at this time.

Implements are sold so the homeowner can clean his own chimney, although it's a messy job. If this isn't your cup of tea, consult the classified directory under "Chimney Cleaning" for the name of a professional chimney sweep.

Blinking lights

What makes my house lights blink every time I turn on the garbage disposal, when my washing machine changes cycles or when I'm using the oven? Even the refrigerator motor causes them to blink. Our budget is tight, and my husband keeps putting off asking a licensed electrician.—(name withheld)

Any electric motor draws more current upon starting than it does when running. Unfortunately, the circuits of some houses weren't designed by professionals; motors such as you mention may have been wired together on the same circuit. This causes overloading, which will temporarily dim your lights.

The best solution is to have a licensed electrician put motors that draw large amounts of electricity on separate circuits.

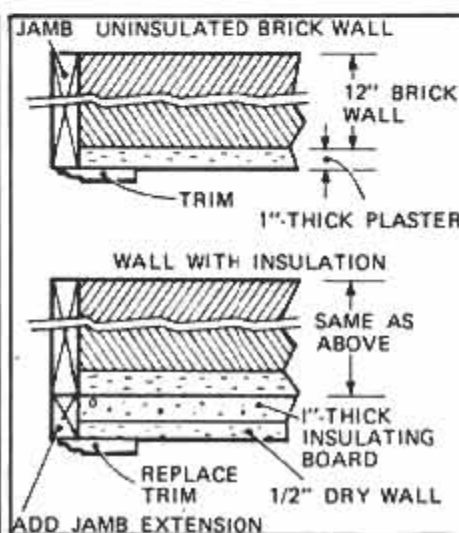
Insulating masonry walls

Over 60 years ago, my father-in-law, a brick mason, built my house of solid, 12-in.-thick brick walls, with 1 in. of plaster on the inside surface. How can I insulate to cut heating and cooling costs? I can't insulate more than 1/2 in. because of the trim.—James A. Murray, Des Moines, Iowa

Use a minimum of 1-in. polystyrene insulating board. To do this, increase your jamb width around all

doors and windows by 1 in., plus the thickness of your new wall finish (see drawing). Remove the baseboard. Then replace it on the newly insulated wall. Also, remove all trim from doors and windows and add extenders, such as the jamb extension shown in the drawing. Glue and nail these strips to the existing jambs. Glue the insulating board to the plaster. Laminate the finish wall (paneling on dry wall) to the insulating board.

The adhesive must be compatible



To insulate a brick wall (top drawing), remove any trim. Then apply insulating board (bottom drawing), finish with dry wall and extend the jamb so it's flush with the dry wall before replacing the trim.

with the insulating board. There are several insulating boards, but I am most familiar with Styrofoam, from Dow Chemical. Use Styrofoam-brand insulation mastic No. 11 to apply the Styrofoam and the wall finish. For fire safety, the insulation board must be covered with dry wall before the finish wall is applied. A vapor barrier isn't used.

Pipe corrosion

I have a few bronze and brass fittings and valves on my galvanized water pipe system. I forgot to put pipe dope on the galvanized pipe. Now I'm worried about corrosion caused by dis-

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

similar metals in contact with each other. Is it harmful to anyone's health? I've had the system for nine years; the water tests okay and I've had no leaks.—Elmer D. Kilmer, Wayland, N.Y.

The dissimilar metals won't be harmful to your health, but they definitely will corrode. This occurrence is known as electrolytic corrosion; it happens when dissimilar metals are in contact in the presence of an electrolyte, such as water, containing small amounts of acid.

Pipe dope isn't considered a separator of dissimilar metals for this reason: As you tighten the fitting, you're bound to get some metal-to-metal contact.

Dielectric connectors are made for this situation. They have a union at one end containing a fiber or plastic separator which prevents direct metal-to-metal contact between the two joined parts.

SERVICE TIP

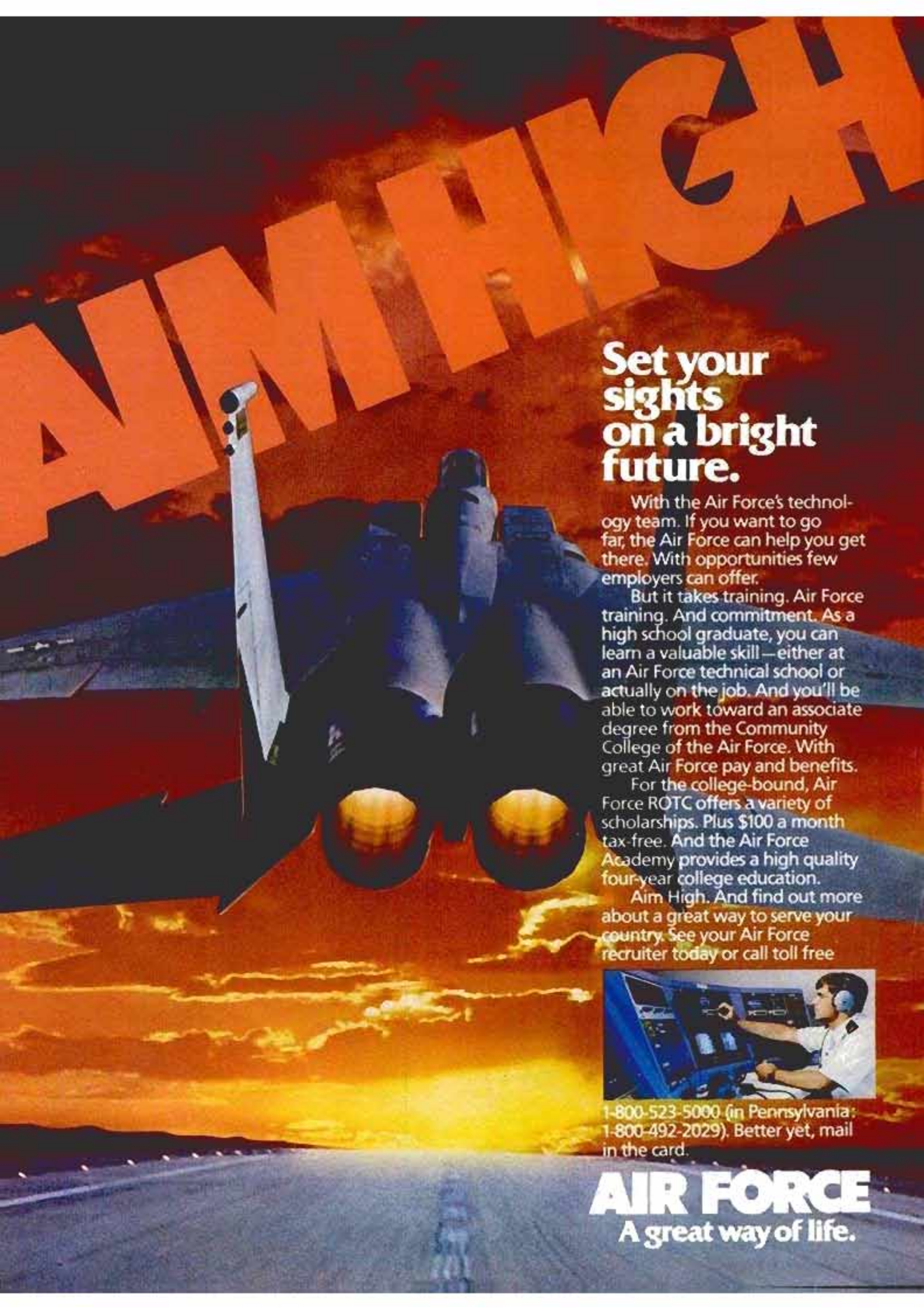
A network of professional home inspectors called Housemaster of America, 18 Hamilton St., Bound Brook, N.J. 08805, came up with the following home deficiencies relating to the age of the house. This interesting bit of information is based on thousands of inspections:

HOUSE DEFICIENCIES (in percent, according to age)

Defects	1 to 12 years	13 to 29 years	30+ years
Inadequate roof insulation	12.1	78.7	88.7
Electrical defects	13.6	8.7	11.2
Mixed plumbing (galvanized steel, copper)	—	9.2	48.9
Water penetration	26.3	28.9	37.1
Poor roofing	0.8	17.7	21.7
Heat deficiencies	6.1	21.5	27.2

Although I personally feel that a 30-year-old house would have had at least one new roof, and even updated insulation, this does give a good idea of what to look for when buying an older home. **PM**





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Classic Reproduction: A Newel Post From Lincoln's Home

You can lathe-turn this beauty for your home.

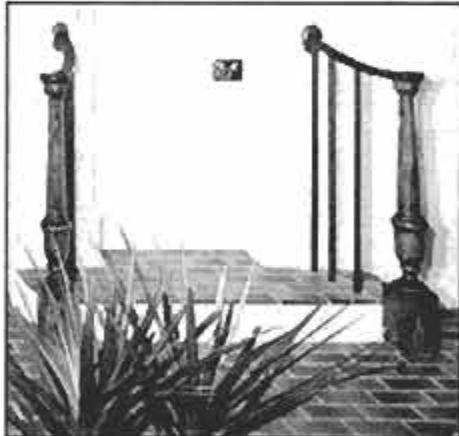
The newel posts that add charm to the entryway at right are reproductions of the one located in the Lincoln Home National Historic Site. The original is of walnut, but to cut costs we used fir and walnut stain. Keep in mind that the dimensions shown might have to be altered to suit your stairs and existing banisters.

Because it's too long for a standard 36-in. lathe bed, the post must be turned in two pieces. The separation is made at the 2-in. mortise. Begin work on the upper section by cutting the $5\frac{1}{2} \times 5\frac{1}{2}$ -in. stock into an octagonal shape on the table saw. By starting the 45° bevels about $1\frac{1}{8}$ in. in from each corner, the eight finished faces should all be about the same width. If you prefer, simply rough-round the stock, using your deep gouge. Center this block on the lathe and, at low speed, turn the posts to the tolerances shown. Be sure to sand the post smooth while it's still in the lathe. Next, bore the mortise in the bottom and the dowel holes in the top.

The bottom section is turned in much the same way, but *do not* trim the block into an octagon. This piece must include the 2-in. tenon, so your overall length will be $14\frac{3}{8}$ in. After sanding smooth, join the two sections with glue and allow to dry.

Using a band saw, rough-cut the post cap and the rail easing (the curved arm that joins the cap to the banister) out of a $3\frac{1}{2} \times 5 \times 9$ -in. block. The angle of the easing relative to the cap will vary, depending on the rise and run of your staircase. Carve the cap to the appropriate shape, using a spoke shave, rasp, Surform tool and sandpaper. Draw guidelines in pencil. If they aren't carved off, they will be sanded off later.

Carefully align the dowel holes in the cap with those in the top of the post. Then join the cap to the post, using dowels and glue. Bore the holes in the post bottom and floor, then join them. Once the post is installed and the glue has dried, finish shaping the easing to match the handrail. Thoroughly sand the joint to reduce the chance of splintering. Finally, stain and apply the finish of your choice.—David J. Warren



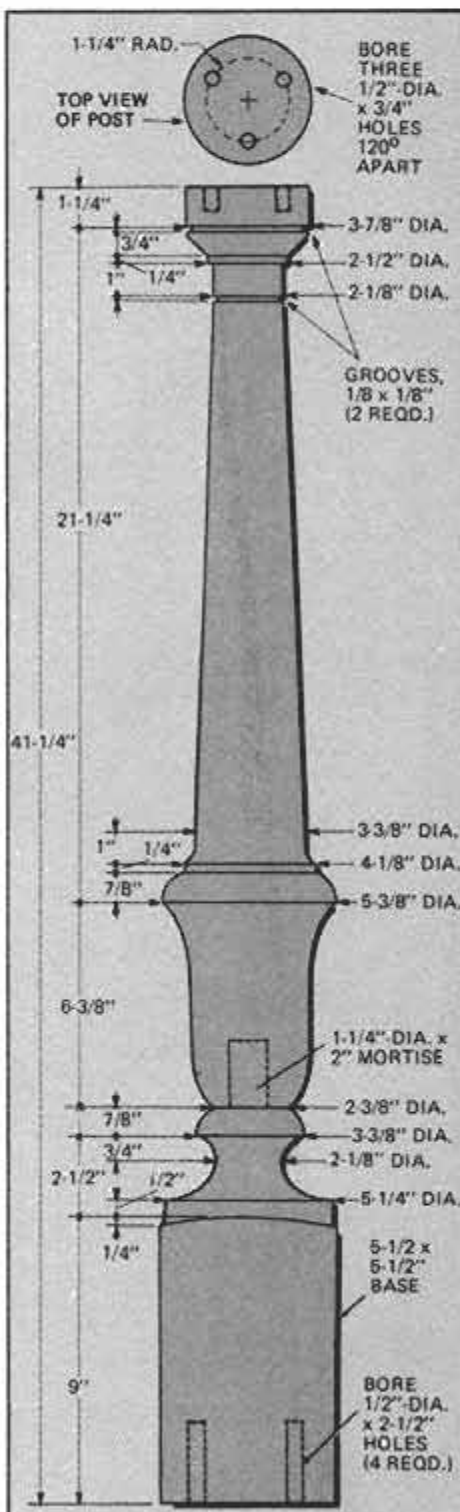
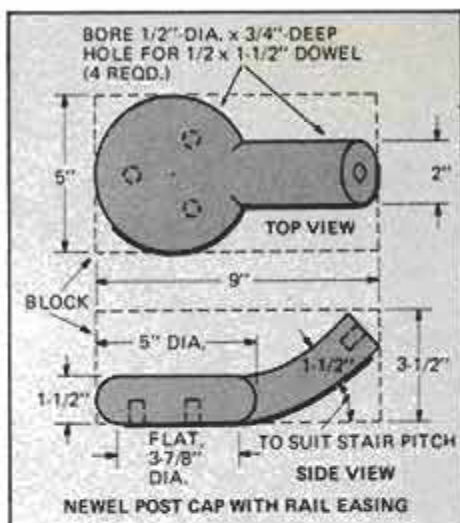
Graceful newel-post reproductions add a touch of class to a plain-looking entrance.



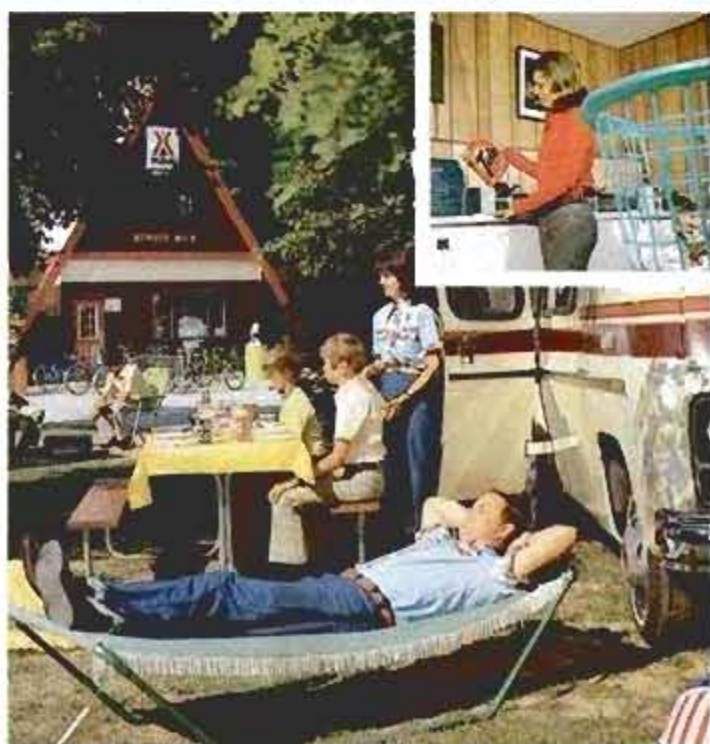
After shaping the post section, sand it smooth before removing it from the lathe.



Our reproductions were based on this newel post at Lincoln's Springfield, Ill., home.



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clean, friendly, & fun

1 Displays at the new Rushmore-Borglum Museum in Keystone, S.D., show how great stone faces were carved on Mount Rushmore.



CAMPING '82

NEW SIGHTS NEAR CAMPING SITES

2 There's a 1909 logging locomotive, demonstrations of old-time logging-camp skills and a monthly woodworking show at the Western Forestry Center in Portland, Ore.




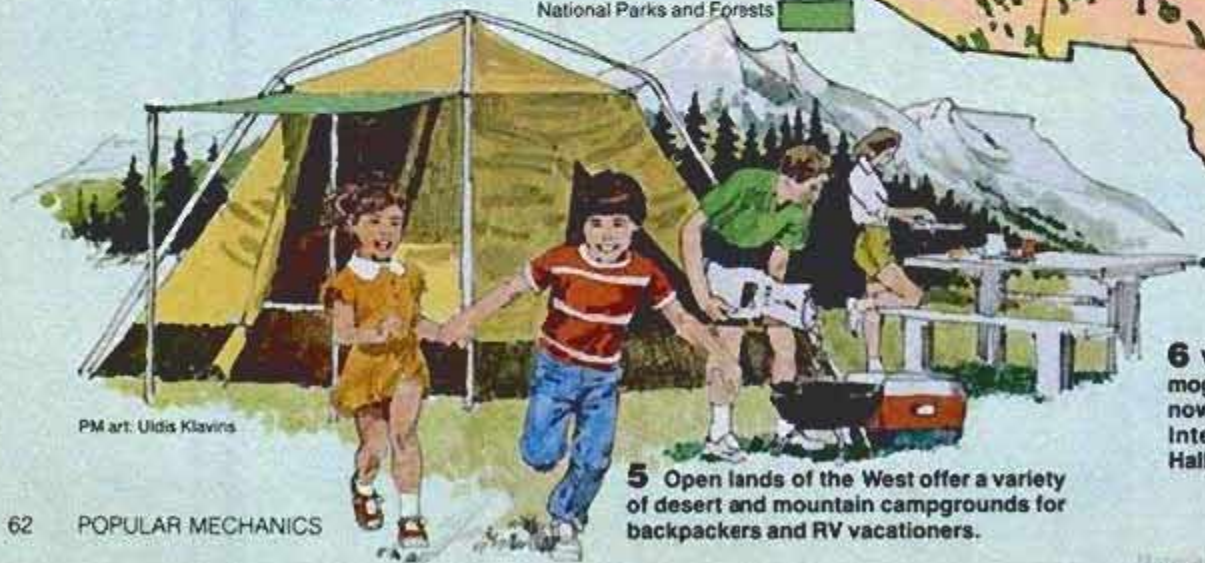
3 Most spectacular of the new sights is the still-smoking Mount St. Helens volcano located near Longview, Wash.



4 Wheeler Historic Farm at Salt Lake City explains Mormon Life, and hydrofoil crosses Great Salt Lake to Antelope Island.



National Parks and Forests 



PM art: Uldis Klavins

5 Open lands of the West offer a variety of desert and mountain campgrounds for backpackers and RV vacationers.

6 Vacationers at Alamogordo, N.M., can now pay a visit to the International Space Hall of Fame.

14 Chicago's Museum of Science and Industry has new exhibits of electron microscopy, plus mechanical and biological timekeeping.



13 Northern New England (Vermont, New Hampshire and Maine) offers good variety of camping spots.

Nearly every city now has attractions nearby. Visit the more distant ones by camping out on the way.

by Richard Dunlop

From old-time tall ships, sailing up the Delaware to celebrate Philadelphia's past, to central Florida's futuristic Spaceship Earth (the world's first geosphere), camping and traveling Americans are

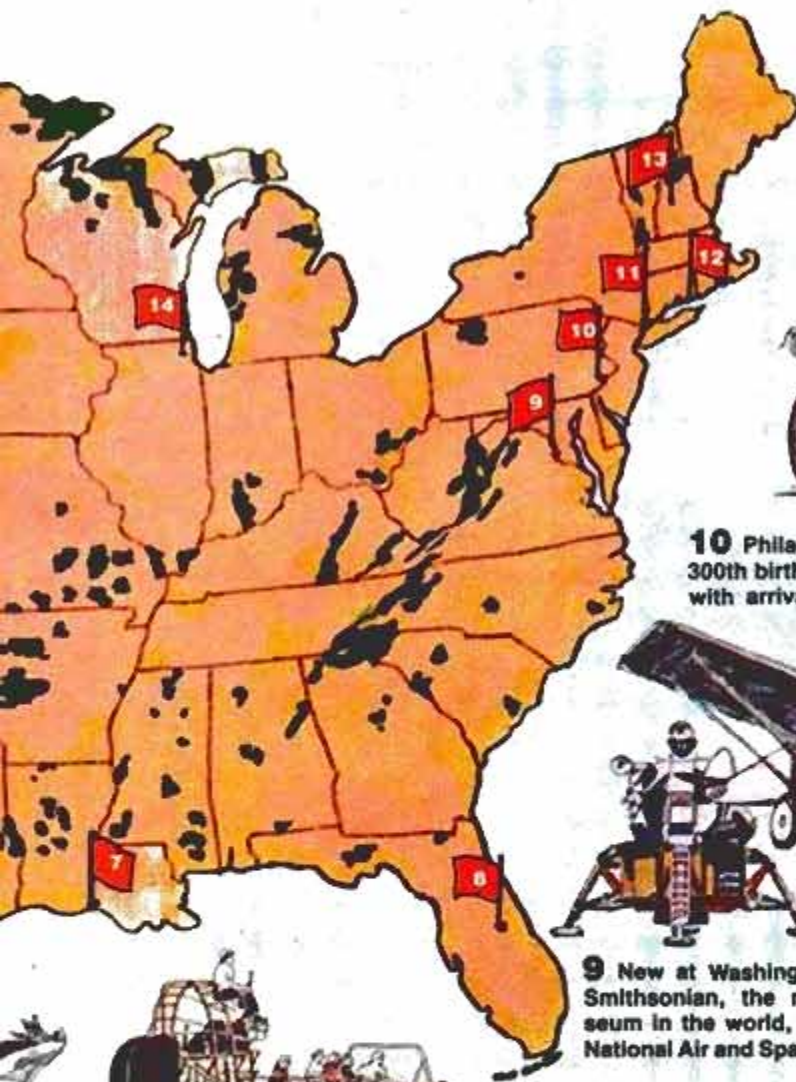
finding spectacular new things to see in 1982. Many sights are less than a day's drive from home. All are near campgrounds that can help make a vacation cost less for fuel and food, lodging and entertainment.

The biggest new attraction of them all will be the World's Fair, which opens at Knoxville, Tenn., on May 1. The theme of the fair is energy, and the Sunsphere, a 74-foot

(Please turn to page 65)



12 Windjammers are at the constantly growing Mystic Seaport in Connecticut, near the Submarine Memorial at Groton.



11 Even New York City has nearby campgrounds, where visitors can stay overnight while seeing such grand sights as the Empire State Building or Radio City.

10 Philadelphia celebrates its 300th birthday this year, starting with arrival of Queen Elizabeth II.



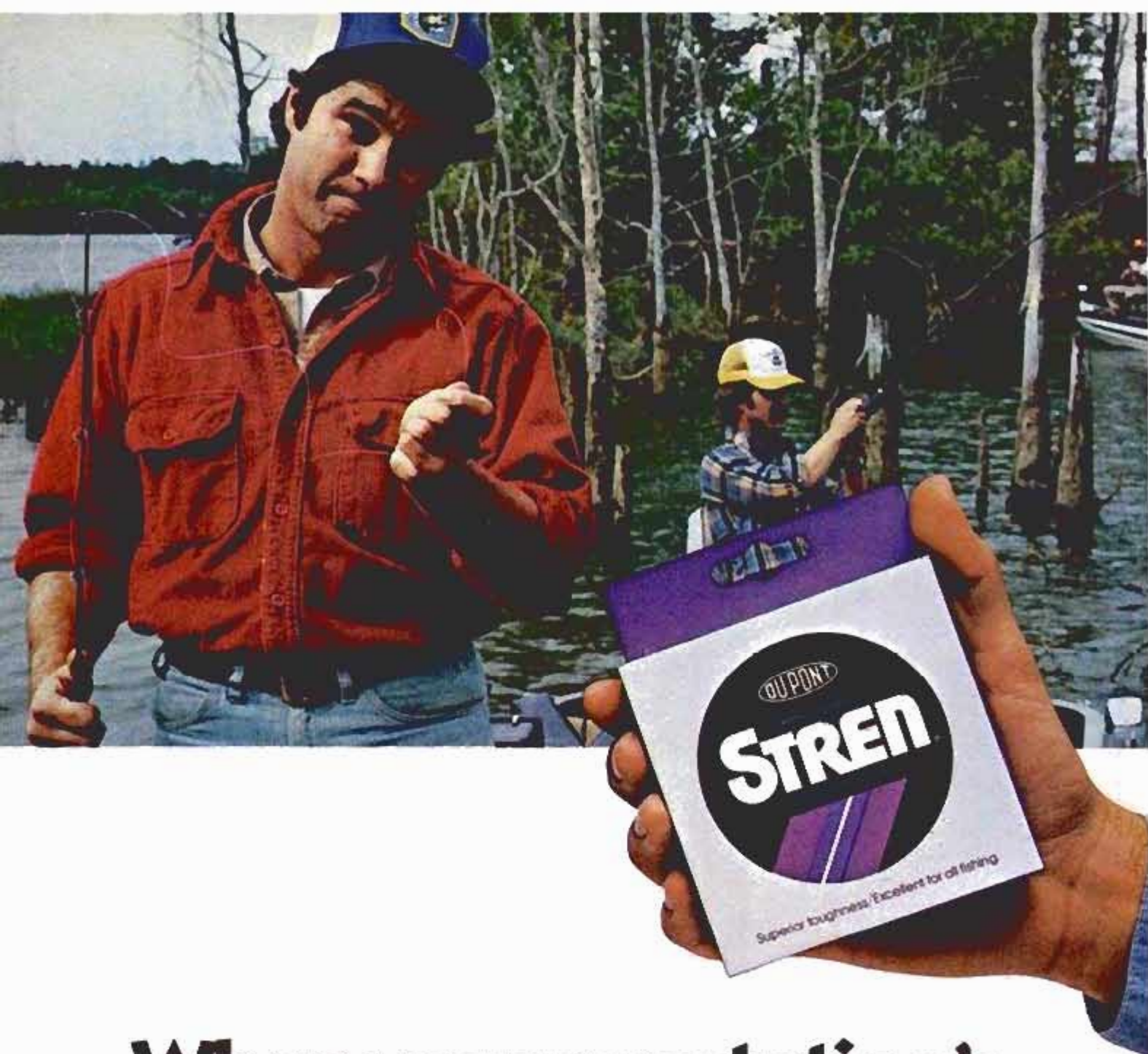
9 New at Washington, D.C.'s, Smithsonian, the most visited museum in the world, is highly popular National Air and Space exhibit.



8 Newest addition to Walt Disney World Magic Kingdom, near Orlando, Fla., is Epcot Center, with its giant geosphere Spaceship Earth, and theme areas Future World and World Showcase. Epcot Center opens officially on October 1.

7 For a close-up of Louisiana's bayou country, boats from Henderson tour the swampland wilderness of the Atchafalaya Basin.





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Electricity makes youngsters' hair stand on end as one of the educational surprises at the Magic House in St. Louis.

Only current steers 12-passenger rafts down the Grizzly River Rampage at the Opryland U.S.A. theme park in Nashville, Tenn. White-water ride twists along the rapids.

cigars by hand, to the new Seven-Mile Bridge in the Florida Keys. Popular Busch Gardens at Tampa will unveil a new water-raft ride at the Dark Continent, called "The Congo River Rapids," while Miami has a new zoo, second only to San Diego's in size.

NEW SIGHTS

(Continued from page 63)

globe of gold glass atop a 192-foot tower, rises at the heart of the exposition. Twenty nations are participating, and fair-goers will have a fine opportunity to sample their products, arts, music and cuisine. The energy exhibits promise to make the Knoxville World's Fair particularly significant, but there also will be the opportunity for visitors to ascend on the world's biggest ferris wheel and to ride a shuttle loop roller coaster that hits speeds of nearly 70 mph. Yet less than an hour's drive southeast is Gatlinburg with its aerial tramway, Alpine slide and museums. It is the gateway to the Great Smoky Mountains National Park.

To the west, Opryland, U.S.A. at Nashville provides kids and grown-ups alike a chance to get drenched in the Grizzly River Rampage, a man-made torrent of white-water-river dimensions. Or sit in on television tapings of shows, both in the theme park and in the Grand Ole Opry House.

Fair-goers will find fascinating new things to visit in surrounding states. Kentucky has a new attraction in the Kentucky Horse Park, on Iron Works Road near Lexington. The heart of the park is the International Museum of the Horse, which traces equine history from Eohippus to the present. The North Carolina mountains east of Knoxville not only have new attractions, but fair-goers

may camp or stay in motels or cabins in such sylvan surroundings as Maggie Valley or Cherokee, and commute to the fair on shuttle buses. They not only can save considerable money this way, but also watch mechanics at Tweetsie Railroad's shops at Blowing Rock restore a steam engine for the forestry service or, just down the road, observe the Goodwin Weavers working, as they have since 1812, on a futuristic machine created by inventive mountain genius John Goodwin.

South Carolina also has its new attractions. The world's first nuclear-powered merchant ship, the *Savannah*, is now moored at Patriot's Point in Charleston. Nearby is the *Yorktown*, World War II's famed "Fighting Lady," and other warships which make Patriot's Point one of the world's foremost naval museums.

Georgia's Savannah easily rivals Charleston in charm, and the Historic Waterfront district has benefited from several new restorations this year. Near Savannah at Richmond Hill, meals are served in the Hermitage plantation home of Henry Ford. It was in the parlor of this house that Ford planned his V8, and on the plantation that the first Ford-Ferguson tractor was built. On Sapelo Island, visitors can study the life in the salt marsh at the University of Georgia Marine Institute.

As might be expected, Florida has much that is new. Innovations range from the Ybor City Museum in Tampa, where cigar makers roll

The most important of all attractions opening in 1982 in the Southeast is Walt Disney World's Epcot Center at Lake Buena Vista near Orlando. Costing \$800 million and covering 600 acres, the vast complex will debut in October. Linked to the Disney World Magic Kingdom by a 2½-mile monorail, the two principal theme areas are Future World and World Showcase. Visitors ride through adventure at Spaceship Earth, a giant geosphere 165 feet in diameter. U.S. firms are creating major pavilions to demonstrate such concerns as energy, the land and motion. A Disney spokesman explains, "In Epcot Center, the 21st century will begin Oct. 1, 1982."

Nearby, in Winter Haven, Cypress Gardens has doubled in size with the addition of a Living Forest featuring exotic animals that can be photographed close-up, magic shows and rides for youngsters.

Fair-goers driving down from the Northeast may go by way of Tidewater Virginia where Colonial Williamsburg offers new insights into early American life. Virginia reveals the future, too, at NASA's Langley Research Center, where astronauts trained for their moon walk. The Shenandoah Valley is still another route to the Knoxville fair, and travelers may want to stop and visit New Market Battlefield Park where, on the second Sunday in May, some 1,000 men, dressed and equipped as Union and Confederate soldiers, will re-enact the battle. Farther west, at Beckley, W. Va., is the Beckley Exhi-

(Please turn to page 67)

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Camper in the Florida Keys can marvel at the new Seven-Mile Bridge that spans clear waters between the small islands along Route 1 down to southernmost Key West.

NEW SIGHTS

(Continued from page 65)

bitation Mine where visitors ride through 1,300 feet of underground coal passageways.

In Washington, D.C., there's always something new at the Smithsonian, where the National Air and Space Museum has become the most visited museum in the world. The 25 galleries feature such machines as Lindbergh's *Spirit of St. Louis* and the Apollo II command module.

America's former capital, Philadelphia, is celebrating its 300th birthday. It all begins with a visit from the transatlantic superliner, *Queen Elizabeth II*, on April 25. The QE-2 will dock at the Packer Avenue Terminal, where an amphitheater has been constructed for ceremonies and entertainment to honor the city's Century IV. Eight historic mansions in Fairmont Park will serve dozens of colonial foods, and on stages throughout the city the first annual American Music Festival will provide tops in music old and new. On June 17, the tall ships will come sailing up to Penn's Landing, and there will be tours on shipboard, parades, and fireworks, all free.

New York City, the nation's first capital, also is making 1982 a festive year. Among Manhattan's new-old attractions are the Empire State Building and Radio City Music Hall, both recently refurbished. The Empire State Building has redesigned sky-high observatories on the 86th and 102nd floors. At Radio City Music Hall, exact replicas of the original carpets and wall coverings have been put in place to return the world's largest theater to its Art Deco elegance.

In New England, Groton, Conn., "submarine capital of the world," has opened up the submarine *Croaker* at the Submarine Memorial, and at Mystic Seaport the 1908 coal-fired steamboat *Sabino* takes visitors on a cruise on the Mystic River. The Sea-



Close-up observation of archeologists at work is possible at Toltec Mounds State Park, site of 16 mounds near Scott, Ark.

port's collection continues to get new additions, but the whaler *Charles W. Morgan* and the square-rigger *Joseph Conrad* remain the most-visited ships. Rhode Island's Canonchet Farm at Narragansett has a new miniature railroad. An adaptation of an 1840 "Iron Horse" pulls the train.

Midwest visitors to Indianapolis, discover this spring that the Zoo and Museum of Art, in a joint exhibition, show how animals have inspired artists since prehistoric times. The largest Children's Museum in the world, also in Indianapolis, will open a new physical science gallery June 5. At nearby Noblesville, Ind., Conner Prairie, a living village, demonstrates Hoosier life in 1836.

At Grand Rapids, Mich., the new Gerald R. Ford Museum features a full-scale replica of the Oval Office when Ford was President. Michigan's other prime 1982 attraction is Greenfield Village & Henry Ford Museum with displays of how America developed mass production.

Chicago's Museum of Science and Industry has major new exhibits of electron microscopy and timekeeping that explain both mechanical and biological "clocks." Old Wisconsin, at Eagle, has become a leading

(Please turn to page 68)

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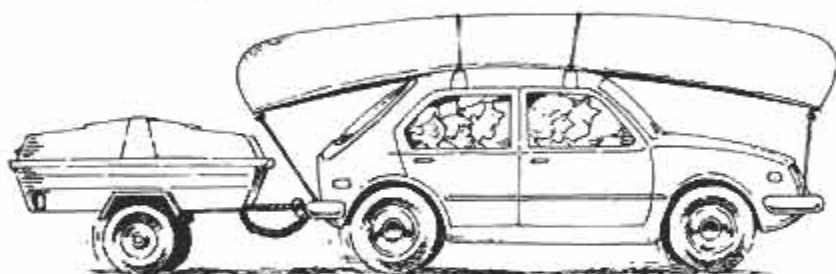
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Woven cocoons intrigue young visitors at the Indianapolis Museum of Art. City also has the world's largest Children's Museum.

NEW SIGHTS

(Continued from page 67)

ethnic museum, and at Wisconsin Dells there is a surprising new Robot Village. South Dakota has a new Mount Rushmore-Borglum Museum, at Keystone, that shows how Borglum carved the great stone faces. In Kirkwood, Mo., Magic House visitors observe how broadcasters of the future will talk with audio delay, and learn how to crack three kinds of safes. At the Toltec Mounds near Scott, Ark., the public will watch archaeologists at work and tour the excavation site. Farther south, in Louisiana, boats now leave McGee's Landing, at Henderson, to tour the Atchafalaya swamp wilderness.

Western vacationers will discover the International Space Hall of Fame, at Alamogordo, N.M., and the Wheeler Historic Farm at Salt Lake City that brings the Mormon story to life. A hydrofoil now operates across Great Salt Lake to Antelope Island, and by May a replica of the old Byzantine Saltair Pavilion will be completed. The West Coast's most impressive new attraction is the California State Historic Railroad Museum at Sacramento, with a million-pound Southern Pacific locomotive, plus a complete narrow-gauge freight train suspended 24 feet above the floor.

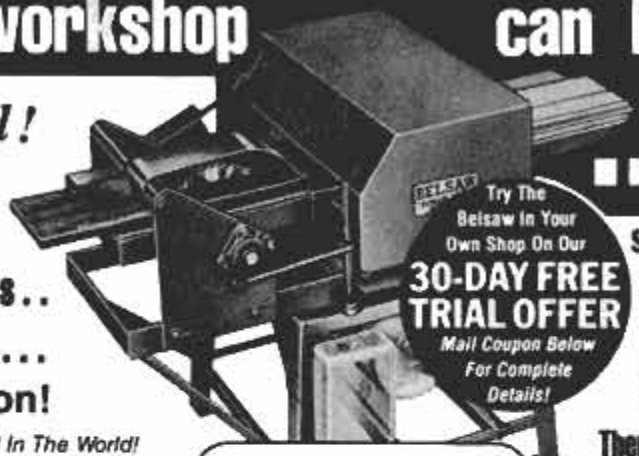
Portland, Ore., also has a 1909 logging locomotive and monthly wood-working shows at its Western Forestry Center, but the newest-oldest attraction spectacular of the Northwest is the still-smoking Mount St. Helens volcano in Washington. **PM**

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Backpacks with flexible, external or internal Peak 1 frames are comfortable to carry.

Astronauts whirling through space, compact cars, hikers' packs and outdoorsmen's weather problems have all had their impact on this year's camping gear.

Compact cars, backpacks and even extraterrestrial travel have taught American campers much the same lesson: The weight of every item that goes on a camping trip and the space it takes up are critical. These days, most people want to live more simply in the woods and closer to nature than they did during the heyday of plush outdoor living, which was before the energy crunch.

Now, more outdoorsmen want to rough it with a new kind of comfort: They expect their tents and sleeping

bags to be warmer, tougher and easier to care for.

Hard-to-pitch and cumbersome tents that can't stand up to wind and rain are out. Some manufacturers are now employing a lightweight nylon that first saw use on Himalayan expeditions. Johnson Camping's Eureka Tent Div. expects its small lightweights to be most popular in 1982. Eureka began business in 1895 as a maker of Conestoga wagon covers and horse blankets and, as a major outfitter of expeditions, has seen trends change. Engineers of its Timberline models have attached the seamless-aluminum-tube ribs to the tents so they won't get lost, and have

(Please turn to page 72)

For lightweight camping, backpack tents like the free-standing 6-lb., 4-oz. White Stag Voyager (below left) and 4-lb., 10-oz. Stargazer are favored. White Stag Horizon (right), like Coleman's Genesis, is about 30 pounds in new Evolution 3 fabric.



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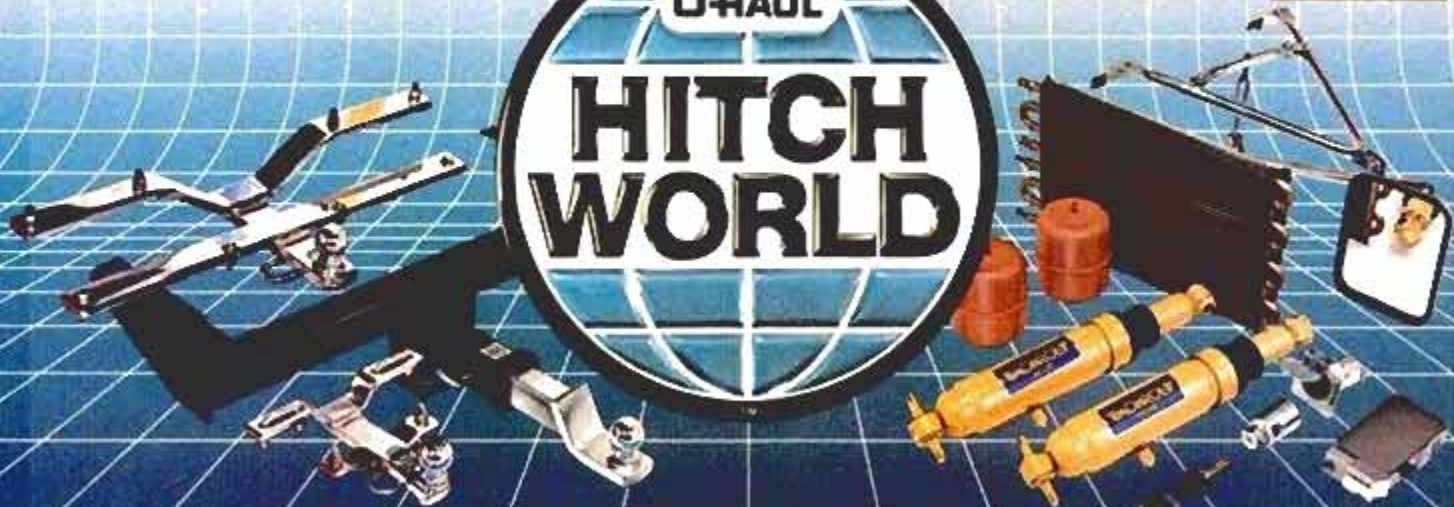
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PM LOG SPLITTER

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NEW OUTDOOR GEAR (Continued from page 70)



Tackle box that can feed fisherman and fish, Plano's Sportster 1000 holds live bait, lunch or six-pack at left, tackle at right.

suspended the tents by shock cords to absorb wind stress.

Kimberly-Clark has developed a three-layer laminate of spunbonded polypropylene for use in hospitals, bedding and upholstery fabrics. Dubbed Evolution 3, the fabric is now being used for tents, since it is a third lighter than canvas and breathes better than nylon. Water vapor from a camper's breath escapes through the mildew-proof fabric instead of condensing on it inside. Coleman uses Evolution 3 for its Genesis and Columbia tent models. White Stag Horizon and Daybreak tents from Henderson Camp Products also employ it.

North Face, the Berkeley, Calif., equipment maker, is producing backpack tents that apply Buckminster Fuller's geodesic designs. "The formula provides greatest volume with the least material and the highest strength-to-weight ratio," claims Barbara Cushman of North Face, who predicts larger, family-size models for 1983. Urethane-coated nylon taffeta is used for floors, side walls and doors. Fine-mesh netting of knit monofilament is used to screen out bugs.

Other new tents include the Gimme Shelter, a 1-foot-high, 3-

CAMPING
'82



For the improved campsite with a picnic table, portable Structo 9016 grill by King-Seeley Thermos has flip-over Grid'L Top.

pound, 2-ounce mini that sleeps two. Stephenson, of Gilford, N.H., has a two-person 2Z tent of Mylar laminate that, complete with poles and sack, weighs in at 1 3/4 pounds.

Americans are camping earlier in the spring and later in the fall, and cross-country skiing has encouraged winter camping. New warmer, lighter sleeping bags are using down and polyester synthetics for insulation. Cold-weather clothing, with breathable but waterproof shells such as Gore-Tex or Klimacore, are keeping the warmth in with fillings of Thinsulate, PolarGuard, Hollofil, Sontique, Quallofil or Kodel. Closed-cell foam pads prevent the loss of heat through conduction.

The loss of heat through radiation is now being checked with new developments. The Space Blanket, adapted from astronaut suits, was the first product to offer a barrier to radiant heat loss. Now, Texolite does the job while allowing the escape of

(Please turn to page 74)



Newest lightweight for one-man paddling, the Old Town Pack Canoe of Oltonar/Royalex (\$365) is 12 feet overall and weighs 30 pounds for easy cartopping or portaging.

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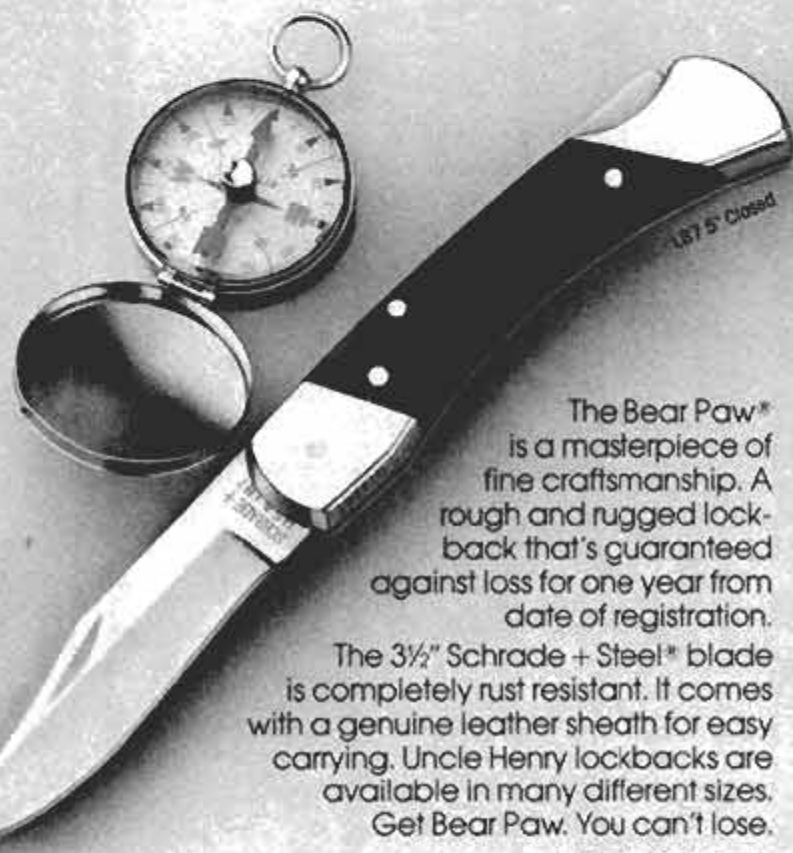
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OUTDOOR GEAR

(Continued from page 72)

CAMPING '82

body moisture. It's laminated from five layers: Two layers of reflective aluminized polyethylene alternate with layers of nylon mesh. Researchers at Kansas State University's Institute of Environmental Research discovered that a polyester bag lined with Texolite is 14 percent warmer and weighs only 6 percent more. Moonstone Mountaineering was first to put Texolite into sleeping bags, and both Cold River's Omega III and Bristlecone Mountaineering's high altitude bags employ it. North Face is also at work on reflective bags.

Self-inflating mattresses

Camping mattresses are greatly improved for cushioned support and insulation. The Therma-Rest Pad has open-cell foam enclosed in a waterproof nylon shell to trap warm air inside and prevent heat loss by convection, conduction and radiation. It inflates itself when a valve is opened. Air Lift uses separate air tubes in its Blue Wing camp mattresses.

Additional camping aids, coming this spring, include new urethane-insulated coolers, and insulated day packs just large enough to carry a six-pack or a few steaks. There are improved backpacking stoves and portable, tabletop gas grills for campsites. Coleman's innovative Peak 1 backpack stove reaches full performance in two minutes and cuts down boiling time. The latest Coleman lanterns also have a new automatic Instant-Lite valve to fire them up. **PM**

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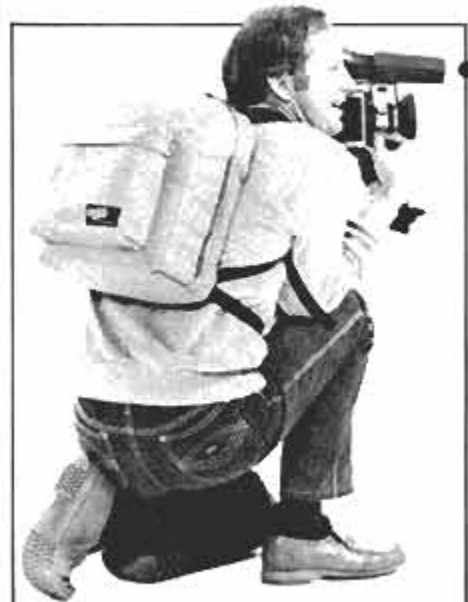
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For backpackers who want to take video gear along, there's Quick Shot Carrier, \$70 from Sport & Photo, Reno, Nev.

CAMPING
'82

Wheels For Traveling Campers

Big trailers and motorhomes still offer everything, *and* the kitchen sink, for living with all the comforts of home away from home. Small travel, fold-down and tent trailers also come with full equipment, but fewer total pounds, as lighter aluminum replaces timber, and foam and plastic take the place of wood and particleboard. Construction strength has been in-



Austrian all-terrain vehicle that is being modified for the U.S. market is the new ATV from Pinzgauer of America, Arlington, Tex.; it tops 70 mph and costs a tidy \$50,000.

creased; streamlining and folding features are reducing wind resistance. Hitch weights are down to where compact cars can tow them easily.

Prices have not shrunk, but RV camping is still one of the most inex-

pensive routes to outdoor fun with budget options that range from driving in luxury to biking with a backpack. At the top end, \$100,000 can be spent on a palatial rolling home with motor. A new ATV, imported by

(Please turn to page 77)



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MARINER
OUTBOARDS
BETTER IN THE LONG RUN.





Sleeping for six is a feature of 17-foot Saga XL, new from Coachmen's Viking RVs.



Twin-size air mattress from Red Ball, for station wagons and vans, is 74 by 51 in.

CAMPING '82

(Continued from page 75)

Pinzgauer of America and adapted for U.S. usage, carries five passengers at 70 mph on the highway, can head cross-country up 45° slopes and through two feet of water. It costs about \$50,000. For this, you get a four-cylinder, air-cooled, 100-hp en-

(Please turn to page 60)

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Coleman Wrangler slide-in tent camper fits standard pickups; Maverick model fits minis.

CAMPING '82

(Continued from page 77)

engine with 10 forward speeds and two reverse gears. It was developed originally for Swiss army maneuvers in the Alps by Steyr-Daimler-Puch in Austria. Mercedes, Porsche-Audi and BMW dealers are expected to handle it here.

For \$5,000, however, a family can take to the hills in new, small, down-sized travel and camping trailers that sleep up to eight and have been designed especially for towing behind a compact. (Check your car's warranty, however, to see if there are restrictions.) Smaller still are tiny cargo trailers that can hold a tent, sleeping bags and ice chest.

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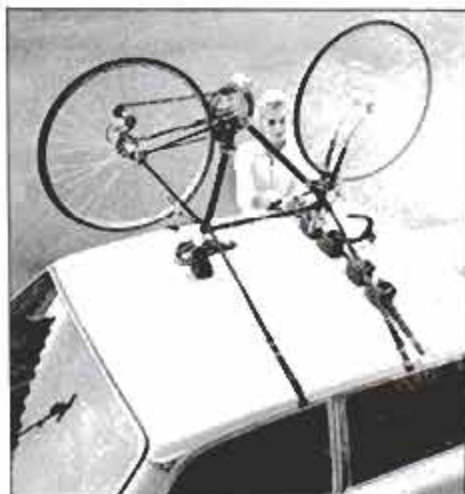
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A rooftop rack that rolls up for storage, Zulu Rack from Cyclesports, Seattle, cartops two bikes without blocking trunk.



A family of four can fit and sleep in new 12½-foot Scotty travel trailer added to its '82 line by Serro Scotty, Irwin, Pa.



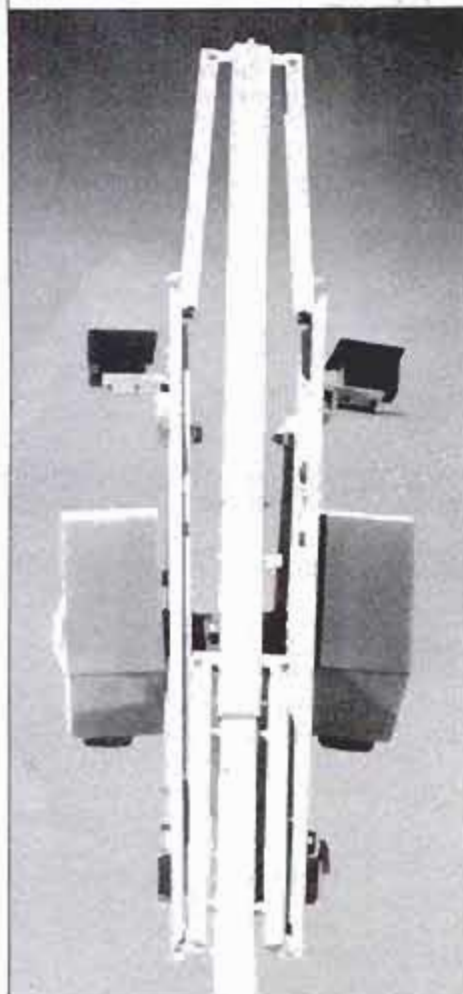
Newest Starcraft camping trailer model, Starmaster XLT 1906, has slide-out stove, stand-up wardrobe, added counter space.

CAMPING '82

Or move down to the latest trailers for bicycles and trail bikes to supplement saddlebags and a backpack. These convenient tag-alongs are now available from a number of sources. Some are even rigged to tote youngsters. Bicycle mounts carry one or more bikes on front or back bumpers or on the cartop. A high mount on the roof will keep the bikes away from road dust and damage, leave the car radiator free for cooling or make using trunk or hatchback easier. **PM**



PacWagon trailer by Prototype Engineering, Chico, Calif., converts to rumble seat.



Hartford Trailers, of Hartford, Wis., unfold without use of tools from a 2-foot width into cargo models of 4x4, 4x6 and 4x8.



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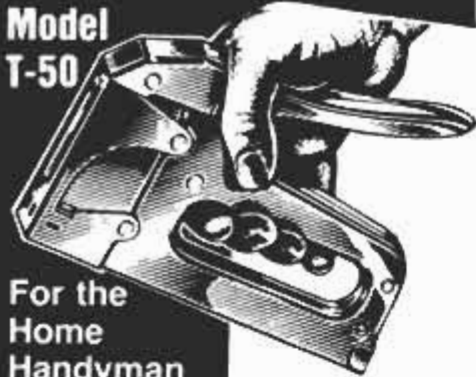
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Easy-To-Build Monopod Stops Camera Shake

Everyone knows that a tripod reduces arm fatigue and permits shooting at slower shutter speeds than is possible with a hand-held camera. But tripods are often bulky, heavy, time-consuming to set up and inconvenient in many photographic situations.

For many photographers, a monopod will do most of the work of a tripod with little of the inconvenience. And, it's easy to build.

One approach requires modification of a leg from an old tripod so that it can screw into a camera's base. This has the advantage of affording variable leg length for different applications. There are two disadvantages to this: Finding an old tripod may not be easy (or cheap); and attaching a bolt to fit the camera's tripod socket may require welding or brazing.

A much simpler and cheaper monopod can be made from a 1/4-inch dowel and a 1/4x1 1/4-inch chair bolt with 1/4-20 machine threads on one end. Drill a 1/16-inch-diameter hole into one end of the dowel and screw in the chair bolt until 1/4 inch of the machine threads stick out. Take



Use of a monopod (above) cuts down on arm fatigue. Note the film canisters taped upside down to the leg for easy opening.



For vertical shots (left), hold pod against arm. Pod is made from a dowel, chair bolt and crutch tip (below). See text for other methods.



care to screw the bolt in straight. Bevel the dowel end.

The lower end of the dowel can be designed a number of ways. I prefer a slight taper so the pod can be stuck into the ground, if necessary, without injuring the photographer. You can also slip a crutch tip over the end of the dowel. Or you can attach a horizontal piece of wood, possibly covered with foam rubber, to the bottom of the dowel, although this makes the pod bulkier.

How long should your monopod be? It's a matter of personal preference. A conveniently sized monopod should reach your waist, but you can construct them to any length. A monopod is so simple to make, that

it's best to build several of varying lengths to meet different needs.

For vertical shots with the camera turned sideways, rest the pod snugly against your arm. You may want to fasten film canisters to the pod to hold extra rolls. Mount the canisters upside down so the film drops into your hand when you open them.

A monopod will keep your arms from tiring, especially when you're following action with a heavy lens with the camera to your eye. Furthermore, it will let you shoot at slow shutter speeds (as slow as 1/4 second with a 135-mm lens) with virtually no camera shake. And it's so easy to build there's no excuse for not having one.—Bob Grewell

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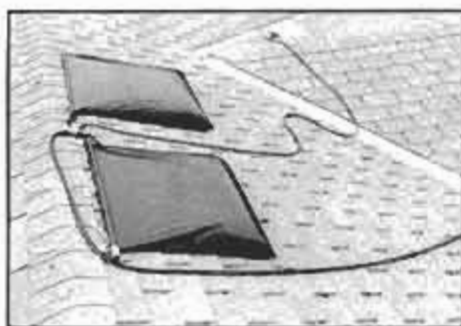
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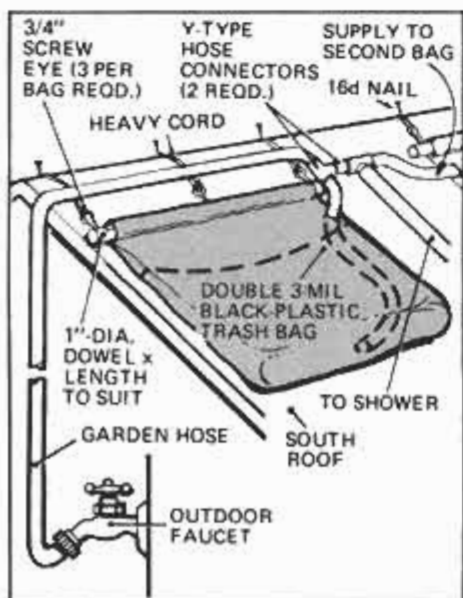
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No pumping is needed. Bags are filled by using a garden hose connected to outside faucet. They're drained by siphoning.

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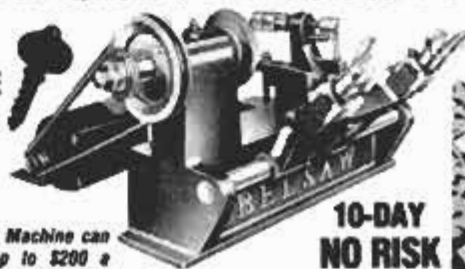
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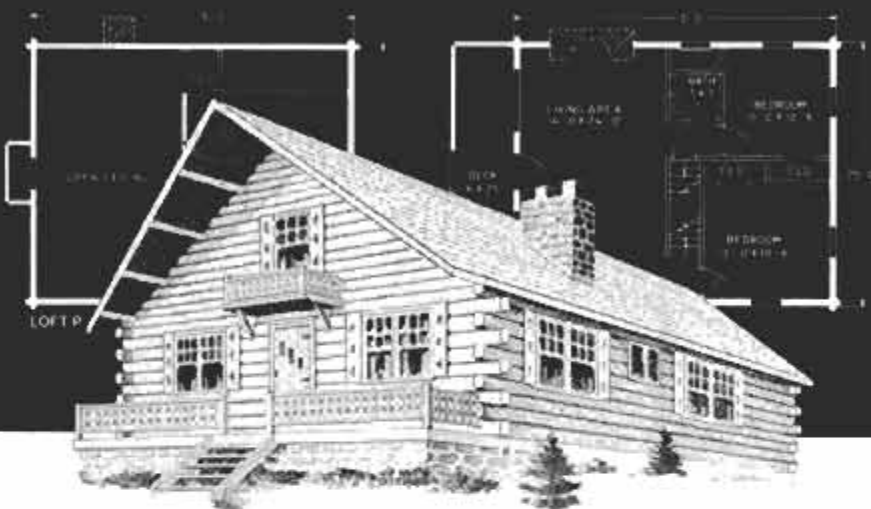
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- Ends sanding—scraping—spraying—chipping—steel-wool FOREVER!
- Amazing European discovery turns layers of paint to a single sheet of 'paper' so it peels away just like you'd lift and turn the pages of a book!

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Amazing new formula actually penetrates old paint (varnish and lacquer, too), in minutes. Transforms it into a soft, plastic-like film. Then simply let set . . . lift, roll, strip up to 18 coats of paint away in a single peel-away action! Yes, years of built-up paint peel away as quick and easy as you'd turn this very page! Ends sanding, scraping, chipping and foul-smelling chemicals ONCE AND FOR ALL!

There's no dust up. No clean up. Just a single peel-away action restores the bare, original finish . . . good as new in a flash!

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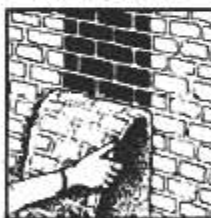
Called 'Peel-Away', this new wonder-formula has been officially registered with Gov't. patent offices throughout the World. It is completely odorless—completely safe! Reacts only with paint, varnish, lacquer or shellac . . . nothing else! So you can use it on even finest furniture, precious art frames, why even delicate wicker or valuable painted-over marble. In fact, it is so safe, so gentle, it is used by London's British Museum and world-famous art galleries to strip old art frames and century-old paneling. Even used by antique dealers to strip down priceless furniture treasures for restoration. Yes, 'PEEL-AWAY' literally lifts away every last layer of old paint even from hard-to-get-at places such as impossible-to-reach windowpane corners . . . grooved molding . . . finely tooled woodwork, etc., etc.

SIMPLY COAT IT ON—SEE IT TURN PAINT TO "PAPER" IN JUST MINUTES . . . AND PEEL IT AWAY IN A SINGLE LIFT-OFF-ACTION!

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PEEL AWAY™ UP TO 18 COATS OF PAINT AT A TIME!



Best of all this new wonder-formula is so easy to use. Simply mix with water and coat onto any painted surface. Then press down special 'Peel-Away' magic-fibre Lift-tex strip-away cloth, (included free) . . . let dry and adhere to surface . . . and without even dirtying your hands, lift away old paint, just like you'd peel a banana. It is as simple and easy as that. No mess. No fuss. No odor. Old paint lifts away like a single sheet of paper. Original bare-wood finish comes through like new again.

SO ECONOMICAL TOO! MERE PENNIES PER JOB! AND THE PEEL-AWAY MAGIC-FIBRE CLOTH IS COMPLETELY RE-USABLE. GOOD FOR YEARS TO COME!

Peel-Away is every home-owner's dream come true. Ideal for indoors on walls, windows, furniture, etc.—plus 101 outdoor uses too. And it costs only a little more than a penny per foot coverage. Homeowner's size alone gives enough coverage to strip away as much as 500 to 750 feet of wall and door trim, window frames, furniture molding, stair railing, patio furniture, roof-gutters . . . its uses are almost endless.

SAVES WORK, SAVES TIME, SAVES MONEY . . . MAKES TAKING OFF PAINT EVEN EASIER THAN PUTTING IT ON!

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STEP 1: Simply coat 'Peel-Away' wonder-formula over old, encrusted paint; (up to 18 layers thick)—



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Test kit comes with sample shingles, positioning template, coverage estimator, instructions, nail apron and warranty.

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The manufacturer is offering the test kit shown for \$10 (refundable if you buy shingles for your whole roof). It includes sample shingles to check for appearance and a well-produced instruction booklet explaining how to reroof your house.

The shingles cost \$30 to \$32 per square (enough to cover 100 sq. ft.) and come in five colors: bark brown, charcoal black, white, woodtone and desert wood. They are shadow banded, with a darker shade of color on the upper portion of each tab, to create a look of depth similar to cedar shakes. Keep in mind that the product is guaranteed only for use over one layer of old asphalt shingles, and the booklet doesn't explain roofing procedures for steep-pitched roofs. The shingles and kit are made by Celotex Corp., 1500 Dale Mabry Highway N., Tampa, Fla. 33607.—S.W.



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Is Lower Back Pain Making You An On-Again, Off-Again Cripple?

by Eugene Griffin

Read how one man freed himself totally from this crippling pain.

It happened aboard a Lufthansa flight to Frankfurt, Germany where I was going for a business meeting. The plane hit an air pocket and suddenly my back "went out." If you've ever suffered from lower back pain, you know what this can mean. In my case, the stewardess had to lead me off the plane when we landed. "This is the first time this has happened?" she asked. When I told her no, she said:

"Oh, then you should have a Prosana Belt." She then told me she had lower back trouble, too, and without the Prosana Belt, she didn't think she could hold her job. "It practically saved my life!" she went on.

I'll be sure to get one, I told her. But what I was really thinking was how could a belt that helped her—a woman about 110 pounds—help a slightly overweight guy of six feet like me? Besides, I thought, I've tried practically everything short of an operation. So I went to my hotel room, took a hot bath, several aspirin and laid down for the night hoping for the best.

Couldn't get out of bed

The next morning the pain was worse than I could ever remember. I had to roll out of bed onto my knees and crawl to a doorknob to get to my feet. Again, I took a hot bath and some aspirin, but again, it didn't do much good. If I had been back home, I would have called and canceled the meeting. But here I was in Germany and scheduled for a meeting with five other businessmen I had set up. So there was nothing I could do but go through with it.

Lunch Included, Too!

The pain must have been apparent the moment I walked into the room because the first man I met smiled sympathetically and said, "You look like your back is bothering you." It is, I answered. "Haven't you heard of the Prosana Belt?" he asked. I nodded yes. "And you don't have one?" he persisted. No, I said, continuing around the room, anxious only to get the meeting over with and go back home.

After the meeting, the man who asked me about the Prosana Belt suggested I join him for lunch. Since he was the key man on the deal, I accepted. But instead of driving me to the restaurant, he took me first to a surgical supply store where he bought me a Prosana Belt. I had no other choice but to put it on right there, though all I

could think of after thanking him was to say, Is that it?

"That's it," he replied. "Now let us take a little walk to a nearby restaurant I know you'll enjoy."

The Most Amazing Walk Of My Life

If I had known the "little walk" was going to take almost a half hour, I never would have gone—business deal or no. But that was all part of his plan! Because by the time we reached the restaurant, my pain was gone! I even reached down and touched my shoelaces just to see if I wasn't imagining things. I can't believe it, I said. It's like a miracle. "Yes, I know," he answered, "I said the same thing when I first wore the Prosana Belt. Occasionally," he added, "I still say it."

Tested & Proved In Hospitals

Over lunch my friend proceeded to tell me about the Prosana Belt. How it was invented by a doctor, tested and proved in hospitals and clinics; even on people so crippled with lower back pain, they had to wear steel braces! How it was, and is, used throughout Europe by tennis champions, Olympic bobsled medalists, soccer players—by all kinds of people who are constantly putting incredible strains and stresses on their backs. In fact, he concluded, its effectiveness has been so proven, its purchase is included under Germany's national health coverage plan.

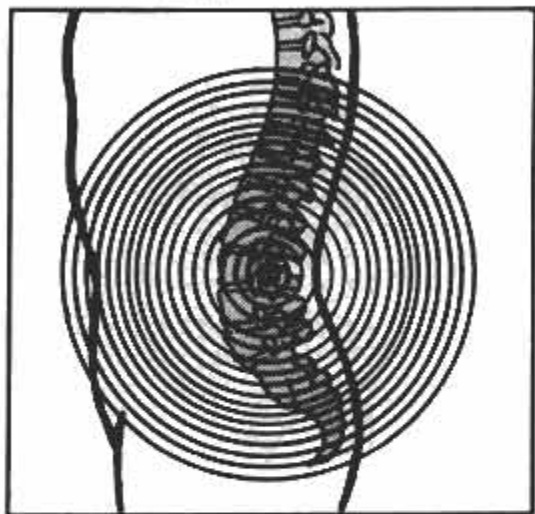
Save \$14.00! Special Free Trial Offer!

When I returned home, I told all my friends with bad backs about this marvelous belt. But when they tried to buy one, they found no one in the United States had even heard of it! So, I called my friend in Germany (incidentally, I got that order) and told him I'd like to import some Prosana Belts. He told me the cost of one in Germany was \$44.00 in American money. Since I would have shipping costs, taxes, handling and so forth, I decided to see if I could make a special bulk importing deal with the manufacturer. And, I'm happy to add, I was able to. Yes, you can now try the Prosana Belt for only \$29.95—\$14.00 less than what you would pay in Germany. What's more...

You Can Prove Its Effectiveness To Yourself Risk-Free For 30 Days!

If you suffer lower back pain like me, you've probably tried every "cure" there is and so you're probably skeptical. Which is why I'm making this iron-clad, no-risk guarantee: If you're not convinced that the Prosana Belt relieves your lower back pain fast...that it works where other methods and devices have failed...that it lets you bend over, garden, do household chores, even play sports pain-free, I'll return your money in full.

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If You Read Nothing Else Read This Doctor's Report:

"I've turned from my initial skepticism, indeed rejection of the Prosana belt, to an eager proponent of it. I now have checked more than 40 cases from my practice and after studying a file with more than 100 statements, I have no doubts about the effectiveness of the belt."
Dr. Ludwig Hecht

HERE'S WHAT USERS SAY:

"I have been suffering from lower back pain for years. Nothing helped, not even a steel corset. After wearing the belt, I am freed from the pain and it has never come back."
Mr. H. Kilian, Olympic Medalist & 3-Time World Bobsled Champion

"I suffered from severe back pain caused by tennis, and since I did not want to take any medication, I have begun to wear your belt. It is hard to believe how quickly I have got rid of my back pain."
Mr. D. Sturdza, Swiss Tennis Champion

"Often I could tolerate the pain only with strong medication. The Prosana Belt has freed me from taking pills."
Mrs. F. Polenz, Housewife

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TOUGH TRACTORS. UNBEATABLE OFFERS.**



INTERNATIONAL HARVESTER

Available at participating dealers. Offers expire May 31, 1982.

Physical Fitness And The Machine Age

Can exercise machines build new bodies? If you know how to use them—and *you* do the work—the right ones can.

by Robin Nelson TECHNOLOGY EDITOR

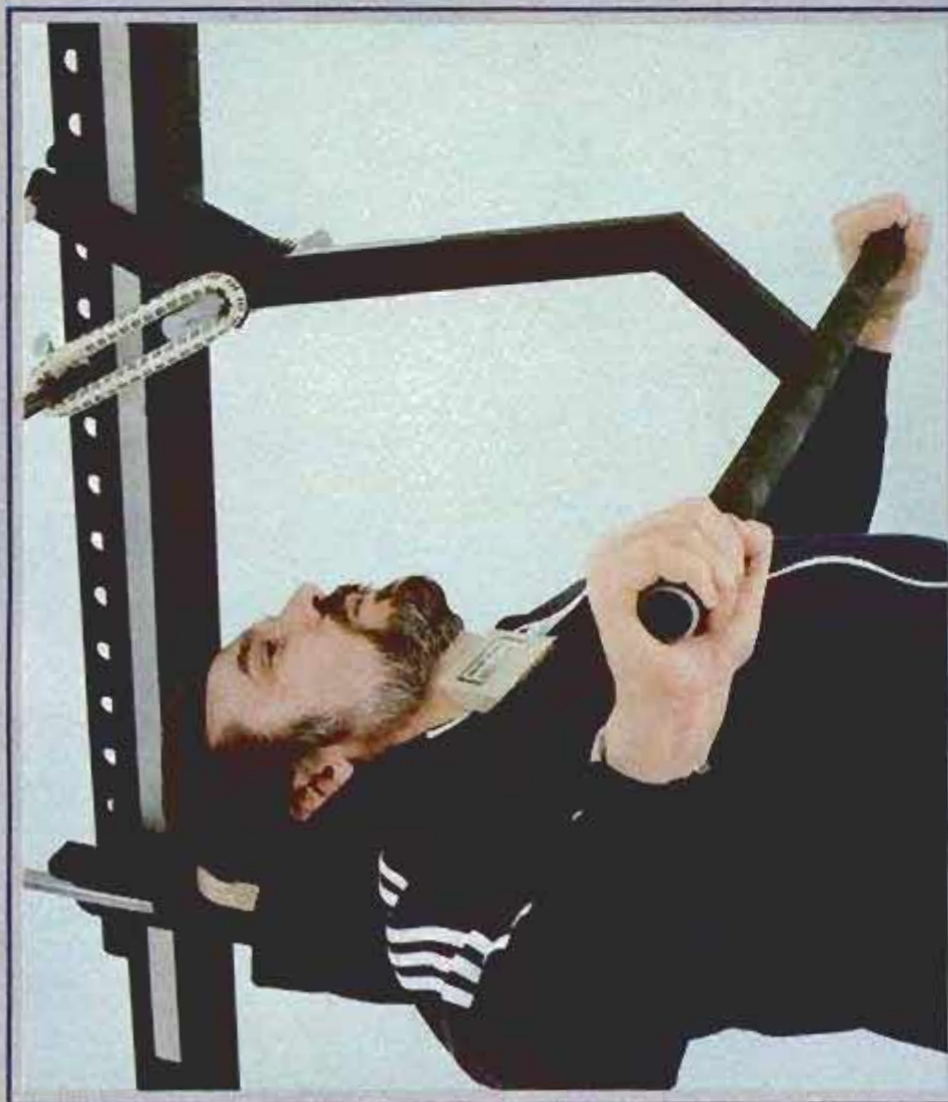
When it comes to exercise, resistance is everything. Resistance—via friction—forces you along the track as you run, or through the pool, thanks to the viscosity of water, as you swim. The gravity-induced resistance of as much as 500 pounds, or more, is what makes the veins stand out on an Olym-

pic weight lifter's tree trunk of a neck. So there's nothing new about resistance. But there are plenty of marketable new ways to package and apply it.

In designing machines to provide physical work, mechanical *disadvantage* becomes a desired characteristic. Special linkages to weight, friction, elastic, hydraulic

and—within the next year—electromagnetic resistances are being incorporated into equipment sold primarily for home use.

As in any leisure-boom area where competition is keen, each manufacturer is apt to claim special benefits and properties for its particular design, includ-



There is one common denominator for evaluating effort required (and therefore benefit received) for performing similar exercises on a wide variety of apparatus: It's your heart. A simple and inexpensive cardiac monitor, like the Heart Alert (above, \$110 from Edmund Scientific, 101 East Gloucester Pike, Barrington, N.J. 08007) sounds a beeping tone when set heart rate is reached and a continuous tone at a higher level of effort (usually the maximum desired). A machine like the Soloflex (left), may have an entirely different feel at a nominal weight setting than free weights for a given exercise, but with the heart monitor and stopwatch or a metronome, you can get an idea of equivalency. This can also tell you if resistance components, like bungee cords, begin to degrade. But remember: As your fitness improves, it takes more effort to reach the same heart-rate levels.

Step One unit uses friction pads that adjust to give resistance for isokinetic (speed-controlled), rotational movements. PM evaluation: Can be awkward to use until you've worked with it a while, but versatile, and probably best suited to multirepetition, light-resistance toning and endurance exercises. It's about \$595 (see text for suppliers).



ing the mode of resistance that is used.

An extensive survey of available scientific literature, plus the comments of exercise physiologists associated with universities and other institutions, however, prompts the conclusion that overstatement is the everyday language of the equipment suppliers. While there has been much research into the essential nature of strength and fitness—the composition of muscle tissues and associated neurological biochemistry, for example—in the past 25

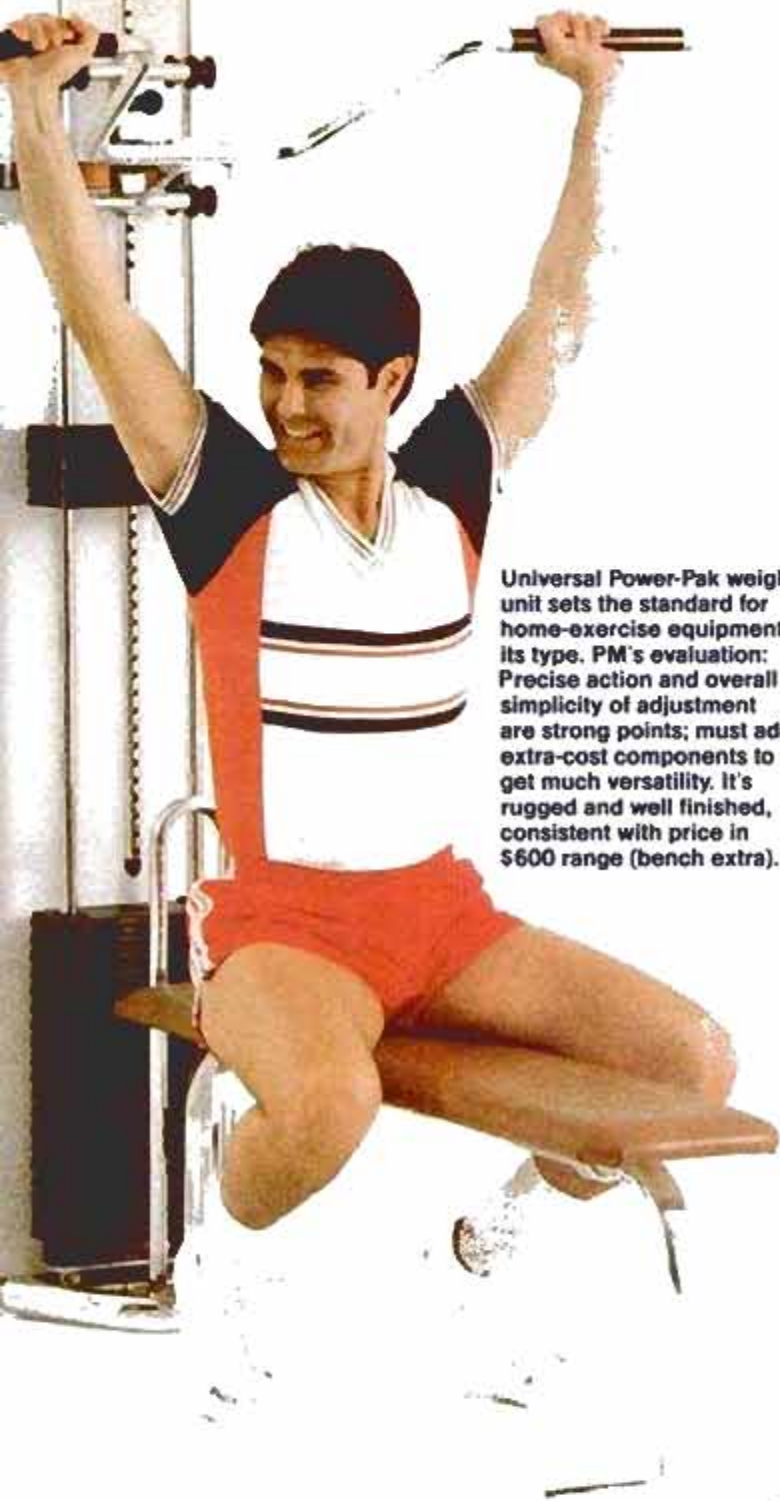
years, it has yielded nearly as many contradictory possibilities as firm conclusions.

Equipment makers pick and choose from among these theoretical pathways, funding the supplemental studies most likely to advance sales of proprietary apparatus. As an example, millions of dollars worth of heavy, expensive weight machines have been sold to institutions on the basis of a variable-resistance feature provided by lever arm (Universal Gym) or cams (Nautilus). By increasing resistance near the full

extension phase of exercises, this is supposed to provide better, quicker results. Perhaps so, but there are at least four independent studies in exercise-physiology literature which indicate this has no measurable effect.

So in spite of divergent techniques and special apparatus that may offer some slight advantages over old-fashioned calisthenics and free-weight lifting, the real news about machines concerns two factors: accessibility and convenience.

Doctors and health researchers



Universal Power-Pak weight unit sets the standard for home-exercise equipment of its type. PM's evaluation: Precise action and overall simplicity of adjustment are strong points; must add extra-cost components to get much versatility. It's rugged and well finished, consistent with price in \$600 range (bench extra).



The Soloflex machine is heavily built so bungee-cord resistances of more than 200 pounds can be loaded for different exercises. PM evaluation: Adjustments and operations require considerable caution; the elastic-resistance "feel" takes some getting used to, but gives a definite workout at extreme range of motion. Cords can deteriorate over time, but are replaceable. Unit is \$495.

know that the key to any rehabilitative program—whether we're talking about serious injury or the generally run-down condition most people pass off as "normal"—is positive reinforcement. If you're like most people, you need to be fed regular, frequent and precise results from an exercise program or you simply won't stay at it. The newer forms of packaged resistance are tailor-made for the job: They are light and compact enough to fit into an appropriate space in the home—accessible—and designed to permit

quick, convenient adjustments of resistance to a wide variety of routines.

That's what they are, and here's what they aren't: No device made can guarantee you either added strength or cardiovascular conditioning "for a few effort-free minutes a day." And no machine can guarantee you a set of bulging muscles—no matter how hard you work. Whether or not your muscles hypertrophy—take on the distended appearance characteristic of bodybuilders' physiques—depends on

your genetic makeup, a matter of hormonal chemistry. If it's right, you'll still have to work hard; if it's wrong, you can gain strength, but not trophies for posing.

And finally, no machine can, by itself, add beautiful pounds or remove ugly ones. Yet by deciding in advance exactly what aspects of your physical being you want to restructure, you can select a resistance machine that can provide a format for dramatic results.

It will depend on your age, cur-
(Please turn to page 217)

14 NEW

While the FAA ponders the fate of ultralights, the latest models look—and fly—more like real airplanes than ever.

by Sheldon M. Gallager

The ultralight world is waiting for the other shoe to drop. The FAA has already decreed that two-place ultralights are true airplanes, requiring N-number registration and pilot licensing.

The second shoe, when it falls after much expected debate, will determine the fate of single-place ultralights, currently exempt from FAA regulation, provided they're foot-launchable.

That some form of stiffer control is coming, no one doubts. Most agree it's not only needed, but long overdue. The foot-launch provision—a hangover from hang-gliding days—is largely a farce and everyone knows it.

Using human anatomy to launch and land a 200-pound aircraft with the wingspread of a Cessna 150 is neither safe nor practical, and few actually attempt it now that ultralights come conveniently equipped with wheels.

To end such nonsense, the FAA is proposing to abandon foot-launchability as a requirement for unlicensed ultralights in favor

ULTRA YOU CAN BUILD



Endangered species? One of first "tail-first" canard designs, exotic Goldwing features sophisticated controls: elevator in canard, inter-linked ailerons and spoilers in wings, rudders in winglets. But at over 200 pounds, the 30-hp, 70-mph craft is one of many ultralights that may lose unlicensed status under new FAA rules. Kit is \$4,295.

PM photos: Howard Levy

TOMCAT



PTERODACTYL
PTRAVELER



LIGHTS

FROM KITS



ROTEC RALLY MARINE

Float-equipped ultralights are a popular new trend. Rotec Rally Marine (above) has elevator, rudder and ailerons for full, three-axis control, does 45 mph on 30-hp engine, weighs 220 pounds, converts quickly to wheeled gear. Kit is \$5,250.

LAZAIR TWIN



One of most original new designs is Tomcat (left, facing page). Angled vanes under wing give lift, stability, automatic roll. Front-mounted canard tilts in two directions to serve as both rudder and elevator. Top speed is 60 mph on 30-hp mill; weight, 198 pounds. Kits start at \$3,695. Weight shift is no longer needed in new Pterodactyl Traveler (right, facing page). Pivoting canard serves as elevator; drag-type winglets function as rudders and spoilers. Max speed is 55 mph on 30-hp engine; weight, 200 pounds. Kit is \$3,900. Twin-engine Lazair (left) has three-axis control, does 55 mph on total of 12 hp and, at 142 pounds, is one of few current ultralights that meet FAA's proposed 155-pound weight limit. Kit is \$3,700.



HUMMINGBIRD TWIN



VECTOR 600

Sporting floats and twin engines, new Hummingbird (upper left) uses V-tail with "ruddervators" (combination rudder/elevators), plus ailerons in wing, for three-axis control. Engines produce 8 hp each, give top speed of 50 mph. Weight (without floats) is 163 pounds. Price is \$4,495. Vector 600 (upper right) also has V-tail with ruddervators, but uses "spoilerons" (spoilers acting as ailerons) for three-axis control. Clever drive arrangement,

with engine in front and prop behind wing, improves weight distribution and balance. Top speed is 50 mph on 22 hp; weight, 195 pounds. Kit is \$4,495. Tailless Kasperwing (facing page) is one of few ultralights that still use weight shift for pitch control, but ingenious wing system employs combination rudder/spoilers for yaw, roll and glide control. Max speed is 80 mph on 23 hp; weight, 150 pounds. The Kasperwing kit sells for \$3,750.



QUICKSILVER MX

Quicksilver MX (above), updated version of earlier two-axis model, now features full, versatile three-axis control (MX stands for multi-axis). Tail incorporates rudder and elevator, while "spoilerons" in wing can be used individually as ailerons for roll control or collectively as spoilers for glide control. Craft does 50 mph on 30-hp engine, weighs 200 pounds. Kit is \$4,195.

KASPERWING



of a more realistic limitation on aircraft weight. The current plan calls for an empty structural weight of no more than 155 pounds and a maximum fuel weight of 15 pounds (approximately 2½ gallons)—a move that could put many present ultralights out of business, at least as unlicensed sports planes.

Many makers are convinced, however, that the proposed fuel and weight limits are "negotiable"—that the FAA would be willing to raise them in return for other concessions, such as a restriction on wing loading, plus industry-wide agreement on requiring some form of pilot training before allowing customers to play with their new toys.

In an effort to nudge the FAA in this direction, the Professional Ultralight Manufacturers Assn. (PUMA) has come up with its own definition of what an unlicensed ultralight should be: "A single-place vehicle with an empty weight not exceeding 100 kilograms (220 pounds), a maximum fuel capacity of 5 gallons, and a maximum wing loading of 3 pounds per square foot."

The Experimental Aircraft Assn. (EAA), the world's largest and most prestigious body of sport-aviation enthusiasts, also backs the 220-pound weight limit and 3-pound restriction on wing loading. (Wing loading is total aircraft weight, including pilot and fuel, divided by wing area in square feet. Thus, to achieve light wing loading, an ultralight must have both low structural weight and a large wing to spread the load—a combination that tends automatically to guarantee docile performance.)

Makers argue that a limitation

(Please turn to page 199)

Airplane or ultralight? Only time will tell. Though never intended for foot launching, Striplin Lone Ranger (right) weighs less than 200 pounds, might qualify as unlicensed ultralight, depending on how FAA rules. A slick design with an enclosed cabin and true aircraft-type controls, it comes with 12- or 20-hp engine, is semiaerobatic, can do more than 80 mph. Kits start at about \$4,500.



STRIPLIN LONE RANGER

New Receivers Listen Across Town Or Over The Ocean

Whether you enjoy listening to Radio Moscow or the local cops, one of these shortwave radios or scanners can open a world of fun to you.

by Marc Stern

Realistic 2020

Bearcat 100



There are buttons and dials galore on all these programmable scanners and shortwave receivers. Scanners, like the Bearcat and Radio Shack models, depend on pushbutton tuning of selected frequencies. Just find a frequency you want to hear, within one of a scanner's ranges of frequencies, and you can set it up as a channel selection.

Pick channels individually, or the unit will choose an active one automatically. Receivers such as the Kenwood and Drake, tune more conventionally. Some have added features, like the Drake R7's timer that turns on radio at preset time so you can catch a favorite international program.

PM photo: Bill Ashe; Space photo: NASA

CO

PM COMPARES 11 SCANNERS AND RECEIVERS

	TYPE	RECEIVES	CHANNELS	SEARCH	COVERAGE	FEATURES
Sony ICF	Tunable	International	6	Yes	150 kHz. to 29.99 MHz.	Battery LCD display
Drake R7	Tunable	International	NA	NA	150 kHz. to 29.99 MHz.	Notch-filter, pass-band tuning
Kenwood R-1000	Tunable	International	NA	NA	150 kHz. to 29.99 MHz.	Wide and narrow selectivity
Bearcat 350	Scanner	Public service	50	Yes	30 to 50, 118 to 136, 144 to 174, 421 to 512 MHz.	Battery backup memory
Bearcat 100	Scanner	Public service	16	Yes	30 to 50, 138 to 174, 406 to 512 MHz.	Pocket portable
Realistic 2002	Scanner	Public service	50	Yes	30 to 50, 108 to 174, 410 to 512 MHz.	a.c./d.c. operations
Realistic 2020	Scanner	Public service	20	Yes	30 to 50, 108 to 174, 410 to 512 MHz.	a.c./d.c. operations
Regency D810	Scanner	Public service	50	Yes	30 to 50, 88 to 108, 118 to 136, 144 to 174, 440 to 512 MHz.	Flat keyboard
Regency D100	Scanner	Public service	10	Yes	30 to 50, 88 to 108, 118 to 136, 144 to 174, 440 to 512 MHz.	Can lock out channels
J.I.L. SX-200	Scanner	Public service	16	Yes	26 to 88, 108 to 180, 380 to 514 MHz.	Three squelch modes
Fox BMP 10-60	Scanner	Public service	16	Yes	32 to 50, 144 to 148, 148 to 174, 420 to 470, 470 to 512 MHz.	60 preprogrammed frequencies

All of the units are programmable, except for the Drake R7 and the Kenwood R-1000. NA: not applicable.

Bearcat 350



Hobby radio listening has entered the Space Age, thanks to the microprocessor. Spurred by this "computer on a chip," a new generation of radio receivers and scanners has appeared on the scene.

PM recently tested three shortwave and eight scanner radios that are representative of what's new in the communications world. Our findings indicate that the radio enthusiast has never had it so good. These receivers all use solid-state technology and boast a range of convenience and user features which make them hard to beat.

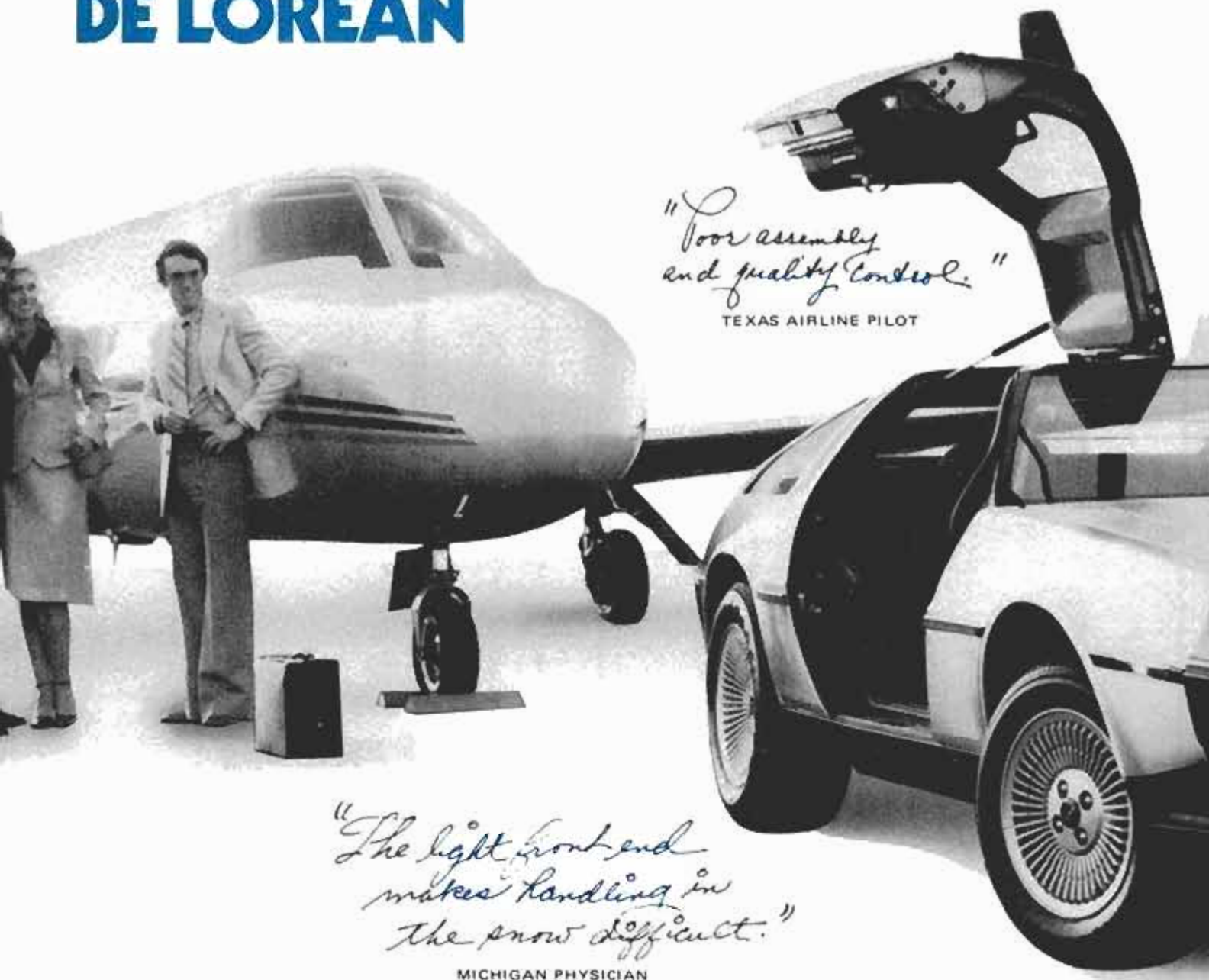
Our shortwave-receiver tests included two lower priced and one Cadillac-priced receiver. These radios allow the user to hear the "low-band" fre-

(Please turn to page 203)

Drake R7



DE LOREAN



*"Poor assembly
and quality control."*

TEXAS AIRLINE PILOT

*"The light front end
makes handling in
the snow difficult."*

MICHIGAN PHYSICIAN

Investors and the well-to-do evaluate the Silver Bullet.

You're about to crash a sparkling, but strictly imaginary, cocktail party. It's PM's Owners Report cocktail party for De Lorean owners.

Every one of the invited guests owns a similar silvery De Lorean, and it forms not only the centerpiece for this party, but the most natural topic of conversation. You're hearing the babble of several hundred enthusiastic De Lorean owners, and they're all talking straight from the shoulder. They're telling each other just what they like and don't like



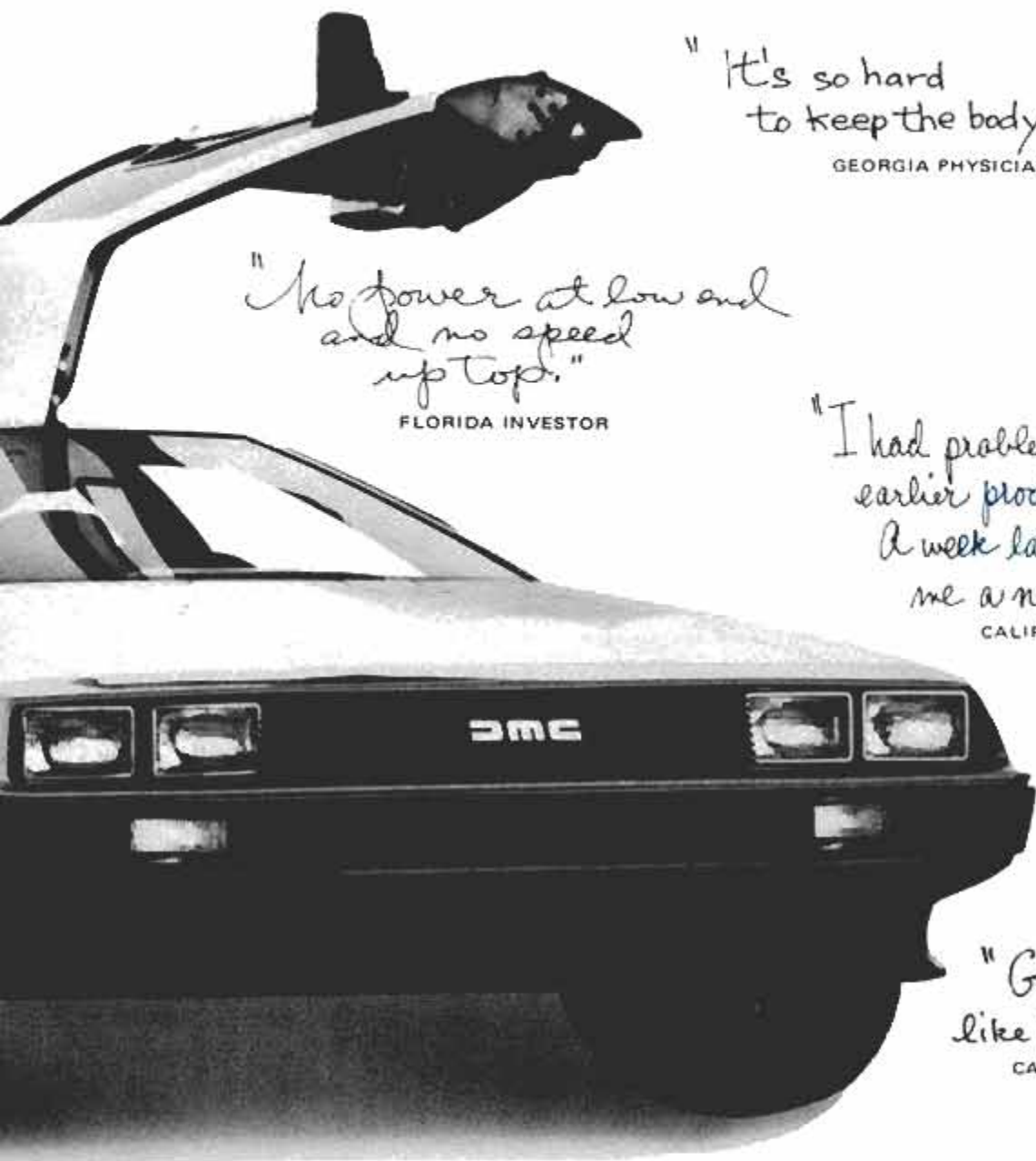
All-leather cockpit was lauded by owners as being extremely comfortable and roomy.

about the car, critiquing the De Lorean's design, workmanship, engineering, performance, handling; dis-

cussing its real, imagined and rumored early production flaws; its major virtues; in short, everything they've learned and noticed about John Z. De Lorean's highly controversial sports car.

Now, we're not truly at a cocktail party, you know, but as I thumbed through our De Lorean Owners Report questionnaires, they began to sound more and more like conversation you'd overhear at a cocktail party. So if you'll bear with me, I'd like to keep the champagne simile and use the cocktail party format for this De Lorean survey. I'm sure John Z. won't mind.

In listening to general comments, I discovered that nearly 75 percent of all De Lorean owners got sold on



"It's so hard
to keep the body clean."

GEORGIA PHYSICIAN

"No power at low and
and no speed
up top."

FLORIDA INVESTOR

"I had problems with an
earlier production car.
A week later, they gave
me a new one -- what a joy."

CALIFORNIA PHARMACIST

"Goes around corners
like it's tied to rails."

CALIFORNIA CHIROPRACTOR

the basis of styling—looks. That's not especially surprising, but it did come as something of a minor jolt to learn that no fewer than 17.8 percent purchased their De Loreans as investments.

A designer from Ford Motor Co. told me frankly that he decided to buy his De Lorean, "... strictly for investment purposes. Whether or not DMC [De Lorean Motor Co.] survives as an auto manufacturer, the car itself, like the first Corvette or Bricklin, will only go up in value. It's better than money in the bank."

Perhaps Pantera would have been a better example than Bricklin, but sidestepping that issue, an Illinois painting contractor not only seconded the Ford designer's investment

theory, but had an eventual sales strategy. "Yes," he averred, "I bought this car as an investment, yet because De Loreans haven't been selling so well as I expected (due to the weak economy), I can't profit in the short term. I plan, therefore, to drive the car very little and will sell it with low miles and in mint condition."

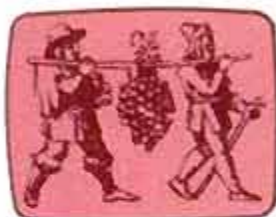
Another statistic that ran higher than most had to do with mechanical problems. I discovered that 63 percent of all owners at our "cocktail party" reported repairs of some sort. Many respondents mentioned ill-fitting doors that were hard to shut, that leaked or had faulty locks. These door complaints were *not* tabulated with the mechanical items.

Other, more common, ills had to do with the De Lorean's electrical system, fuel pump, fuel gauge and speedometer cable. Things owners would like to see changed or improved include better vision out the back and past the rear quarter pillars, windows that open more than just a few inches and a different radio antenna, not embedded in the windshield.

A substantial number of partygoers noted, too, how hard it was to remove fingerprints and road dirt from the stainless-steel body. And by far the greatest number of owners (16.4 percent) suggested a more powerful engine than the Peugeot/Renault/Volvo V6 (2,849 cc, 130 hp at

(Please turn to page 208)

The Art Of Winemaking



Wine consumption rocketed from 160 million gallons in 1960 to 500 million in 1980, while U.S. wine production jumped from 10th to 6th worldwide. The future is even rosier with new growing, harvesting and winemaking techniques in the offing.

by Dennis Eskow SCIENCE EDITOR

As if some kind of genie were unlocked in the 1960s, America went from rank amateur to world-class winemaker and wine drinker. We were consuming just over 150 million gallons in 1960, compared to the 500 million gallons we're sipping and quaffing today. And we've moved from No. 10 among wine-producing countries to No. 6—even ahead of West Germany—in two short decades. (The top five, in order of their production, are France, Italy, Spain, the U.S.S.R. and Argentina.)

Some say the American palate is becoming more sophisticated and the wine revolution is the result. But

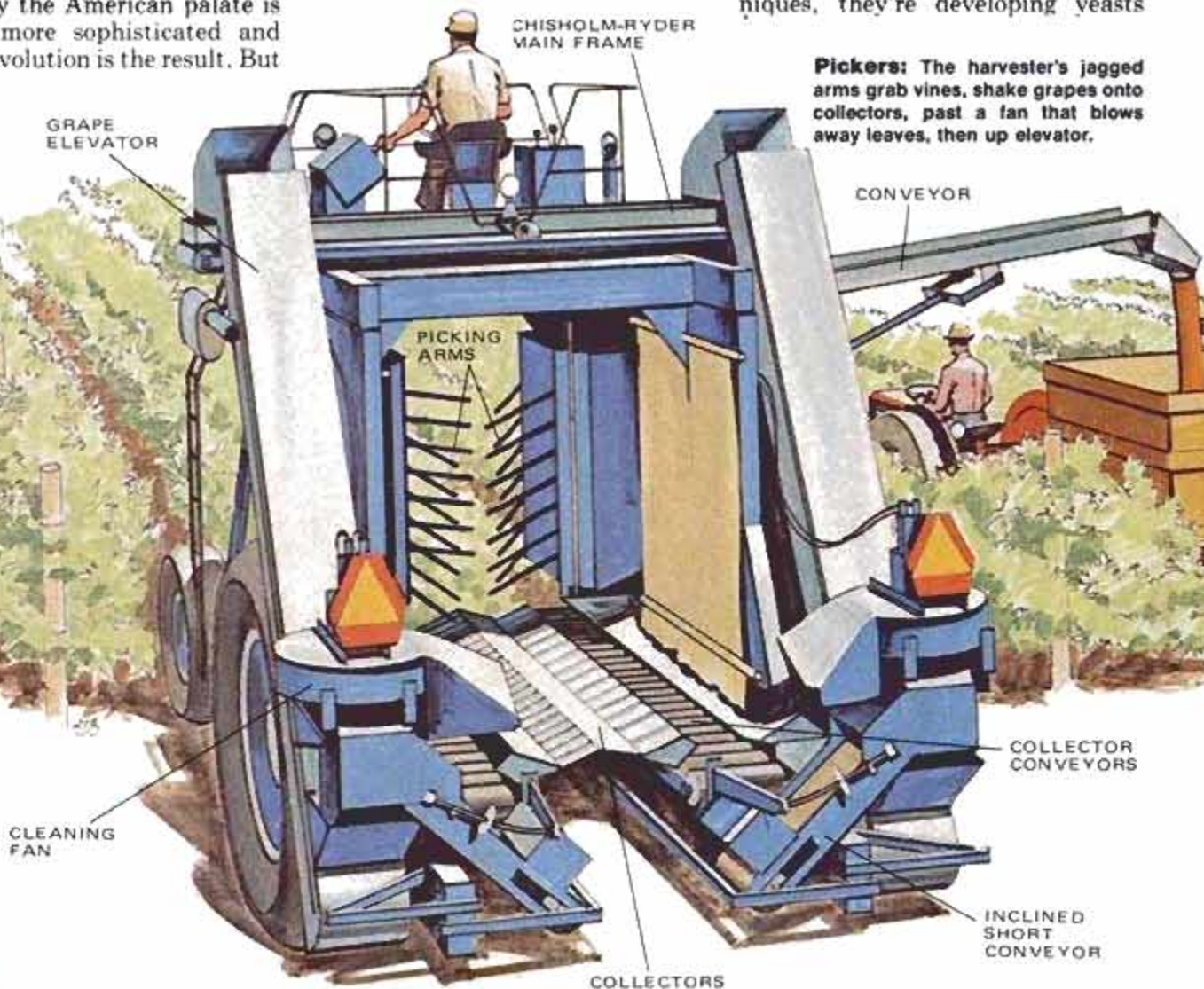
others point out that much of the wine made and consumed in America today is of the middle-of-the-road variety—not the stuff of which official wine tastings are made.

A better explanation for America's wine revolution can be given in two words: "viticulture" (the study of grape growing) and "enology" (the study of winemaking). These two branches of agricultural science have had their own revolution since the '60s. And with the emergence of new techniques for growing, cloning and

nurturing living things, they promise to continue their explosive expansion throughout the 1980s.

Tough grapes

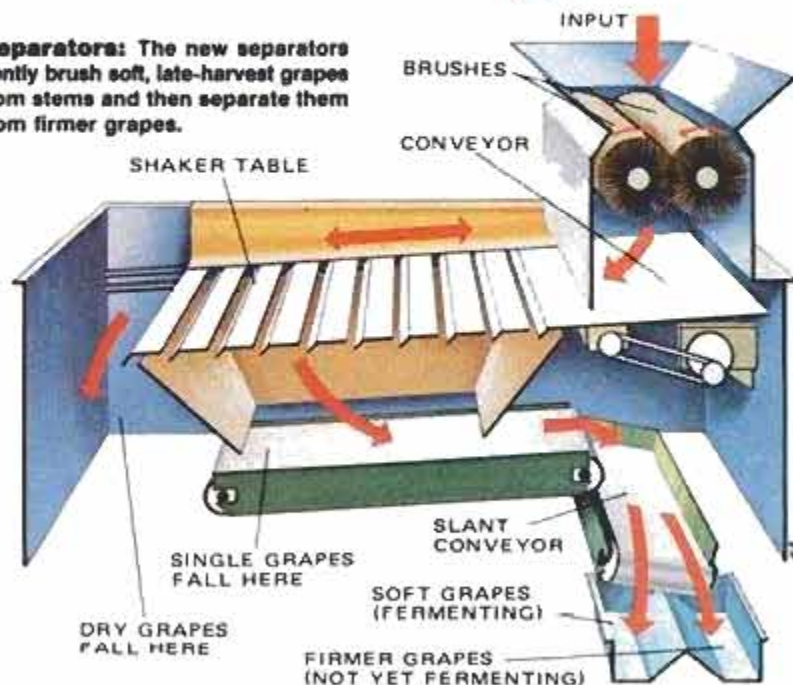
Viticulturists are developing grapes with higher and higher yields. And today's grape can stand up to both the toughest of winters and the newest, automatic harvesters, which pick 10 tons or more in an hour. The enologists, meanwhile, are uncorking the mysteries of flavor and aroma. Using advanced chemical techniques, they're developing yeasts



Is Becoming A Science



Separators: The new separators gently brush soft, late-harvest grapes from stems and then separate them from firmer grapes.



1990s, largely because of expanding mechanization. California—where human grape pickers are still economically competitive with machines—is about 50-percent mechanized; its grapes will be close to 100-percent machine-harvested by the end of the decade.

New York, which cultivates only 50,000 wine acres to California's more than 600,000, is nevertheless a technological leader. More than 90 percent of its wine crop is machine picked.

The new machines are expensive—one manufacturer, Labeco, advertises a rig for \$100,000—but the machines can pay for themselves within three years. According to one California state study, it costs \$15 to \$30 per ton to machine-harvest a vineyard. The study says handpicking costs \$25 to \$80 per ton.

Tractor-driven harvesting machines move up and down rows of plants, typically clutching a vine between two jagged metal teeth which pulsate. Or the machines shake off the grapes and stems with bristled wheels.

The squeeze is literally on in the crushing phase of grape science and faster and more specialized crushing devices are expected to be used in the field in the next few years. No-

(Please turn to page 218)

and machines that can help preserve the quality of an excellent wine, or that can turn out gallons of plainer tasting nectar within hours as opposed to months. (See *Artificial Wine Is Here*, at end of story.)

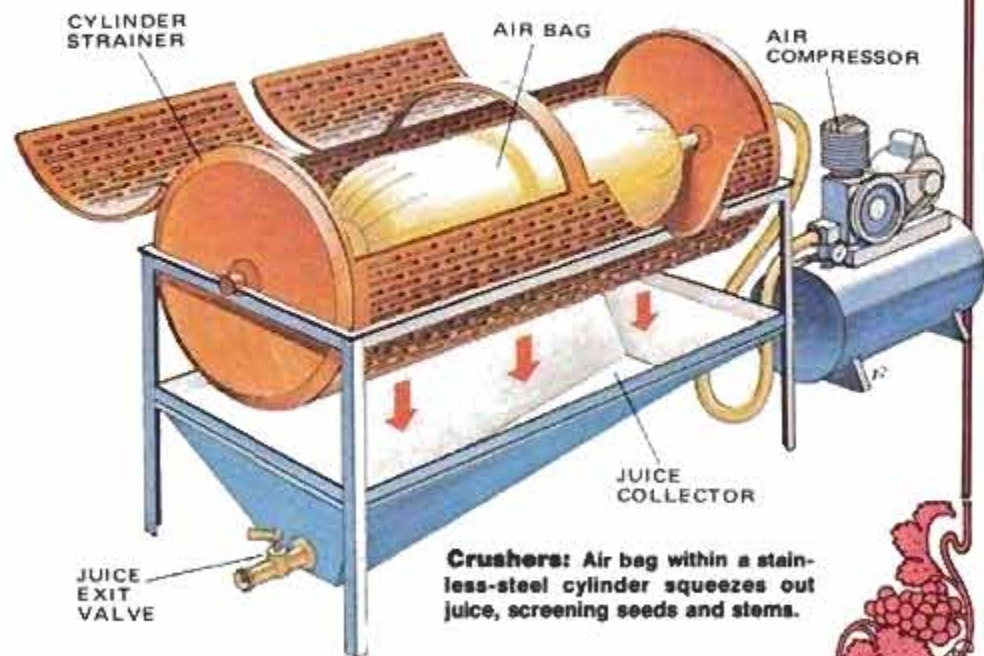
As you read this article, the New York State Agriculture Experiment Station at Geneva is distributing the first general-use cuttings of a new grape—65.533.13.

By dissecting this long number, you can get a picture of what goes into the creation of a new grape. The "65" means the first buds of this plant appeared in 1965 after a German Gewürztraminer vine was grafted onto a French-American hybrid. The "533" tells you how many crosses the Cornell University experimenters had to make before they were satisfied with the grape they were growing. And the "13" indicates that the scientists rejected 12 selections of the final cross before choosing this plant as the parent of the new variety.

The new grape promises to have the hardiness and productivity of an American vine with the flowery aroma and pleasant taste of the German fruit.

Meanwhile, scientists at the University of California at Davis—widely considered the finest wine-research center in the country—have identified "microclimates." Instead of looking at the weather of a state or region, the Davis researchers, and lately others, have identified small areas where specific data about the climate have led to the raising of breeds that grow best in that one place.

On a grander scale, America is expected to move past Argentina and the U.S.S.R. in production by the



Crushers: Air bag within a stainless-steel cylinder squeezes out juice, screening seeds and stems.





1



Three Wine Racks You

Wine buffs take great pains to store wine correctly, and our handsome racks let you do that—as well as show off a favored vintage or two.

It's safe to say that many people who buy wine by the case like to display their stock as part of their home decor. On these pages, we show three wine racks created in the *Popular Mechanics* workshop. Plans and instructions for making all three are on the following pages. At the end of this story you will find instructions for making a closet-type wine rack, a bonus if you are a serious collector of fine wines.



1 Our oak rack interlocks and joins together without hardware; each box holds six bottles of your favorite wine. Reproduction bin pulls add a hint of the mission furniture "look" to handsome rack.

2 This wine rack has the capacity to hold all of your prize stock—about 10 cases. Crafted in plywood, the wine rack gets its strength from the interlocking diagonals.

3 Spanish-style ornamental iron rack is an excellent project for those who prefer to work in metal. The rack shown holds 18 bottles.

Design and construction: No. 1, Harry Wicks; No. 2, Rosario Capotosto; No. 3, Steve Kayne
PM photos: Harry Hartman Studio
Stylist: Gabe Herrick



Can Build

The racks shown on these pages satisfy various needs: No. 1 is a clever box-type arrangement that can be used one atop the other, as shown, or individually, if preferred. The sides, top and bottom interlock in an ingenious system devised by *Popular Mechanics'* Home and Shop Editor. No. 2 is for those who stock considerable amounts of wine. You might never guess it with a quick glance, but there are more than four cases of wine

bottles in the pair of large racks shown in the photograph. No. 3 is a traditional Mediterranean-style iron wine rack. Each circular bay is used to contain one bottle; the rack holds 18 bottles in all.

The oak rack

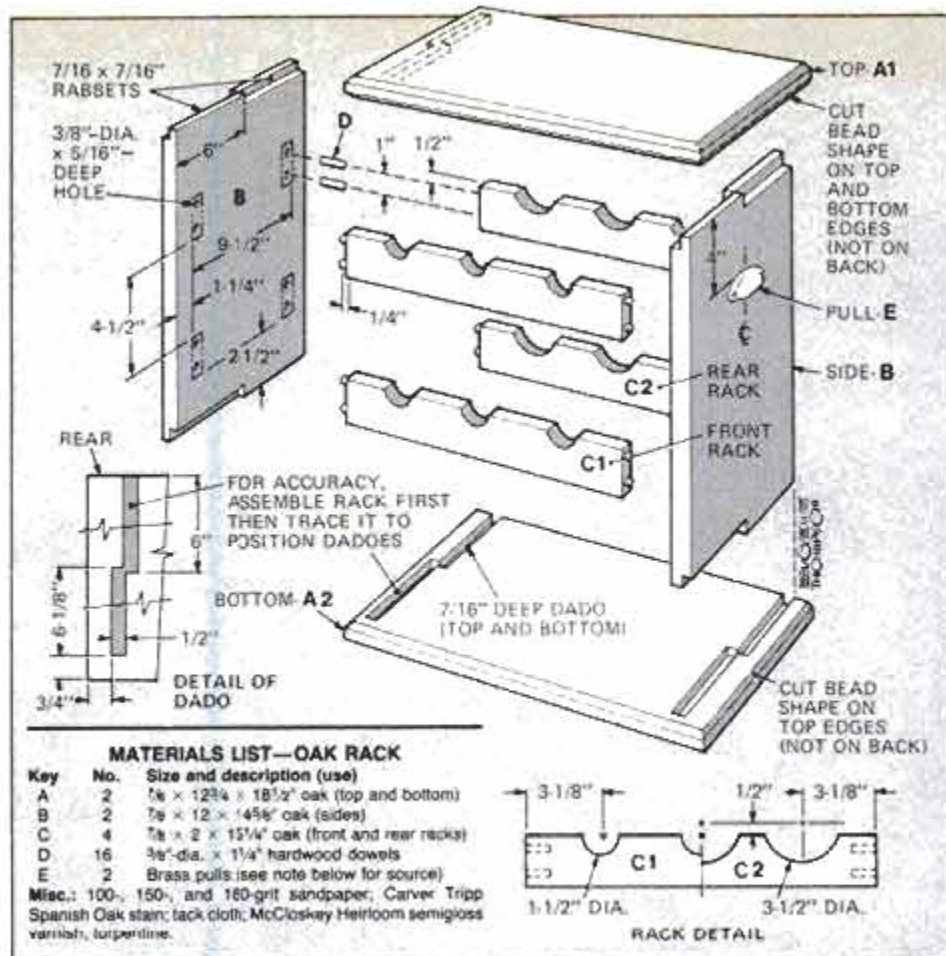
This countertop beauty is designed using the modular system. Each module holds six wine bottles; thus, you will need a pair if you buy your wine by the case. The tops and bottoms of the module sides are routed to a specific rabbet conformation, and the top and bottom pieces are dadoed to receive the sides.

The result is a rack that stacks securely without any hardware. If you desire, the top can be removed by lifting off.

Start by cutting the parts to size. Since you are working with oak, make certain you work only with sharp blades and cutting tools. After cutting all the parts, sand them smooth, starting with 100-grit paper and finishing with 120.

Cut the rabbets in the side pieces before assembly. Lay them out as shown in the drawing and use your router and a $\frac{3}{8}$ in. rabbet cutter. Because you are shaping oak, you should make the cuts in two passes. Do the first pass at half-depth and the final one at full depth. The rabbet width must be at least half the thickness of the wood stock.

When the cuts are completed, sand the sides, using 150-grit paper to remove any "whiskers" that have been made by the router cutter.



Next, assemble the modules. You install the bottle racks using blind dowels and white glue. Use a minimum amount of glue to avoid squeeze-out. If any glue should squeeze out of a joint, allow it to dry and harden overnight. The next day, you can remove it cleanly and easi-

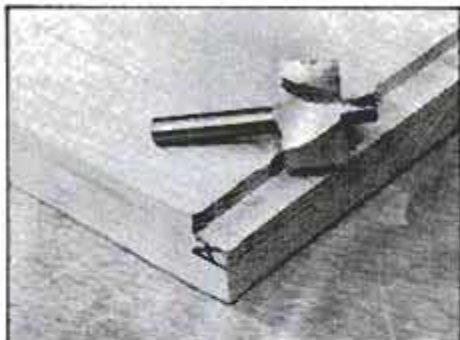
Note: The two brass Rounded Bin Pulls are available from The Renovator's Supply Inc., Millers Falls, Mass. 01349 for \$2.90 each (shipping and handling are \$2 for any order less than \$20).

ly, using a razor-sharp chisel. The easiest method for assembly is to use the techniques shown in the photos on page 107. Make sure you

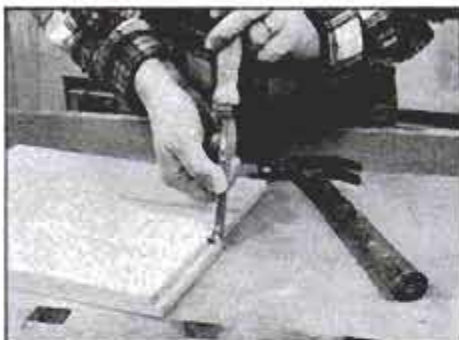
The interlock feature



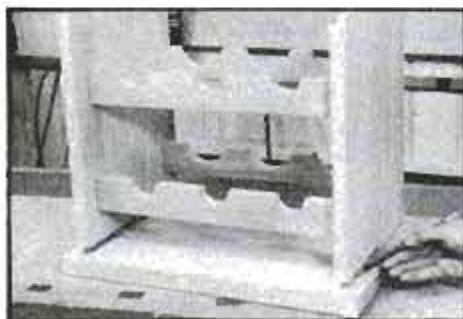
1 To create the interlocking joint, use router freehand to a mark, or with a stop.



2 Avoid damage to wood by making first pass at half-depth, then the final pass.



3 Clean out the rounded corners left by the bit, using a sharp, $\frac{1}{4}$ -in.-wide chisel.



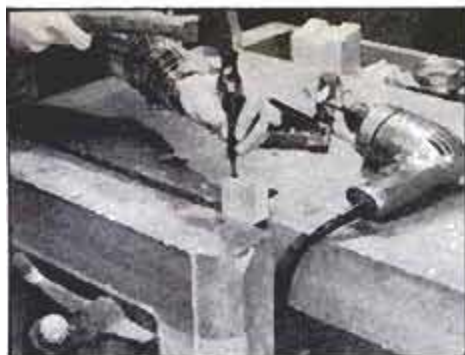
4 After box is assembled, position it on base, mark for dados. Repeat for top.



5 To prevent chance of router drift, clamp a guide for the shoe to bear against.



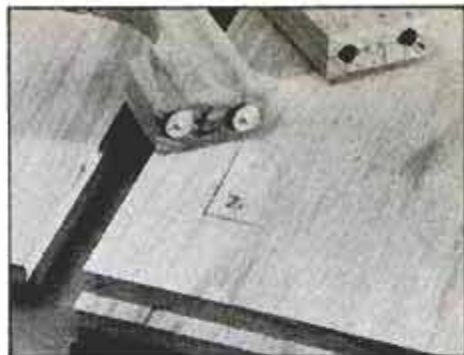
6 Carefully clean out dados using a chisel. Check joint frequently with mating piece.



7 To avoid drill-bit drift in end grain, center-punch the holes to be bored for dowels.



8 Bore dowel holes to desired depth; note masking-tape depth stop on the bit.



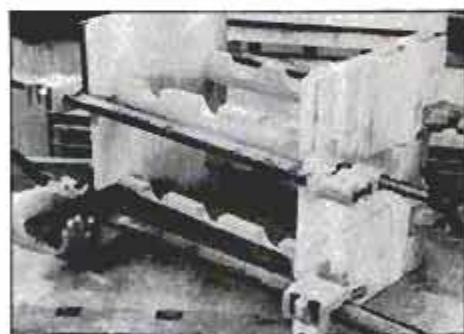
9 Use dowel centers to transfer marks from racks to sides. Note the match marks.



10 Bore blind dowel holes on marked sides. Check stop often; don't bore through.



11 Cut dowels to length, apply glue and insert them into the ends of the rack pieces.



12 Align match marks, assemble rack. Use at least four bar clamps overnight.

use match marks on the rack ends and mating surfaces of the sides so the module will go together without aggravation.

When it is assembled, clamp the module and allow it to stand overnight; use protective scraps of wood

or cardboard between the clamp jaws and the wood to protect the latter from tool marks.

Cut the top and bottom pieces to size and shape the edges using your router. Next, align the module on the base piece.

The rack should be flush at the back and the space at the ends should be equal. Check these dimensions and move the module about until they are correct.

When you're satisfied with the rack
(Please turn to page 211)

Egg-Crate Rack

Intended for serious wine buffs, this pair of racks holds about five cases each, for a total storage space of 10 cases. Like the oak rack, it is built using the modular system. In the photo on page 105 we have two racks arranged to display a modest wine collection.

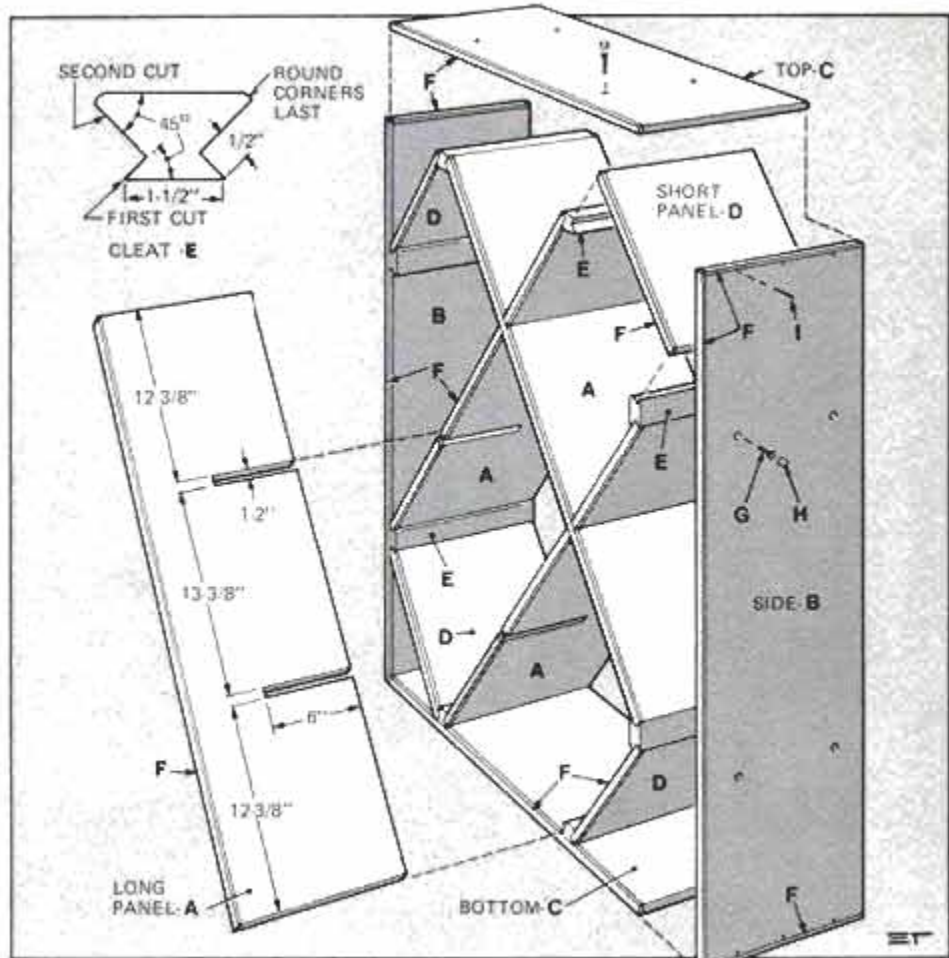
This rack is made with $\frac{1}{2}$ -in. birch veneer plywood. All exposed plywood edges are faced with $\frac{1}{8}$ -in.-thick strips of solid birch. The angled joining blocks are cut from $\frac{3}{4}$ " stock. If you can't obtain solid birch in this size, you can substitute maple because it has a fairly similar appearance.

Start by sawing the panels to size, making sure to allow for the add-on

(Please turn to page 212)

MATERIALS LIST—EGG-CRATE RACK

Key	No.	Size and description (use)
A	4	$\frac{1}{2} \times 11\frac{3}{8} \times 39\frac{3}{8}$ " birch plywood (long panel)
B	2	$\frac{1}{2} \times 11\frac{3}{8} \times 38\frac{3}{4}$ " birch plywood (side)
C	2	$\frac{1}{2} \times 11\frac{3}{8} \times 38$ " birch plywood (top, bottom)
D	4	$\frac{1}{2} \times 11\frac{3}{8} \times 12\frac{3}{8}$ " birch plywood (short panel)
E	8	$1\frac{1}{8} \times 2\frac{1}{2} \times 11\frac{3}{4}$ " birch (cleat)
F	36 ft.	$\frac{1}{8} \times \frac{1}{2}$ " birch (edging)
G	16	$1\frac{1}{2}$ " No. 8 fh screw
H	16	$\frac{3}{8}$ "-dia. dowel plug
I		6d finishing nails (as reqd.)



15 Accessories For Wine



13



1



2



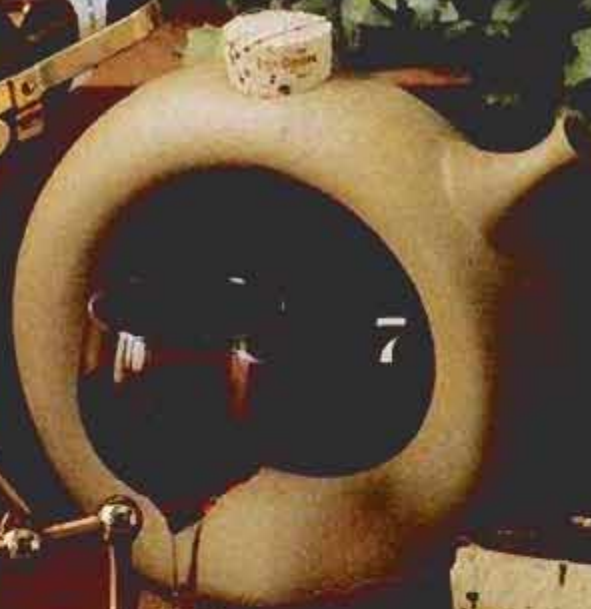
3



6



7



8



5



Enthusiasts



15

14



12

9

11

10

Here are some wine accessories, both decorative and useful, aimed at furthering your enjoyment of wine. These items also make good gifts for the serious wine lover, or for the more playful weekend buff. **PM**

1 Age lesser wines in this 2½-gal., American white oak barrel with solid brass hoops. It's \$103.10 postpaid at America's Wineland Crafts, Box J99, Rolling Hills Estates, Calif. 90274.

2 Silver-plated, dripless wine pourer, \$11.95 postpaid, has a double silver lip to catch small drops. It's available from Wine Caves Inc., 92 North 12th St., Brooklyn, N.Y. 11211.

3 Gourmet-Topf, 1216 Newport Ave., Long Beach, Calif. 90804, makes this wine crock; it's about \$10. Evaporation of premoistened clay maintains the wine bottle temperature.

4 The Screwpull corkscrew, about \$15, takes the hassle out of opening wine. The Hallen Co., Box 1392, Houston, Tex. 77001, is the manufacturer.

5 Kingtapp bottle stoppers have spring-lever design for easy pouring. From the Deleo Corp., 77 Haddon Ave., Shrewsbury, N.J. 07701; about \$4.50 for a pack of two.

6 Slow-action, brass decanting machine on walnut base pours wine into glass or decanter. It's \$325 postpaid from Morrell & Co., 307½ East 53rd St., New York, N.Y. 10022.

7 Sculptural, bisque ceramic wine tote by Hartstone Inc., 299 Ridgedale Ave., East Hanover, N.J. 07936, keeps wine at constant serving temperature. It's about \$21.50.

8 Pierced-silverplate bottle coaster with removable cork insert is 4¾ in. in diameter and costs about \$13.50. Block China Corp., 11 East 26th St., New York, N.Y. 10010 makes it.

9 Silver-plate wine caddy with handle wrapped in raffia is \$12. Leonard-Raimond Silver Mfg. Co. Inc., 144 Addison St., Boston, Mass. 02128.

10 This *fastevin*, a French wine taster's cup used by cellar masters and restaurant sommeliers, is \$26.95 postpaid from Wine Caves Inc., 92 North 12th St., Brooklyn, N.Y. 11211.

11 Silver-plate wine funnel with grape motif has a curved spout for slow decanting. It's available for \$69.95 postpaid from Morrell & Co., 307½ East 53rd St., New York, N.Y. 10022.

12 Wine service for six (\$55) has glasses and two carafes in a carrier from MaLeck Industries Inc., Box 247, Wingate, N.C. 26174.

13 La Cave Petite is a cooled wine cellar only 32 in. high, yet it stores up to 65 bottles. It costs \$995. La Maison Ebery Inc., 447 Madison Ave., New York, N.Y. 10022 makes it.

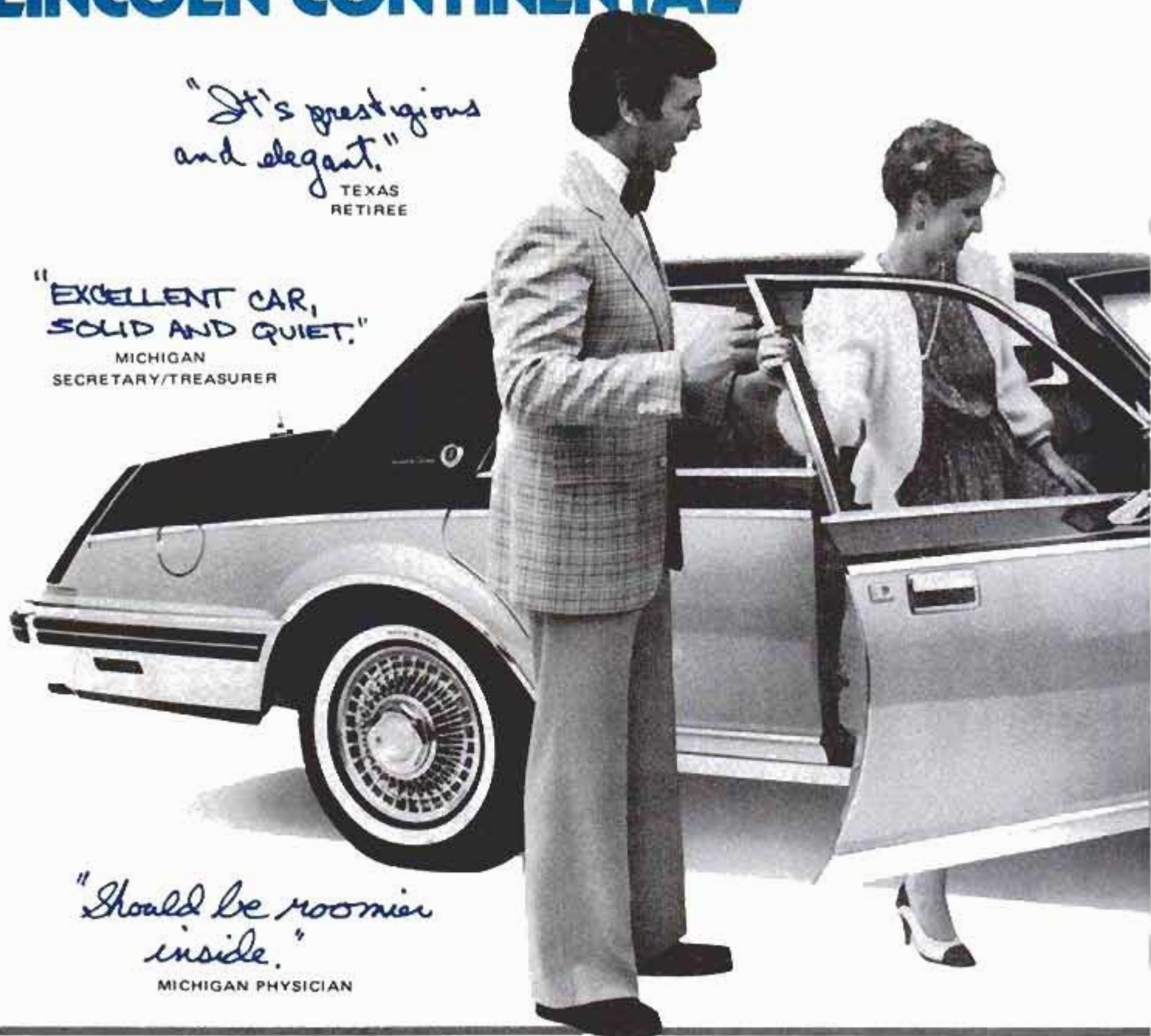
14 For a photocopy of the plans for building PM's own wine cart, send \$1 to: Wine Cart, c/o Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

15 Canvas picnic tote has special compartments that can hold two bottles of wine. Tote is \$13.75 postpaid from International Corp., Box 2561, Canoga Park, Calif. 91306.

LINCOLN CONTINENTAL

*"It's prestigious
and elegant."*
TEXAS
RETIREE

*"EXCELLENT CAR,
SOLID AND QUIET."*
MICHIGAN
SECRETARY/TREASURER



*"Should be roomier
inside."*
MICHIGAN PHYSICIAN

The smaller Continental has style and handling, but it lacks punch.

Well over half of the Continental owners we surveyed (65 percent) admitted to being at least 50 years of age. So it's still not a young person's car by any means (that's understandable, though, because accumulating the \$25,000 or so needed to buy the car takes a little time).

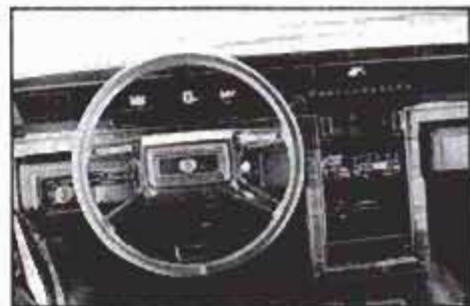
Nearly 40 percent of our respondents bought the Continental because they liked its styling, and another 28.7 percent purchased it

because they'd had a Lincoln before. A retired Ohioan told us, "I've been buying Lincolns for years, liked the looks of this one, and I appreciate the big-car comfort and ride."

A Texas investor echoed, "I've had good past experience with Lincolns and I liked the looks of this new series."

But a lot of buyers, like this plant superintendent from Illinois, stated simply that, "... I've wanted a Continental for a long, long time."

A surprising number, too, switched to Lincoln from Cadillac. A Texas home builder confided, "We had an '80 Cad diesel and wanted to get rid of it, but we couldn't deal with our Cadillac dealer. I liked the



Outstanding interior sports digital-gauge package, on-board trip/mileage computer.

style of this Continental and I've had good luck with Ford products in the past."

A New York retiree: "Continental has it all over the Seville. Continen-

"WISH WE COULD
GET A CONVERTIBLE."

DELAWARE MANAGER

"Overdrive locks back in
too fast when you're trying
to step out in traffic."

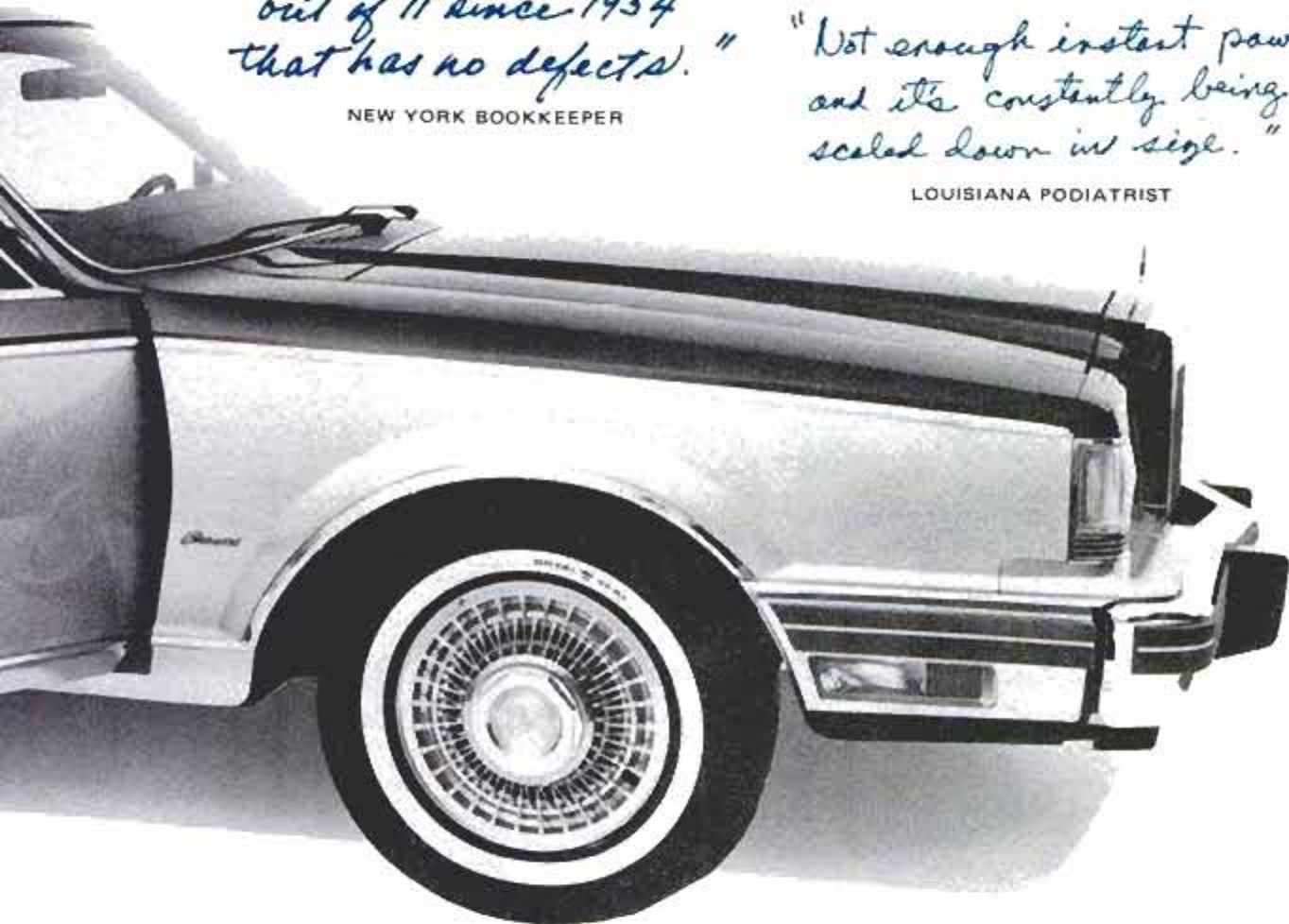
ILLINOIS PLANT SUPERINTENDENT

"My first car
out of 11 since 1954
that has no defects."

NEW YORK BOOKKEEPER

"Not enough instant power,
and it's constantly being
scaled down in size."

LOUISIANA PODIATRIST



tal is a very smooth-running automobile, very quiet."

A Florida housewife: "Lincoln gave me a better trade-in on my Buick than the Cadillac dealer would."

And a New York retiree: "My 1981 Cadillac V8-6-4 was driving me crazy. After 4,000 miles of aggravation, I traded for the Continental."

And what's it like to drive one? "Really easy to handle," replied an Alabama retiree, "and very comfortable. I feel safe in it."

A Michigan realtor: "Great road car; comfortable to sit and ride in; large trunk capacity."

An Ohio housewife: "I like the way the Continental handles. It's similar

to the foreign sports car I owned previously. Yet the ride, size, styling and comfort are much better."

A California obstetrician: "Comfortable, smooth ride, quiet and marvelous gadgetry!"

But a Montana farmer wasn't alone when he told us, "The engine—and mine's the optional V8—lacks power. The cruise control can't hold 55 mph on the highway, because there's not enough horsepower to overcome the automatic overdrive's tall gearing. Also, the transmission shifts into overdrive too soon."

A Michigan CPA added, "About 90 percent of my driving is in the city, and the transmission keeps upshift-

ing and downshifting all the time. It's very annoying. There should be a selector position for third-gear range so the transmission wouldn't keep hunting and pecking between third and overdrive."

Only 1.9 percent of our sampling opted for the standard V6 engine, with 98.1 percent going instead for the fuel-injected, 302-cu.-in. V8.

Unfortunately, our V6 sampling was too small to get performance impressions or fuel-mileage figures, but with the V8, our owners logged 15.1 mpg in town and 20.9 mpg on the highway. Most said they were pleased with the Continental's fuel economy and only 6.5 percent men-

(Please turn to page 221)

3 FOR THE OUTDOORS

This kids' play box can take a workout, yet is light enough to move—even into your garage.



1 Children's Play Box

This versatile and sturdy play box will provide your children with hours of summertime fun and, at the same time, be an attractive addition to your back yard. The unit has two covered sections (a sandbox and a toy box) and two open sections that will put any child's imagination and creativity to work. And when winter comes, you can empty the sand and store the box for next year.

Begin by cutting the 2x4 blocks and stiffeners to size. Then do the same with the plywood sides, dividers and sandbox floor. Make every

effort to cut this material square. Otherwise, once the play box is assembled, the two covering doors won't work properly.

Next, nail the sandbox floor to the dividers and the box back with 6d galvanized nails. Then assemble the remaining parts as shown. Be sure

to set the nails slightly below the surface to reduce the chance of injury to your children. Add the four corner braces to stabilize the open front compartment, then cut the door parts to size.

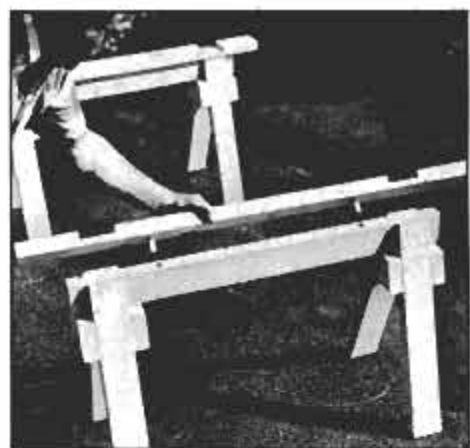
The folding top is assembled as shown in the drawing at right. For safety reasons, use roundhead stove bolts, lock washers and acorn nuts to join the strap hinges to the panels

2 Sawhorse Racks

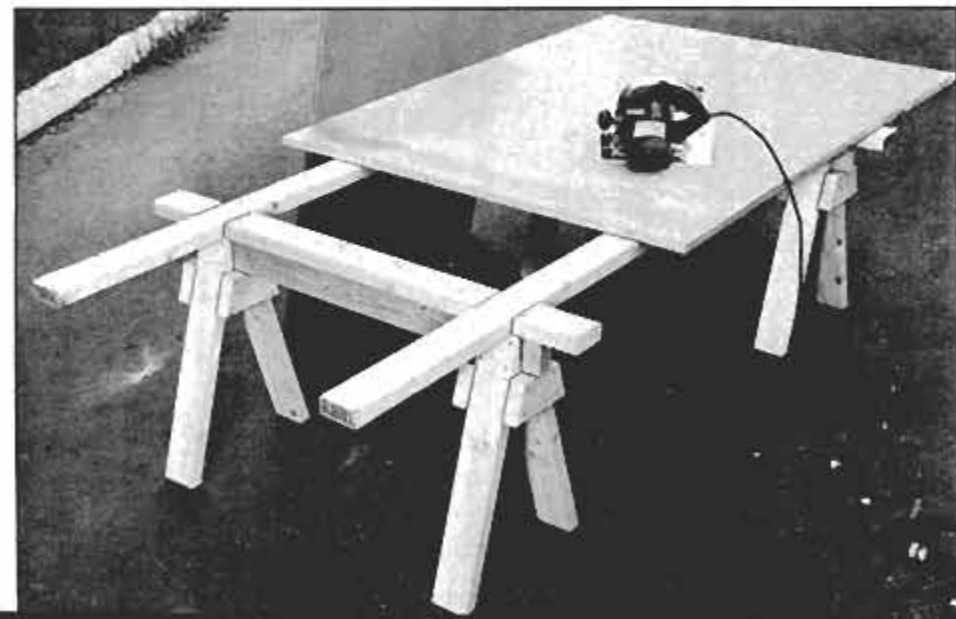
To saw large plywood panels on regular sawhorses you must use support boards to prevent the material from sagging and, thus, binding the saw blade. These supports assure better cuts and greater safety, but they can be annoying. Positioning them can take as long as making your cuts.

These easy-to-build sawhorses with a flush-mounting rack are a good solution. They provide adequate support regardless of cutting direction. And because none of the rack supports are attached permanently, the rack can be removed and stored. (If you prefer, make the rack and install it on your existing horses.)

First, cut all parts to size as shown in the drawing on the facing page. Then assemble the horses with waterproof glue and galvanized nails.



Sawhorse rack allows you to cut large panels comfortably, without binding the saw blade.



Rack mounts on horses with dowel pins. To remove for storage, just lift off boards.

Next, cut the matching half-lap joints in the four rack members, using a dado head or repeated kerf cuts with a standard blade.

Position and bore the dowel holes in the rack and horse members as shown, taking care to line them up precisely. Then finish up by gluing the dowels into the rack support only and bevel the projecting dowel ends so they will fit the matching holes with no trouble.

To use the rack, just drop the cross pieces into the horses, then bridge them with the longer members.

—Rosario Capotosto

3 Car Ramps

Lacking about an inch of space to crawl under my car for routine maintenance, I fabricated these ramps, using construction-grade lumber. They give me all the room that I need and are considerably less expensive than steel ramps.

These ramps were designed for the compact-car tires shown below. Wider tires will require wider ramps. So measure the width of your tire, add at least one inch for leeway and use the appropriate-size lumber.

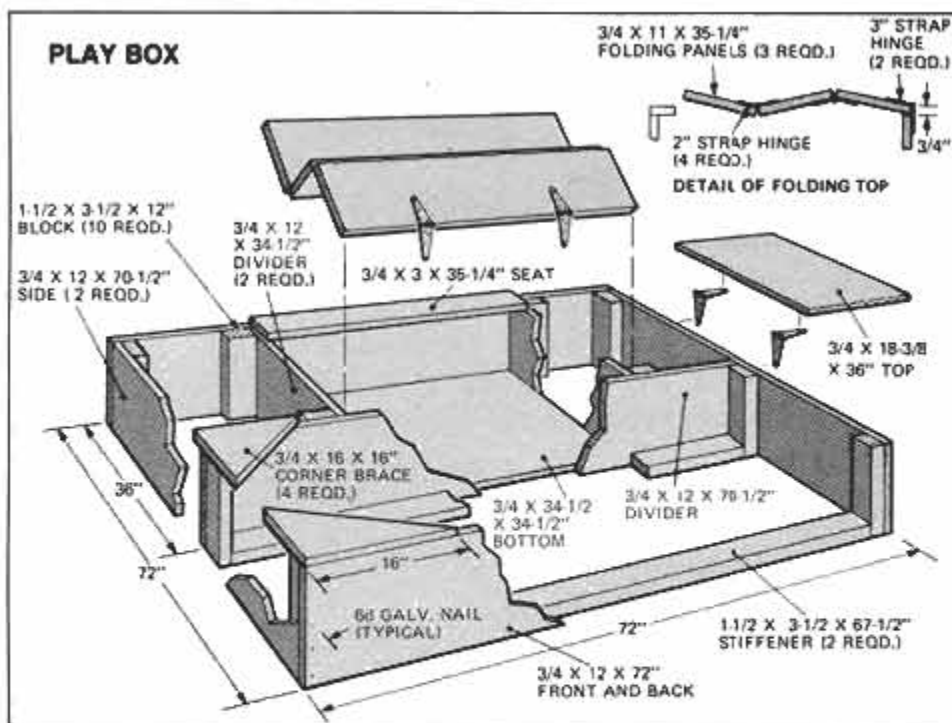
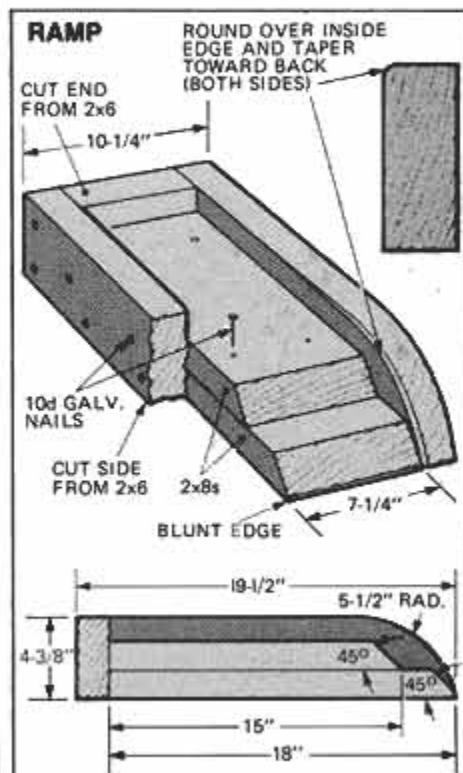
Cut the base parts to length from 2x8 stock, then cut a 45° bevel on one end of each board. Cut 1/4 in. off the beveled end of the bottom board to eliminate the sharp point.

Next, rip the 2x6s for the sides and end to width and cut them to length. Cut the curves on the side pieces and round over their inside edges, tapering them toward the back as shown below. Assemble with 10d galvanized nails.

—Charles D. Neal



Sturdy ramps simplify routine under-car maintenance—such as an oil change.

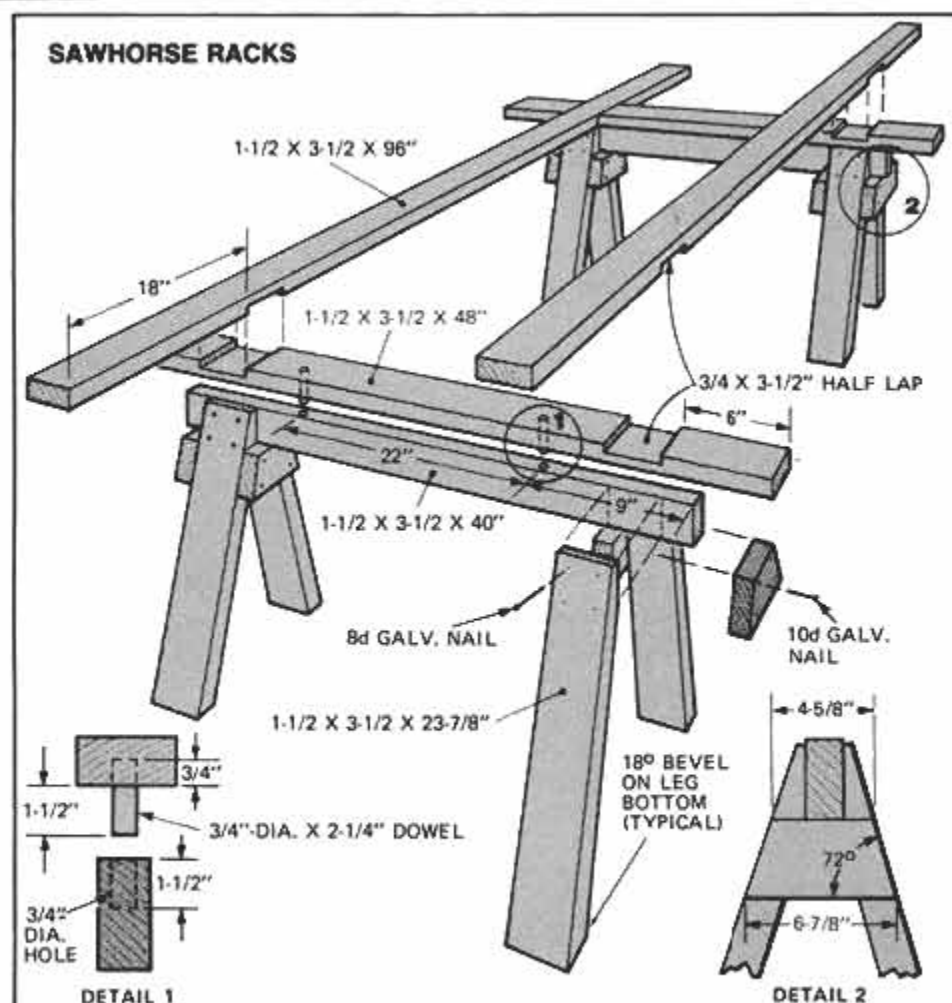


and the panel assembly to the box. When the folding top is spread over the sandbox opening, it should fall halfway on the top edge of each side divider and 3 in. in from the back. If it's a little short or long, cut the seat width to fit.

The toy-box door is mounted in the same way and should fall halfway on

top of the short divider and fully cover the top edge of the long divider and the back.

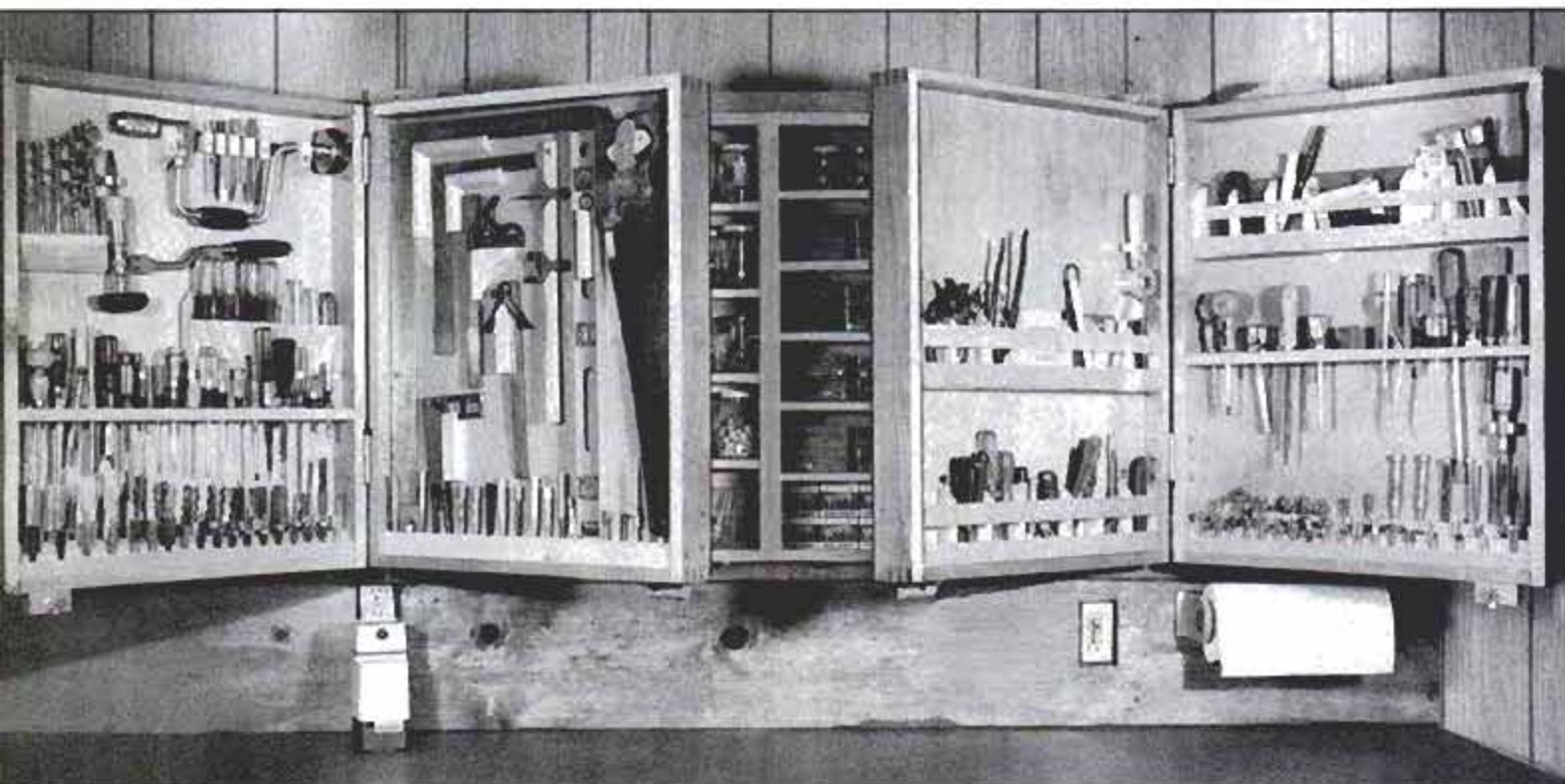
When assembly is complete, sand the whole unit well to reduce the chance of wood splinters. Then prime it and paint it with brilliant colors that your children will enjoy.—Alan W. Farrant



2 Projects For A Master Craftsman's Shop

Efficient storage of tools and supplies, as well as efficient use of power-tool equipment, are absolute necessities in a professional shop. Here are two ways one master woodworker meets those requirements.

by C.E. Banister



Use the inside sections of the outer cabinets (far left and right) and the outside sections of the inner cabinets to store the tools you

use most often. Lay these sections flat before joining them with hinges. Then mark the positions of the tools and the holders.

Storage Cabinets

Perhaps you've decided to put together a workshop, or maybe you've accumulated so many tools that it's time to think of a way to store them. Either way, you'll want a plan that will make economical use of space and provide maximum accessibility to your tools. You'll also want your tools arranged in a logical manner, so you won't spend undue time looking for similar tools stored in different locations.

The cabinet shown is easy to build, and it offers all the qualifications of a well-designed tool cabinet. You'll be able to judge from the photographs the number of tools that are cleverly stored in this compact unit. If it provides more space than you

need currently, the center sections can be eliminated from the plan and added later as your tool collection grows.

Cutting steps

Cut the tops, bottoms and sides for all sections. Since we used finger-lap joints at the corners of these cabinets, allow about $\frac{1}{16}$ -in. greater length for the frame members than indicated in the materials list on page 115. The "fingers" will then project about $\frac{1}{32}$ in. when assembled. Sand these projections smooth as a final step after assembly.

The base cabinet with shelves is divided in the center by a $\frac{1}{4}$ -in. partition. Cut a dado on the inside centers of both top and bottom to receive this partition. Cut a $\frac{1}{4}$ -in.-wide by $\frac{1}{2}$ -in.-deep rabbet on the

back edges to receive the $\frac{1}{4}$ -in. plywood back. Assemble these parts with high-quality carpenter's glue and brads, and clamp until the glue dries.

Make the shelves for the base cabinet and install them, using nailed-in spacers. Note that the shelves have a stopped bead on their front edges. Don't use glue on either the spacers or shelves, since you may want to adjust these parts later in order to accommodate different tool-storage needs.

Center and outside sections

The center sections are grooved in the center of the inside surfaces of the tops, bottoms and sides to receive the $\frac{3}{8}$ -in.-thick plywood panel. Once they're assembled, lay these sections flat, lay out your tools in

these sections and mark the locations for the tool holders.

The outside sections are grooved $\frac{1}{4}$ in. from the front edges to contain the front panel. Use screws to attach the holders. You may also prefer to buy commercial holders for many of your tools, if they can help to produce more economical use of cabinet space.

Drawing board

The drawing board is optional, but if you do any plans drawing at all, you'll find it a pleasure to use. The board folds up against the front panel to save space. This also means that the drawing-board surface is always free of shop dust, which otherwise can be an aggravation when working on plans or layouts.

The drawing contains all the information needed to construct the drawing board. Note that the leg measurements given are for a cabinet mounted $11\frac{1}{2}$ in. from the work-bench surface. If your cabinet is mounted at a different height, you'll have to adjust the length of the leg-assembly members to maintain a drawing-board angle of 15° . If you have trouble making the adjustment to maintain the correct angle, mount the board and leave the assembly of the legs until after you can position the board with a temporary prop. Take the measurement from the leg cleat, then cut and assemble the legs. Note that the base of the stand and the top are stylized with rounded corners and a cutout in the base.

Make the T square and add the T square holders after the board has been attached.

Final steps

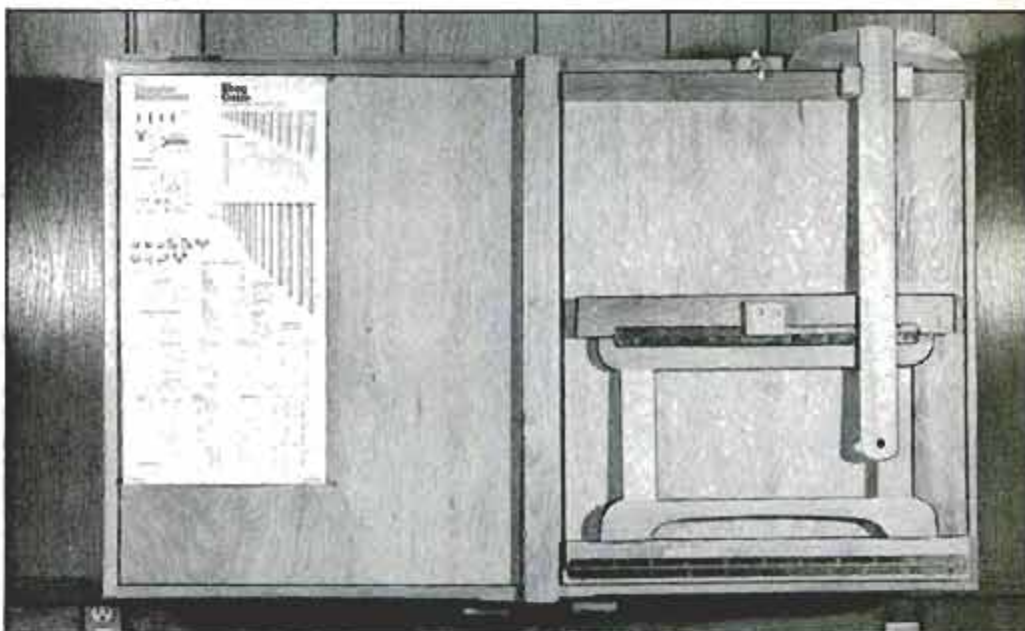
Before assembling the cabinet sections with the 3×3 -in. butt hinges, position the base cabinet section on the wall and position the corner irons so that the screws (P) can penetrate into the wall studs. Note that the cabinet is wide enough to span three studs, 16 in. on center. The corner angles are recommended for insurance against the pulling force of heavily loaded cabinets. Screws through cleats (E) should also penetrate the studs.

After the cabinet sections are mounted together with the hinges, attach the elbow catches so they catch when the sections are held firmly closed. This will prevent shop dust from settling into the cabinet. The strip (F) also helps keep dust out and produces a neater appearance.

I used three coats of polyurethane varnish to finish, and I sanded lightly with 150-grit paper between coats for a finer finish.



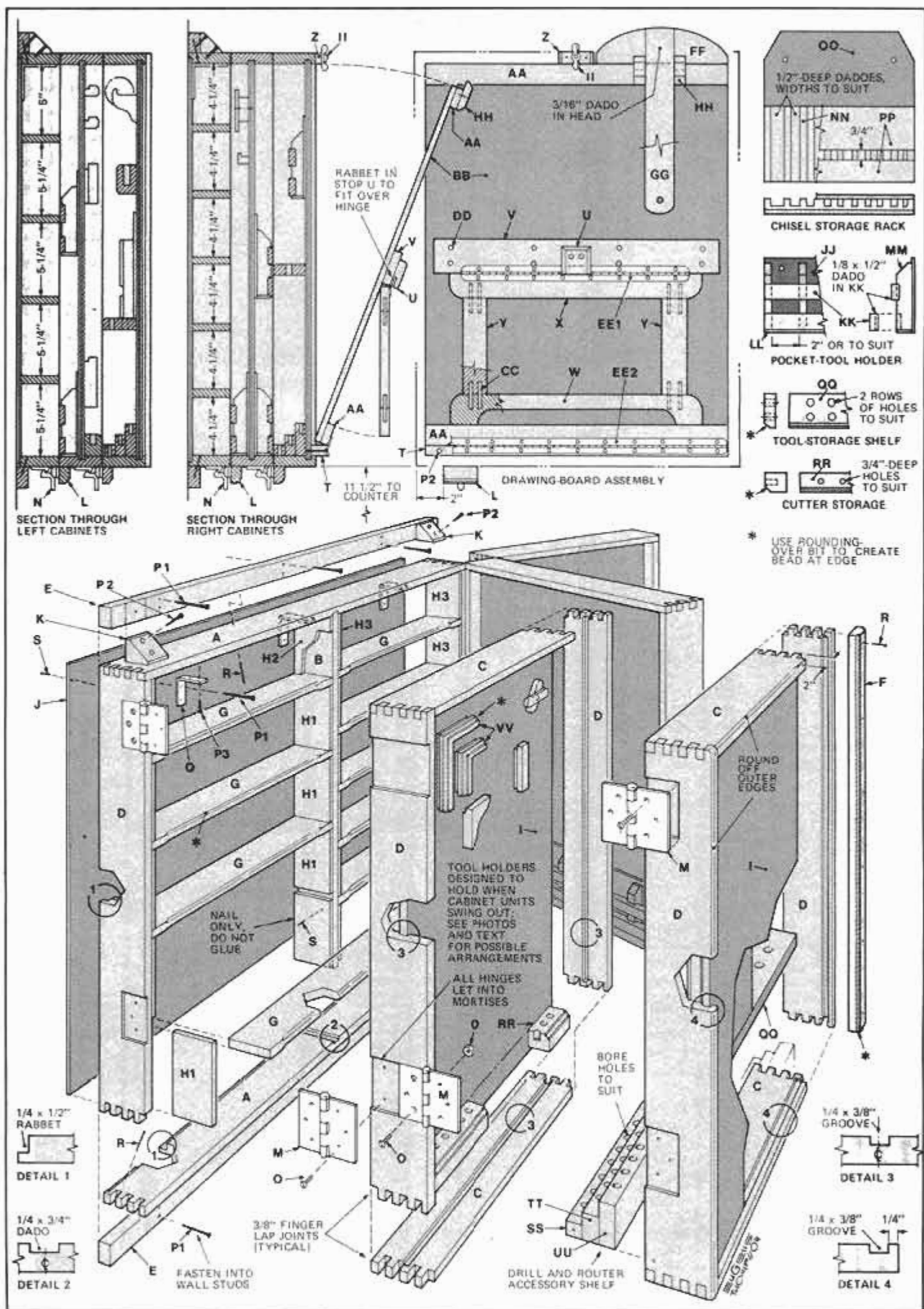
Drop-down drawing board is convenient. Store drawing materials on inner side of left inner cabinet. Drawing utensils in use are kept in a trough created when board is down.



To keep all materials free of dust, close cabinets and drawing board when not in use.

MATERIALS LIST—CABINETS

Key	No.	Size and description (use)			
A	2	$\frac{3}{4} \times 3 \times 47\text{-}1/2$ ' alder (top, bottom)	AA	2	$\frac{1}{2} \times 1\text{-}1/2 \times 21\text{-}5/8$ ' hardwood (top and bottom stiffener)
B	1	$\frac{3}{4} \times 2\text{-}3/4 \times 28\text{-}1/2$ ' alder (divider)	BB	1	$\frac{3}{8} \times 21\text{-}5/8 \times 26\text{-}1/2$ ' fir plywood (drawing board)
C	4	$\frac{3}{4} \times 3 \times 23\text{-}1/2$ ' alder (top, bottom)	CC	8	$\frac{5}{16} \times 2$ " dowel
D	10	$\frac{3}{4} \times 3 \times 29\text{-}1/2$ ' alder (sides)	DD	8	1" No. 10 fh screw
E	2	$\frac{3}{4} \times 1\text{-}1/2 \times 47\text{-}1/2$ ' alder (cleats)	EE ₁	1	1" \times 16-1/4" continuous hinge
F	1	$\frac{5}{8} \times 1\text{-}1/2 \times 29\text{-}1/2$ ' alder (center stile)	EE ₂	1	1" \times 21-1/2" continuous hinge
G	9	$\frac{1}{2} \times 2\text{-}5/8 \times 22\text{-}5/8$ ' alder (shelves)	FF	1	$\frac{1}{2} \times 2\text{-}1/2 \times 9\text{-}1/2$ " maple (T-square head)
H ₁	8	$\frac{3}{8} \times 2\text{-}5/8 \times 5\text{-}1/4$ " alder (shelf support)	GG	1	$\frac{1}{4} \times 2 \times 22$ " maple (T-square base)
H ₂	2	$\frac{3}{8} \times 2\text{-}5/8 \times 5$ " alder (shelf support)	HH	2	$\frac{5}{8} \times \frac{3}{4} \times 2$ " hardwood (T-square cleats)
H ₃	12	$\frac{3}{8} \times 2\text{-}5/8 \times 4\text{-}1/4$ " alder (shelf support)	II	1	Turnbutton
I	4	$\frac{3}{8} \times 22\text{-}1/2 \times 28\text{-}1/2$ " fir plywood (partition)	Pocket Tool Holder		
J	1	$\frac{1}{4} \times 29 \times 47$ " fir plywood (back)	JJ	1	$\frac{1}{8} \times 5\text{-}1/4 \times 22$ " plywood (back)
K	2	$1\text{-}1/2 \times 1\text{-}1/2 \times 3$ " hardwood (wedge block)	KK	1	$\frac{3}{8} \times 1\text{-}1/4 \times 22$ " plywood
L	4	$\frac{3}{4} \times 1\text{-}1/4 \times 2\text{-}1/2$ " hardwood (catch block)	LL	1	$\frac{1}{8} \times 1\text{-}1/8 \times 22$ " plywood (bottom)
M	8	3×3 " loose-pin butt hinge	MM	8	$\frac{1}{2} \times 1\text{-}1/2 \times 4\text{-}3/4$ " plywood (divider)
N	4	Elbow catch, model No. D8006 (see below)	Chisel Holder		
O	48	1" fh machine screw, washer and nut	NN	1	$\frac{3}{4} \times 5\text{-}3/8 \times 10\text{-}3/4$ " plywood
P ₁	18	$3\text{-}1/2$ " No. 12 fh screw	OO	1	$\frac{1}{4} \times 7\text{-}3/8 \times 10\text{-}3/4$ " plywood
P ₂	8	$1\text{-}1/2$ " No. 10 fh screw	PP	1	$\frac{1}{4} \times 5\text{-}3/8 \times 10\text{-}3/4$ " plywood
P ₃	6	$\frac{5}{8}$ " No. 8 fh screw	Miscellaneous Accessories		
Q	2	$2\text{-}1/2$ " corner angles	QQ	1	$\frac{3}{4} \times 2\text{-}3/8 \times 22$ " tool-storage shelf
R		6d finishing nails (as reqd.)	RR	1	$1\text{-}1/4 \times 1\text{-}1/2 \times 22$ " hardwood (cutler storage)
S		$\frac{3}{4}$ " brads (as reqd.)	SS	1	$\frac{3}{4} \times \frac{3}{4} \times 22$ " hardwood (drill storage)
Drawing Board					
T	1	$\frac{3}{4} \times 1 \times 21\text{-}5/8$ " hardwood (hinge cleat)	TT	1	$\frac{3}{4} \times 1\text{-}1/2 \times 22$ " hardwood (drill storage)
U	1	$\frac{3}{4} \times 2 \times 2$ " hardwood (leg stop)	UU	1	$\frac{3}{4} \times 2\text{-}1/4 \times 22$ " hardwood (drill storage)
V	1	$\frac{5}{8} \times 2\text{-}3/8 \times 20\text{-}3/8$ " hardwood (hinge cleat)	VV	1	$\frac{3}{4} \times 1$ " hardwood, length and number as reqd.
W	1	$\frac{5}{8} \times 2 \times 18$ " hardwood (stand base)	Misc.: Carpenter's glue, finishing materials.		
X	1	$\frac{5}{8} \times 1\text{-}3/4 \times 18$ " hardwood (stand top)	Elbow catch: The Woodworkers' Store, 21801 Industrial Bld., Rogers, Minn. 55374.		
Y	2	$\frac{5}{8} \times 1\text{-}3/4 \times 7$ " hardwood (stand leg)			
Z	1	$\frac{5}{8} \times \frac{3}{4} \times 2\text{-}1/2$ " hardwood (turnbutton block)			



Power-Tool Accessories

Every time a new piece of equipment appears in my shop, I see it as a challenge. I always ask myself these two questions: 1. "How can I best utilize the area in and around this new equipment for the most economical use of my shop space?"; and 2. "Are there any accessories I can add to make this tool more functional or require less maintenance?"

Shown here are the answers to these questions, as they apply to my motorized miterbox. The modifications are: 1. a boxed-in storage area underneath the table; 2. a dust collector mounted on the back of the table; and 3. a folding extension arm.

Storage below

I boxed in the area underneath the table to make use of space often ignored in shops. Here, I store wrenches, a saw key, blades and other tools that come in handy when I am using the miterbox.

Dust collector

The dust collector has an upper hood to catch the dust and a separate lower bin in which the dust settles. The bin is designed for easy removal. Attach handles to carry it directly to the waste area without

further transfer. The less you must handle dust, the less it will escape into the air.

Extension arm

The folding extension arm can be adapted to most any miterbox with few or any changes. We show how to make it with an easy-to-follow drawing. The stop is a combination 45°/90° when turned over, end for end, from one setting to the other. This design makes the accessory particularly handy for frame work.

Cut the parts, then the dadoes for a snug fit. Test-assemble the table and support without glue. If all parts are snug and well aligned, disassemble and cut the dovetail groove in the table's rear edge. Make two passes on the table saw with the blade set at 10°. Then remove the center part in two passes with the blade set at 90°. Be sure the sliding wedge of the stop is free-moving, but tight enough so it won't touch the spacer.

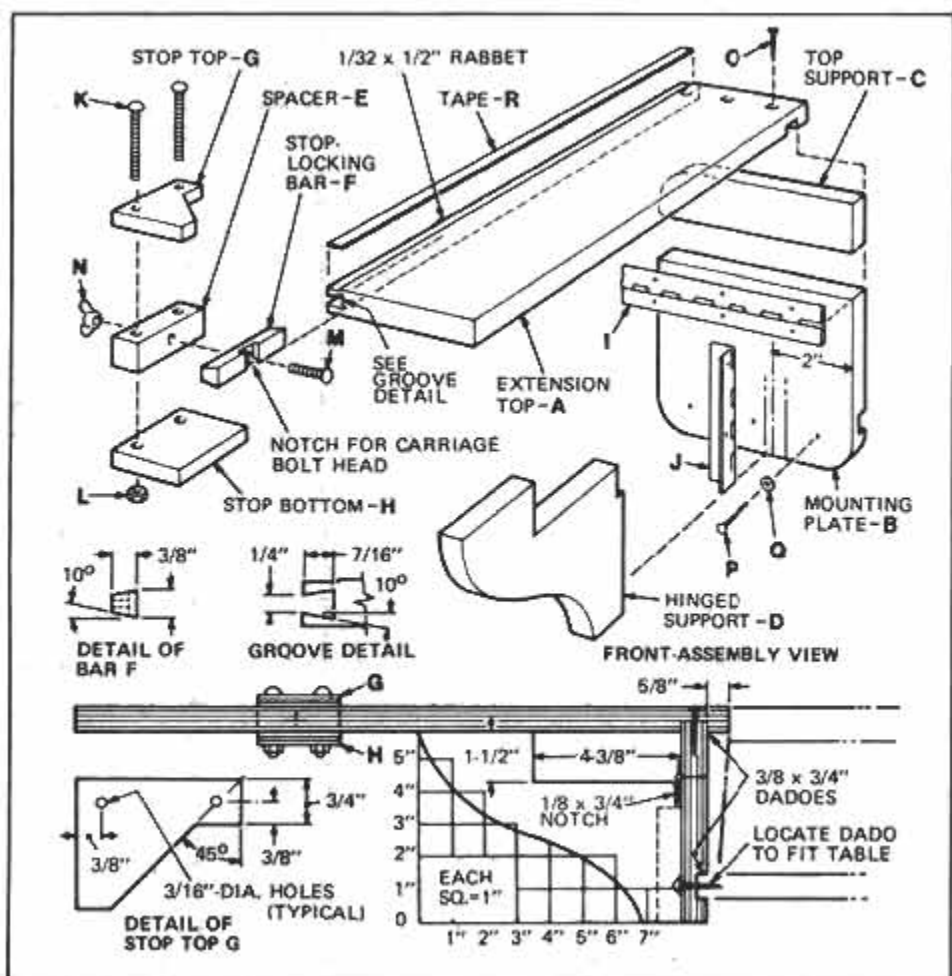
After cutting the 1/32-in.-deep rabbet, apply the adhesive-backed tape with a mild burnishing, using a soft cloth against the tape surface. Add two coats of polyurethane varnish to help seal the tape and make your extension arm more durable. **FM**



Use your extension arm and the 45°/90° combination sliding stop to cut frame members speedily and accurately. Other shop-made accessories include a boxed-in storage area under table and a dust hood and bin attached to the back of the table.



When not in use, swing the hinged support to the rear and allow arm to collapse to its vertical storage position. Corner angles are used to support the detachable dust bin (on the floor). Use hooks and eyes to secure bin to the back of the table.



MATERIALS LIST—EXTENSION ARM

Key	No.	Size and description (use)
A	1	3/4 x 4 x 20" birch plywood (extension top)
B	1	3/8 x 4-1/2 x 6" birch plywood (mounting plate)
C	1	3/4 x 1-3/4 x 6" birch plywood (top support)
D	1	3/4 x 5-7/8 x 8" birch plywood (hinge support)
E	1	1 3/16 x 1 3/16 x 2-1/2" pine (spacer)
F	1	3/8 x 7/16 x 2-1/2" hardwood (stop locking bar)
G	1	3/8 x 2 x 2-1/2" plywood (stop top)
H	1	3/8 x 2 x 2-1/2" plywood (stop bottom)
I	1	1-1/2 x 6" continuous hinge
J	1	1-1/2 x 3-1/2" continuous hinge
K	2	3/16 x 2" rh stove bolt
L	2	3/16" hex nut
M	1	3/16 x 1-1/2" carriage bolt
N	1	3/16" wingnut
O	3	1-1/2" No. 10 fh screw
P	3	1-1/2" No. 10 rh screw
Q	3	No. 10 flat washer
R	1	1/2 x 30-1/2" adhesive-backed tape, Brookstone model No. Y2447

Misc.: Glue, polyurethane varnish.
Adhesive tape: Brookstone, 127 Vose Farm Rd., Peterborough, N.H. 03458.

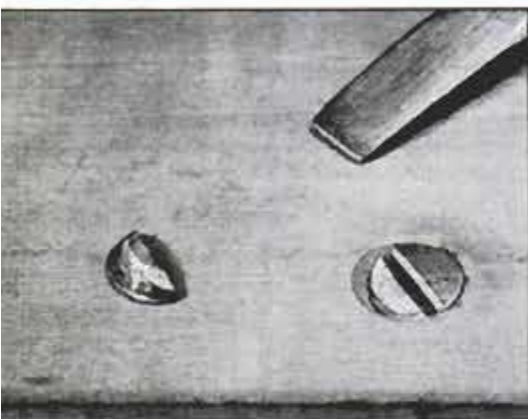
Expert Solutions For Nitty-Gritty Shop Problems

Have you ever painted yourself into a corner? Here are 11 typical workshop aggravations—and how the experts solve them.

by John Ingersoll

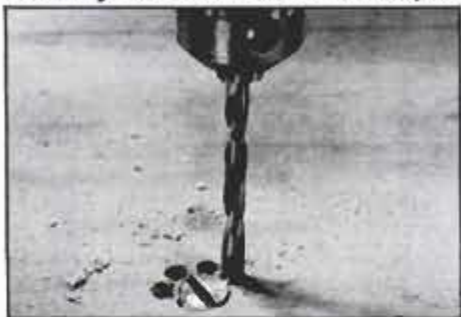
Beginners do it. Journeyman carpenters do it. Even mastercraftsmen do it. No one who tackles home repairs or has a workshop is immune to an occasional woodworking snafu. The professional falls back upon his experience—time-proven steps and methods that will get him out of trouble with comparative ease. You can, too.

On these pages, we have collected 11 of the most common workshop problems, and the solutions for extricating yourself from them. The answers come from a number of professional woodcraftsmen who were happy to share the techniques they use to get their jobs back on the track again.



1 Embedded Screw

When you back out a screw, its head breaks off.

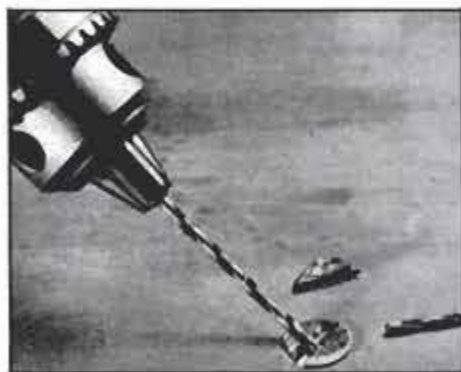


Grab the screw with square or needlenose pliers and twist it out counterclockwise.

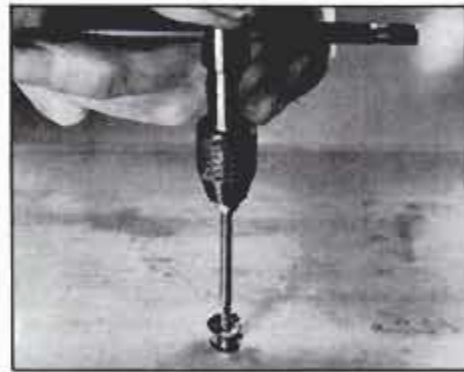
With a $\frac{1}{8}$ -in. bit, bore holes straight down all around the screw shaft. In softwood, puncture with a thin finishing nail. A little digging may be needed to get needlenose or locking pliers around the top of the shaft. Twist and pull.

If you can't mar the wood, drill a hole in the center of the shank, about one-third the shank's diameter. Pick a screw extractor to fit the hole; set extractor head in a socket or tap wrench; insert head and turn wrench counterclockwise. Reverse threads on the extractor bite into the inside of the screw shaft, forcing it to turn. This also works on a shorn bolt in an engine head.

If surface damage is no problem, bore a circle of holes around the shank of the screw.



To avoid damaging the surface around an embedded screw, drill a hole in the shank. Start at an angle if the surface is uneven.



Into the screw-shank hole, insert a screw extractor set in a tap wrench. Twist out counterclockwise. Sets are available for about \$14 from the Brookstone Co., Vose Farm Rd., Peterborough, N.H. 03458.



2 Miscut Miter

After you cut two members of a wood frame to size, you discover that the miter joint doesn't match.

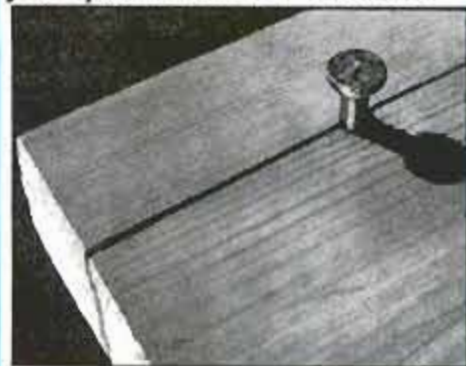
If you have plenty of frame stock, simply cut another length. If not, carefully measure the width and angle of the joint undercut area. From any leftover scraps, cut a slightly oversize section to fit the gap. Glue the piece to the undercut member. When the glue sets, file or sand away excess wood.

This may sound easy, but it isn't,

according to master woodcraftsman John Harra, the president of John Harra Wood Supply Co., New York. "Cutting that tight an angle takes a lot more skill than most people have. It would probably be easier to use plumber's epoxy and mold the stuff into the joint," he suggests. This is meant for wood frames that you plan to paint.

3 End Splits

When you drive in a nail, you split the end of a board.



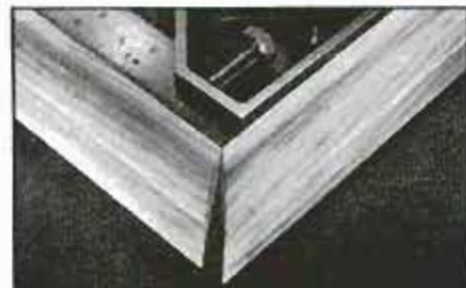
Apply carpenter's glue to the area of the split; work it in with a thin metal strip.



Extract nail; wipe away glue squeeze-out. After glue dries, bore pilot hole for the nail.

Force a thin line of carpenter's glue in the crack; remove the nail. Wood tends to return to its original form, so it will press sides of the crack together. When glue sets, bore a hole slightly less than the diameter of the nail and renail through this hole.

Predrill holes for all fastening near the edge of a wood member.



Position the frame members perpendicular with a square. Then carefully measure the gap size. From same framing stock, cut a piece slightly oversize to fill the gap.

4 Stuck Drawers

Humidity swells drawers, forcing them to stick.



Locate a retail outlet that sells desiccants (chemical drying agents) such as silica gel or calcium chloride. Well-stocked hardware stores often carry them.

If you can't find any, write to Lionel Industries Inc., 2035 Burlington Rd., Akron, Ohio 44313. This company makes a desiccant called Hum-dry in 12-ounce packages for about \$2.

Now, buy a plastic trash bag large enough to enclose the chest, or make your own sealed cover with a polyethylene dropcloth and tape. Put the pack of humidity-absorbing chemical in a saucer on the chest or follow instructions on label. Cover everything with the plastic and seal tightly with tape. Wait about 48 hours. Unseal the bag. The chemicals should have absorbed enough moisture—the culprit that makes drawers stick—to loosen them.

If this doesn't work, examine each one of the drawers. You will probably find scuffed marks in the areas where the drawers started binding before they finally became stuck. Use a piece of 220-grit abrasive to sand these scuffed areas. Sand scuffed areas in the cabinet also.

Once the drawers slide out as they did in the drier weather, put a coat of sealer over the drawer interiors. Clear, glossy polyurethane varnish is a good choice.



After gluing piece to the shortest member, sand for the fine adjustments, using a medium-, then a fine-grit abrasive paper.

5 Lost Nailhead

A nailhead breaks or becomes mangled as you pull it out.



There are several solutions. You can set the shank below the surface with a nailset and fill the hole with wood putty. If the nail must be removed, start driving the shaft down with a nailset, then force it through the other side of the wood member with a nail of the same diameter, the tip of which you've clipped off with a hacksaw. Then pull out the shank from the other side.

If the shank juts above the surface, grip it with locking pliers and rock the pliers back on the outer curve of the jaws. This produces the same action as a hammer's claw.

If you do a lot of remodeling work and run into this problem often, you might want to get a tool that's specifically designed to yank out headless nails. The Brookstone Co. makes one—it's called a "nail outener"—for under \$16. Its action is similar to that of locking pliers.



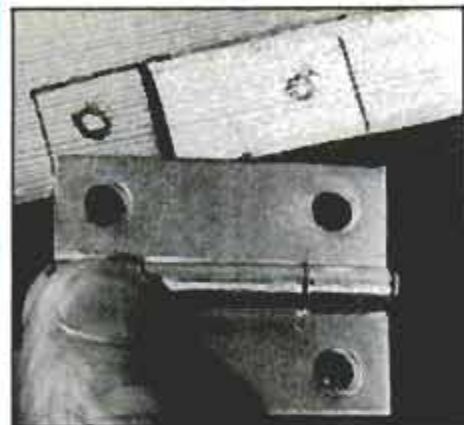
Straighten the protruding shank and set it well below the surface with a nailset. Fill hole with wood putty and sand smooth.



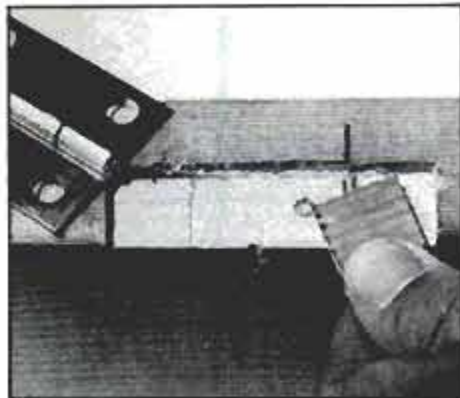
If nail must be removed, cut tip off nail of same size or file tip flat. Then use nail like a nailset to drive embedded nail through far enough on other side to pull it out.

6 Miscut Mortise

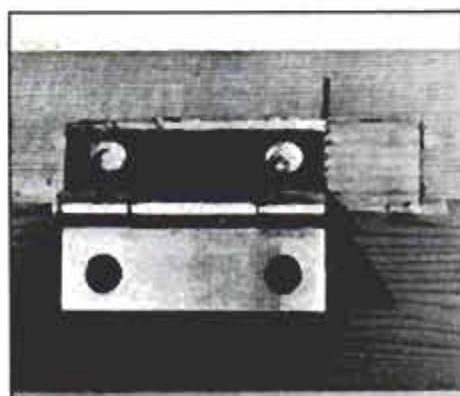
You mistakenly chisel a hinge mortise in the wrong place.



Start by marking the correct measurement for the hinge. Score the marked lines and mortise the piece with a sharp chisel. Position the hinge and install the leaf. Then measure the portion of the mortise to be filled. Cut the wood patch (called a Dutchman in the trades) of the same type of wood as the door, if possible. Check it for fit. Apply carpenter's glue sparingly to both surfaces and install the Dutchman. If the wood is pine, secure it with $\frac{5}{8}$ -in. brads set below the surface. If it's hardwood, prebore lead holes so you don't split the patch. Wipe off all glue squeeze-out. After the glue dries, fill the joints, set nails with filler and sand smooth.



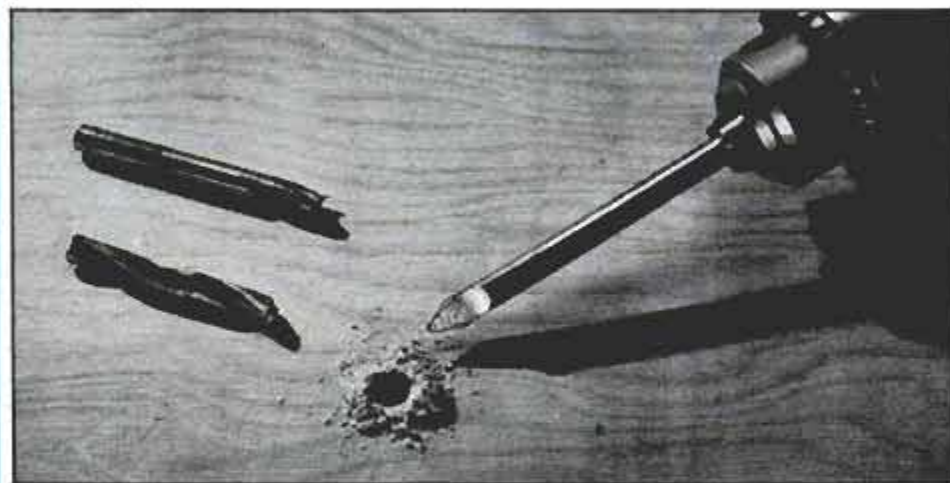
Extend mortise to receive the hinge in the corrected position. Cut a Dutchman to fill the excess portion of the mortise.



Check the Dutchman for proper fit; then hold it in position with carpenter's glue.

7 Broken Drill Bit

In the middle of a drilling job, your only drill bit breaks.



The first thing to do is to file away the burrs on the protruding tip of whatever is left of the broken bit. Then, you can reChuck this piece and continue the drilling procedure, if possible.

If this doesn't work, there's another solution to the problem. File a

spade tip on a nail of the same diameter as the broken bit. Then, cut off the nailhead, insert the revised bit (the nail) in your drill chuck, tighten securely and resume the drilling. "You may burn the wood a little, but you'll get the hole drilled," says Harra.

8 Cracked Handle

While working with your hammer, the handle breaks.



Wrap the handle tightly with electrical tape. This is not intended to be a permanent solution to your dilemma; it's only a temporary measure to keep you going until you can purchase a new handle.

Henry Lanz of Garrett Wade Tools in New York recommends that you saturate the split or broken portion of the handle with an epoxy glue mixed with sawdust. "Of course, that's going to take 24 hours to dry," he says.

For those of you who are a little more ambitious, Lanz also suggests that you whittle a new handle from scrap hardwood in your shop or from a larger handle that's intended for a bigger tool.



Wrap the handle with electrical or other strong tape and proceed with caution. Replace the handle as soon as possible.



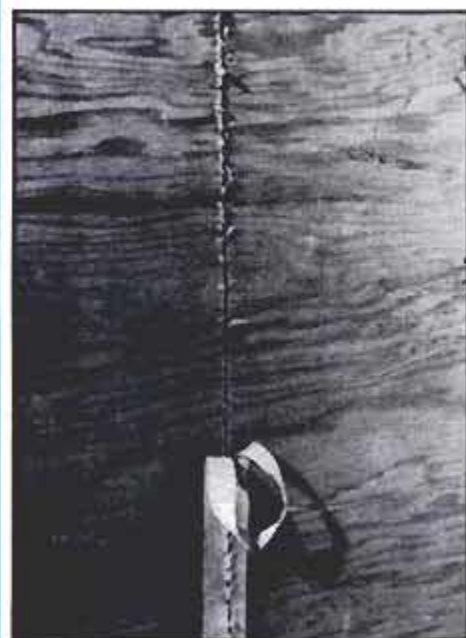
An ax, or other oversize handle, may be chiseled down to fit hammerhead. This unbalanced arrangement is cumbersome, but can be used on a temporary basis.

9 Splintered Cuts

In sawing plywood, how do you avoid splintered wood particles on the underside?



Using a backup board is the usual way to minimize splintered edges. But for this to work, the boards must be clamped together tightly. Since clamps are often unavailable at the job site, you can make do with masking tape. Press the tape securely to the plywood on the back side of the cut. The cut won't be absolutely clean, but it will be better than without tape.



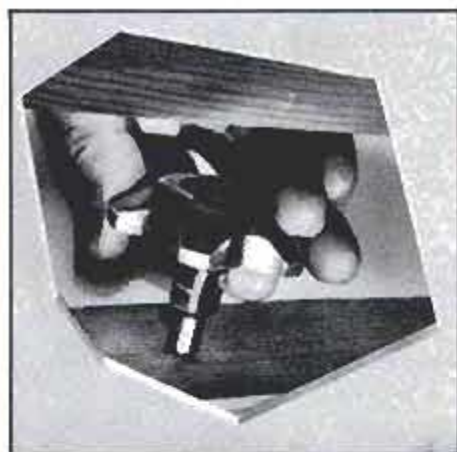
Tape peeled away reveals cleaner, less splintered cut made with this technique.

10 Limited Space

You want to tighten a nut in close quarters, but even a right-angle wrench won't fit in the space.



This is a tough one. If the job doesn't require that the nut be tightened to the maximum, chances are you can reach in and push the nut finger-tight. But, if it must be absolutely secure, you can try holding it with an adjustable-grip or needle-nose pliers while you turn the machine screw or bolt with the



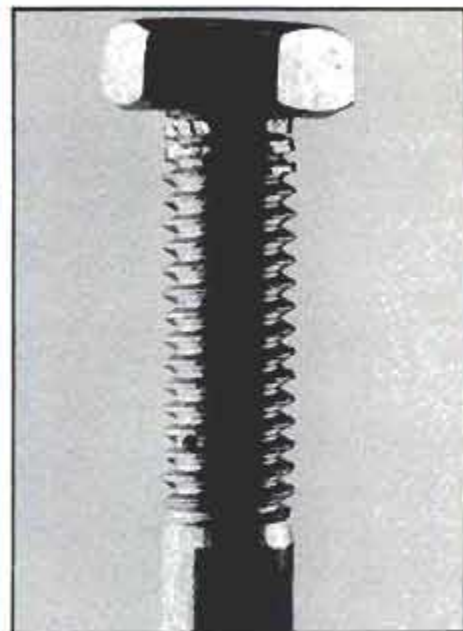
This cutaway view shows a spot where you would have a hard time using a long, standard wrench or longer socket handle.

appropriate tool. To keep the plier jaws from slipping off the nut, wrap a turn or two of masking or friction tape over the serrated jaw surfaces.

For those jobs where this stunt won't work, you should consider adding a specialty tool (that Brookstone offers) to your toolbox. Called Star-wheel Ratchet Drive, the tool is only 1 1/16 in. high. With this tool, you can tighten a nut with your hand on the wheel at all times; the ratchet allows you to turn the handle without removing your hand from the tool. Brookstone sells it for approximately \$14.

11 Crushed Threads

Nut won't thread or back off because threads are crushed.



A hand-operated thread restorer from Brookstone (around \$33), does the job. It slips over the bolt at a point where good threads remain. Claws are tightened until the cutting edge is inside a groove. You rotate the tool over the damaged part and the cutter restores the threads to let the nut pass.

Where enough threads are exposed, a standard thread-cutting die of the correct size may also be used. **FM**



Use a thread restorer for this job. With one of these handy tools in your toolbox, you'll be able to make quick repairs. It's about \$33. Order it from the Brookstone Co., or write firm about availability in your area.

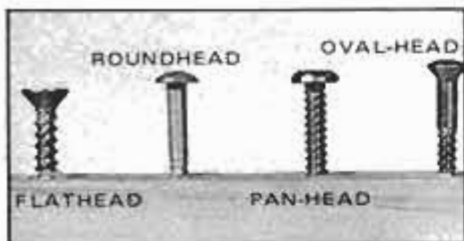
WHAT'S YOUR PROBLEM?

As you can see, many woodworking snafus are correctable. If you have an especially tough problem, write to the Home and Shop Editor, *Popular Mechanics*. While we can't answer such letters individually, if enough readers tell us their everyday, nitty-gritty problems, we'll do another article on ways to solve them.

WORKSHOP MINICOURSE

MORE ABOUT DRILLING HOLES

It's safe to say that the portable electric drill is the most used power tool in the home. Yet, despite its popularity, and ownership by millions of do-it-yourselfers with varying degrees of handyman skills, my personal experience has shown me that the majority of users are not aware of the great variety of good and useful accessories that you can buy for this tool.



These are the four types of screws that you'll work with more than 90 percent of the time. From left, flathead requires a countersunk (or counterbored) hole; roundhead is generally used where the screw will be visible; pan-head comes on sheet-metal screws (these are used most by author); oval-head also requires a countersunk hole, so head is partially buried.

Make no mistake about one point; I am *not* a fan of tools or devices that purport to enable one tool to do another's task equally well. For example, because of the great difference in speed between router (approximately 30,000 rpm) and typical drill (maximum speed 2,200 rpm), I would neither attempt, nor recommend that others attempt, to make a drill do the work that a router

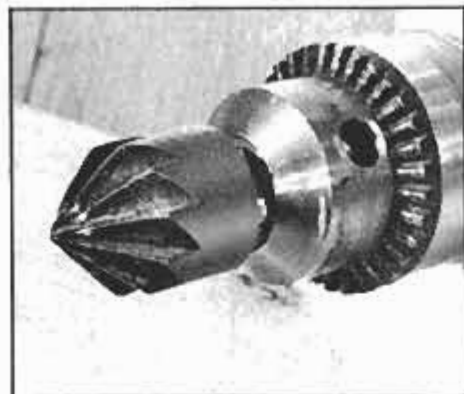
should. A router bit has no business in a drill's chuck, in my opinion.

But, there are many great accessories that make the portable drill one of the most versatile tools.

When most of us pick up a drill, it is generally to bore a pilot hole for either a screw or a nail. But, often, the task doesn't end there.

The four most commonly used screws, shown in the photo at left, make it clear that two of the four—the flathead and the oval-head—require some additional drilling in order to drive the screws properly. The rosette countersink lets you handle this task expertly.

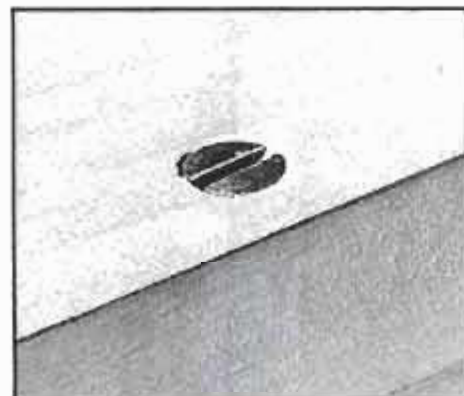
Be aware that as screw size increases, so does the diameter of the screw's head. Thus, if you are tooling up a workshop, you are well advised to buy several different-size countersinks. Keep in mind that the countersink is not intended to bore gaping holes; rather, it should be used simply to enlarge the pilot hole by flaring it out.



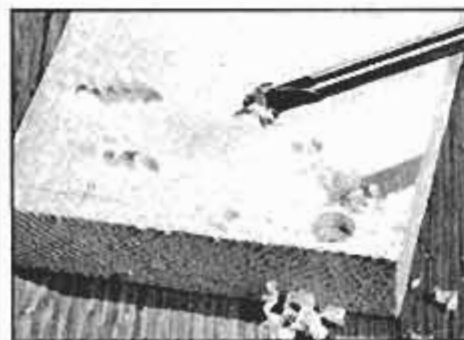
Rosette countersink comes in several diameters. At the least, you should have the $\frac{3}{8}$ - and $\frac{1}{2}$ -in. sizes in your drill box.



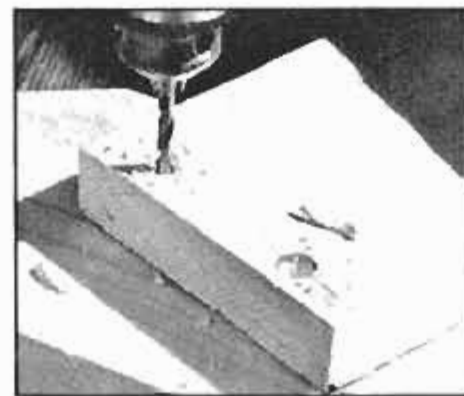
Countersink is centered in pilot hole and drill is turned on. Depending upon pressure, you can vary hole's top diameter. Increase size if screwhead is to be deep.



Here screwhead sits slightly below the wood surface to allow for finish sanding.



If a counterbore is to be used (i.e., screw will be concealed by a following dowel or dowel plug), this hole *must* be bored first, using a spur or brad point bit. The author's favorite bit for this is Stanley's Power Bore bit, because holes are perfectly round.



If you forget—and bore the pilot hole first—it will be impossible to achieve a perfectly round counterbore hole because you will have lost the hole's center.

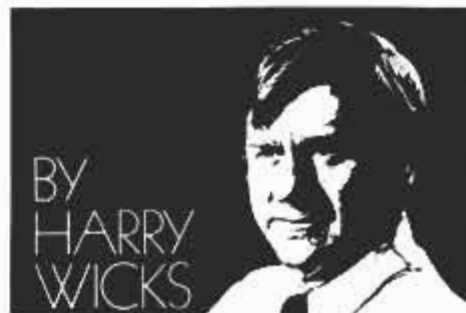
Versatile bits

There are bits available that bore pilot body holes, as well as countersink or counterbore in one operation. Several manufacturers (including Sears) even offer adjustable versions so that one bit can be used for several different-size screws.

When a flathead screw is to be set deep and concealed with either dowel plug or button, the countersink is bored within the counterbore to ensure that the screw seats properly in its hole.

Make certain when counterboring that you bore the last hole, the counterbore, first. The bit's spur point will give you center for the following pilot and body holes.

Finally, remember that if you want two boards to close tightly, you *must* first bore the correct size pilot and body holes. *Do not* use one bit for both holes.





Popular
Mechanics

1982

CAR CARE GUIDE

Troubleshoot like a pro: Diagnostic sections in PM's 10th annual Car Care Guide show you how to find the causes of your car problems.

PLUS: SET UP A "PRO'S" GARAGE: DESIGN AND EQUIP YOUR OWN DREAM GARAGE SO YOU CAN DO ANY JOB.

PM photo: George Ancona

Not available in California.

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Shows with optional equipment.



OH
WHAT
A
FEELING!

TOYOTA

THE 1982 TOYOTA DIESEL TRUCK

YOU ONLY KNOW IT'S A DIESEL AT THE PUMP.

The Toyota Diesel Truck. It won't remind you it's a diesel when you start it on cold mornings. The dependable Toyota Diesel has two heavy duty batteries for extra cranking power! No other small diesel truck does.

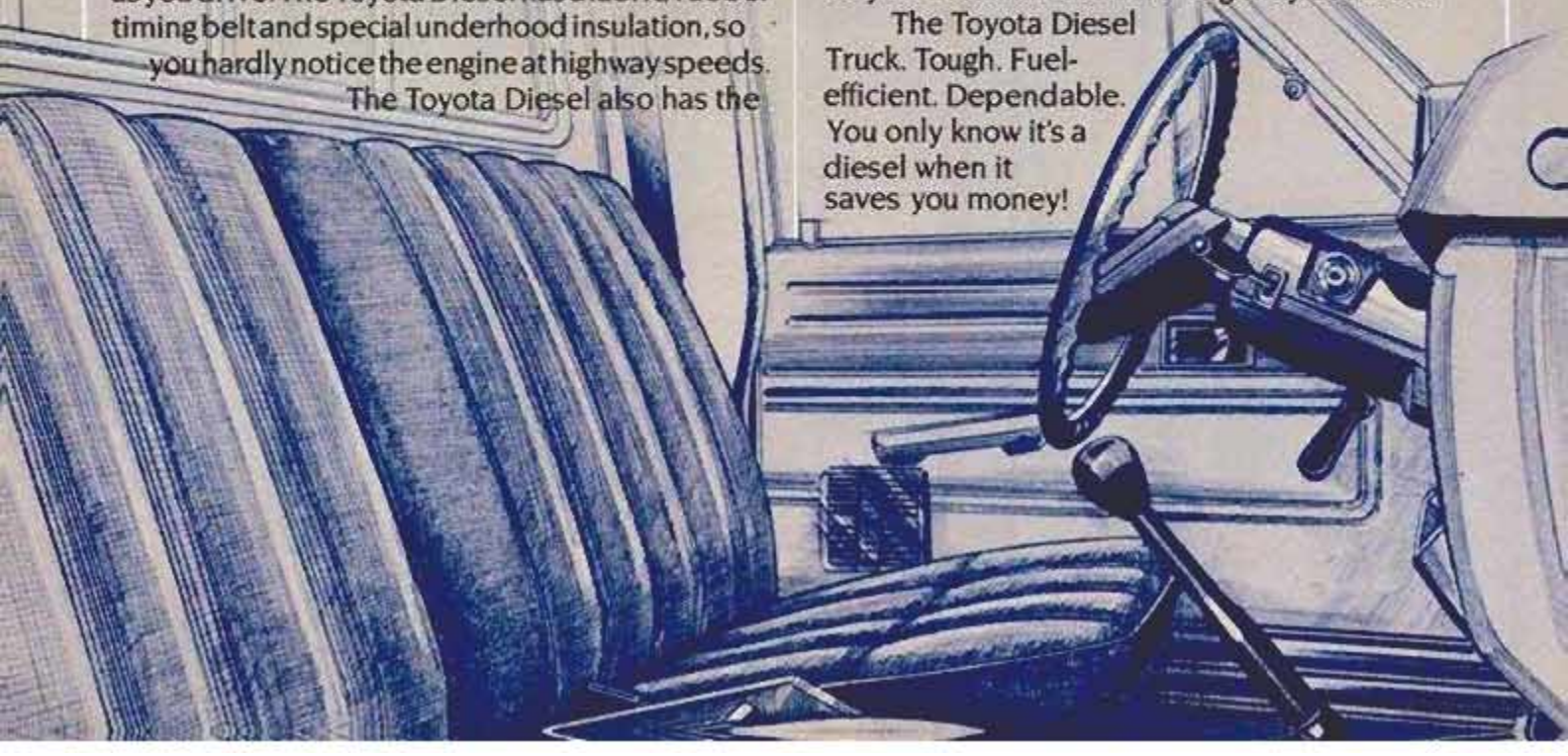
And you won't know it's a diesel by listening as you drive. The Toyota Diesel has a fabric/rubber timing belt and special underhood insulation, so you hardly notice the engine at highway speeds.

The Toyota Diesel also has the

features you want as standard equipment. Like a 5-speed overdrive transmission. A 7-foot cargo bed, not 6-foot like some. And a separate, rugged frame (like an 18-wheeler has) so Toyota's Diesel Truck carries a full 1100 pound payload.

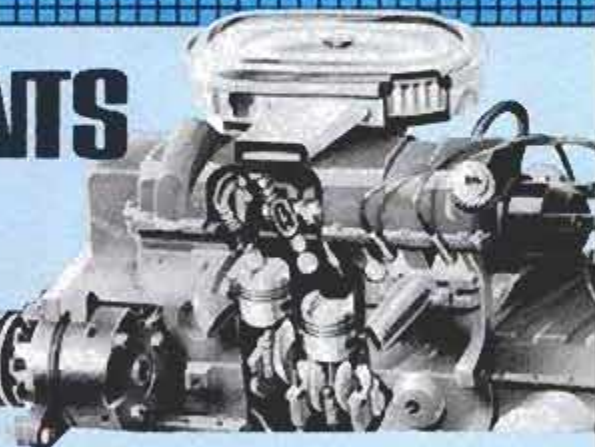
The Toyota Diesel Truck. It's rated at 38 EPA Estimated Highway MPG. (31) EPA Estimated MPG. Remember: use this estimate for comparisons of other small trucks with manual transmissions. Your mileage may be different depending on speed, trip length and weather conditions. Actual highway mileage will probably be less than the EPA "Highway Estimate."

The Toyota Diesel Truck. Tough. Fuel-efficient. Dependable. You only know it's a diesel when it saves you money!



1982 CAR CARE GUIDE

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Cover: 1982 Pontiac Firebird in PM's Dream Garage.

HOW TO DESIGN AND EQUIP YOUR OWN DREAM GARAGE

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"Why Won't My Engine Start?"

SECTION 2. ROUGH IDLE
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SECTION 4. LACK OF POWER
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SECTION 6. PING AND KNOCK
"Why Does My Engine Sound
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SECTION 7. ENGINE DIESELING
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SECTION 8. ENGINE HESITATION
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SECTION 13. LOSS OF BRAKES
"Why Am I Losing Braking
Power?"

SECTION 14. DIESEL NO-START
"Why Won't My Diesel
Engine Start?"

OIL LEAKS?

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have solved this problem
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Wynn's Engine Stop-Leak
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PM photo: George Ancona

It isn't easy or cheap, but once you've put this garage together, you'll never need to visit a mechanic again.

HOW TO ***Design And Equip***

What does your mechanic have that you don't? What is it that makes him able to tackle a job you might be reluctant to do yourself? Other than the accumulated experience of working on cars every day of the week and professional training, his big advantages over the weekend mechanic are tools and a place to work.

You can compensate for his

advantage in training and experience because you probably only have one or two cars to learn about. You can get to know your car better than any mechanic possibly could, simply because you live with it and have the time to read the shop manuals in depth.

The other advantages—tools and a place to work—aren't as easily overcome. If you live on the 40th



The envy of any NASCAR pit crew, PM's ultimate garage can handle anything, from a flat tire to an engine swap. Insulation and a kerosene heater allow year-round use.

Your Own Dream Garage

floor of a high-rise and can't afford to rent, or even find, a two-car garage, you're pretty much out of luck. But, if you *do* have a garage, your battle is 80 percent won. Here's how we did it.

We started with the shell of a garage. The stone concrete walls were bare, the wooden, pyramid-shaped roof was uninsulated, and the floor had 20 years' worth of dirt

and grime compacted by a thick coating of oil drips and grease spills. The only available light was from a 60-watt bulb that barely cast a shadow on its best day.

The first thing to go in was the roof insulation. We used a six-inch layer of fiberglass with an R19 value. That took less than half a day to install and cost \$151, including the staples for the staple gun. With

heat from a 12,000-BTU Kero-Sun kerosene heater, the garage managed to stay comfortable, even when the outside temperature dropped below freezing with a wind-chill factor of well below zero. It wasn't exactly toasty warm, but at least your hands didn't stick-freeze to the tools.

If you've got a low, flat roof on

[\(Please turn to page 130\)](#)

If you think STP is think again.

STP was born on the racetracks of America. STP—The Racers' Edge®—throughout the world. And from that discipline... where performance is all that counts...

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That's where STP Oil Treatment comes in. It gives your oil muscle. STP's special polymers flex with heat... strengthening the film between vital moving parts, just where it's needed. And STP adds a special anti-wear, anti-oxidant agent for better lubrication.



Introducing STP "4". Because 4-cylinder engines work harder, rev higher and can run hotter than larger engines.

STP "4" is specially formulated to reduce oil thinning and fight oil break-down in 4-cylinder engines.

Whenever you change or add oil, get STP Oil Treatment... in original or new 4-cylinder formulas. And give your oil muscle.

2. STP FILTERS. The STP Double Oil Filter is the state of the art in oil filters. Quite simply, it's a filter within a filter. Two filters to clean your oil more effectively than one. Each and every filter is individually tested to help give you high performance.

The STP Air Filter helps keep your carburetor clean by protecting it from airborne dirt and grit so you get better performance and better mileage. For high-efficiency filtration, use STP Air Filters.



only for racing cars...

3. STP PROTECTOR /BEAUTIFIER. STP Protector /Beautifier, with its exclusive "Sunscreen" formula, protects your car's vinyl, leather and rubber surfaces from fading, drying and cracking. It actually screens out the sun's harmful ultra-violet rays.

STP Protector /Beautifier helps keep your car in showroom condition.



4. STP GAS TREATMENT.

Tune-up your gas... with STP Gas Treatment...no matter what grade gasoline you're using. Used regularly, it keeps water from building up in your tank, helps clear your entire fuel line, cleans your carburetor, saves gas.... For better performance and better mileage get STP Gas Treatment.



5. AND OTHER PERFORMANCE PRODUCTS. The lineup goes on and on... Carburetor Cleaner, Diesel Fuel Treatment, PCV Valves, Breather Elements, Foaming Engine Degreaser, Motor Oil and more. All consumer-proven. All satisfaction guaranteed or your money back. If the brand name is STP, you'll get proven performance. Depend on it.

Depend on STP proven performance.





Our dream garage started out as a nightmare (inset, right). Like many garages, it was just dead storage for things that should have been junked years before. The workbench that we fabricated ourselves (above) goes together like an Erector set. It's cheap, versatile and can adapt easily to any special requirements that you have.



DESIGN YOUR OWN DREAM GARAGE *(Continued from page 127)*

your garage, the R19 and heater combination will probably allow you to work in your shorts. If you've got an 18-foot-high, peaked ceiling like ours, we'd suggest something we tried—installing a 10-inch fan on the roof to blow the hot air that's trapped up there toward the floor.

The next step was to install 2×3 cleats and wiring. The cleats were no problem, going in with a hammer and concrete nails. The wiring took a certain amount of planning. We knew exactly what power tools we wanted and how much current they would draw. We also had to figure

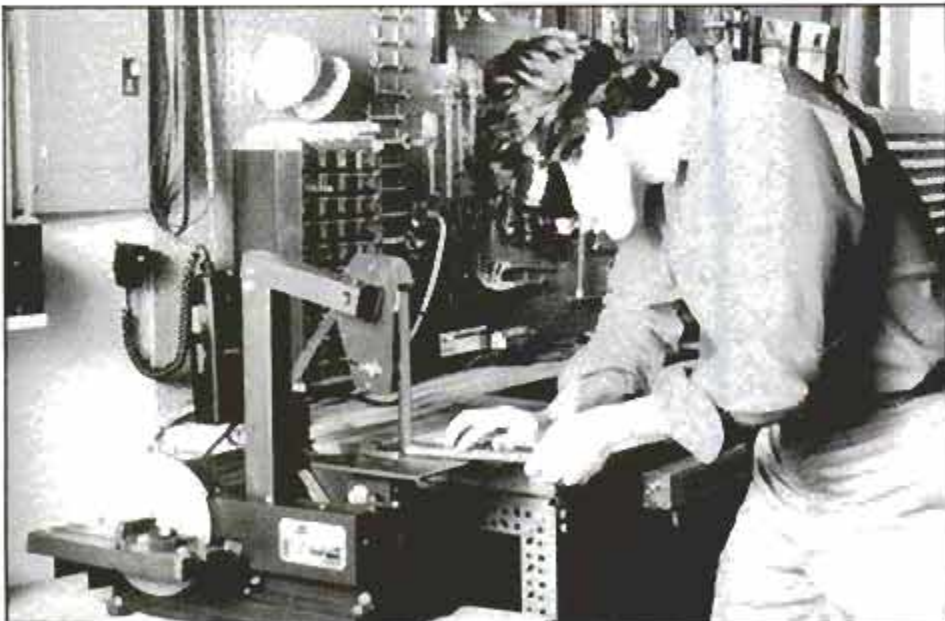
out ahead of time how big the tools were and where we wanted them.

The major pieces of equipment we wanted were an air compressor, drill press, arc welder, bench grinder and a sander/grinder.

Since all these tools would be coming right out of the Sears catalog, it was just a matter of looking up the dimensions and current requirements, and figuring out on paper the most space-efficient way of placing the tools in the 20 by 20-foot garage space we had.

Once we knew where the tools would go and where we wanted to run the 220-volt and 110-volt lines, we were then able to install the BX cable and terminal boxes. At the same time, we ran the lines for the fluorescent lights. We were determined to make this garage as bright as possible and went to a little overkill. We used three 8-foot sections of fluorescents, plus a small 4-foot section mounted over the workbench. With all that light, we now don't even need a trouble light, no matter how deep we go into a car's innards.

After the cleats, cable and terminal boxes were installed, we put in a 1-inch layer



The sander/grinder sits on an extension built onto the end of the workbench. It's an invaluable device for deburring metal.



Hard to believe it's the same garage. Here's one corner before (inset, left)—and after (above). Before buying the tools, you can have an insulated, well-lighted and heated garage for about \$500. The fire extinguisher (on the wall) is a necessity. We've got three handy for any emergency. This one is located near the arc welder.

of Styrofoam insulation between the cleats. This insulation is rated at R4 and does a creditable job of keeping the chill from penetrating the stone wall.

We spent \$45 for the Styrofoam insulation, \$60 for the BX 12-gauge cable and terminal boxes and \$120 for the light fixtures. Local ordinances may vary, so check your utility company before hooking up the wiring. In New York we had to have the job inspected by a certified electrician before the utility company installed the meter.

Once the insulation and electrical system were installed, we had to choose wall paneling. A wood-grained veneer panel would have looked good, but since this would be a no-nonsense workhorse of a garage, we wanted something durable and cheap. It had to be strong enough to handle the shelves full of parts, tools and cabinets we need to hang on the wall and take a coat of paint. Particleboard was the final choice. It was cheap (\$12 for a 4×8-ft. sheet), and has stood up exceptionally well.

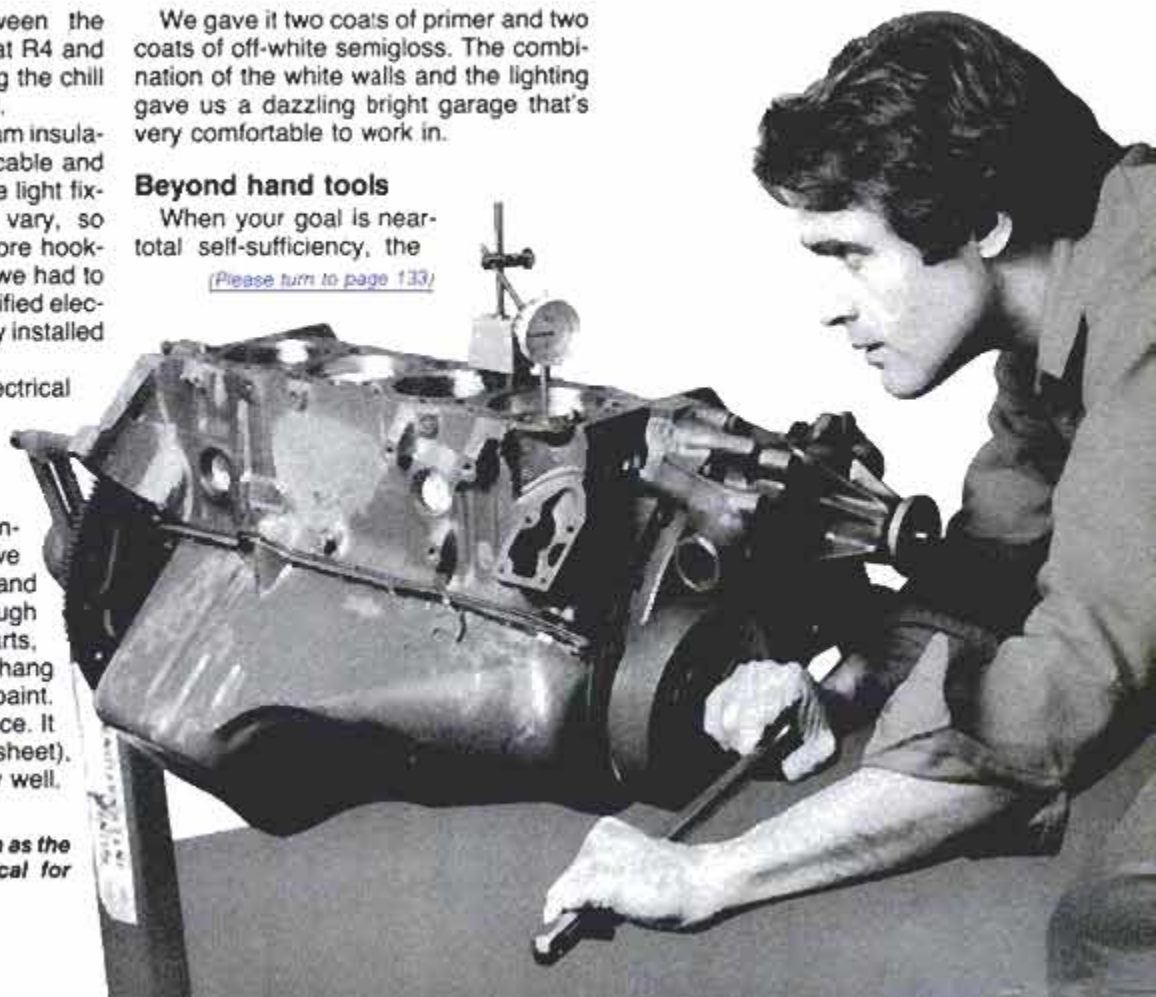
Fine measuring instruments, such as the dial indicator at right, are critical for checking minute dimensions.

We gave it two coats of primer and two coats of off-white semigloss. The combination of the white walls and the lighting gave us a dazzling bright garage that's very comfortable to work in.

Beyond hand tools

When your goal is near-total self-sufficiency, the

[\(Please turn to page 133\)](#)





Simoniz SuperPoly

Guaranteed to Outbead, Outshine,
Outlast the Leading Professionally
Applied Poly Treatment.



CLEANS • SHINES • WATER RESISTANT SEAL

SIMONIZ INTRODUCES

THE STREETFIGHTERS.

Nobody has to tell you it's rough out there on the street and getting rougher.

The SIMONIZ SuperPoly line is designed for the world today's car lives in, with SuperPoly tough polymers that bond to your car's finish to give it a fighting chance against the worst the street and weather can dish out.

It's used like any car wax or poly-coating. But SuperPoly is so tough that it's guaranteed to outbead, outshine, outlast the leading

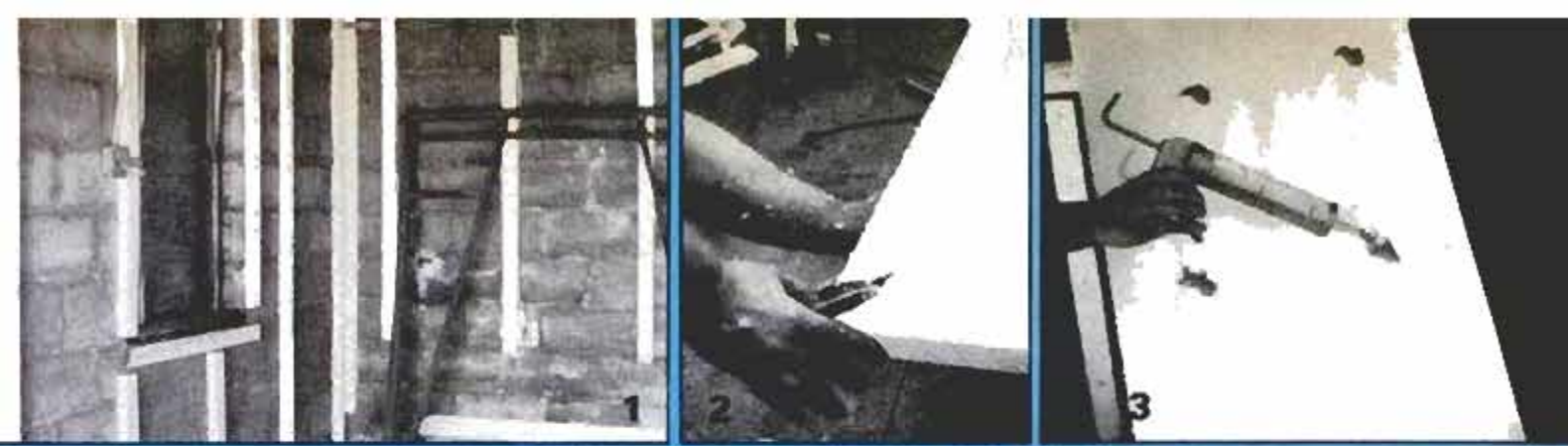
professionally applied poly-coating, or your money back from Simoniz. Street testing on new and older cars proved it to us. Long-lasting water



beading and shine will prove it to you. Other innovative car-care products in the SuperPoly line, Poly Glaze shine renewer, 10 Minute Pre-Wax Pre-Poly Cleaner and SuperPoly Car Wash, all share the same Simoniz polymer technology to fight back against the street. Give your car a fighting chance with the SuperPoly Streetfighters from Simoniz.

SIMONIZ. The Perfect Finish.

*Simoniz and SuperPoly are trademarks of Union Carbide Corporation, Danbury, CT 06817.



First three construction steps: 1. Cleats, BX cable, terminal boxes installed; 2. Insulation being trimmed; 3. Adhesive being applied to insulation.



Drill press with indexing-table accessory will let you fabricate custom pieces like vented brake rotors. Bench grinder (below left) will repair drill bits, polish and grind metal. Air compressor (below) will sandblast metal, paint a car, clean parts and drive a host of air tools.

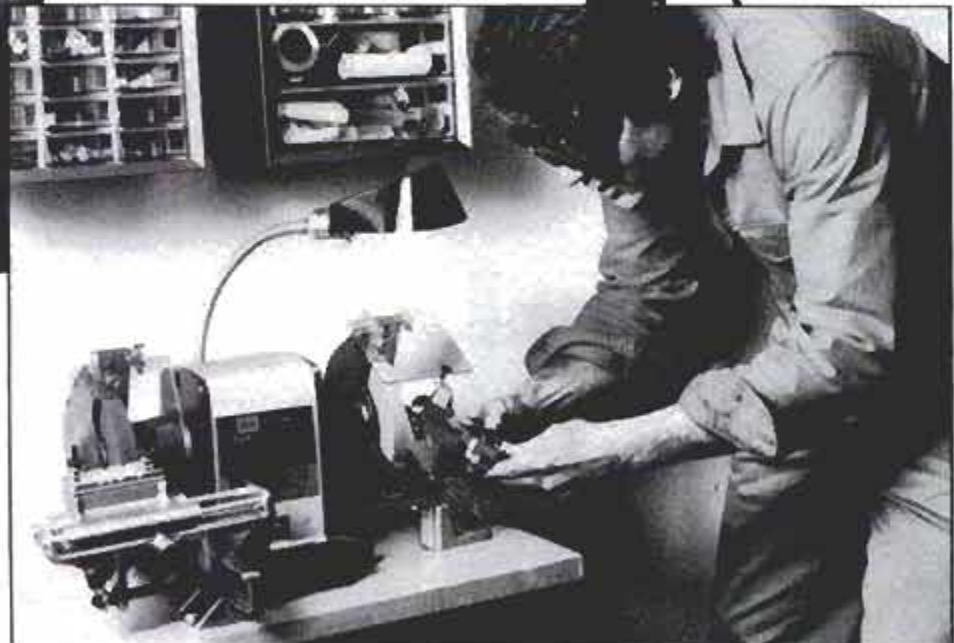
DREAM GARAGE *(Continued from page 131)*

most complete set of hand tools alone will leave you far short of your mark. You need power tools to bridge the gap. With that in mind, the first item on our list was an air compressor. We used a Sears 3-hp unit that allows us to run air tools, power a sandblaster and spray paint, as well. We also got a sandblasting kit to go with the compressor.

Next up was an arc welder, also right out of the tool catalog. It isn't a tool that you'll use every day, but it's worth its weight in Krugerands when you need to fabricate something that's otherwise unavailable or expensive. For instance, we used it to weld up a frame for a press. A two-ton hydraulic car jack bolted up inside our fabricated frame gave us a really useful hydraulic press which can drive wrist pins in a piston, bend bar stock or squeeze the shafts out of a manual transmission.

A drill press speaks for itself. With a few accessories, like a milling table, tilting

(Please turn to page 134)





The final two construction steps show: 4. Notches being cut in the paneling for electrical outlets; 5. Particleboard being installed and prepared for the two coats of primer and two coats of semigloss paint.

table and an indexing accessory, you can make virtually anything you can dream up. We've drilled brake discs, bored out valve guides and made up a custom aluminum dash panel with it.

One piece of equipment that's indispensable is a parts washer. The one in our garage came from Buck Supreme and it's made specifically for the home garage. It's big enough to hold a complete two-cylinder motorcycle engine or a cylinder head from a V8. We use mineral spirits for solvent with a 120°F. flash point. One neat safety feature of the parts washer is a fusible link in the prop rod that holds the lid open. In case of a fire, the link melts and the lid shuts over the basin.

Our other pieces of power equipment include a sander/grinder and a bench grinder. These are excellent for repairing screwdriver tips and drill bits, deburring metal, grinding small bevels and, with a buffing wheel attached, cleaning up or shining aluminum castings, chromed parts or steel pieces.

The investment for all this equipment is

sizeable. There are alternatives, however, that could save dollars. PM plans are available, for instance, for an air compressor, milling table, boring machine and a small drill press.

Diagnostic equipment

All the tools in the world won't help unless you can find the source of a problem. As this year's Car Care Guide points out, the name of the game from now on is

(Please turn to page 137)

Parts cleaner (below) is great for degreasing dirty parts. Low-cost unit is made for home garage. A sturdy tool cabinet (right), like this unit, keeps all tools handy.



If your old guzzler is on this list, you're in luck.

AMC

8 Cyl.—1968-76 304", 360" 2 bbl. engines, all transmissions. **6 Cyl.**—1970-76 252", 258" 1 bbl. engines, all transmissions.

BUICK

8 Cyl.—1970-76 350"-455" 2 & 4 bbl. engines, all transmissions. **6 Cyl.**—1968-75 250" 1 bbl. engines, all transmissions. 1978 231" 2 bbl. engines, all transmissions.

CHEVROLET

8 Cyl.—1968-76 327"-454" 2 & 4 bbl. engines, all transmissions. **6 Cyl.**—1963-74 230", 250" 1 bbl. engines, all transmissions. **4 Cyl.**—1975-77 140" 2 bbl. engines, all transmissions.

DODGE/CHRYSLER/PLYMOUTH

8 Cyl.—1970-77 318"-440" 2 & 4 bbl. engines, all transmissions. **6 Cyl.**—1969-77 170"-225" 1 & 2 bbl. engines, all transmissions. **4 Cyl.**—1979-80 1.7 litre 2 bbl. engines, all transmissions.

FORD/MERCURY

8 Cyl.—1962-77 289"-400" 2 bbl. engines, all transmissions. **6 Cyl.**—1965-77 170", 200" (Incl. 2800cc) 1 & 2 bbl. engines, all transmissions. **4 Cyl.**—1971-74 1977 2000cc, 2300cc 2 bbl. engines, all transmissions.

OLDSMOBILE

8 Cyl.—1975-77 350"-455" 2 & 4 bbl. engines, all transmissions. **6 Cyl.**—1968-78 231", 250" 1 & 2 bbl. engines, all transmissions. **4 Cyl.**—1976-77 140" 2 bbl. engines, all transmissions.

PONTIAC

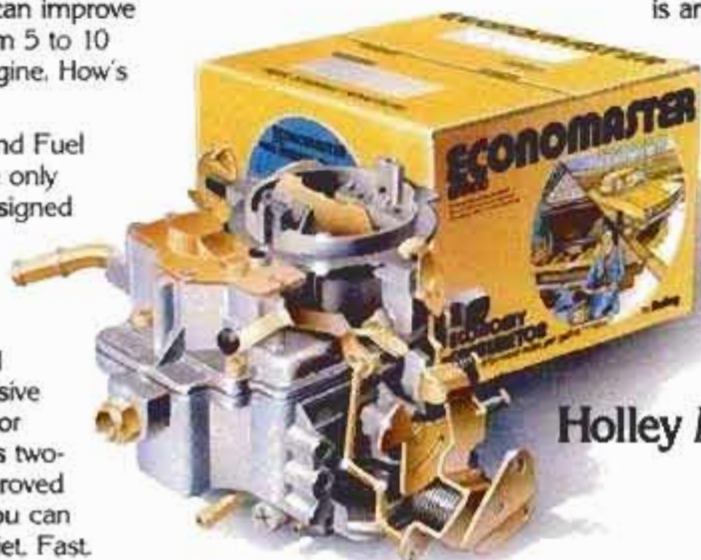
8 Cyl.—1967-78 305"-455" 2 & 4 bbl. engines, all transmissions. **6 Cyl.**—1970-78 231", 250" 1 & 2 bbl. engines, all transmissions. **4 Cyl.**—1975-77 140", 151" 2 bbl. engines, all transmissions.

TOYOTA

4 Cyl.—1975-77 1600cc 2 bbl. engines, all transmissions.

If it's there, then there's an **ECONOMASTER**[®] brand Fuel Economy carburetor that can improve your car's gas mileage from 5 to 10 percent* depending on engine. How's that for luck?

The **ECONOMASTER** brand Fuel Economy carburetor is the only replacement carburetor designed to deliver improved fuel economy. Many models have enlarged metering ports in the carburetor's idle system to improve fuel conditioning. And an exclusive vane-style booster venturi for better fuel atomization. Plus two-stage power valves for improved mid-range efficiency. So you can put that old guzzler on a diet. Fast.



If your car isn't on this list, you're still in luck. There is an **ECONOMASTER** brand Standard Replacement carburetor for your car. It can restore your car's original performance.

Holley Replacement Parts Division;
11955 East Nine Mile Road,
Warren, Michigan 48090.

*Actual economy may vary due to application, engine and driving conditions, engine modifications and driving habits.
[®]Registered Trademark

Holley Makes Fuel Efficient

Holley

Replacement Parts Division

Colt Industries





**GET UP TO \$9.50 BACK
ON MOTORCRAFT PRODUCTS, AND A CHANCE TO
WIN A NEW CAR TO USE THEM IN.**

Now get up to a total of \$9.50 in refunds on spark plugs, tune-up kits, air filters, oil filters, oil, and wire sets.

And to get even more, enter our "Win the World" Sweepstakes. Grand prize is a 1982 Ford Escort, plus a trip for two to a game of the '82 World Series, and \$5,000 cash. Or win one of our other world of prizes. A three-day, all-expense-paid trip for two to the 1982 World's Fair in Knoxville — plus \$2,000 cash. There's luxury handcrafted

luggage. Sport action binoculars. Digital travel clocks.

Refund and sweepstakes offer good through May 31, 1982. Details available from your participating Motorcraft retailer. No purchase is necessary to enter the sweepstakes.

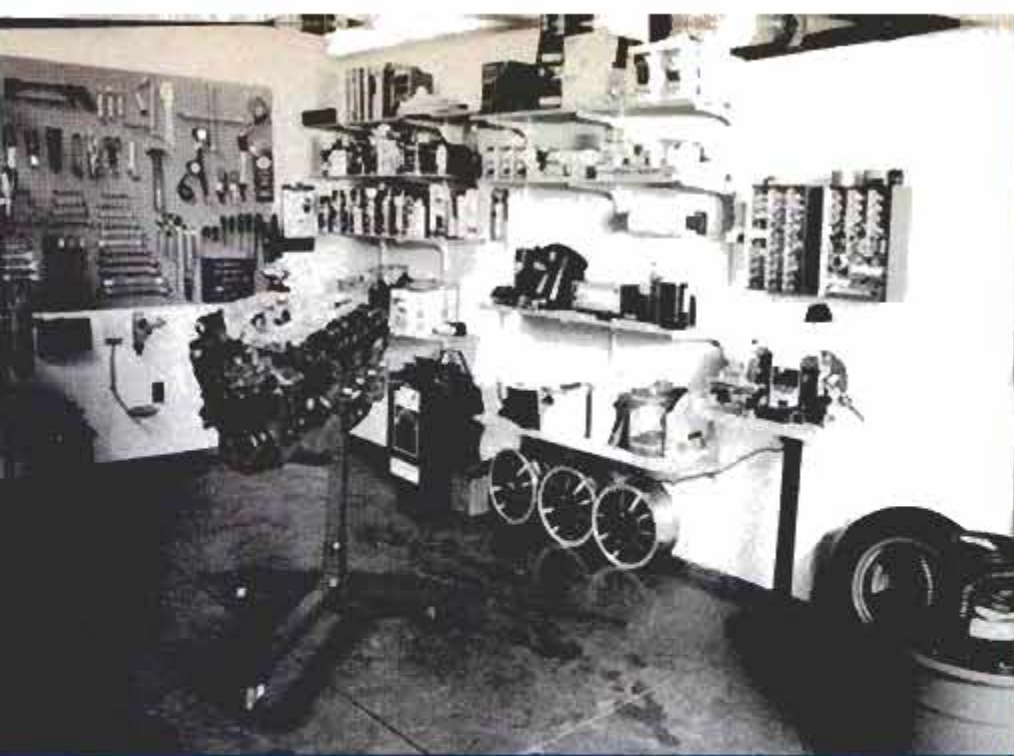


To obtain an official sweepstakes entry form, send a self-addressed stamped envelope with your request to: Win the World Sweepstakes, P.O. Box 10061, Maple Plain, MN 55341. See official rules on entry form for details on sweepstakes.

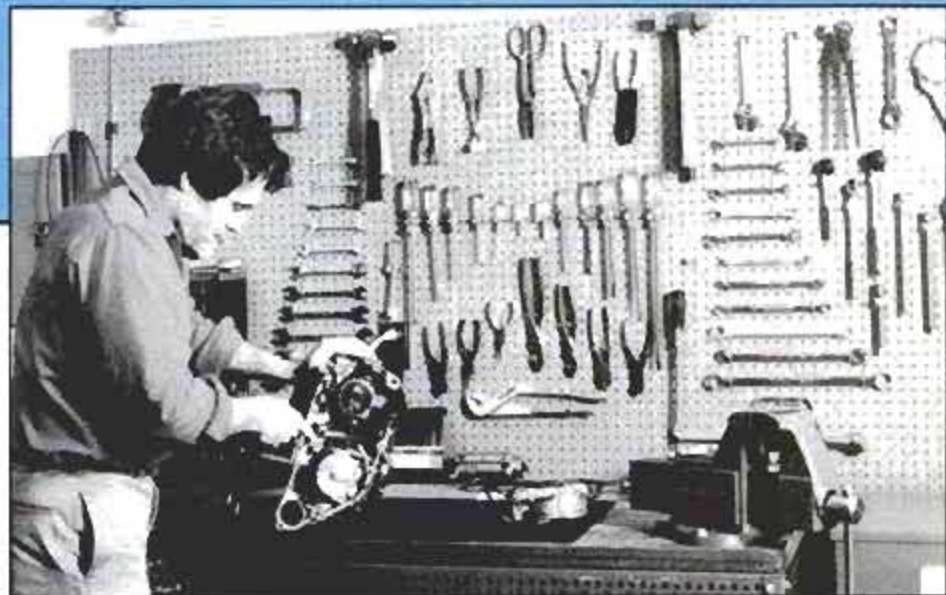
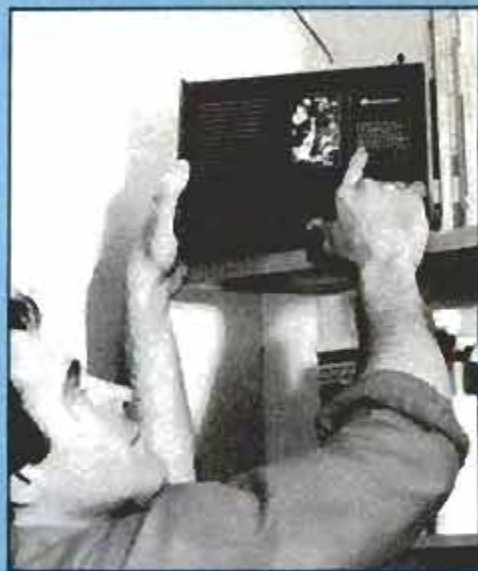
Sweepstakes is void in Wisconsin and where prohibited by law. You must be 18 years of age or older to enter. Entries must be received by midnight, May 31, 1982.

...FOR SURE!

MOTORCRAFT



The venerable perforated board (above) is still the best way to keep your tools visible and within reach. The Radio Shack ultrasonic alarm (above right) is mounted high in the garage and covers the entire area. A substantial vise with swivel base (right) is a must for any kind of work.



DREAM GARAGE

(Continued from page 134)

diagnostics. Briefly, these are the diagnostic tools that we're stocking in our garage.

From Dixon Inc. we've got digital volt/ohm and tach/dwell meters. These are compact, handheld units that are great for a quick spot check. For more elaborate diagnostics, we've got a Sun Electric diagnostic kit that includes a timing light, compression tester and electronic box that lets you check everything from simple timing to more elaborate electronics troubleshooting. The whole kit comes in a sturdy plastic suitcase.

The other pieces of test equipment we've stocked are the more common vacuum gauges, vacuum pump, fuel-pump pressure tester, cooling-system analyzer, dial indicator, vernier calipers and a few special tools that will apply only to some cars.

For instance, there will soon be introduced on the market a handheld tester specifically made to check out all the electronics of the GM 3C computer. If you don't have a 3C on your car, obviously you won't need it, but the same type of specialized equipment exists for other makes of cars. See the list for addresses the end of this article.

Security systems

Whether or not you have as many tools as we do, your shop could be a target for thieves. We went a little overboard on this because we've stocked ours so well.

The first line of defense is a pager from Micronics. This is an automobile unit powered from a 12-volt transformer plugged into the wall. It's merely a tiny microphone screwed into the garage door (from the inside) which detects the noises of someone tampering with the lock. If it hears something, it transmits a signal through a four-watt transmitter which sets off a beeper you carry with you. Depending on terrain, the transmitter's range is one to three miles.

Our second line of defense is another car alarm, a motion detector, which is activated by the garage door being opened. This is also run by a 12-volt transformer and activates a 125-decibel siren.

The third line of defense is a Radio Shack ultrasonic alarm which senses motion in the garage itself. We set it up to detect motion in the area starting at one foot inside the garage door. This detector activates a siren plus two KC HiLites, which are off-road driving lights. They produce 385,000 candlepower each. We

SUPPLIERS—DREAM GARAGE

- Air compressor, drill press, arc welder, bench grinder, sander/grinder, hand tools, tool cabinet — Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60607.
- Parts washer — Buck Supreme Inc., 4561 West Dixman Rd., Battle Creek, Mich. 49015.
- Burglar alarms — Radio Shack, 1600 Tandy Center, Fort Worth, Tex. 76102; Micronics International Inc., 3356 East La Palma Ave., Anaheim, Calif. 92806.
- Air tools, power tools — Black & Decker, 701 East Joppa Rd., Towson, Md. 21204.
- High-intensity lights — KC HiLites, Williams, Ariz. 86046.
- Torx wrenches, wire ties, nut drivers — Vaco Products, 1510 Skokie Blvd., Northbrook, Ill. 60062.
- Hand cleaner — Go-Jo Industries, Box 991, Akron, Ohio 44309.
- Hand tools — Ingersoll-Rand, Proto Tool Div., Box 717, 2600 East Nutwood Ave., Fullerton, Calif. 92631; K-D Manufacturing Co., 3575 Hempland Rd., Lancaster, Pa. 17604; Summit Tool Co., 4150 Fox St., Denver, Colo. 80216.
- Diagnostic equipment — Sun Electric Corp., 1560 Trimble Rd., San Jose, Calif. 95131; Dixon, Automotive Div., Box 1449, Grand Junction, Colo. 81501.
- Waxes, polishes, cleaners, solvents — Johnson Wax, S.C. Johnson & Son, Racine, Wis. 53403; Armorall Products, Box 19039, Irvine, Calif. 92713; Meguiar's, Box 17177, Irvine, Calif. 92713; E.I. du Pont de Nemours & Co., Wilmington, Del. 19898; Taylor Made Products, 3200 West Market St., Akron, Ohio 44313.

tested them prior to installation and we were able to pick up airplanes at night flying around 10,000 feet. On level ground they have a range of four miles. **FME**



GUNK Fast Action
Liquid Wrench® acts on carbon, corrosion. 8-oz. 1-08 **99¢**
Professional formula removes grease and oil from barbecues, floors, mowers. 16-oz. FGI **1.69**

HAVOLINE Motor Oil
All-Climate lubrication protects engines at high temperatures, prevents engine wear, carbon, rust. 10W30-Qt. **99¢**
1.50 rebate when you buy 5 qts.



WD-40 Lubricant
Penetrates instantly to free frozen metal parts, stop rust and corrosion. Will eliminate moisture to reduce electrical shorts. 9-oz. spray. 40011 **1.29**




Wynn's Stops Leaks
Special blend formula stops engine oil leaks, revitalizes rubber gaskets and seals. Dissolves deposits to free parts, reduce noise. 11-oz. 50613 **1.69**



Keep your car running at top efficiency with economical do-it-yourself products from the

Value leader in

There are over 6,000 True Value Hardware Stores in 50 states. Just look under "Hardware" in the Yellow Pages. 



14.99 high-low beam rebate from GE your final cost **12.99**

7.99 high or low beam rebate from GE your final cost **5.99**



Bright New Ideas In Headlights

Popular Halogen Plus sealed beam headlamps give more light from the same number of watts. High or low beam lights available in round or rectangular sizes. Or select high and low beam for double light option, in round or rectangular sizes.

H5006/4001/4656/4651/6014/6054.



Maintenance-Free Battery Power

Premium 60-month car battery provides fast, even starting power plus maximum cold cranking power in the roughest weather. Easy to inspect, never needs water under normal driving conditions. Available in sizes to fit most popular cars.

54.99



from the makers of Blue Guard

Spiffs Up

Bleche-Wite™ whitewall tire reconditioner and cleaner sprays on, wipes off to clean, brighten and condition tires, rubber mats. 32-oz. 555 **2.29**



bando Body Repair

Body filler repairs scratches, dents, holes. Pt. 261 **2.29**
Fiberglass resin resurfaces cracks, leaks, rusted areas in wood & metal too. Pt. 401 **3.69**



4.99 our price - 2.00 factory rebate 2.99 your final cost

Rally One Step

High performance polymer bonds to car's finish to clean, protect and shine. Choose 16-oz. liquid or 14-oz. paste. Each **4.99** less \$2 rebate. 580N/582N.



turtle wax Fast Finish

Minute Wax™ gives your car a hard shell finish that lasts and lasts without waiting or rubbing. Simply spray on and wipe off. 18-oz. T15 **3.99**



KLEENEST Quality Oils for Every Engine

2-cycle outboard oil for clean exhaust. Qt. **1.49** 8-oz. **49¢**
 2-cycle oil is BIA-certified for high-hp performance. Qt. **1.69**
 Bar & Chain oil keeps saws working smoothly. Gal. **5.49** Qt. **1.49**
 4-cycle motor oil for mowers, motor bikes, generators. Qt. **1.49**
 Chain Saw oil reduces engine wear. Qt. **1.49** 8-oz. **49¢**



LOCTITE Adhesives

Permanently bonds rear view mirror to windshield. 11067 **1.69**
 Auto Trim adhesive bonds emblems, moldings, bumper impact strips fast. 00215 **1.88**



CUSTOM Foot Pump

High pressure air pump inflates tires, rafts, boats, shocks, sports balls, more. Has long hose, two adapters, easy-read dial. 57770 **4.99**

CAR CARE



Road Atlas Full-color 80-page atlas has detailed maps of the U.S., Canada and Mexico plus helpful travel information. **2.95** value now **99¢**



Special prices good thru June 5

\$2 value FREE!
 Pat Summerall's all-time great **Sports Stars** Collection is free with any purchase at participating True Value Hardware Stores. Offer expires June 5, 1982.

CAMPBELL & HAUSFELD

Power Pal™ Compressor

Versatile new power source brings professional help to do-it-yourself jobs. Just plug in, attach accessories to caulk, paint, staple, inflate, more. MA100 ... **129.99**
 Accessory kit contains blow gun, sprayer, caulk canister and power handle. MA1000 ... **22.99**



Put Mileage Back Into Your Motor

High performance air filters and oil filters offer simple do-it-yourself savings! They are precision designed to reduce harmful contaminants that can shorten engine life. Change regularly to improve on gas mileage. In sizes to fit most American cars.



Check our low prices.



ARMOR ALL Fights Rot

Polymer formula penetrates vinyl, rubber, leather to help prevent rot. 8-oz. 11080 ... **1.88**
 All purpose cleaner removes dirt, grease. 16-oz. 30150 ... **1.49**



CHAMPION Sure Firers

Replace worn spark plugs yourself to save money, get better mileage, smooth engine. Regular plugs, each ... **1.09**
 Resistor-type, each ... **1.45**



HOLLYWOOD ACCESSORIES On Time

Electronic digital clock is crystal-quartz accurate with built-in alarm, bold easy-read display of time and date. Installs easily without wiring. 320N ... **11.98**

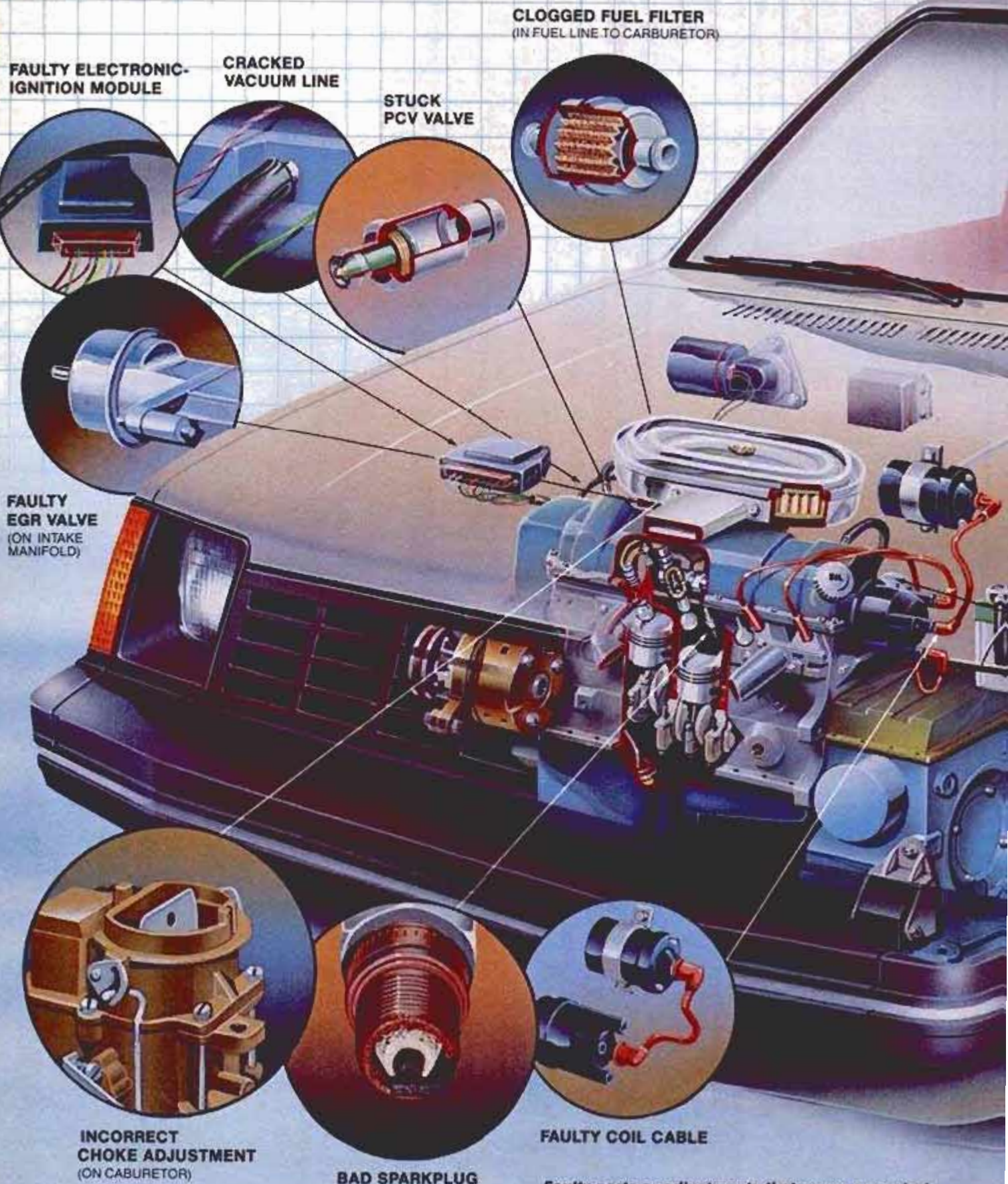


Tri-Flow Penetrates

Multipurpose 3-oz. lubricant with Teflon reduces friction & wear, shields against rust, frees frozen mechanisms. Now **1.88** less a \$1 factory rebate.

1.88 our price
 -1.00 factory rebate
 88 your final cost

WHY WON'T THIS CAR RUN?



FAULTY ELECTRONIC-IGNITION MODULE

CRACKED VACUUM LINE

STUCK PCV VALVE

CLOGGED FUEL FILTER
(IN FUEL LINE TO CARBURETOR)

FAULTY EGR VALVE
(ON INTAKE MANIFOLD)

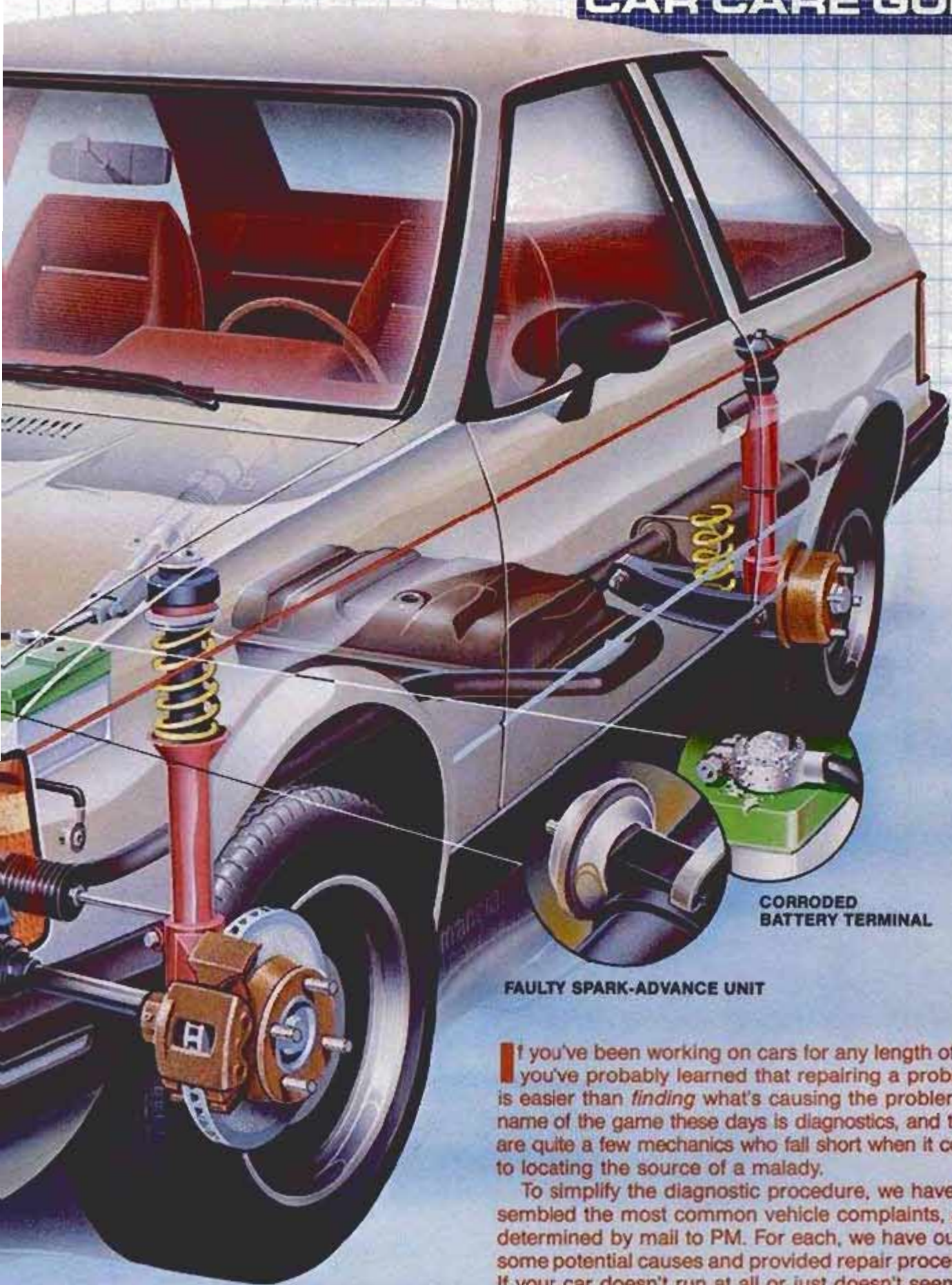
INCORRECT CHOKE ADJUSTMENT
(ON CARBURETOR)

BAD SPARKPLUG

FAULTY COIL CABLE

Faulty parts or adjustments that cause a no-start problem are detailed here. In the following sections you'll learn how to find them on your car.

CAR CARE GUIDE



CORRODED
BATTERY TERMINAL

FAULTY SPARK-ADVANCE UNIT

If you've been working on cars for any length of time, you've probably learned that repairing a problem is easier than *finding* what's causing the problem. The name of the game these days is diagnostics, and there are quite a few mechanics who fall short when it comes to locating the source of a malady.

To simplify the diagnostic procedure, we have assembled the most common vehicle complaints, as determined by mail to PM. For each, we have outlined some potential causes and provided repair procedures. If your car doesn't run at all or just doesn't seem to run properly, chances are you'll find out why in one of the sections. Section 1 begins on the next page.

Ride the Thorobreds



Dayton's Thorobred radials are bred for quality, strength, and endurance. Our full stable of smooth-riding, American-made tires can save you gas, and money. There's a Dayton dealer nearby, coast to coast. Ask him about written mileage warranties that cover you now, and down the road. Whether you're riding a smooth ribbon of highway or carving out a path of your own, ride the Thorobreds. Dayton Tire, P.O. Box 2797 Akron, Ohio 44319.

Dayton



TIRES

CAR CARE GUIDE

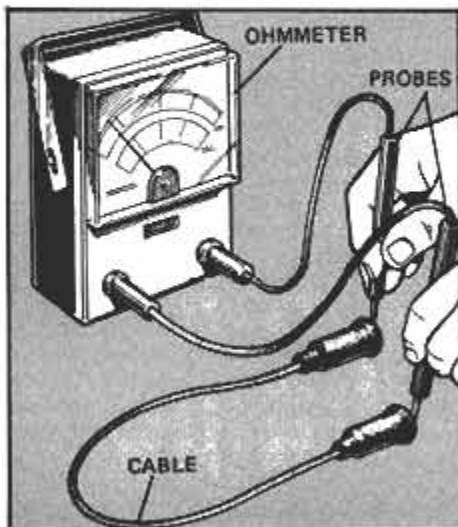
SECTION 1. HARD STARTING

"Why Won't My Engine Start?"

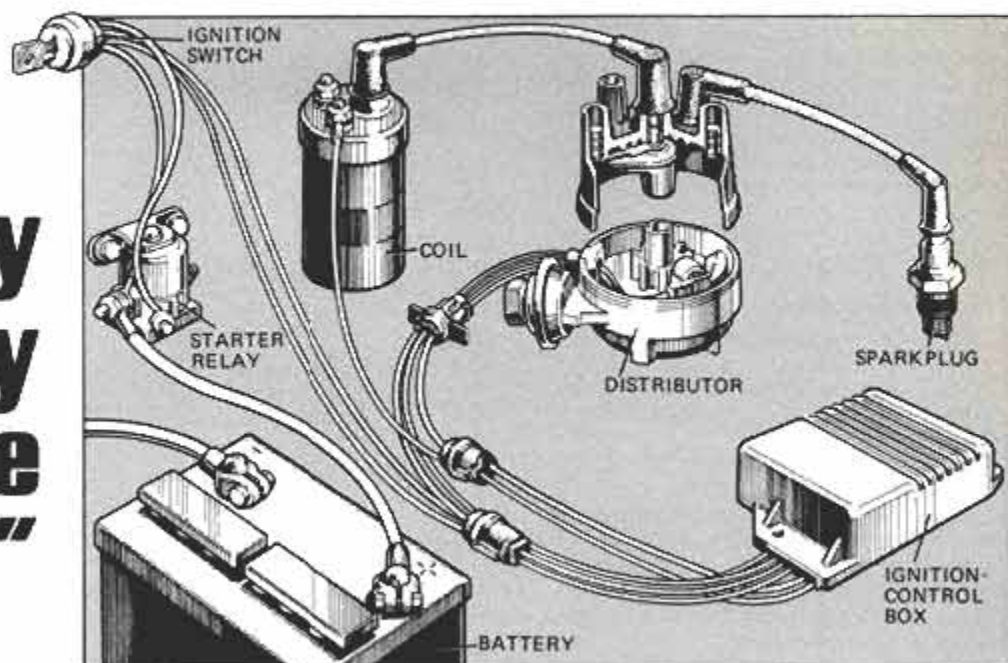
Perhaps the most frustrating automotive problem is the car that cranks, but won't start. It's also one of the more difficult conditions to diagnose because you have only one really solid piece of evidence to work with: the fact that the darn thing refuses to run. However, you may be overlooking more subtle evidence. For example, does the car crank quickly or grind laboriously when the no-start condition occurs? Does it happen only when it's cold or only when it's warm?

A multitude of malfunctions can prevent your car from starting. They include:

- Improper technique and poor maintenance.
- Defective CFI cold-start valve (K-Jetronic Fuel Injection).
- Clogged fuel filter.



Use an ohmmeter to see if resistance in sparkplug cables is within specification.



A faulty component located anywhere on this ignition circuit could result in a no-start condition in your car. Check each of these seven units, starting with the battery.

- Electronic ignition problems.
- Loose or corroded battery cables.
- Flooded engine.
- Defective or wet high-tension cable.
- Incorrect choke adjustment.

Improper technique

A mechanic who helped many stranded motorists last winter claims the main cause of cold-start problems is a combination of improper starting technique, poorly maintained engine and undercharged battery.

Many drivers ignore the maker's advice for starting a cold engine. They get away with it when the weather's okay; Warm fuel is more volatile than cold fuel. The usual technique calls for depressing the accelerator to the floor once or twice; then cranking at idle. This does vary, so check your owner's manual.

The same can be said about a poorly maintained engine. Electronic ignitions will readily fire grossly neglected sparkplugs when the combustion chamber is full of warm gasoline vapors, but may fail to fire the same plugs in a cold chamber.

If the engine is not cranking quite as fast as it could be, the problem is compounded. If you make short trips at night with the heater going full blast and shut the car off as soon as you roll in the driveway, you can expect it won't start when the mercury dips to 5° next morning.

Testing CFI cold-start valve

If your engine has a continuous fuel-injection (CFI) system, it has a cold-start valve. This valve acts like the choke on an engine with a carburetor; it enriches the fuel mixture of a cold engine to permit easier starting by injecting gasoline into the cylinders through the intake

air distributor. Such a valve is referred to as the fifth injector by those who designed the four-cylinder CFI Volkswagen engine.

A faulty cold-start valve causes starting problems under different conditions, depending on how it fails. If it won't open, gas won't be injected into the fuel stream to help a cold engine start. If the valve leaks when supposedly closed, the engine is likely to flood as it's being cranked, especially when hot.

To check the valve on 1980-82 Volkswagens with CFI, do the following:

1. With engine cold, disconnect the plug attached to the cold-start valve.

2. Remove the valve from the intake air manifold. However, leave the fuel hose connected to the valve.

3. Remove the fuel-pump relay from the fuse panel.

Caution: Be sure ignition is turned off.

4. Attach jumper with an in-line fuse (part No. US 4480/3 at VW dealers) in place of fuel-pump relay. The jumper has a toggle switch for the fuel pump.

5. Disconnect high-tension cable from ignition. Use a jumper to ground cable.

6. Wipe nozzle of cold-start valve and flip on toggle switch of jumper US 4480/3. After one minute, if fuel drips from the nozzle, the valve is leaking and should be replaced.

7. If valve is not leaking, remove jumper 4480/3 and reinstall fuel-pump relay. Reattach plug to cold-start valve; disconnect plugs from control pressure regulator and auxiliary air regulator.

8. Aim nozzle of the cold-start valve

CAR CARE GUIDE

SECTION 1. HARD STARTING

into a glass receptacle and have someone crank the engine. Spray from the nozzle should be a perfect cone in shape. An irregular stream or pinpoint jet of fuel indicates a dirty or damaged cold-start valve. Other cold-starting causes on K-jetronic systems include thermotime switch failure, jammed air-flow sensor plate or control plunger, jammed auxiliary air valve, inoperative fuel pump and faulty warm-up regulator.

Clogged fuel filter

Before a fuel filter is clogged enough to keep an engine from starting, it will usually cause partial fuel starvation, making an engine stall while you're driving. If you disregard this, a blockage can occur.

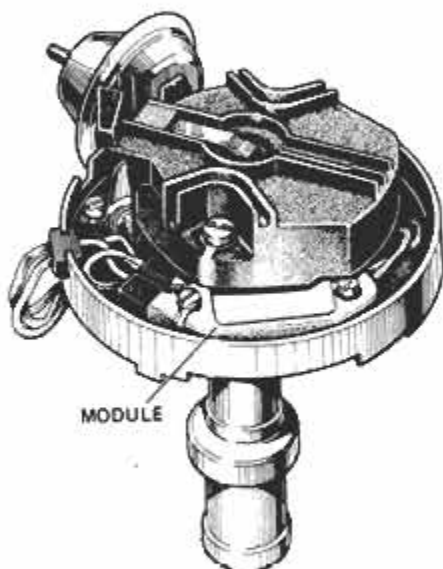
To determine if your fuel filter is clogged, remove the carburetor air cleaner and move the throttle linkage by hand (or have someone pump the accelerator pedal) as you look down the throat of the carburetor. If gas does not squirt from carburetor jets, you may have a clogged filter, a bad fuel pump, or a clogged fuel line or fuel-tank pickup.

All fuel filters should be replaced at intervals recommended by the maker. Here's how to replace the most common:

(Note: Before starting, see that the engine is cold and disconnect the battery ground cable. Lay rags under the fuel filter to catch any gasoline drip. No smoking!)

■ To replace an *in-line fuel filter* in the fuel line between fuel pump and carburetor—do this:

1. Loosen spring-type hose clamps and pull hoses off the fuel line with pliers. If crimp-type clamps are used, cut or pry them open; then, pull off hoses. Discard old filter.



The control module in an HEI distributor cannot be serviced. Replace if it's bad.

2. If clamps are shot, slide new clamps on hoses. Replace distorted crimp clamps with spring or screw clamps.

3. Insert the new filter, making certain it faces the right way. Usually, an arrow points toward the carburetor.

4. Slide clamps in place to secure filter to hoses. Then start the engine; if there's a gas leak, chances are clamps are not properly positioned.

Some model cars have an in-line fuel filter that screws into the carburetor inlet. To change it, release the clamp holding the fuel hose to

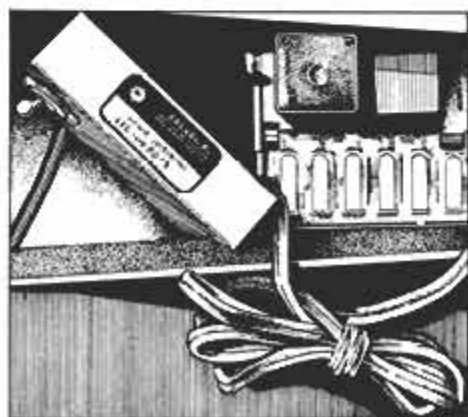
the filter nipple and pull off the hose. If the car has a steel fuel line, hold the filter with one wrench and loosen the fuel-line nut with another. Unscrew the filter, which has a hex-head to accept a wrench. When replacing it, be sure the hose and clamps are in good shape.

■ To replace an *internal fuel filter*—found inside the carburetor inlet—do this:

1. Use a wrench to hold the fuel-inlet nut; another to loosen fuel-line nut. Use of only one may twist the fuel line.

2. Unscrew the fuel-inlet nut. Replace gasket with a new one if cracked or torn.

3. Remove and discard filter. Leave



To test cold-start valve, this jumper is wired in place of the fuel pump relay. It provides fuel without turning on engine.

spring behind the filter in place. It's probably okay. If not or if it's lost, get another from an auto parts and accessories store.

4. Insert a replacement filter. Some filters have a check valve in one end. This end should face the fuel-inlet nut.

5. Screw on and securely tighten the fuel-inlet and fuel-line nuts.

6. Run engine and check for leaks.

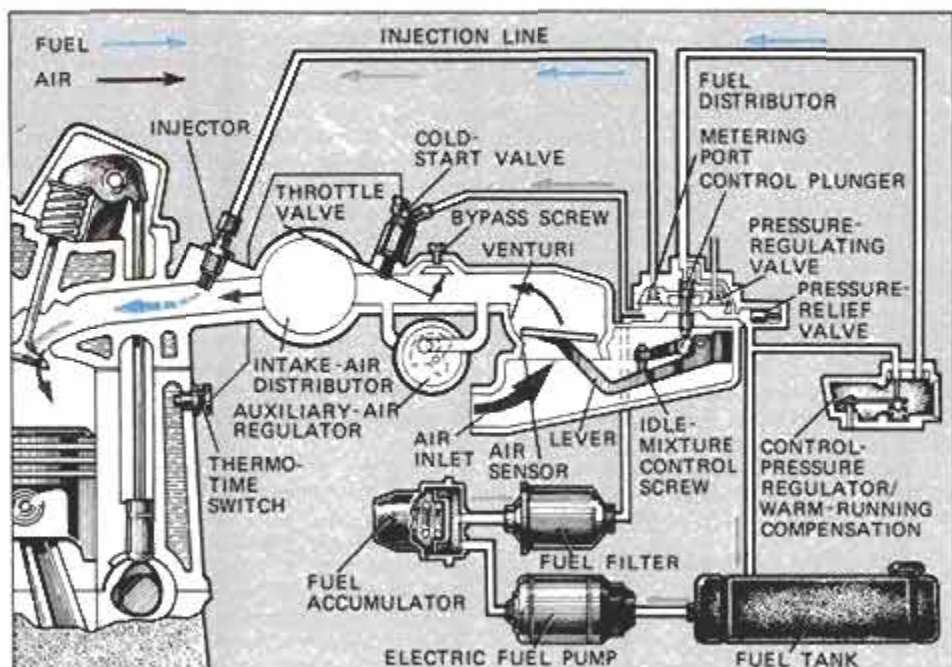
Electronic-ignition failures

If your car has electronic ignition, one component could cause a no-start problem. The electronic-ignition pickup sends signals to the ignition control unit which then fires the coil at the appropriate time. The distributor directs this voltage to the correct sparkplug. The pickup, mounted in the distributor, is connected by wiring to the control unit or module. The latter is also located in the distributor on GM HEI units. On Ford and Chrysler vehicles, it's mounted in the engine compartment.

If the pickup fails or its wiring breaks, the control unit won't get a trigger signal and the plugs won't fire. Pickup problems, however, are generally evidenced first by what is best described as a "surging condition." See Section 10 for more details.

Control module failures are a more common cause of no-start problems than pickup failures, because they frequently aren't revealed until the car won't start. However, many prob-

(Please turn to page 146)



A malfunctioning fuel pump or a cold-start valve could be the cause of hard starting in a fuel-injected engine. The cold-start valve should be taken out for testing.

WHAT DO ALL THESE CARS HAVE IN COMMON?



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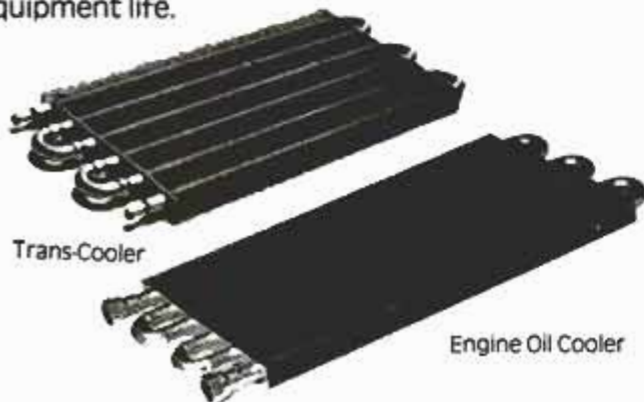
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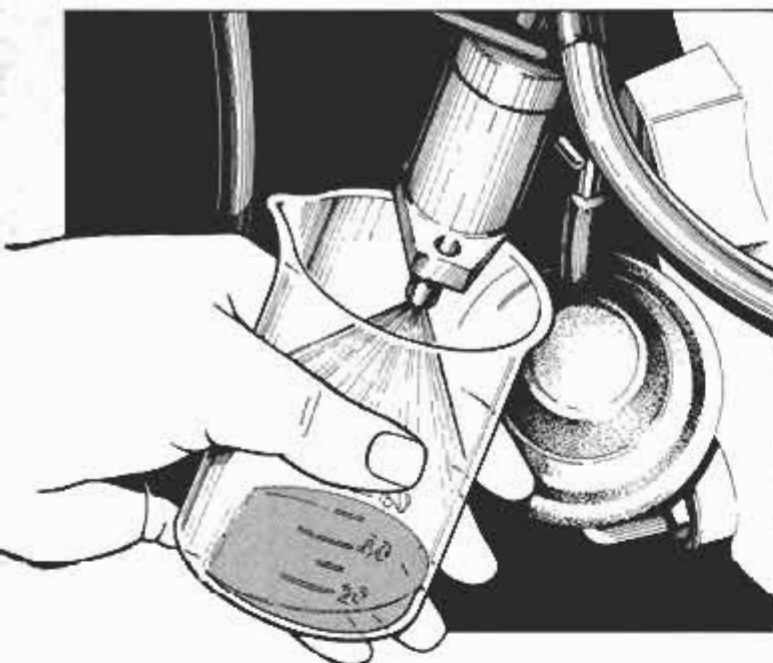
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CAR CARE GUIDE

SECTION 1. HARD STARTING



You should get a cone-shaped spray from the cold-start valve when fuel is delivered to it. If not, the valve should be repaired or replaced. You should also check the fuel pump to make sure it is delivering fuel at the pressure recommended by the manufacturer.

(Continued from page 144)

lems are actually caused by corroded connections and very hard to diagnose. Some electronic-ignition testers available for under \$100 will usually detect a control-module failure, but that's pretty costly if you figure this may occur once or twice during the life of your car.

The only other sure ways to detect most control-module failures are through process of elimination or substitution testing. Many mechanics try combining both. They crank the engine to test for spark. If none, they check all connections, pickup and condition of coil and distributor-to-coil cable. If they find no other problem, they substitute a good control module. If it works, they leave it. If it doesn't, and they're honest, they put the old one back.

Other malfunctions

Loose or corroded battery cables could keep an engine from cranking. Less extreme corrosion leads to resistance that can cause it to crank slowly. To overcome resistance, the battery must supply much more current than normal, which reduces available voltage. To test for resistance in the starting circuit, measure battery voltage while the engine is cranking. Generally, the battery should produce at least 9.6 volts.

An engine flooded with gas will crank, but may not start. It often floods because of overzealous accelerator pumping. If this happens (you may smell gas), floor the accelerator pedal and keep it there as you crank (up to 15 seconds). Then, turn off ignition and wait 30 seconds before trying again. Don't add a run-down battery to your troubles.

An engine may also flood due to internal carburetor leakage. If your car cranks well but won't start 15 to 20 minutes after shutoff, the carburetor may be defective.

All breaker-point and electronic ignitions, except the GM HEI system, have a high-tension

cable between distributor tower and ignition-coil tower. If cable wires are pulled apart or terminals are eroded or wet, current flow will stop and the engine won't start.

To check your distributor-to-coil high-tension cable, remove it and look for burned terminals and cracked insulation. Replace a damaged cable. If cable ends are moist, wipe them and their sockets with a lint-free rag and spray them with a dielectric lubricant. If an inspection reveals nothing, use an ohmmeter set to the high scale and touch each cable terminal with one of the ohmmeter probes. Compare the resistance registered with the value for the high-tension cables given in the car service manual. If the manual is not available, use the rule that resistance should not exceed 15,000 ohms for each foot of cable. For example, if the high-tension cable is 8 inches long, the resistance should not exceed 10,000 ohms. If it does, replace the cable.

Note: The allowable cable resistance for Ford-Mercury-Lincoln models with electronic ignition is 60,000 ohms per foot.

Servicing an automatic choke

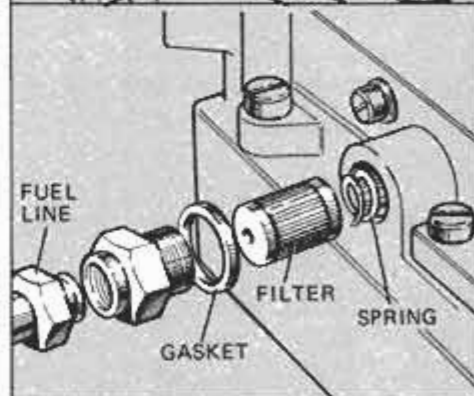
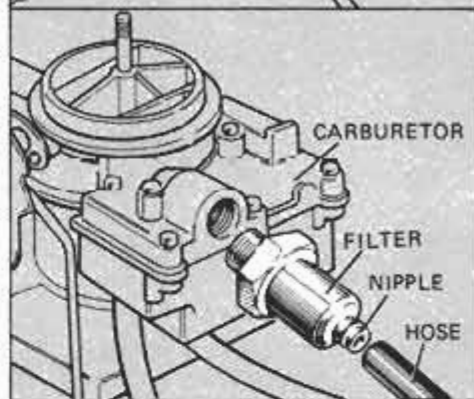
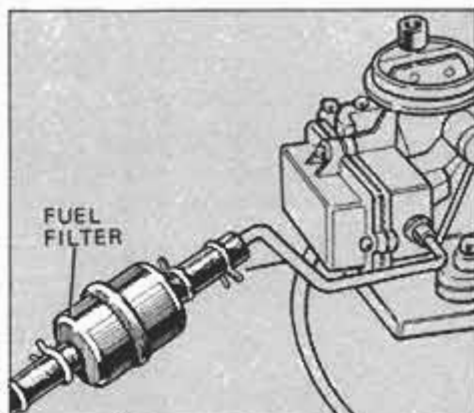
If excessive pumping of the accelerator pedal causes carburetor flooding, consult the owners manual for correct starting procedure. If you have been doing this right, check the automatic choke. To do this:

1. Let the engine get cold (first thing in the morning is best).

2. Remove the carburetor air cleaner and press the accelerator pedal to the floor once or twice. The choke plate should close.

3. Start the engine and let it warm up. The choke plate should begin opening almost immediately and be wide open when the engine reaches operating temperature.

If the choke operates, but the cold engine



No matter what fuel filter you have—in-line (top), carburetor inlet (middle) or paper element (above)—see that it isn't clogged.

runs poorly, starts with difficulty or stalls repeatedly, check that the choke is adjusted properly. An electric choke will fail to open if no voltage is available. A choke heated by exhaust gas may not open if the heat-riser tube is broken or missing.

If the choke plate doesn't operate this way, make sure the linkage and plates aren't binding. If they don't operate smoothly, spray the linkage and pivot points with carburetor and choke cleaner. Don't oil them unless recommended by the maker.

Other reasons why gasoline engines will crank briskly but won't start include being out of gas; ignition-system part failures (Section 5); bad fuel pump (Section 9); incorrect distributor or camshaft timing (Section 6); and low engine compression (Section 4).

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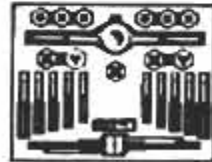
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CAR CARE GUIDE

SECTION 2. ROUGH IDLE

"Why Does My Engine Keep Stalling?"

There are probably 50 different reasons why gasoline engines will start and stall, or will start and idle roughly. Included are all of the following:

- A plugged positive-crankcase-ventilation (PCV) valve.
- A stuck thermostatic air-cleaner-assembly damper valve.
- A leaking exhaust-gas-recirculation (EGR) valve.
- A stuck early-fuel-evaporation (EFE) valve or manifold heat-control valve.
- Faulty sparkplugs.
- Water in gasoline.
- A vacuum leak at the base of the carburetor.
- A weak fuel-injection delivery system.

Faulty sparkplugs, vacuum leaks and contaminated gasoline are some obvious causes of rough idle and stalling. Water in gasoline is an old problem, but this is not as common as it once was, particularly in populated areas, where fuel is quickly pumped from storage tanks.

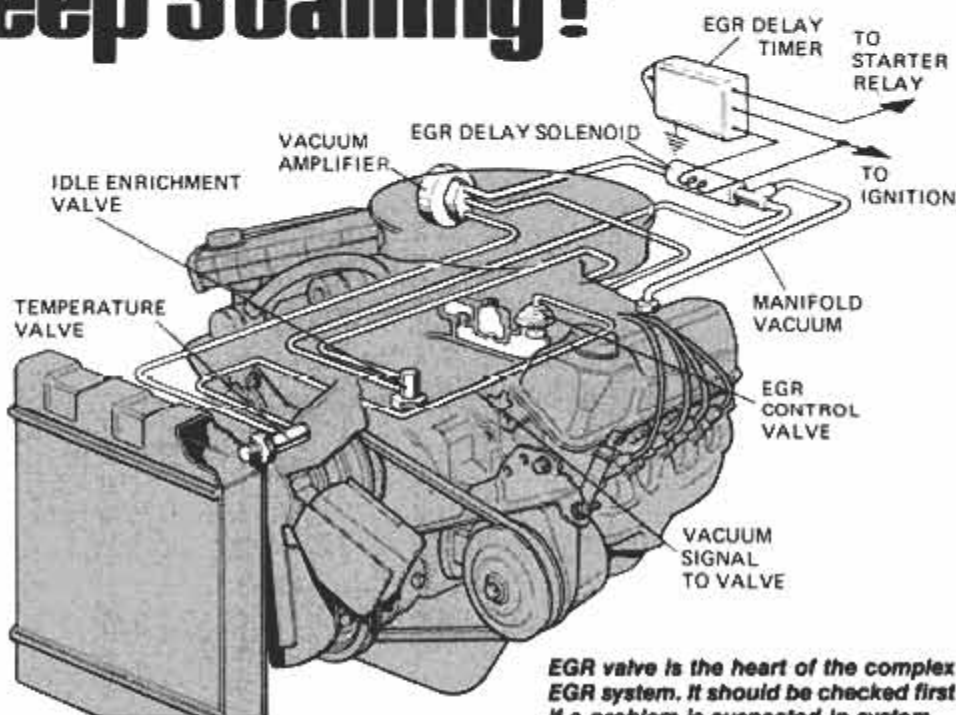
But how about some of those "new" causes—like the first four on the list? Each of them is part of an emission-control system, and practically every car built in the United States during the 1970s and '80s is equipped with them.

Among the dozens of other reasons why an engine stalls or idles roughly are the following:

- Percolation and vapor lock.
- Incorrect ignition timing (Section 6).
- Faulty ignition-system part(s).
- Disconnected vacuum hose (Section 3).
- Incorrect carburetor idle speed or fast-idle adjustment (Section 3).
- A defect in the automatic-choke system (Section 1).
- Partially clogged fuel filter (Section 1).
- Weak fuel pump (Section 9).
- Dirty carburetor.

How to check the PVC system

The PCV system provides ventilation of crankcase gases into the engine's intake manifold. To prevent these gases from interfering with combustion, they are allowed into the engine only when it's burning large amounts of fuel and air. The PCV valve is inserted somewhere in the line that connects the crankcase to the intake manifold. When intake manifold vacuum is high at idle or part-throttle, low-speed operation, the PCV valve is held in a closed position and crankcase vapors are kept



EGR valve is the heart of the complex EGR system. It should be checked first if a problem is suspected in system.

out of the intake manifold. When vacuum drops at greater throttle openings, the crankcase pressure overcomes the manifold vacuum acting on the valve, and vapors enter the intake manifold where the hydrocarbon content is drawn into the engine and burned. Fresh air is drawn into the crankcase through a filter or through a hose to a filter within the air cleaner. This keeps pressure in the crankcase from falling below atmospheric, which would inhibit the flow of the crankcase vapors into the intake manifold.

A faulty PCV valve is more likely to cause rough idling than stalling, since the valve is supposed to be fully closed during idle when intake vacuum is high. If the valve doesn't close, an excessive amount of vapor flowing to the cylinders will lean out the fuel mixture, and the engine will stutter. To check the system:

1. Find the PCV valve, which on four- and six-cylinder engines is usually located in the cam or rocker-arm cover. On V8 engines, the valve is found (depending on the engine) in the intake manifold, pushrod cover, valley cover under the intake manifold, rocker cover or oil-filler cap.

2. Pull the valve from its seat (leaving it connected to its hose) and shake it. If it doesn't rattle, it's plugged. Replace it.

3. However, even if the valve rattles, it may still be defective. To find out, run the engine at idle and close the valve opening tightly with your finger. If you don't feel a strong

suction, the valve or vacuum hose is probably bad.

4. Check the hose for splits. Make sure it's connected tightly to the vacuum port on the engine. Then pull the valve off the hose and, with engine running, cover the end of the hose with paper. If the pull isn't strong, the hose is probably clogged. Replace it. If hose is okay, replace the valve.

5. The PCV filter is an essential part of the whole system. Most cars have the filter positioned on the carburetor air cleaner. Check to see that the filter is clean. If not, replace it.

Some AMC and Chrysler engines have the PCV filter in the oil-filler cap and crankcase-inlet breather, respectively. Rinse these parts in solvent and allow them to air-dry.

How to test a damper valve

When you start a cold engine, the damper valve in the snout of the thermostatic air cleaner is supposed to close and allow air entering the carburetor to be preheated. Preheated air is necessary to maintain good cold-engine driveability while permitting the leaner carburetor and choke calibrations called for by emissions standards. As the engine warms up, reducing the need for preheated air, the damper valve is supposed to open.

If something goes wrong with the thermostatic air-cleaner temperature sensor or vacu-

(Please turn to page 151)

YOUR CAR

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Over the past ten years, CAR CARE programs co-sponsored by Automotive Parts & Accessories Association and POPULAR MECHANICS have increased the awareness of and provided the fundamentals of car care to millions of car owners.

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Technical assistance for CAR CARE CENTRAL has been provided by POPULAR MECHANICS. PM-prepared brochures give step-by-step instructions covering each week's features.

DON'T MISS THIS EXCITING AND INFORMATIVE SHOW!

See your local participating Retailer for details and check your newspaper for time and channel.

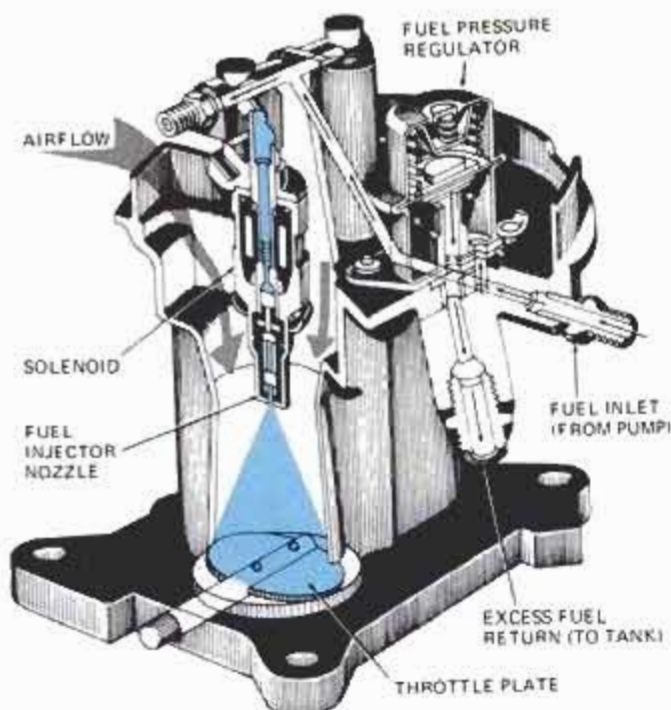
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Additional stations will be added. Consult listings for day and time.

CAR CARE GUIDE

SECTION 2



Stalling in a car with GM's Throttle Body Injection system could be caused by insufficient fuel pressure. To check it, remove the fuel line at the inlet and attach a pressure tester.

(Continued from page 148)

um motor and the damper valve fails to close or open, stalling or rough idling results. Check the operation of the valve as follows:

1. If the engine stalls or idles roughly when cold, remove the duct over the air-cleaner snout, if there is one, so you can observe the valve. If you have trouble seeing the valve, hold a mirror at the snout opening as you shine a flashlight into the opening.

2. Start the engine, which should be cold. The valve should close. If it doesn't, turn off the engine and pull the vacuum hose from the vacuum motor, which is on top of the snout. Then, connect a handheld vacuum pump to the vacuum motor. Apply at least 7 in. Hg of vacuum. (You may, instead, pull the vacuum hose from its place on the air cleaner and connect the vacuum pump to the end of the hose.)

3. If the valve closes, the sensor inside the air cleaner is bad. Replace it. If the valve doesn't close, the vacuum motor is bad. Replace it.

4. If the engine stalls or idles roughly when warm, check the valve in the same way, but with the engine warm. If the valve is not open, the sensor is probably shot. Replace it.

What you should know about EGR

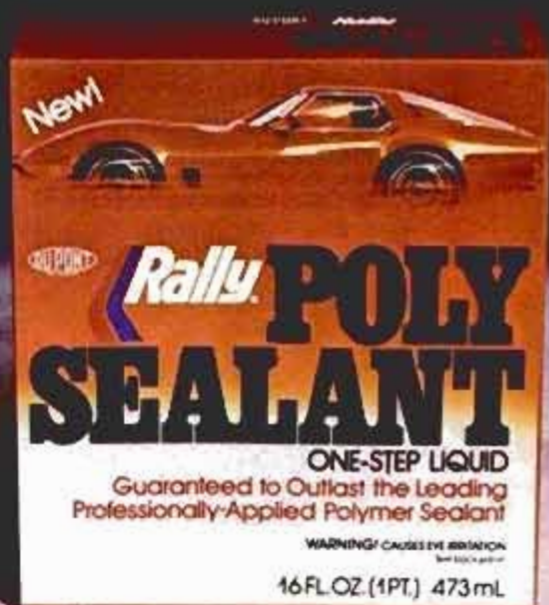
The EGR valve is thought to cause more stalling and rough-idling problems when the engine is cold than any other emission-control component. After it was introduced in the early seventies and for a few years thereafter, it probably did. Now, however, the EGR system has been perfected and it causes no greater or lesser amount of stalls and rough idling than other components.

The purpose of the EGR system is to divert a portion of engine exhaust gases back into the cylinders to lower high combustion temperatures that produce too much nitrogen oxide (NOx). The valve also prevents detonation. Eliminating it can ruin an engine. When the engine is cold, the EGR system is not supposed to operate. If it did, the engine would stall or idle badly. It operates primarily when an engine is warm and at part throttle—when conditions are ripe for NOx production and detonation.

Yet when the engine is cold, EGR valves cause the most problems. A leaking valve lets exhaust gases seep into the cylinders when they aren't supposed to be there. Gases lean out the fuel mixture and can stall an idling engine or, at best, cause rough idle.

(Please turn to page 152)

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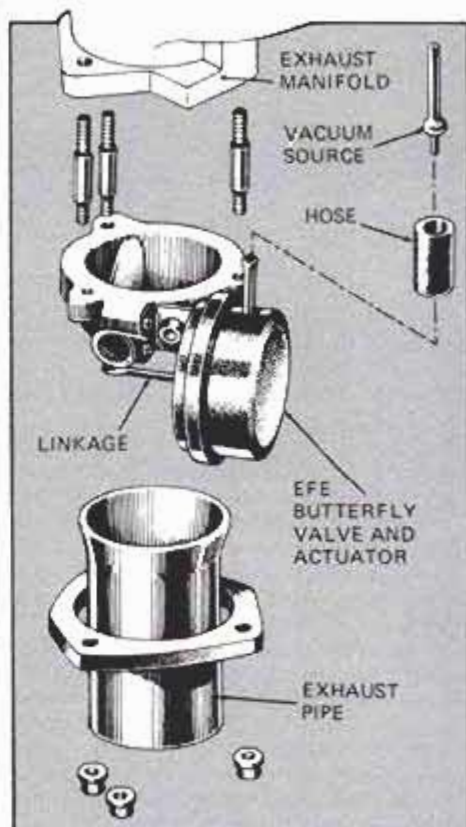
CAR CARE GUIDE

SECTION 2

(Continued from page 151)

Depending on the engine, an EGR system may be very simple or very complex. All systems have an EGR valve (there are different types) and vacuum hoses, and may have one or all of the following components: a coolant-temperature control switch, vacuum reservoir, vacuum amplifier and vacuum delay switch.

Procedures for checking most systems are lengthy, preventing us from giving how-to details. However, the weakest link in the system is the EGR valve.



If a stuck EFE valve doesn't loosen after lubricant is applied, replace the valve.

To check the valve itself as a potential cause of rough idle, reach under it while the engine is idling and push its diaphragm up until the valve opens and the engine idle becomes rougher yet, or the engine dies. Wear a glove to protect your hand.

If no change is noted, the valve may be leaking, causing the rough idle. If you should find that the valve is faulty, it will have to be replaced.

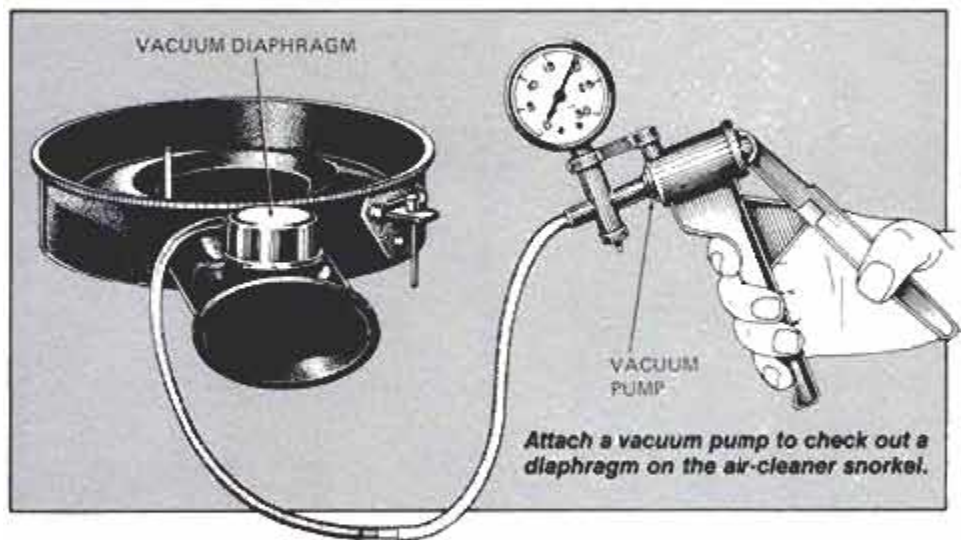
If your engine detonates severely under light-throttle acceleration, the EGR valve may have a broken diaphragm that prevents it from opening, or the valve itself or the passages to it may be clogged. This condition must be corrected before it leads to serious internal engine damage.

Before you condemn the EGR valve, however, make sure it gets a supply of vacuum at 2,000 rpm with the engine warm, and inspect exhaust-gas passages in the valve and intake



CAR CARE GUIDE

SECTION 2. ROUGH IDLE



manifold to be sure they're not restricting the flow of gas to the valve.

EFE and MHCV

EFE valves are used primarily by GM on some models with V6 engines, such as the X-body cars (Citation, Omega, Phoenix and Skylark).

The EFE valve serves the same purpose as the manifold heat-control valve on other cars—it provides instant heat to the engine induction system for rapid fuel vaporization and good cold-engine operation.

Unlike a manifold-heat-control valve, operated by a thermostatic spring in the exhaust manifold that contracts and expands according to engine heat, the EFE valve is controlled by a thermal vacuum switch (TVS) that passes vacuum to the valve when the engine is cold. Vacuum closes the valve, allowing heat to concentrate where it assists fuel to vaporize. When the engine warms, the pull of vacuum is released and the valve opens. The much-more-common manifold-heat-control valve serves the same purpose. Its thermostatic spring holds it closed. Exhaust heat opens it as the engine warms.

From this description it may seem obvious that a malfunctioning EFE valve or manifold-heat-control valve could make an engine stall or idle roughly only when the engine is cold. But obvious isn't always accurate.

Damaged EFE and manifold-heat-control valves that stick in the closed position permit good cold-engine operation. However, the engine will stall or idle roughly when it causes excessive heat to be concentrated on fuel. Instead of vaporizing normally, fuel will practically evaporate.

To check a GM EFE valve, do this:

1. See that the engine is cold and locate the EFE valve.

2. Start the engine and watch the valve. You should see the actuator link being pulled into the diaphragm housing. This action closes the valve.

3. If this doesn't happen, shut off the engine, remove the hose from the valve and apply at least 8 in. Hg of vac-

uum to the valve with a hand vacuum pump. If the linkage doesn't move, apply a manifold-heat-control-valve lubricant. If it still doesn't work after a shot of lube, replace the valve.

To check the manifold-heat-control valve—if you're in the majority, your engine has one—do this:

- 1. See that the engine is cold.**
- 2. Find the valve counterweight** under the exhaust manifold. Try to move it.
- 3. If the valve is stuck, apply manifold-heat-control-valve lubricant to the counterweight pivot point and tap the counterweight lightly with a plastic-headed hammer.** Try moving the counterweight again.

Unless you've neglected valve maintenance for a long time, the valve should loosen. If it doesn't, you may have to remove the manifold and replace the valve. Once the valve is free to operate, start the engine and watch the counterweight as the engine warms. It shouldn't flop open instantly, but should open gradually as the engine warms.

How to control a carburetor vacuum leak

In seeking a reason for a modern engine stalling or idling roughly, don't overlook some old standbys, one of which is a vacuum leak. A key spot where a leak may develop is at the carburetor/intake manifold joint.

To keep a leak from developing here (or to get rid of one that has developed), periodically tighten carburetor mounting bolts. Also, tighten all carburetor assembly screws. You can verify whether the joint is sealed by following this procedure:

- 1. Connect a tachometer.**
- 2. Start the engine.**
- 3. Eject SAE 30-weight engine oil from a squirt-type oil can around the base of the carburetor.** If the tachometer needle rises, indicating an increase in engine speed, oil has been sucked into an empty space, sealing it momentarily. A vacuum leak

(Please turn to page 155)

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MICHELIN
We put America on radials.

(Continued from page 153)

exists. If tightening bolts doesn't fix the problem, replacing the carburetor-base gasket may.

Testing fuel-injection delivery

Stalling or rough idling of a gasoline engine with a fuel-injection system will usually result when one injector fails. This can also occur if ample fuel pressure is not delivered to the injectors. This lack of pressure can result from a weak fuel-delivery pump, partially clogged fuel filter or a restriction in the fuel-delivery line.

Without proper equipment, the removal, testing and overhauling of injectors is difficult, but checking fuel delivery isn't. Using a typical



A PCV valve that won't rattle when you shake it is shot and should be replaced.

throttle-body-injection (TBI) system as an example, here's how to do it:

1. Bleed pressure from the injection system. You do it by removing the fuel-pump fuse from the fuse panel and cranking the engine for about 30 seconds.

2. Break the fuel-line connection at the fuel inlet.

3. Using a tee, install a fuel-pump pressure tester in the fuel-line connection point.

4. Crank the engine. The pressure tester should record the fuel pressure specified by the manufacturer. For example, the new Pontiac 2.5-liter TBI engine requires at least 9 pounds per square inch (p.s.i.). If it doesn't get this much, not enough fuel will reach the injectors.

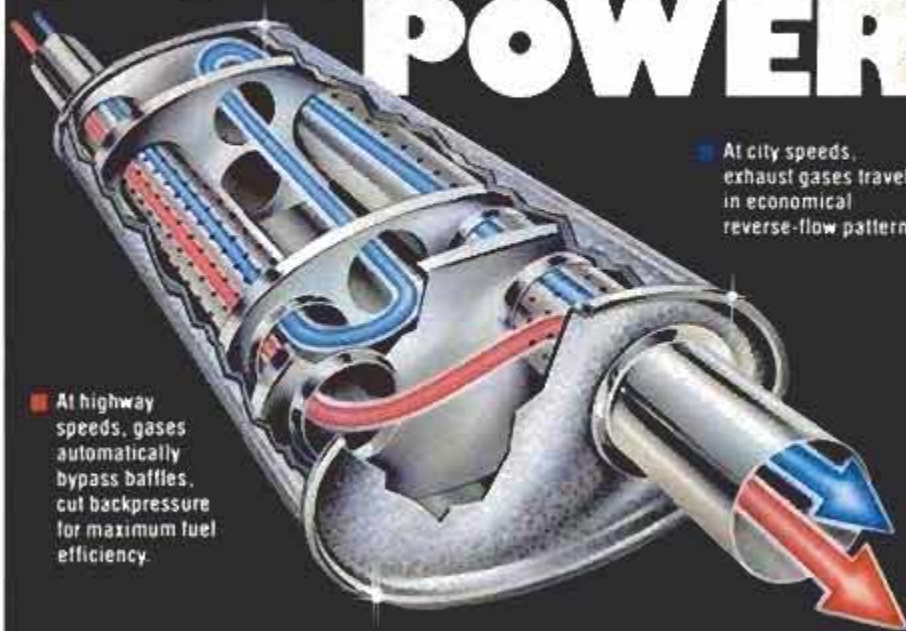
Caution: Gasoline will probably drip when the fuel line is disconnected. Try to collect it in a container or absorb it in a rag. It's wise to keep a fire extinguisher handy when you do this. You should have one for your shop in any case.

If you do collect any spilled fuel with a rag or paper towels, don't leave them lying around. Not only are such rags dangerous, but fumes of evaporating gasoline are highly explosive. Obviously, don't smoke while you're doing this and keep the work area well ventilated. **FM**



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CAR CARE GUIDE

SECTION 3. POOR FUEL ECONOMY

"Why Is My Mileage So Lousy?"

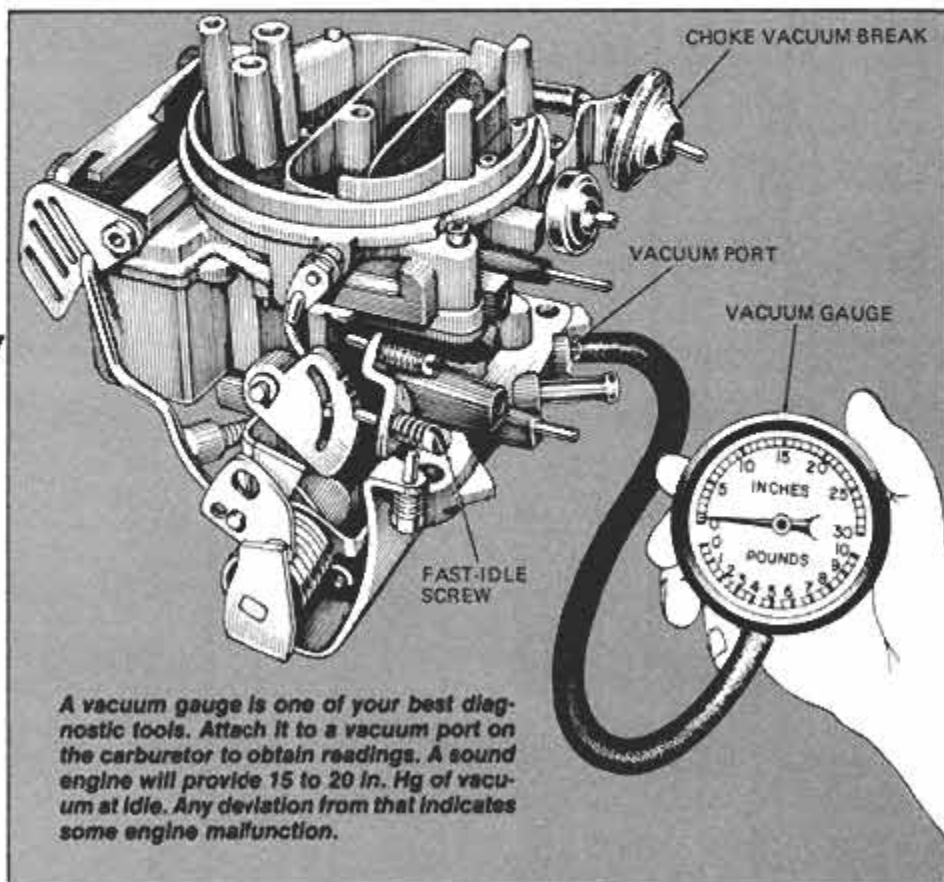
Nearly any malfunction that causes poor engine performance will result in poor fuel economy. However, there are also some reasons for poor fuel economy that are not related to engine problems. The following potential causes include both engine malfunctions and other problems:

- Poor driving technique.
- Leaking vacuum hoses.
- Underinflated tires.
- Dragging brakes.
- Internal or external carburetor fuel leakage.
- Incorrect idle adjustment.

It's in your hands

A car that is mechanically perfect will still consume more fuel than it should because of bad habits on the part of the driver. Since there is no substitute for the sensible handling of a vehicle, here are some of the things that drivers should keep aware of in their daily travels if they don't want to waste gasoline:

- Drive smoothly, avoiding fast starts and sudden stops.
- Anticipate traffic-light movement and traffic blockages by coasting to them so that your car is still moving when you receive a "go" signal. In other words, try to avoid stopping, if possible. You will use 20 percent less fuel by accelerating back to cruising speed from as low as 5 mph rather than from a full stop.
- As you cruise at highway speed, try to keep that speed constant. Varying your speed by as little as 5 mph (for example, from 55 to 60, back



A vacuum gauge is one of your best diagnostic tools. Attach it to a vacuum port on the carburetor to obtain readings. A sound engine will provide 15 to 20 in. Hg of vacuum at idle. Any deviation from that indicates some engine malfunction.

to 55, up to 60 and so forth) can increase fuel consumption by 1.3 miles per gallon.

- Steer smoothly around the slower-moving vehicles rather than running up to them, braking and then accelerating around them. Every time you hit that accelerator pedal unnecessarily, you waste gas.
- Try to avoid hitting your brake pedal to slow down. If you're traveling too fast on a level road, take your foot off the gas pedal and let the engine "brake" the car to the desired speed.
- When you're tooling along at highway speed, keep the windows closed to reduce the air resistance on the vehicle. Open the vents to draw in fresh air or turn on the air conditioner.
- If you are stuck in a traffic jam or have to wait in the car for a length of time for any other reason, turn off the engine. How often have you

seen a line of cars with their engines running while waiting many minutes for a long freight train to clear a crossing or for a drawbridge to open and close? Each engine is consuming a pint of gas every five minutes.

- Don't let a car engine warm up before you drive off. Start it up and proceed to drive at low speed immediately. Not only will you be using gas that would otherwise be wasted if the engine were merely idling, but you also will be warming up the engine faster than would happen if the car were standing still.
- Anticipate all hills and gradually accelerate your car to the speed you will need to negotiate them before getting to them.
- Don't top off a gas tank to the point where the fuel fills the filler neck. The chances are good that some fuel will be spilled from the

(Please turn to page 158)

SEVERAL TROUBLE SPOTS YOUR VACUUM GAUGE CAN IDENTIFY



Low, steady reading at 5 in. shows vacuum loss in system.



Low, steady reading at 10 in. indicates timing is incorrect.



Fluctuation 2 to 6 in. below normal is bad breaker points.



A fluctuation from normal to 5 in. is a leaky head gasket.



Drifting around normal is an incorrectly tuned carburetor.



High, steady reading indicates that the choke is stuck.

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So if it's nothing but the best for your car, change to Mobil 1. You can't buy a better oil at any number.

Mobil 1. The oil that saves you gas. And more.

*Add-on extended New Carwarranty. Follow warranty instructions. Other owners follow dealer's instructions.

**If everything you put into your car has
to be No.1, we've got your number.**

Mobil

1

CAR CARE GUIDE

SECTION 3. POOR FUEL ECONOMY

(Continued from page 156)

tank. This is especially true in hot weather, since heat causes gasoline to expand.

How to find a leaking vacuum hose

A vacuum leak can affect acceleration, cause an engine to lose power and result in

misfiring. These conditions, in turn, could lead to a reduction in fuel economy. An engine that has a vacuum leak will tend to idle roughly.

The modern engine has a number of hoses that control the operation of vacuum-operated components. Among these components are the brake power booster, distributor spark

advance, choke vacuum break, EGR valve, PCV valve and EEC canister.

If a hose should split or become disconnected, you may hear a loud hissing sound when you raise the hood and let the engine run at idle. This is an indication that vacuum is being lost.

However, a lack of hissing doesn't mean that there is no vacuum loss. It just may mean that you can't hear it. Therefore, to be assured that there is, indeed, no loss of engine vacuum, examine the hoses for splits, kinks and loose connections. Replace all damaged hoses. Then connect a vacuum gauge to a source of vacuum, such as a vacuum port on the engine or a port at the base of the carburetor.

If you can't find a vacuum port, disconnect the vacuum hose at the brake power booster and tap a vacuum gauge into the hose through the use of an adapter, but first make certain that the hose is in good condition.

Start the engine and let it idle. A sound engine will provide 15 to 22 in. Hg of vacuum. However, altitude can affect this reading. A vacuum gauge will record 1 to 2 in. Hg lower vacuum for every 1,000 feet you are above sea level.

If the vacuum gauge holds steady at about 5 in. Hg, it means that there is a disconnected or leaking vacuum hose, a leaking vacuum diaphragm in one of the vacuum-operated components named above, or a loss of vacuum coming from the carburetor-intake manifold area. Check the hoses again and test the carburetor/intake manifold junction as explained in Part 2.

To test the various vacuum-operated components for leaks, close off the hose leading to each component by squeezing it with a needle-nose pliers while the engine is idling. If the idle smooths out or changes when you squeeze the hose, the component that the hose is attached to (or the hose itself) is leaking vacuum.

Tire inflation basics

The following tips may help you get better gas mileage:

1. Check your air pressure at least once a month. A typical tire will lose up to one pound of air during that time. Although this isn't critical, the monthly examination can uncover a slow leak that can't be detected by eye until a tire, especially a radial, is almost flat. The underinflation causes a loss in fuel economy as well as abnormal tire wear.

2. Follow your tire manufacturer's inflation recommendation. The air pressure recommended by the car manufacturer in your car's owners manual may not provide the best fuel economy. If you have replaced the original tires with metric-size radials, inflate them to a higher pressure than what the car manufacturer recommends for conventional-size radials.

Metric-size radials are designed to handle pressures up to 35 pounds. Using maximum air pressure reduces rolling resistance which, in turn, improves gas mileage. According to the

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CAR CARE GUIDE

SECTION 3. POOR FUEL ECONOMY

Firestone Tire and Rubber Co., 5 to 10 percent of the fuel consumed by an engine is used to overcome the rolling resistance presented by tires. Increasing air pressure will, however, increase ride harshness.

How much air pressure should your tires hold—whether metric-size or otherwise—to obtain the best fuel economy? Certainly it should not be less than that recommended by the car manufacturer. Usually it should be at least three or four pounds more as long as you don't exceed the maximum pressure the tire is designed to hold. This specification is printed on the tire sidewall. With metric-size tires, therefore, you can use an inflation pressure of up to 35 pounds if the maximum air-pressure specification embossed on the tire says so.

3. Don't check for tire pressure by using a service-station gauge. Get your own gauge to ensure greater accuracy.

4. Check pressure when tires are cold. The best time is first thing in the morning before driving the car.

If a tire needs additional air, drive to a service station and add the difference between your gauge reading and the recommended pres-

Note: As cold weather sets in, keep in mind that tires lose one pound of air for every 10° drop in temperature. Checking tire pressure on a more frequent basis in the fall and winter is sound practice. Once a week isn't too often.

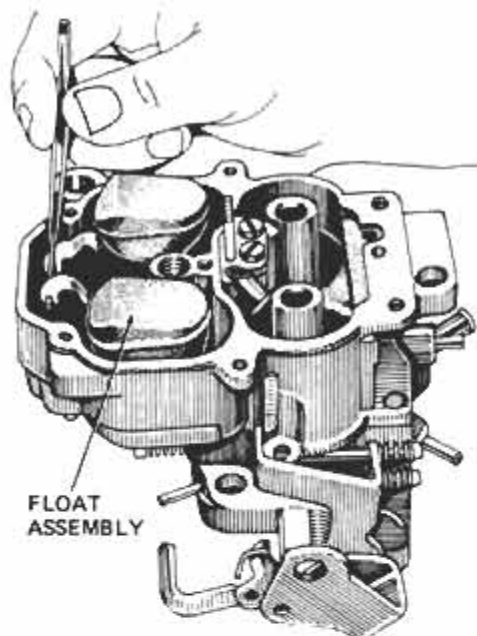
In summer, maintaining recommended air pressure helps to insure that tires won't over-

heat. Dropping pressure in an attempt to prevent overheating does just the opposite.

Checking brake drag

If your brake pads or shoes drag on the rotors or drums, fuel economy will suffer. To

(Please turn to page 161)



Incorrectly set float bowl or one that's saturated will keep the inlet needle off its seat, leaking gas into engine at idle.

sure, after taking a reading at the service station. For instance, if your tire gauge reading at home is 26 pounds and the recommended pressure is 32 pounds, you should add 6 pounds at the station. But suppose the reading at the station is 28 pounds. Then, inflate tires to 34 pounds to get the correct differential.

5. Don't bleed air pressure in winter. Lowering tire pressure below recommended levels in winter does not improve traction—it only increases fuel consumption and leads to rapid tread wear.

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The advertisement features a large image of a hand holding a pair of Channellock pliers. Below this, a vertical column of various sizes of Channellock pliers is shown. The text 'No Bone Crusher Grip Needed...' is prominently displayed. At the bottom right, the Channellock logo is shown, along with the company name and address: 'CHANNELLOCK, INC. • Meadville, Pennsylvania 16335'. Below the address is the slogan 'Meet The Rest Of The Family. Send For Our Free Catalog.'

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2. Clip certified UPC bars (Universal product code) from each package of GE All Temp Silicone Brake Fluid you claim for a refund.

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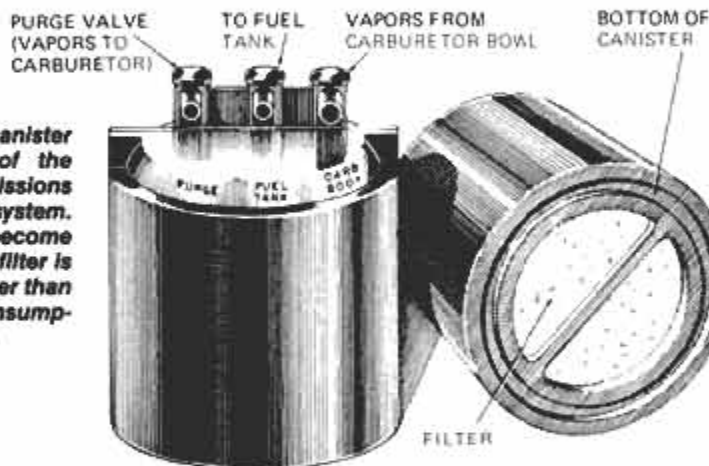


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CAR CARE GUIDE

SECTION 3. POOR FUEL ECONOMY



The charcoal canister is the heart of the Evaporative Emissions Control (EEC) system. If passages become clogged or the filter is blocked, a higher than normal fuel consumption can occur.

(Continued from page 159)

check for brake drag, simply raise the car on jackstands. Lift the front end first, with the transmission in PARK (automatic transmissions) or REVERSE (manuals). Use a hydraulic jack and lift only on a structural member recommended by the manufacturer as a lift point. Place the jackstands in the recommended positions. Be sure to lower the car carefully onto the stands.

Spin each of the front wheels. They should spin freely. If they don't, the brake pads may be dragging. A common cause of disc-brake-pad drag is a caliper that is corroded internally, causing its piston to stick in the applied position. Such a caliper must be replaced or rebuilt.

Sources of carburetor leakage

Carburetors can develop both internal and external fuel-leakage problems, either of which can result in a significant loss of fuel economy. External leaks are evidenced by unusually clean spots on the intake manifold. Sometimes it may only be the fuel-inlet line that is leaking. Other leaks may be the result of faulty float-bowl gaskets or porous or cracked carburetor castings. Try tightening the float-bowl screws before you pull the carburetor off the car.

Internal leaks can be caused by porous castings, defective power valves, leaking float check valves or faulty accelerator-pump check valves. Some internal leaks, like porous castings or leaking float-check valves, are most evident when the car is first shut off. They cause the engine to flood and make it difficult to start for the first 15 or 20 minutes after it has been shut off. Other internal leaks, like faulty accelerator-pump check valves or defective power valves, may occur only when the engine is running. They can be detected by the rough idle and high emissions that they cause.

Inefficient idle

If either the idle-mixture adjustment or the idle speed is incorrect, fuel economy can suffer, sometimes much more than you would think. For example, if the throttle plates are opened wider to compensate for a richer idle

mixture, fuel economy will suffer. If the maladjustment is considerable, the carburetor may begin pulling fuel from its main metering circuit while the engine is idling. This can cause significant loss of fuel economy.

When adjusting either idle speed or idle mixture, the other must be adjusted as well, because changes in throttle-plate opening (idle speed) change the mixture as well. The opposite is also true. So, once you've adjusted the mixture, check the idle speed again. And if you adjust the speed, check the mixture. Mixture is easiest to adjust with an emissions analyzer, but these machines are prohibitively expensive. The propane enrichment is an optional, acceptable method of mixture adjustment. Don't try to adjust idle mixture by ear or with a tachometer.

Other causes of poor fuel economy

Here are some of the other things that will make an engine burn more fuel:

- A malfunction in the ignition system that leads to misfiring. (Sections 1 and 10)
- A stuck or incorrectly adjusted choke. (Section 1)
- A clogged carburetor air cleaner.
- Worn or damaged internal engine parts, particularly valve-train components. (Section 4)
- A restricted exhaust system. (Section 4)
- Incorrect spark or cam timing. (Section 6)

One other item that might be the cause of excessive fuel consumption is the carburetor float.

Carb floats can be made out of hollow metal, hollow plastic or solid plastic. A mere pinhole punched into a hollow float will cause it to sink, allowing fuel to flood the bowl. A solid float can, in time, become so saturated with fuel that this would cause it to sink also.

In either case, you'll be using more fuel than is necessary and your average mileage figure will suffer as a result.

A carburetor float could also introduce a problem if it has been bent and seated at the wrong angle. **PM**

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BODY SHOP
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CAR CARE GUIDE

SECTION 4. LACK OF POWER

"Why Doesn't My Engine Have Any Get-Up-And-Go?"

If your engine doesn't seem to accelerate the car as it once did, or if it sometimes feels like it can barely maintain speed on an incline, you may have an engine problem that is causing a lack of power. Many of the engine performance problems already discussed can cause a lack of power. So can all of the following:

- A restriction in the exhaust system.
- A misaligned electronic-ignition trigger wheel.
- Low engine compression.
- A defective spark advance mechanism.

Uncovering a restricted exhaust system

1. Warm up the engine to normal operating temperature.

2. Connect a vacuum gauge (see Section 3) and tachometer. The ground lead of the tachometer, which is usually black in color, connects to a clean ground on the engine, and the other lead (usually red) connects to the primary wire contact on the ignition coil which, in most cars, is the negative terminal.

Important: If you are connecting a tachometer to a GM HEI distributor, attach the red lead of the tachometer to the terminal marked TACH. You will probably have to use an adapter, which is connected to the terminal. The tachometer lead is then connected to the bare-wire end of the adapter.

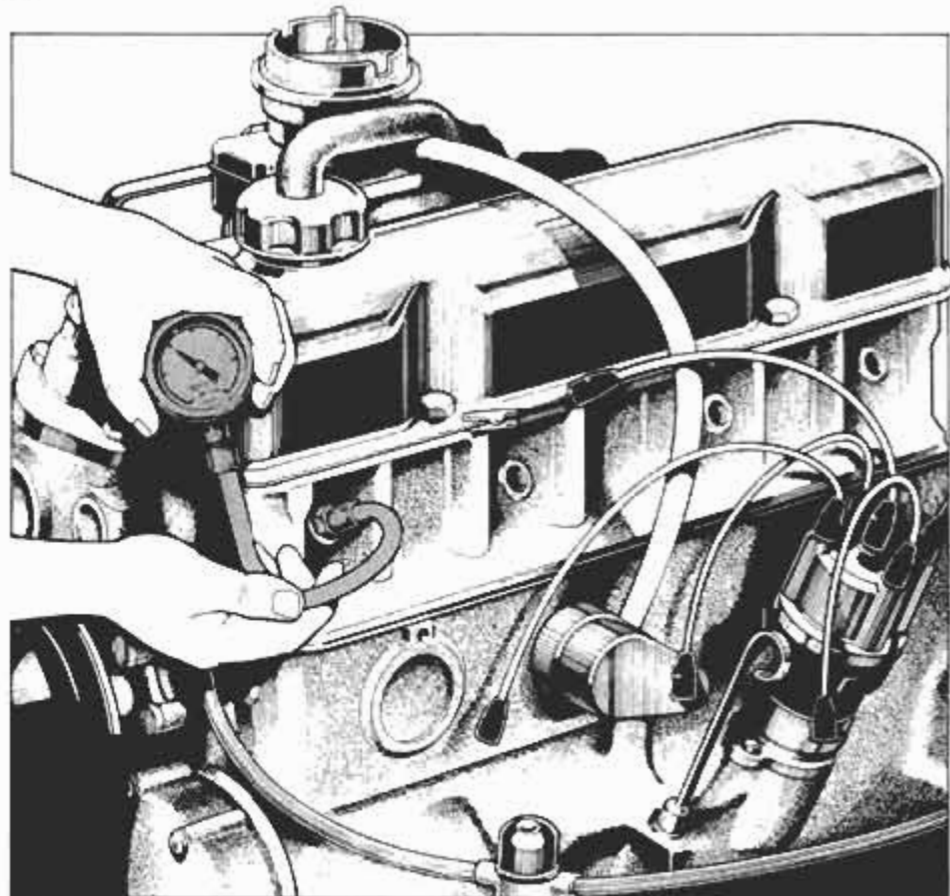
3. Start the engine and run it at idle. Then, accelerate gradually to about 2,500 rpm. If the vacuum gauge shows a steady reading when the engine first starts, drops to 0 when it idles and rises slowly during acceleration, suspect an exhaust-system restriction. The restriction can be in any number of places, including the tailpipe, catalytic converter, or manifold heat control valve (see Section 2).

Realign a trigger wheel

Generally, electronic ignition systems other than the GM HEI system have a trigger wheel which is rotated by the distributor shaft. As the teeth of the trigger wheel align with the pickup coil (or sensor), a surge of high voltage is transmitted by the ignition coil to the distributor cap, where it's picked up by the rotor and directed to sparkplugs.

Actually, "trigger wheel" is what AMC calls the part. Ford calls it an armature and Chrysler calls it a reluctor.

In any event, on Fords, the part is held firmly to the distributor shaft by a small pin which fits into a groove in the shaft. If the distributor has been worked on, the pin may not have been reinstalled properly or may have been lost and



Test engine compression by first removing all sparkplugs and then cranking the engine with the throttle held open. The battery should be fully charged for peak cranking power.

not reinstalled at all. The trigger wheel may, therefore, be out of line with the pickup. This condition will cause a change in spark timing, misfiring, especially at higher speeds, and poor power.

If the cause of your problem hasn't been uncovered and there has been an inexplicable change of initial spark-advance timing, it may be worth the effort to check the position of the trigger wheel.

After you have removed the distributor cap and rotor, place two screwdrivers under the trigger wheel. Work the wheel off the shaft, but be careful not to damage the teeth or lose the pin, if the pin is there.

Note: If you can't move the trigger wheel with screwdrivers, use a small gear puller to get it off the shaft. Place a thick washer on top of the distributor shaft. Then, place the puller so its turn screw rests on the washer and its jaws grip the inner shoulders of the trigger wheel. Turn

the turn screw until the trigger wheel comes loose. Incidentally, you may not have to buy a gear puller if you have a battery cable puller in your toolkit. It works just as well.

Check the trigger wheel for damage. If it's cracked or a tooth is broken, replace it.

Now, make sure the small roll pin is in its slot in the distributor shaft and press the trigger wheel back firmly on the shaft. Make sure the trigger wheel is pushed down securely, so the teeth align with pickup. No part of the roll pin should extend either above or below trigger wheel.

Internal engine problems

Engine-compression testing is the best method at your disposal for determining if internal engine parts are sealing properly. If compression is leaking past valves, pistons or a head gasket, loss of engine power is one of several

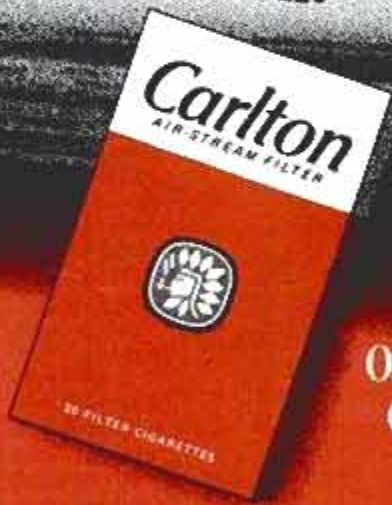
(Please turn to page 164)

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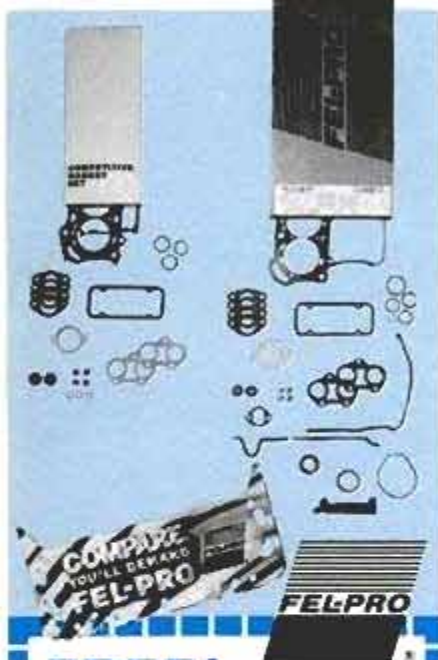
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CAR CARE GUIDE

SECTION 4. LACK OF POWER

(Continued from page 162)

problems that can result. Others are hard starting, stalling, abnormally high fuel usage and rough running.

Note: Since testing involves cranking the engine repeatedly without having it start, be sure the battery is fully charged; otherwise, the battery may weaken to the point where cranking is weak, and erroneous test results will occur.

1. Warm up the engine to normal



Vacuum reading close to zero when the engine is accelerated, followed by the needle returning to near normal, indicates a blocked exhaust system.

operating temperature. Then turn it off.

2. Remove the carburetor air cleaner and all sparkplugs. (Now is a good time to look for worn or damaged plugs.)

Caution: Make sure sparkplug cables are identified, so that when you reattach them to the cylinders they serve, you don't switch them accidentally. Mismatching cables and cylinders will cause the engine to misfire, which may damage the engine.

3. Ground the ignition system to prevent a spark from igniting fuel vapors or battery gas. In non-HEI systems, pull the distributor-to-ignition coil high-tension cable from the coil tower, attach one alligator clip of a jumper wire to the metal terminal in the cable boot and attach the other alligator clip of the jumper wire to a clean metal part of the engine, such as the alternator bracket.

To disable a GM HEI system, disconnect the wire attached to the BAT terminal in the distributor cap.

4. Install the end of the compression gauge firmly into the first sparkplug port. The end of your gauge may be threaded, so it holds itself; or it may have a cone shape, so you must hold it in place. In either event, the end of the gauge must be tight in the sparkplug port to keep compression from leaking.

Caution: If you have a screw-in compression gauge, finger-tighten it. Don't use a wrench. You may damage the sparkplug port threads.

5. Have someone in the car hold the accelerator pedal to the floor and crank the engine for 10 seconds to assure four revolutions. Count needle deflections or engine surges, leaving the gauge in place for the same number of deflections per cylinder. Record the reading. Repeat this procedure for each of the other cylinders and record the readings.

6. Study results in relation to minimum and maximum compression readings given by the manufacturer in service literature. If specifications aren't available, use the following criteria:

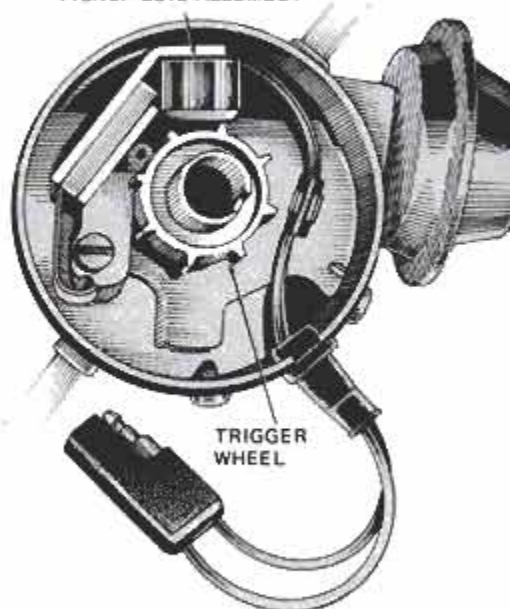
Readings no less than 90 pounds per square inch (p.s.i.) from each cylinder are generally acceptable, as long as the highest and lowest readings are within 70 percent of one another. For example, if the highest reading cylinder is 140 p.s.i. and the lowest is 98 p.s.i., with all others falling within this range, the engine shows marginally acceptable compression.

If one cylinder, or more than one, is lower than 90 p.s.i., or not within 70 percent of the highest reading cylinder, or if two side-by-side cylinders are 20 or more p.s.i. lower than the others, an abnormal compression loss exists. To establish the reason for it, inject about a tablespoon of SAE 40-weight engine oil into the weak cylinder through the sparkplug port and retest. If the new reading shows higher compression than before, piston rings are worn. If the new reading is much the same as the first reading, valves are sticking or burned, or valve seats are worn. If two adjacent cylinders stay 20 or more p.s.i. lower than the others, the head gasket is blown.

If one cylinder, or more than one, shows a reading 10 p.s.i. or more above normal for the engine, there's probably a buildup of carbon in the cylinder. Higher-than-normal compression won't cause lack of power, but we mention it here because a buildup of carbon may be the reason why your engine detonates. Treat the engine with a carbon solvent. It may prove an effective, yet inexpensive way to alleviate a spark-knock problem. If this fails, the cylinder head may have to be removed to purge carbon from cylinders and from around valves.

(Please turn to page 167)

PICKUP COIL ASSEMBLY



Trigger wheel misaligned with pickup coil compromises ignition timing, performance.

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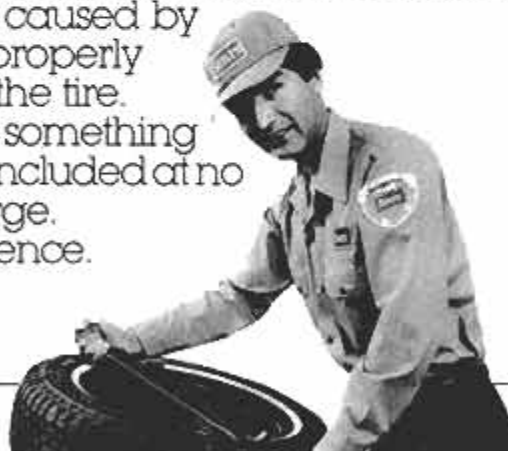
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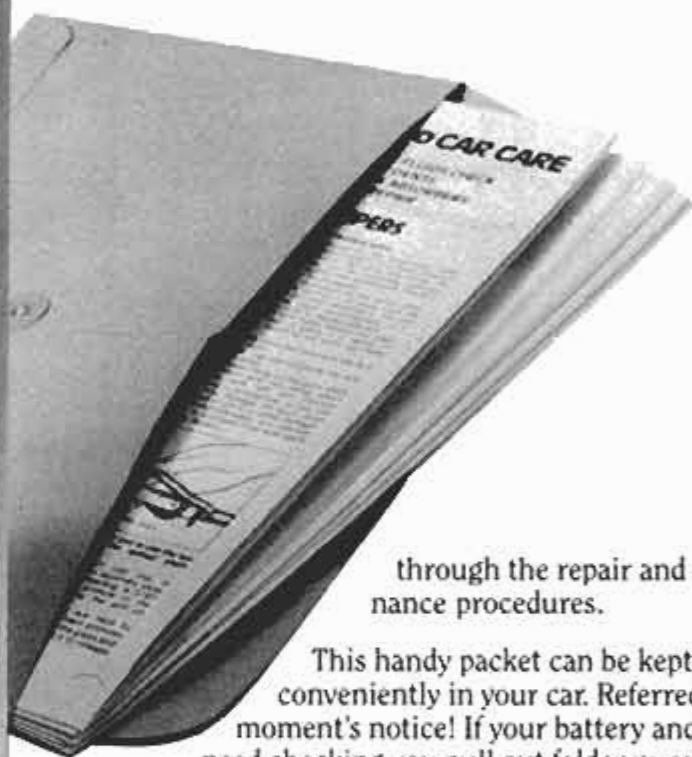


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CAR CARE GUIDE

SECTION 4. LACK OF POWER

(Continued from page 164)

Spark-advance units

Most breaker-point and electronic-ignition distributors have two controls that advance (or retard) ignition timing to meet the changing load demands on an engine. One of these is a vacuum-operated component which is normally located on the side of the distributor. The other is a mechanical device, consisting of weights and springs inside the distributor, that takes over control where the vacuum advance leaves off. The condition of both units may be checked with a timing light when you suspect failure of either is causing loss.

Check the vacuum advance as follows:

1. Aim the timing light at the timing marks and run engine at 1,500 rpm.

2. Once the engine is fully warm, pull the vacuum hose from the vacuum-advance housing and cover the end of the hose with your finger. There should be a noticeable shifting of the timing mark in relation to the index pointer.

Note: You should also feel a strong pull from the hose. If you don't, a bad or disconnected hose is affecting operation.

3. Reattach the hose to the vacuum-advance housing. The timing mark should return to where it was before.

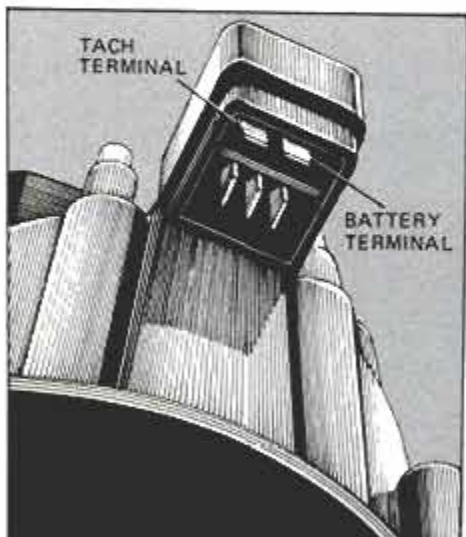
If you don't get this action, replace the vacuum advance. The vacuum diaphragm in the chamber has probably sprung a leak.

Note: If there is more than one vacuum

advance, consult a factory service manual.

To test the mechanical-advance unit, which is referred to commonly as the centrifugal advance, connect a tachometer. Slowly increase engine speed to 2,500 rpm as you aim the timing light at the timing marks.

You should see the timing marks begin to advance smoothly somewhere between 1,800 and 2,500 rpm. If action is sluggish, jerky or doesn't occur, there is a malfunction. Springs that control the weights may have lost tension or the advance mechanism may be stuck.



Disable GM HEI system by disconnecting wire on BAT terminal in distributor cap.

Other reasons for power loss

- Clogged carburetor-air-filter element.
- Sticking choke plate, linkage (Section 1).
- Clogged fuel filter (Section 1).
- Damaged EGR valve (Section 2).
- Bad thermostatic air cleaner (Section 2).
- Out-of-spec basic engine adjustments.
- Faulty PCV system (Section 2).
- Damaged distributor cap, rotor (Section 5).
- Worn sparkplugs (Section 5).
- Damaged, loose or disconnected vacuum hose (Section 3).
- Worn or bad distributor breaker points of a conventional ignition system.
- Worn distributor shaft.
- Weak ignition coil.

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CAR CARE GUIDE

SECTION 5. ENGINE MISFIRES

"Why Is My Engine Missing?"

The term "missing" is interpreted differently by different people. Generally, it means that you feel a steady pulsating or jerking feeling as you increase speed up to about 35 mph, or that you hear the exhaust emitting a spitting sound at low speed and idle. All of the following are potential causes:

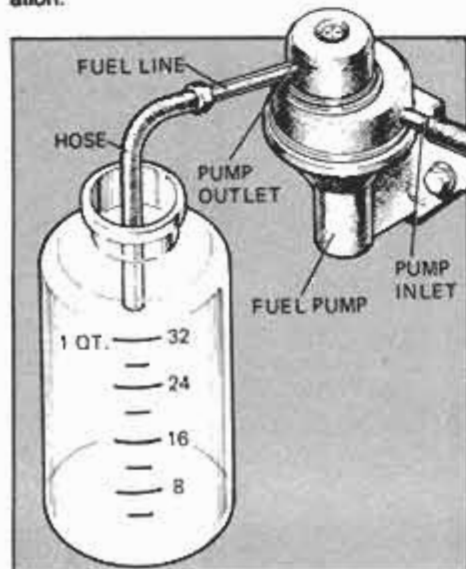
- Excessively lean fuel mixture.
- Defective electronic control module.
- Worn sparkplug or sparkplugs.
- A corroded distributor cap or rotor.

Lean fuel mixture

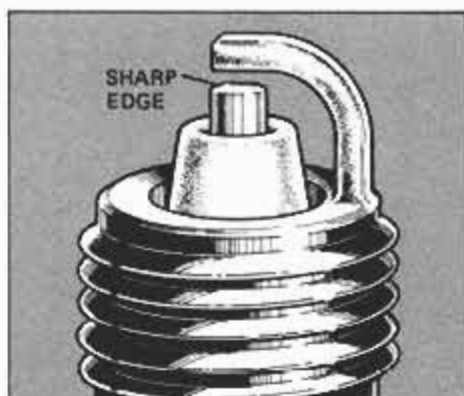
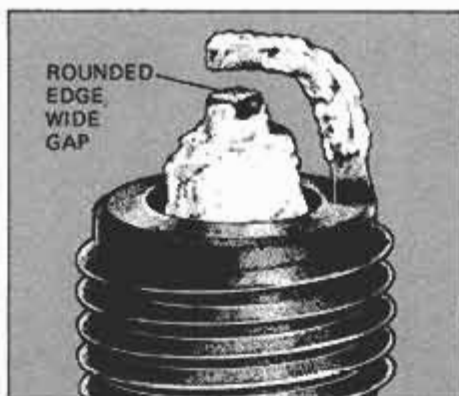
An excessively lean fuel mixture will cause an engine to stumble or miss upon acceleration. This is due to the fact that lean mixtures are not always ignited by the sparkplug. A lean mixture can be the result of a vacuum leak in one of the hoses, in one of the emission components, or between the carburetor and intake manifold or intake manifold and cylinder head. The most common cause of lean fuel mixture is a dirty carburetor. If dirt gets into the carburetor's jets or main metering circuit, fuel delivery will be impeded and lean stumble will result. The solution to a dirty-carburetor problem is either a complete carburetor rebuild or replacement.

Defective electronic control module

A defective electronic control module was mentioned as one potential cause of no-start problems. Perhaps it should be mentioned again here, because a defective module can make itself known in a variety of ways, one of which might be intermittent, stumbling acceleration.



To perform a fuel-pump volume test, you need a graduated container to catch fuel.



If you have a sparkplug which is fouled with heavy deposits (left), you can often clean it up to a reusable condition (right) by using a sandblaster and a small flat file.

As we mentioned before, control-module failures are somewhat rare nowadays, and very difficult to pinpoint. Changing control modules should be a last resort. Try to eliminate all other potential sources of engine problems. GM has a procedure designed to zero in on the cause of misfire and prevent the unnecessary replacement of expensive electronic components. The GM method calls for an inspection and testing procedure as follows:

1. Examine vacuum hoses for splits, kinks and loose connections.
2. Test to make sure there is no vacuum leak at the carburetor/intake manifold area.
3. Examine ignition wires for cracks and loose connections.
4. Warm up the engine and disconnect the vacuum hoses from the thermostatic air cleaner sensor and from the EGR valve. Seal the ends of both hoses. You can use golf tees or pencil stubs. If this clears up the miss, the EGR valve, the thermostatic sensor or the air-cleaner vacuum motor is defective.
5. With the engine running, use insulated pliers to remove sparkplug cables, one at a time, from sparkplugs. Reconnect each cable before removing another. Every time a cable is removed, there should be a drop in engine rpm.
6. If there is a drop in rpm for all cylinders, then check the following areas in an effort to locate the trouble.

- Virtually all carburetor systems and components.
 - Timing and choke adjustments.
 - All emission-control devices that operate on, or limit, engine vacuum.
 - Electronic control module.
 - Overall cylinder compression.
7. If there is no drop in rpm when you disconnect one of the sparkplug ca-

bles from a cylinder, do the following:

- Remove the sparkplug and look for damage, wear, incorrect gap and heavy deposits.
- Check sparkplug cables with an ohmmeter.
- Examine the distributor cap and rotor for damage.
- Check for worn camshaft lobes, worn rocker arms, bent pushrods and broken valve springs.
- Check the compression of that particular cylinder.

Working on sparkplugs

If there's one component which causes performance problems most frequently, including missing, it's the sparkplug. Even in this day of engine computers and esoteric sensing devices, sparkplugs haven't changed much in one basic respect: If they fail, no amount of "space-age" componentry placed on an engine is going to make that engine run well.

There's only one way to remove sparkplugs for examination and cleaning (or replacing)—and that's the right way. Any other method can cause engine damage.

1. Before removing cables from sparkplugs, identify each cable in some way so you can reattach it to its proper cylinder. Incorrect reinstallation can alter the engine firing order and damage engine parts.

2. If necessary, use a sparkplug-cable removing tool to twist and pull cable boots from plugs. Your auto-parts and accessories dealer can show you several types. Some car models have boots that are preformed into a handle. If you have one of these, you won't need a tool. Grasp the boot handle, twist and pull.

Caution: Don't pull on cables. You will damage them.

3. Before removing the sparkplugs,

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To install new or used plugs, screw them into ports until they are finger-tight. Then, tighten them with a sparkplug wrench, but don't over-tighten them. If plugs have tapered seats without gaskets, turn them approximately $\frac{1}{8}$ of a turn from the finger-tight position. If plugs use gaskets, tighten them until the wrench offers only moderate resistance.

Damaged distributor cap or rotor

As indicated in the GM troubleshooting procedure just presented, a badly corroded or cracked distributor cap or burnt rotor can cause misfire.

Be particularly suspicious of cap and rotor condition when you have just removed a set of badly worn sparkplugs. The extra voltage required to fire the worn plugs will quickly corrode the cap and rotor and may cause tracking within the cap. Tracking is evidenced by thin lines of carbon across the interior surface of the cap. The spark voltage can easily be induced to follow the track if there is something that makes the cylinder a little hard to fire. Replace any caps or rotors that show evidence of potential problems.

To prevent hooking up the wires incorrectly when you're replacing a distributor cap, use the following procedure. Remove the old cap, but keep the wires attached to it. Install the new cap on the distributor. Then, with the old cap and wires oriented next to the new cap, remove the wires one at a time from the old cap and install them at the corresponding positions on the new one. This should keep you from getting your wires crossed.

FM

SECTION 5

blow dirt particles from sparkplug ports to prevent them from falling into cylinders as plugs are removed. Use compressed air, if it's available. You can buy compressed air in cans; one such product, called Dust-Off, is available in photo and hobby shops. As a last resort, aim a straw at the sparkplug ports and blow through it to dislodge dirt.

4. Using a ratchet wrench and socket, turn plugs counterclockwise to loosen and remove them. The socket must fit plugs properly, or you may break a plug. Most plugs need a $1\frac{3}{16}$ -in. hex socket, but some require a $\frac{5}{8}$ - or $\frac{7}{8}$ -in. size.

Important: Remove plugs with the engine cold. If the engine is warm, plugs may bind and be more difficult to loosen.

5. As you take each sparkplug out of the engine, wrap a piece of masking tape around it and write a number on the tape that coincides with the cylinder number. If you reuse plugs, put them back into the cylinders from which you took them.

If one or more plugs are worn, replace the whole set. However, it is okay to replace just one damaged plug if the others are fairly new.

If all sparkplugs are in good condition and apparently aren't causing the engine miss, don't reinstall them immediately. As long as they're out of the engine, you might as well clean and gap them first.

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"Why Does My Engine Sound Like It's Going To Self-Destruct?"

Ping or spark knock is the rattling sound that you hear during light to medium acceleration. It's most noticeable when the engine is under heavy load, such as when you're going uphill. The noise is actually caused by a combustion problem called detonation.

Detonation results when two separate flame fronts are established within the combustion chamber. Each of these flame fronts produces heat and, consequently, pressure. This pressure and heat cause unburned fuel between the two flame fronts to ignite. Because the burning gases don't have room to expand gradually, a violent explosion takes place and causes the piston, connecting rod, and cylinder block to vibrate.

You hear the vibrations as pinging or spark knock.

Detonation can be caused when a secondary flame front is ignited after spark ignition has taken place. It can also result when the mixture is ignited by part of the combustion chamber before the spark occurs. When the secondary ignition occurs before the spark, it is sometimes called preignition. The symptoms, however, are identical, and many of the causes are overlapping.

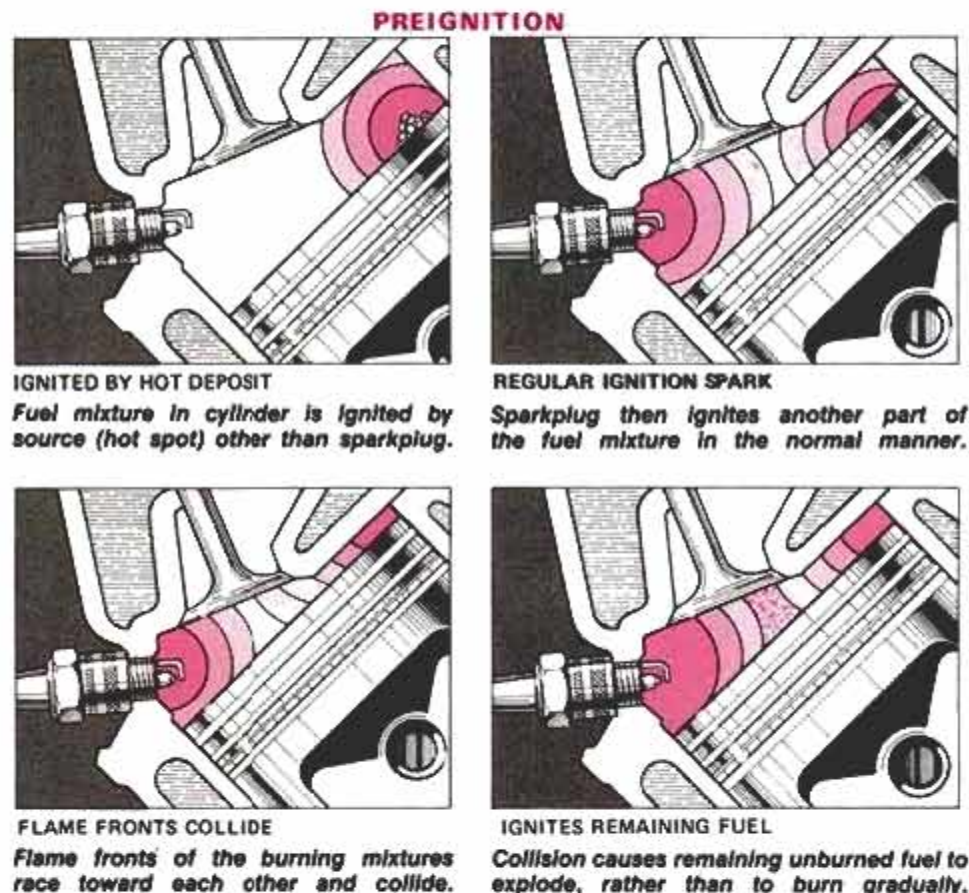
The causes of detonation include:

- Excessively low fuel-octane number.
- Ignition timing too far advanced.
- Overheated engine.
- Incorrect sparkplug heat range.
- Crossfire through sparkplug cable induction.
- Carbon deposits in the combustion chamber.

Choosing the right fuel

Contrary to what you might believe, low-octane fuel produces more heat when it burns in the combustion chamber than high-octane fuel. It's also easier to ignite. That's why a fuel that is too low in octane number can cause detonation.

If your car was made to run on unleaded gasoline, you have your choice of regular or premium unleaded. Some cars that once performed satisfactorily on regular unleaded may have accumulated enough carbon in the combustion chambers that they now have higher cylinder pressures during combustion. Higher cylinder pressure means more heat, and more



heat means detonation. Sometimes a switch to high-octane unleaded is all that's need to solve such a problem. These premium unleaded fuels are available in a range of octane numbers. Shop around to find one that your engine likes.

If you're driving a car with a high-compression engine (9.5 to 1 or above) that was designed to run on premium leaded gasoline, you'll have to resort to other tactics. While some of these engines will not detonate on unleaded premium, they need a dose of lead to protect the exhaust valves. Therefore, a mixture of 75-percent unleaded premium and 25-percent leaded regular may be just right for these cars. A mixture of 50/50 should also be

tried. Use the one that performs best without detonation.

Some reports suggest that the mixture of these two grades of gasoline produces a fuel with an octane number that is actually higher than the octane number of either. This is possible because octane numbers are not related to the chemical composition of the fuel, only to its knock resistance.

With engines of ultrahigh compression (over 10.75 to 1), you'll definitely have to use aviation gas or specially formulated racing fuel. The other alternatives are water injection, a camshaft designed to lower dynamic cylinder pressure or an engine modification to reduce compression ratio.

(Please turn to page 174)

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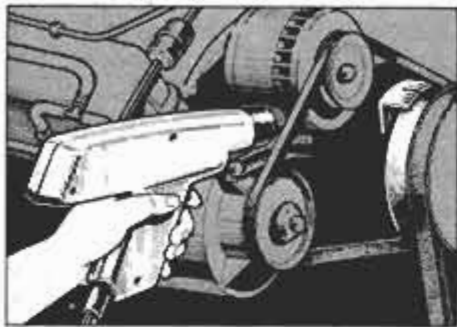
SECTION 6. PING AND KNOCK

Adjusting Ignition timing

About two milliseconds separate the ignition of the fuel mixture and complete combustion of the fuel mixture.

Sparks across sparkplug electrodes have to arc early enough to assure this complete combustion.

If sparks occur too late—that is, timing is retarded—power is lost. On the other hand, if timing (spark) occurs too early—that is, timing is too far advanced—extreme pressure from trapped gases builds up before combustion is completed.



Point timing light directly at the timing marks and sight straight down the barrel.

This pressure causes the unburned portion of the fuel mixture to ignite and detonation results.

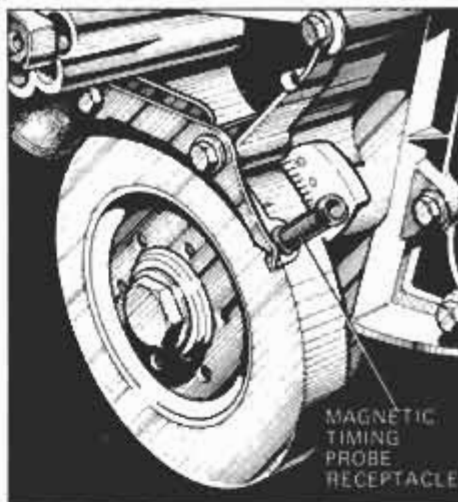
Undoubtedly, proper timing adjustment is important for all-around good engine performance.

However, changes in automotive technology, primarily in electronic engine controls, are calling for a different way to check this adjustment. Many modern engines now have magnetic-timing-probe holes, so that timing can be checked with special electronic timing equipment. On practically all engines, though, you can still use the old-fashioned timing light. Here's how:

1. Warm up the engine; then turn off the ignition.

2. Find the timing marks and the index or reference pointer. If they don't stand out, dab the timing mark that corresponds to the correct amount of advance for your engine and the index or reference point with white paint. The location and significance of the timing mark on your engine are provided in the car owners manual, service manual and/or on the emission-control label mounted under the hood.

Note: Starting at 0, you can usually figure out the calibration of each of the timing marks.



Magnetic timing probe hole allows timing to be checked with special equipment.

However, if you can't and you don't have a service manual to guide you, ask the service manager at a dealership that sells your make of car.

3. To time practically all ignition

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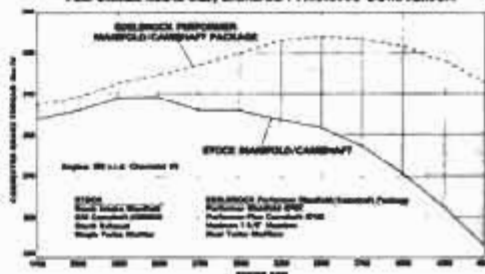
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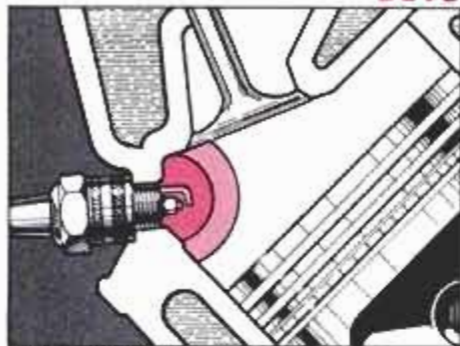


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CAR CARE GUIDE

SECTION 6. PING AND KNOCK

DETONATION



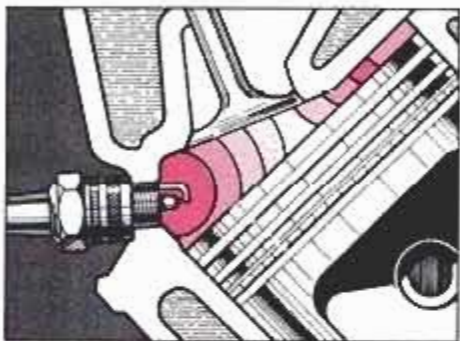
SPARK OCCURS

Detonation begins when the sparkplug ignites a portion of the fuel mixture.



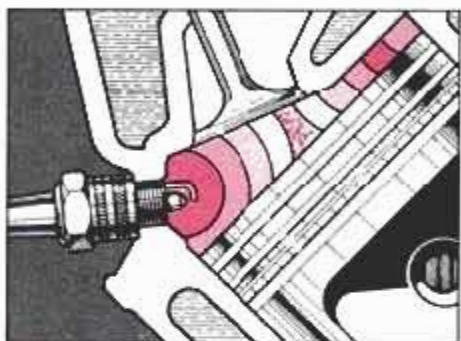
COMBUSTION BEGINS

Fuel mixture burns with a traveling flame that moves away from the sparkplug tip.



CONTINUES

The second ignition of the fuel mixture occurs in another area of the cylinder.



DETONATION

Flame fronts collide and cause the remaining unburned fuel mixture to explode.

systems, first disconnect the hose from the spark-advance vacuum chamber. Plug the end of this hose with a golf tee or pencil stub.

4. If you have a magnetic (inductive) lead on your timing light, attach the clamp to the cable of the No. 1 sparkplug. Connect the other two leads to the car battery. Be sure to observe correct polarity.

If your timing light doesn't have a magnetic pickup, detach the ignition cable of the No. 1 sparkplug and insert a pickup adapter (available from an auto parts and accessories dealer) between the cable terminal and plug. Attach the timing-light pickup to the adapter and hook up battery leads.

Caution: Never puncture the sparkplug cable with a probe to connect the timing light. You will ruin the cable.

5. Start the engine and point the timing light at the timing marks. Hold the light straight and look down the "barrel," if you can.

With some cars, such as some Fiestas, don't tilt the timing light to see the timing marks. Instead, look at the marks by peering down the side of the timing light.

If timing is properly adjusted, the correct timing mark and index or reference pointer will appear to be aligned each time the stroboscopic light flashes. If the timing mark and index or reference pointer are not aligned, adjust the timing as follows:

1. Working with a distributor wrench, loosen the distributor hold-down bolt.

2. With the engine running and the timing light pointed at the timing mark, rotate the distributor until the timing mark and index or reference pointer appear to be completely in alignment each time the strobe light flashes.

3. Tighten the distributor hold-down bolt and recheck the setting.

Don't forget the cooling system

Don't overlook the obvious in searching for the cause of pinging. Excessive engine heat can ignite fuel prematurely or cause a secondary ignition, so look for a low coolant level, a restricted air flow, an inoperative electric cooling fan (in cars that have these), a loose water-pump drive belt and a thermostat that is stuck in the closed position.

Sparkplug heat range

If the sparkplugs are too hot for your engine, preignition will occur, causing subsequent detonation. This preignition results when the incoming fuel-air mixture comes in contact with the hot sparkplug electrodes or insulator. Each engine is designed to operate best with a specific sparkplug. Sparkplugs vary in heat range

(Please turn to page 176)

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CAR CARE GUIDE

SECTION 6. PING AND KNOCK

(Continued from page 175)

according to the length of the insulator cone and the distance the electrode and cone protrude from the end of the plug.

Generally, the plug that is recommended as original equipment will be best for your engine. However, automakers have sometimes revised sparkplug recommendations after or during a model year.

If you suspect that hot sparkplugs may be causing detonation, remove them and examine them. The insulator should range from very light gray or tan in color to dark gray or tan. Electrodes should show only wear, not melting. There should be no blistering of the insulator. If the engine has been detonating, the insulator may be cracked. If inspection reveals your plugs to be too hot, replace them with a set that is one-half heat range colder. Run these for a few hundred miles and repeat the inspection. If most of your driving is done at high speed on the highway, you may need a plug that is slightly colder than what the manufacturer recommended. Generally, it is not advisable to use a sparkplug that is in a hotter range than recommended.

Crossfire prevention

Crossfire occurs when current moving

through one plug wire induces a current to flow in a parallel wire. The induced current causes a spark in a plug that was not supposed to fire at that time. It can establish a flame front which will cause detonation when the actual ignition occurs.

Crossfire is easily prevented by making sure plug wires that are next to each other cross, rather than lie parallel.

Carbon deposits in the combustion chamber

As mentioned earlier, carbon deposits in the combustion chamber can cause detonation. One way they contribute to this problem is that they raise combustion pressure, which, in turn, causes heat.

However, carbon deposits can also be a direct cause of preignition, if they continue to glow after the spent gases have been exhausted from a cylinder.

There are commercial solvents available for removing carbon deposits from engine combustion chambers and pistons. Try one of these, if you suspect that carbon buildup is causing detonation. Another possible cure, already mentioned, is switching to a higher octane fuel.

A final solution is removing the cylinder

heads and scraping the carbon from the chambers and pistons.

Other reasons for detonation

Among the other common causes of detonation are:

- A nonfunctional EGR valve (Section 2).
- A lean fuel mixture (Section 5).
- Vacuum leaks (Sections 2 and 3).
- Sticking centrifugal-advance weights. **PM**



Holed piston can result when detonation or preignition condition goes unchecked.

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"Why Does My Engine Run On After I Turn It Off?"

An engine is said to diesel when it continues to run—although unevenly—after the ignition is shut off. The following malfunctions can contribute to this:

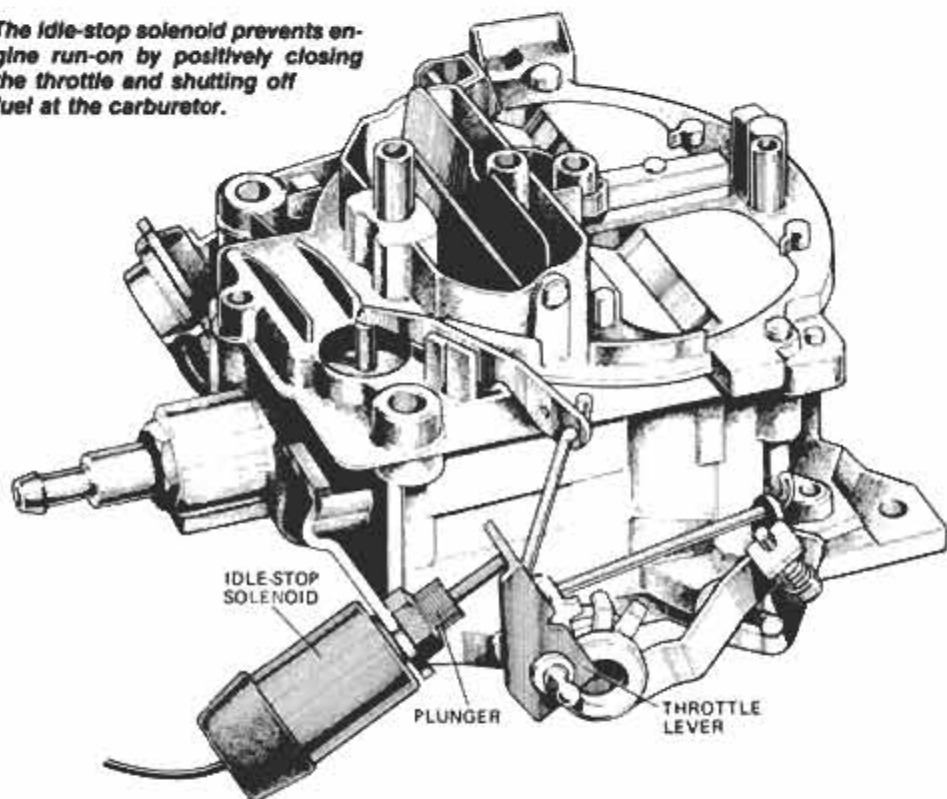
- A defective EGR valve.
- A leaking fuel-injector nozzle.
- Carbon in a cylinder.
- A ruptured spark-advance diaphragm.
- A damaged choke vacuum break.
- An inoperative idle-stop solenoid.
- An incorrect idle adjustment.

Three conditions—a combination of unburned fuel in the cylinders, a source of ignition after the engine is turned off and a supply of air—must be present for dieseling to occur. The fuel burns and engine run-on continues until all fuel is consumed.

To control dieseling, you must stop the input of fuel as the ignition is turned off, shut off the air supply or control the ignition source. If your engine diesels, consider:

- Is the octane of your fuel too low? An additive in higher-octane fuels resists ignition when the engine is turned off.
- Is engine timing set properly? Incorrect ignition timing can raise combustion temperature. When the engine is shut off, deposits in the chamber glow and provide ignition.
- Any component controlled by vacuum can cause dieseling if it is defective and offers an air inlet after the engine is turned off. See Section 2 for an EGR valve check and Section 8 for a vacuum-break diagnosis.
- Is the carburetor out of adjustment? A high idle speed is the most likely cause of dieseling.
- Is the throttle linkage catching on something as it returns to idle position in preparation for a shutdown? If so, idle speed will rise and probably cause dieseling.

The idle-stop solenoid prevents engine run-on by positively closing the throttle and shutting off fuel at the carburetor.



- Have you ever treated your engine with carbon solvent? It's worth a shot, since a plug of carbon in a cylinder may get hot enough to serve as a source of ignition.

Testing an idle-stop solenoid

If your engine has an idle-stop solenoid, you'll find it on the carburetor. To test it:

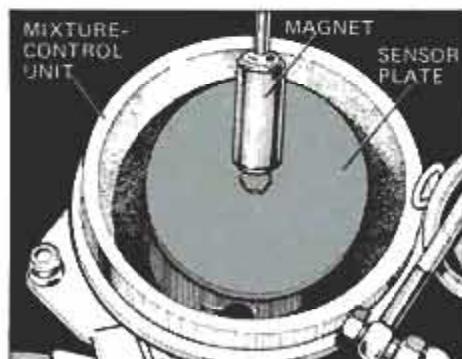
1. **Watch the solenoid as someone starts the engine, accelerates it quickly to half-throttle and then lets it drop to idle.** The solenoid plunger should come out and catch the throttle lever as it snaps closed.
2. **Turn off the engine.** The plunger should retract at once, letting the throttle close. If it doesn't, the engine may diesel.
3. **If these things don't happen, detach the wire from the solenoid terminal and turn off the ignition.** Check with a voltmeter or test light for battery voltage. If there is none, replace the wire. If voltage is okay, reconnect the wire.
4. **Hook up a tachometer and adjust engine idling speed to maker's specification.** Use a small wrench to turn the idle-

stop plunger. Retest solenoid. If it doesn't function, it's no good. Install a new one.

Test for a leaking injector

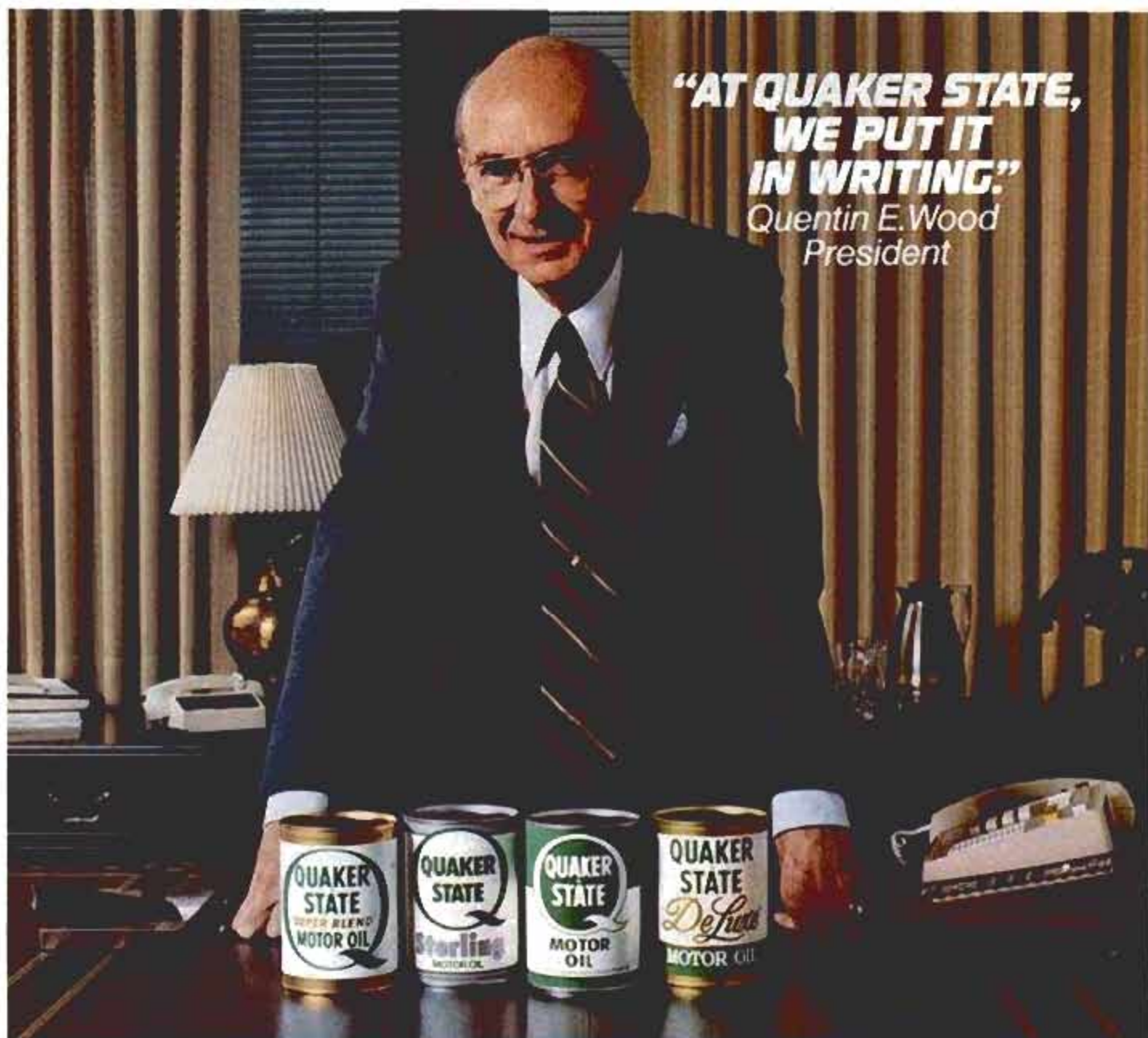
Fuel injection systems are not hard to troubleshoot. For example, to test for a VW leaking injector system, you'd do this:

1. **By hand, pull one of the injectors from the manifold tube.** Leave the fuel hose attached.
2. **Remove the rubber duct from the top of the mixture control unit to uncover the sensor plate.**
3. **Remove the fuel-pump relay and connect a jumper** (see Section 1).
4. **Point end of the injector in a glass and use a magnet to lift the sensor plate.** The injector should eject fuel in a proper spray pattern.
5. **Release the sensor plate.** If the end of the injector drips, replace it.
6. **If the injector is okay, moisten the rubber seal with gasoline and press the injector firmly in its seat in the manifold tube.** Test each injector the same way.



Test VW fuel injector with magnet to lift sensor plate in mixture control unit.

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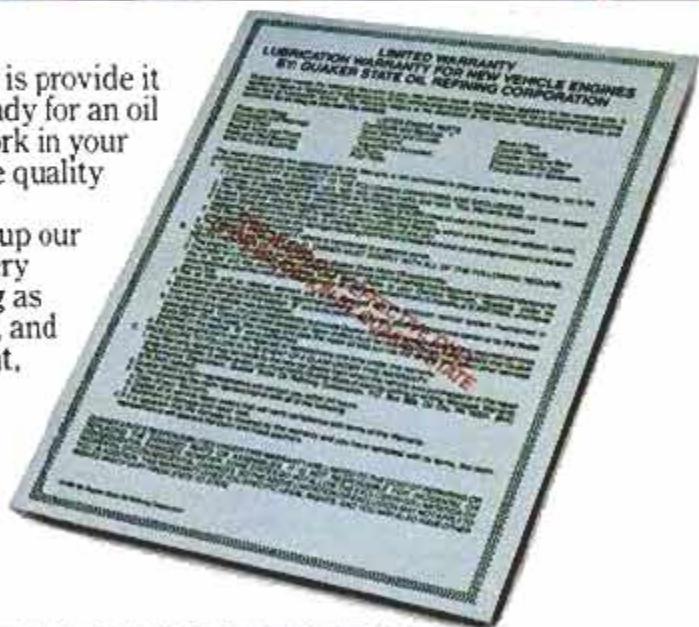
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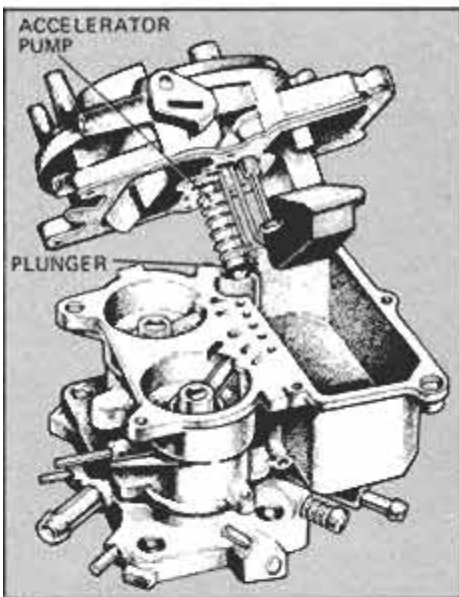
SECTION 8. ENGINE HESITATION

"Why Does My Engine Balk When I Step On It?"

You've tuned up the engine—there are new plugs, all adjustments have been made to the carmaker's specification and so forth. Still, when you attempt to accelerate, the engine stumbles. Why?

Some of the likely causes include:

- The vacuum break is ruptured
- The accelerator pump is damaged
- The thermostatic air-cleaner valve hangs up.



Faulty accelerator pump may have a weak spring or plunger that's become brittle.

In addition to these you can add vacuum-hose leaks, an air leak at the carburetor-manifold joint and damaged ignition wires.

Defining the problem

Let's make sure that we're speaking about the same problem: Stumbling, flat-spot acceleration, hesitating and faltering are defined as a momentary lack of response as you push down the accelerator pedal. Although this trouble can occur at any speed, it is usually most pronounced when you take off from a dead stop.

The condition doesn't usually cause the engine to stall. However, it could—if the problem is severe enough.

Once you are satisfied that the engine is properly tuned, follow this diagnostic approach as you try to get to the bottom of the problem:

1. Examine vacuum hoses (see Section 3). Look for an air leak at the carburetor-manifold joint (see Section 2), and also examine and test the ignition wires (see Section 1).

2. If stumbling on acceleration occurs only when the engine is cold, check operation of the automatic choke. Also test to make sure that the valve in the thermostatic air-cleaner snorkel closes when the engine is cold. Incidentally, if the engine is warm when you are performing this test, wrap some ice in a rag and hold it over the sensor, which is located in the air-cleaner housing. The valve should close with the engine running. Test the action of the accelerator pump (see below).

How to test the choke vacuum break

The purpose of the choke vacuum break is to help the choke plate overcome the resistance that's imposed by the thermostatic spring when the engine is beginning to warm and the choke plate is opening. The "pull" on the choke plate by the vacuum break opens the plate slightly to lean the fuel mixture just enough to avert performance problems caused by an overly rich mixture.

When a vacuum break fails, the choke plate will remain closed until the engine gets warm enough for the thermostatic spring to release its grip. In the several minutes it takes for warm-up, the overly rich fuel mixture can cause the engine to stumble on acceleration.

To find out if the vacuum break is working as it should, follow the procedure outlined below:

1. Start the engine and then pull the hose away from the vacuum break chamber.

2. Close the end of the vacuum hose by pressing your thumb against it. Do you feel a strong pull (vacuum)? If not, check to see that the other end of the hose is connected to the vacuum source, and that the hose isn't kinked or split.

3. Turn off the engine and reconnect the hose to the vacuum break chamber.

4. Now, disconnect the same hose at the other end, that is, at the vacuum source. Attach your hand vacuum pump to the hose.

5. Keeping your eye on the link connecting the vacuum break to the choke actuator lever, pump up the vacuum. This should cause the link to move.

If it doesn't, you should replace the vacuum break.

How to check the accelerator pump

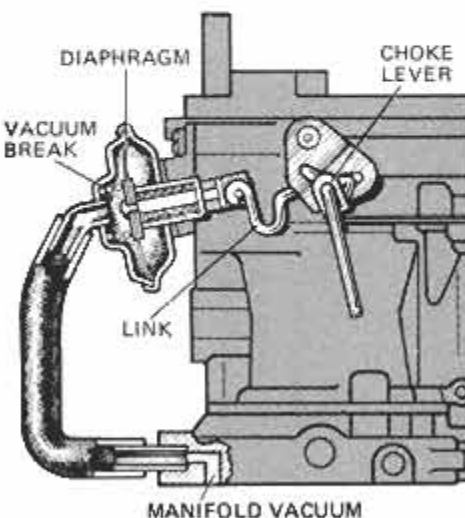
The accelerator pump is a device that provides a steady stream of fuel within the carburetor when you suddenly depress the throttle. This quick action is designed to prevent the mixture from suddenly becoming very lean, which, in turn, results in the feeling of hesitation.

Some accelerator pumps provide fuel by means of a leather or synthetic plunger that pushes the fuel out of a reservoir past a check valve, and through a nozzle which is aimed at the carburetor bore. Other types of accelerator pumps depend on a diaphragm to move the fuel. In either case, the movement of the throttle linkage actuates the pumping mechanism. If the plunger or diaphragm should be defective, the accelerator pump won't function.

1. Remove the air cleaner from the carburetor.

2. With the engine turned off and the choke valve open, move the throttle valve once or twice while looking for gas to squirt into the carburetor.

3. If there's a weak squirt or none at all, replace the accelerator pump. To do this consult a car repair manual for procedure. After installing the new pump, make adjustments conforming to the manufacturer's specifications. **PM**



Vacuum break opens choke slightly when engine starts in order to stop flooding.

11 mg. "tar", 0.9 mg. nicotine av. per cigarette, FTC Report DEC. '81

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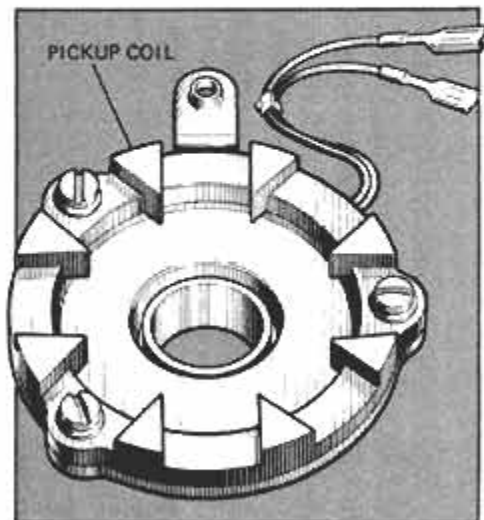
SECTION 9. ENGINE CUT-OUT

"Why Is My Engine Cutting Out?"

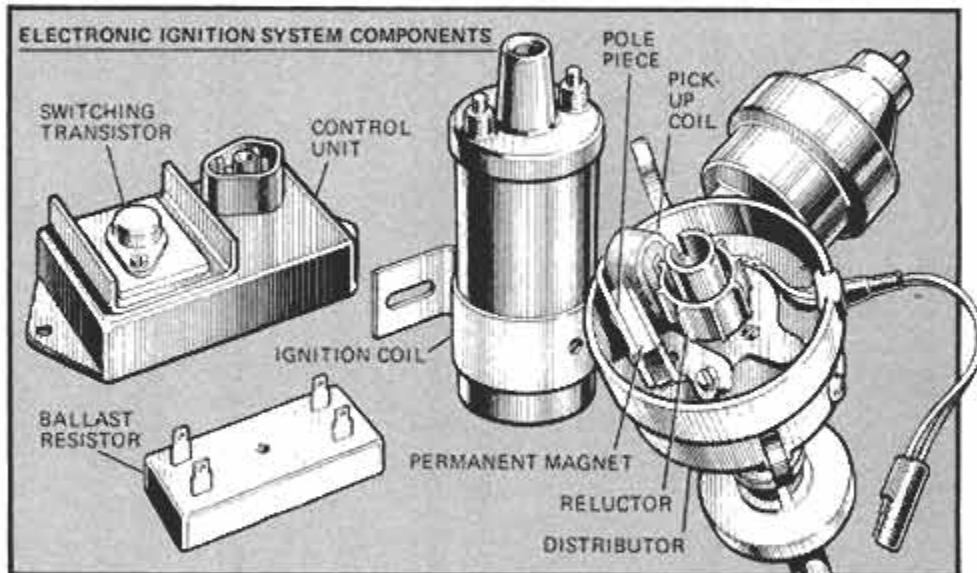
One of the most harrowing experiences you can have is to be driving along, come to a hill, press the accelerator pedal to gain speed and have the engine quit. It restarts, but as soon as you accelerate, the same thing happens. Following one frustrating attempt after another, the engine finally starts and stays started as if a problem never existed. However, a couple of days or weeks later, the trouble strikes again.

The main factor for the increase in occurrences of this problem is oxidation on electronic ignition modules. If you have a GM car with the High Energy Ignition (HEI) system, oxidation buildup may be causing intermittent cut-out. In non-HEI systems, when the electronic control unit (ECU) fails, an engine that cuts out cannot usually be started again until the ECU is replaced.

The ECU and HEI modules perform essentially the same function. The ECU, however, is a box separate from the distributor, while the HEI module is a rectangular component inside the distributor.

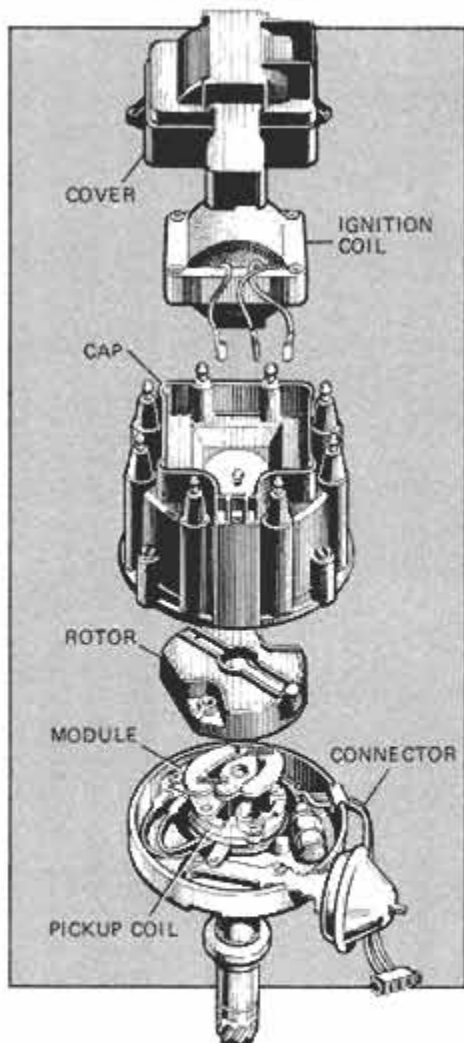


Pickup coil consists of a permanent magnet with internal teeth. Test with ohmmeter.



Malfunction of one or more of these ignition components can cause the engine to cut out intermittently or just stop dead.

INTEGRAL IGNITION COIL AND DISTRIBUTOR



GM's Delco High Energy Ignition (HEI) system has ignition coil built into cap cover.

On several occasions, *Car Clinic* has discussed how you should try to salvage a defective HEI module (the part costs over \$60). This information was last presented two months ago, so if you are experiencing cutout in a GM car, turn to *Car Clinic*, page 45, Mar. '82.

Diagnostic procedure

There are several other possible reasons why engines cut out, but the cause is not always easy to find. Follow this approach:

1. Look for damaged and loosely connected ignition wires, bad spark-plug boots and a damaged distributor cap.

2. Check sparkplugs—just in case.

3. Replace fuel filter (see Section 1).

4. Test fuel pump (see Section 5).

5. Check the ignition coil for intermittent breakdown. Since the coil doesn't always show "bad" on a coil tester, except when the trouble is actually occurring, the only other way to do this is to substitute a coil you know is good.

6. Test the pickup coil, another part of an electronic ignition system that can cause trouble. Use an ohmmeter.

7. Check fuel lines for splits through which air is being drawn.

8. Check inside the distributor for bare or loose wires. A worn distributor shaft may also cause engine cutout. You may have to remove the distributor for inspection.

9. Although fuel tank strainers are made of coarse material that don't usually clog, it's a possibility. Therefore, at this point, drop and open the tank, remove the pickup, replace the strainer and clean the tank before putting it back.

10. Finally, a dirty, damaged carburetor may be the culprit. You may want to overhaul or replace it if it's been in use for many thousands of miles.

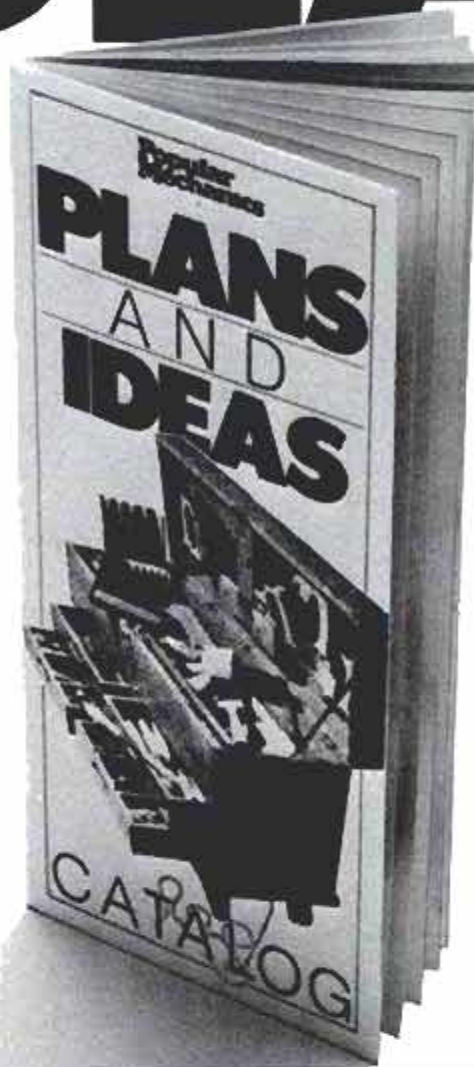
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SECTION 10. ENGINE SURGES

"Why Is My Engine Like A Bucking Bronco?"

Surging is another engine-performance problem that has become prominent in recent years. The condition is described as a variation in engine power or a complete loss of power, although a steady pressure is being applied on the accelerator.

It differs from the condition described in the last section in that it is not aggravated by increased pressure on the accelerator pedal and may even disappear at wider throttle openings. The car seems to speed up and slow down alternately.

Surging can occur because:

- The EGR valve diaphragm leaks vacuum.
- PCV-valve movement is restricted.
- The vacuum (spark) advance isn't functioning.
- The electronic-ignition pickup is defective.

For information about EGR and PCV, see Section 2. Section 4 explains how to test the vacuum (spark) advance.

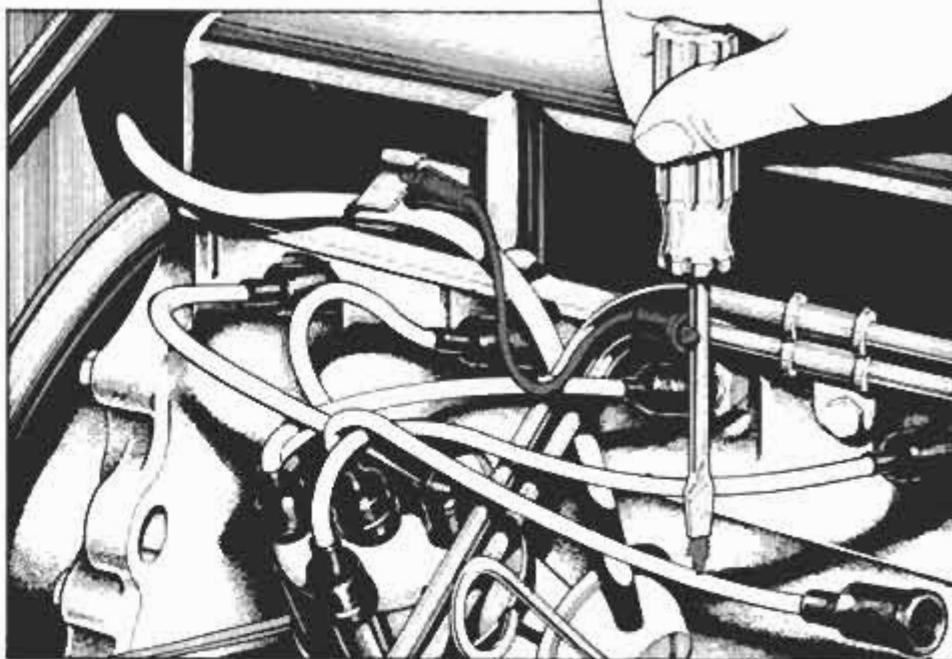
If you examine the preceding list of causes carefully, you'll see that we have actually included two distinctly different types of problems under this heading. The first three are related to fuel mixture. They are all potential sources of vacuum leaks which can lean out the mixture, resulting in misfire. Depending on when and how severely this misfire occurs, the resulting symptom can be interpreted as missing, rough idle or surge.

The last item, electronic-ignition pickup failure, can produce a symptom that is very similar to a lean misfire, because it also results in misfire. However, this misfire is the result of ignition failure, rather than a fuel mixture that is too lean to ignite. While some pickup failures may first make themselves known with a symptom that is better described as a miss, some pickup failures, particularly GM HEI, produce a symptom that is better described as a surge.

In fact, a professional mechanic who operates one of the nation's largest independent repair facilities told us recently that pickup failures are the primary cause of surging in GM cars equipped with HEI ignitions.

Diagnosing pickup failures

Actually, the failures that plague GM HEI pickups are not due to problems in the pickup coil itself; they are the result of broken or partially broken pickup wire leads. These leads are attached to the pickup at the time of manufacture and they connect it to the control module when it is installed in the distributor. The pickup of pre-1982 GM ignitions without electronic spark control is mounted on the distributor's breaker plate. When the vacuum-



Test sparkplug cables by grounding a screwdriver to engine with a jumper wire. With cable off plug and engine running, draw screwdriver along the cable and check for sparks.

advance mechanism rotates the breaker plate to provide additional spark advance, the pickup leads must bend. After they've been bent a couple of million times or so, they sometimes break internally. This causes the engine to lose power intermittently, as the advance mechanism moves the breaker plate back and forth. The result is a symptom that can be described as surging.

To check for this condition, you'll need an ohmmeter and a vacuum pump. (Sometimes, however, you can detect a break in a pickup lead merely by examining it.) The test involves checking pickup resistance while moving the breaker plate and can be performed as follows:

1. With the engine shut off, remove the distributor cap and the vacuum-advance hose. Attach a hand vacuum pump to the vacuum-advance port.

2. Disconnect the two pickup leads from the control module and attach them to the two leads of an ohmmeter.

3. Move the breaker plate back and forth by activating the vacuum-advance unit with the hand vacuum pump while watching the ohmmeter. If the ohmmeter indicates infinite resistance at

any point, a pickup lead is broken and the pickup will have to be replaced.

To replace the pickup of a GM HEI distributor, the distributor must be removed from the car. Before removing the distributor, mark the position of the rotor and the position of the distributor base in respect to the engine so the ignition timing can be reset easily. Disconnect external distributor leads and remove the distributor hold-down bolt and clamp. Then pull the distributor up and note the new position of the rotor. (It will turn as the distributor is raised.) Mark this position as well. (You will locate the rotor in this position when you reinsert the distributor. Then you'll check to see that it rotates to the other position when reinstalled.)

Once the distributor has been removed, mark the distributor shaft and gear so that they can be reinstalled in the same relative position. Then drive out the roll pin that secures the gear and remove it. Remove the distributor shaft with the rotor and advance weights in place. Then remove the thin "C" washer from on top of the pickup coil. Disconnect the pickup coil leads from the module and remove the pickup coil. Don't remove the three screws.

To install a new pickup, repeat the above procedure in reverse, noting alignment marks

(Please turn to page 186)

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(when others do)

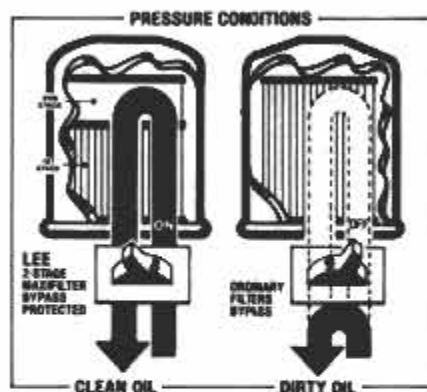
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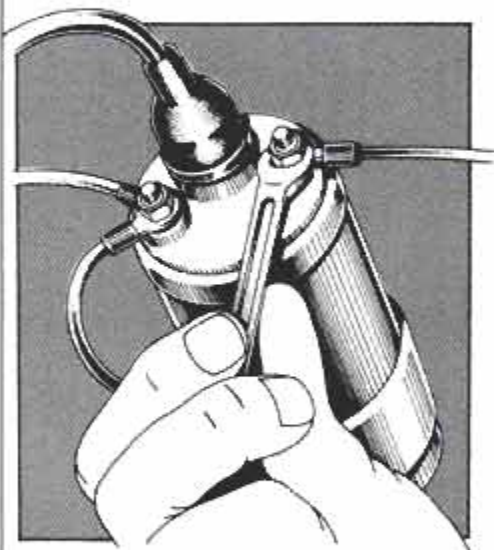
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CAR CARE GUIDE

SECTION 10



Check all electrical connections for corrosion and tightness—especially at the coil.

(Continued from page 184)

when reinstalling the gear and when replacing the distributor in the engine.

After the distributor has been reinstalled in the engine and secured, set the initial spark advance according to specifications on the vehicle emissions-control information label. On most GM cars, this important source of tuning specifications is located on the radiator support panel.

Other causes of surging

Surging can also result if one of the following conditions exists:

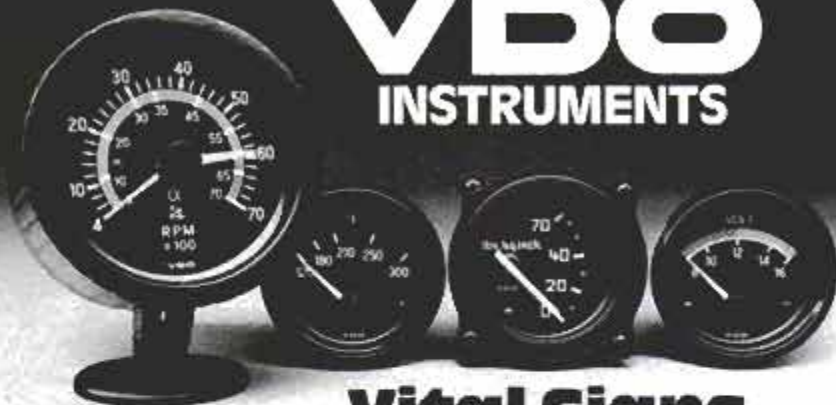
- Inoperative thermostatic air cleaner or a clogged air-cleaner filter (Section 2).
- Split, kinked or improperly connected vacuum hose (Section 3).
- Leak at the carburetor-manifold junction (Section 2).
- Faulty centrifugal-advance mechanism (Section 4).
- Dirty or damaged carburetor (Section 5).
- Faulty sparkplug wires (Section 5).
- Poor or loose electrical connections (Section 5).

To check for a faulty sparkplug wire, do the following:

1. **Disconnect the sparkplug wire at the tip of the sparkplug** while the engine is running.
2. **Connect a wire from the shaft of a screwdriver to a good engine ground.**
3. **Run the tip of the screwdriver along the length of every sparkplug wire** while watching closely to see if you can spot a spark jumping from the wire to the screwdriver.

If a spark occurs on any of the wires, you should replace them all. If you do need to replace wires, use silicone wire sets. They resist heat and cracking much better than the more conventional fabric- and rubber-insulated wires. **PM**

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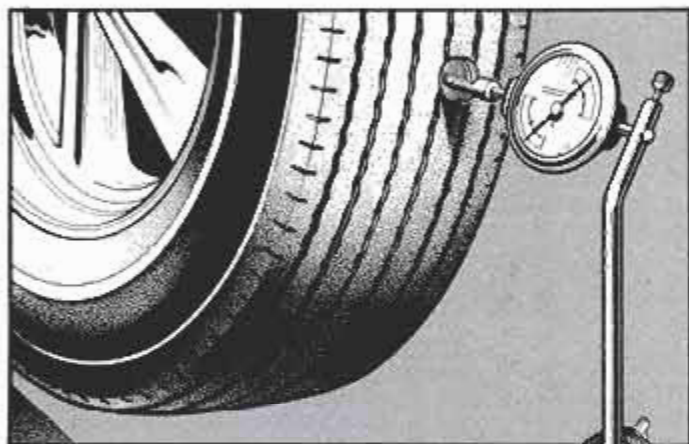
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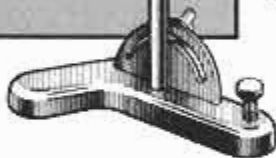
CAR CARE GUIDE

SECTION 11. WHEEL VIBRATION

"Why Do My Wheels Feel Like They're Going To Shake Off The Car?"



Radial run-out gauge is used to locate tire that is out-of-round by measuring high and low spots around tire circumference. Such a tire can be ground or trued. Grinding is done with a load put on the tire. Truing is done with the wheel spinning freely and no load on tire. Out-of-balance wheels also can cause annoying vibration problems.



About 98 percent of all vibration problems are tire-related. If you have bias-ply tires on the car, the troubleshooting procedure is relatively simple. If you have radial-ply tires on the car, however, the procedure is much more involved.

Since the tires are almost always the cause of vibration problems, attack the few other causes first, then zero in on tires.

Start with basics

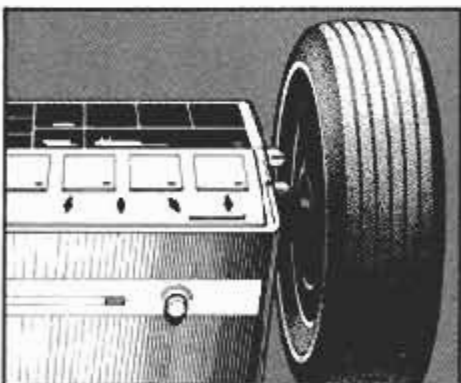
Make sure all tires are the same size and the same type—that is, bias or radial. Also make sure that they are inflated to the pressure recommended by the manufacturer. Road-test the car on the smoothest surface you can find and take note at what speed vibration is most pronounced.

If your tires are bias-ply, inflate each one to 50 p.s.i. and take the car back on the road. Drive at the speed that produced the strongest vibration. If the severity of the vibration is the same as it was before, tires are not to blame. Examine the driveshaft balance and motor mounts as the most probable cause of the vibration.

One way to check driveshaft balance and straightness is to lift the car, using lift supports on the frame, so the wheels hang loose and the drive shaft is not blocked. Have someone start the engine, place the transmission in drive, and rev the engine. You watch the driveshaft. If the shaft appears to be blurry around the edges, it

is definitely out of balance. Look for damage to the shaft and for a loose universal joint.

One way to test for a loose motor mount is to start the engine, and while running it at a fast idle, turn off the ignition. If the engine seems to rock abnormally, check motor mounts. With



Off-car dynamic wheel balancers correct up-down and side-to-side vibration forces.

automatic transmission cars, you can lock your left foot down on the brake pedal while feeding some gas with the engine running. Have a friend stand at the side of the car and observe the engine. If it seems to rise abnormally high

(Please turn to page 188)



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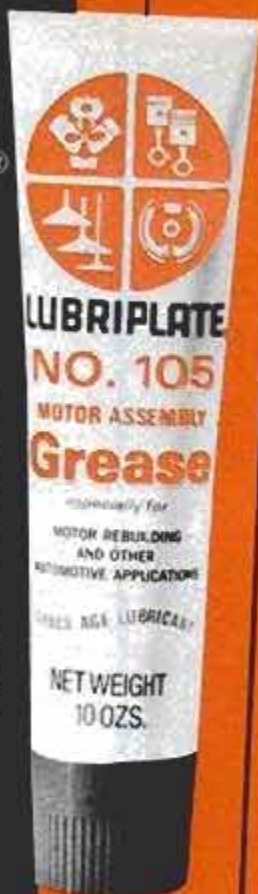
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CAR CARE GUIDE

SECTION 11

(Continued from page 187)

on one side, have a professional mechanic check your motor mounts.

Tire testing

Once you know the driveshaft and motor mounts are not the culprit, the cause is almost surely tires. If no vibration was felt at 50 p.s.i., a tire (or tires) is definitely at fault.

Bleed off air pressure in one tire and road-test again. Do the same with each tire until vibration occurs. Then you have uncovered the troublesome tire.

Don't waste time trying this test with radial tires. It doesn't work. You either have to (1) use a substitute (control) tire; (2) assume tires are out-of-balance or out-of-round and have them balanced and tested for out-of-roundness; or (3) have tires tested by a shop that has a device called a Tire Problem Detector.

The spare tire/wheel may be used to make a control test. Substitute it for one of the mounted tire/wheel assemblies and road test to see if vibration persists. Replace one mounted tire/wheel assembly with the control assembly until each in turn has been tested.

Be sure the substitute (spare) is inflated properly and is the same size and type as the radials on the car. It must also be balanced before it can be used. You cannot use a space-saver spare tire and wheel for this test.

Balancing act

Most vibration problems, if they are caused by a tire/wheel assembly, can be corrected by proper balancing. Although you may have recently balanced all the tires on your car, don't overlook the possibility that a tire has lost its balance because a balancing weight came loose and flew off.

With radials, tire manufacturers generally recommend two-plane balancing. This is done by placing each tire and wheel on an off-the-car balancing console or by balancing them on the car using a stroboscopic unit.

Two-plane balancing offsets up-and-down and side-to-side forces that cause vibration. Conversely, single-plane balancing, which is done with a static balance unit or with a dynamic on-the-car spin balancer, offsets only up-and-down forces that cause vibration.

Rounding it out

You can usually find an out-of-round tire with a radial run-out gauge, which measures high and low spots around the circumference of a tire.

Drive the car a few miles to warm up tires. Then, put the car on a lift, set up the gauge to test one of the tires and turn the tire slowly. A reading recorded by the gauge can indicate that the tire is not perfectly round.

If the tire is out-of-round, it can be ground or trued. Grinding is done with a load placed on the tire. Truing is done with the wheel spinning freely and no load on the tire.

Goodyear recommends tire grinding as the most effective method to repair an out-of-round tire that's causing vibration. After grinding a tire, be sure to rebalance the tire/wheel assembly.

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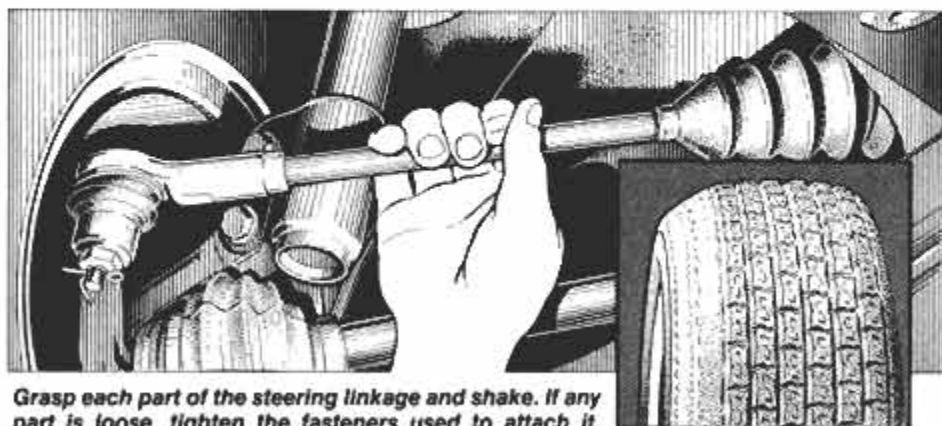
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CAR CARE GUIDE

SECTION 12. WHEEL WANDER

"Why Do My Wheels Have A Mind Of Their Own?"



Grasp each part of the steering linkage and shake. If any part is loose, tighten the fasteners used to attach it.

Wander is the term used to describe a condition that causes a car to drift left or to the right when you take your hands off the steering wheel. Some refer to this condition as lateral pull.

Hard pull, a different condition, is much more severe and can be felt with your hands on the steering wheel. Both wander and hard pull occur without brakes being applied. Pulling of the car when brakes are applied is a different problem.

To get at the root of a wandering problem, start with the easiest and least expensive repair by checking tire pressure. Then, road test the car.

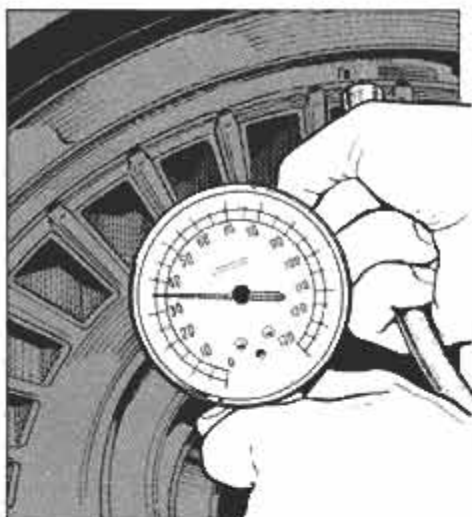
If wander persists, raise the car. Grasp, in turn, each part of the steering linkage and shake it. If any part is loose, try tightening the fasteners used to attach it. If looseness persists, it's a signal that the part is worn and should be replaced.

A loose steering-linkage component, in addition to being the principal cause of wander, can throw the toe or camber adjustment out of whack. Therefore, it can be the cause of abnormal tire wear.

The final step in trying to correct a wandering condition is to make sure that the front-end alignment is made to the carmaker's specification so that both toe and caster get the proper adjustment.

Rascally radials

Instances of new radial tires causing wandering have been reported. The tires may be creating a side force that could result in a slight lateral pull. This is caused by the radial belt under the tread shifting slightly to the left or right. If you should happen to notice this condition, switch the front tires from left to right, and vice versa.



Correcting tire pressure is the cheapest "repair" of a vehicle-wandering problem.

Note: This tire-switch pattern is only acceptable to try to solve a wander condition when new radials are involved. In rotating radial tires as part of your regular maintenance, you use a switching pattern different from that normally followed with other types of tires. Switch the right front and rear tires with each other. Then do the same with the left front and rear tires.

If the wander is first noticed after new radial tires have been on the car for 1,000 miles, the tires cannot be held accountable for the condition.

Go back to the beginning of this troubleshooting procedure and start again. If all else fails, have your front end checked by a professional mechanic.



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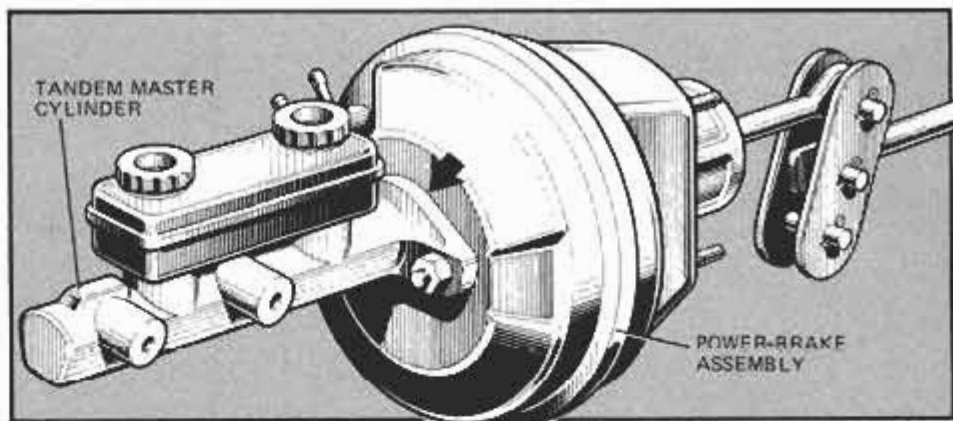
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CAR CARE

SECTION 13.

"Why Am I Losing Braking Power?"



Faulty vacuum power booster can cause brake fluid to be sucked into the engine through a ruptured booster diaphragm. Brakes still will work with very high pedal pressure.

Brake problems come in a variety of forms—grabbing, grinding and/or squealing; pulling and locking; spongy, pulsating or hard brake pedal, and so on. But the scariest malfunction of all is finding yourself with a brake pedal that sinks to the floor as you try to bring the car to a stop.

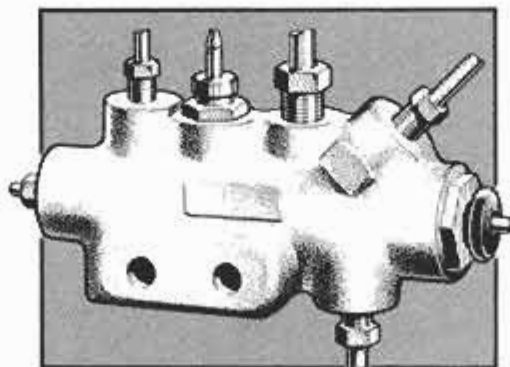
Caution: Working on your car's hydraulic system is tricky business. If you have any

complete loss of braking power. Braking systems today actually consist of two independent hydraulic systems. In most rear-wheel-drive cars and some front-wheel-drive cars, the hydraulic system is split front to rear. That is, both front brakes are paired together and both rear brakes are paired together. If the hydraulics at one end fail, the other two still function.

Most front-wheel-drive cars use a dual diagonally split hydraulic system—left front and right rear brakes are coupled, as are right front and left rear brakes. Again, if one set of hydraulics fails, the other will stop the car.

Both types of split braking systems are served by a dual-chamber master cylinder that holds brake hydraulic fluid. One chamber of the cylinder holds the fluid for one side of the system, while the other chamber services the other side of the system.

All of this background information is necessary because the hydraulic system is the cause of almost all brake failures and this is where you should concentrate your troubleshooting.



Combination valve has brake-failure switch and circuits to stop rear-wheel lockup.

doubts about your mechanical abilities, leave brake hydraulic work to a professional.

Brake loss usually involves hydraulic components of the brake system. The hydraulic components are all units that hold hydraulic brake fluid and the brake fluid itself.

Other reasons for a low brake pedal are a warped disc-brake rotor, out-of-round brake drum, leaking wheel cylinder, a bad master cylinder, worn brake pads or linings.

It would be most unlikely for anyone driving a car built since the mid-1960s to experience a

Checking the hydraulics

Testing the efficiency of the hydraulic components of a brake system can be done from behind the steering wheel. If the car doesn't have a power booster (power brakes), hold your foot solidly against the brake pedal for 30 seconds. If the pedal sinks slowly to the floor, there's a fluid leak somewhere.

If the car has a power booster, place your foot lightly on the brake pedal and start the engine. You should feel the pedal drop slightly as vacuum takes over booster operation.

Now, apply firm pressure to the pedal for 30 seconds. Again, if pedal sinks lower, a leak exists. Don't panic. Finding a leak isn't difficult.

GUIDE

LOSS OF BRAKES

Verify that a leak exists by checking fluid level in the master cylinder. The levels in both compartments shouldn't be more than 1/8-inch below the top rim of the cylinder. A slightly lower level can be expected in a compartment on a car with disc brakes. As disc brake pads wear, the piston moves closer to the rotor, leaving more space in the piston cylinder to be filled by fluid. However, this amount is small, so if fluid level is really down, there's a leak.

How to find a leak

Start at the master cylinder. Run your finger around each line fitting. It should come away dry.

Look to see if the joint where the master cylinder and power booster come together is wet with fluid. If so, the seal around this power booster pushrod has probably ruptured.

Remove the vacuum hose from the fitting on the power booster. Twirl a screwdriver inside the hose. Check to see if fluid is on the screwdriver shank. If so, brake fluid is being pulled from the master cylinder into the engine through a ruptured power-booster diaphragm. Overhaul or replace the booster.

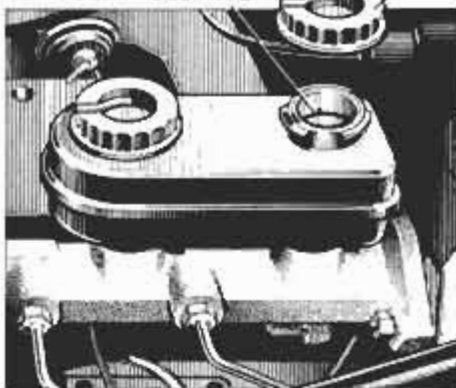
From under the car, trace each brake line, in turn, from the master cylinder to the flexible brake hose to which it connects, and then on to the wheels. You'll probably come to one of the valves mentioned above. Don't overlook valve fittings during your inspection. These valves are part of the hydraulic system and the fittings can work loose. Try tightening a loose fitting. If this procedure doesn't stop a leak, replace the valve.

Examine each flexible brake hose. As a car ages, hoses become more susceptible to cracking, peeling and rupture. Feel the hose. If it's soft, replace it.

Also, inspect hoses for cracks or splits. One likely sign of a leak is a smear of wet dirt. You should replace any suspicious-looking brake hose.

On cars with drum brakes, look for signs of fluid on the backing plate, from the bleed valve and at the point where the brake hose connects to the wheel cylinder fittings. Try to stop a leak

FLUID LEVEL TO BOTTOM OF FILLER-HOLE RING



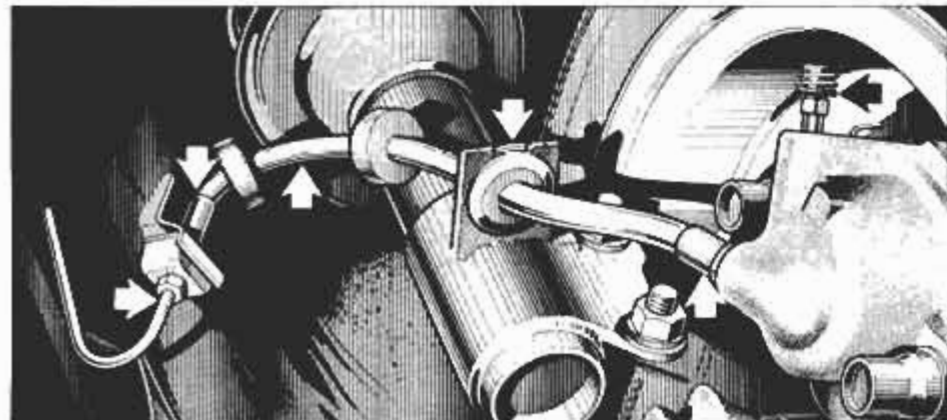
A dual-circuit master cylinder requires checking fluid in each reservoir chamber.

from the hose fitting and from the bleed valve by tightening. If this doesn't work, replace the parts.

A large amount of fluid on the backing plate indicates that the wheel cylinder is probably leaking. Take off the brake drum and remove the wheel cylinder for overhaul or replacement.

On a wheel served by a disc brake, look for signs of fluid from the bleed valve and from the fitting that connects the brake hose to the brake caliper. As with a drum brake, try tightening the part. If there is fluid all over the wheel, caliper seals have probably failed. Replace the caliper.

If the leak has not been detected, chances are the master cylinder has an internal leak. In this case, the brake pedal will sink to the floor within 30 seconds as you apply firm pressure to it with the engine running. However, the fluid level in the master cylinder will not change. When you apply the brake pedal, the fluid will be leaking past a damaged seal in the cylinder itself, but it's not leaving the cylinder. This is why there is no fluid loss. In this case, you will have to replace the master cylinder. **PM**



Leaks from hose fittings and brake bleed valve may be fixed quickly by tightening the fitting or valve. If this doesn't work, you'll have to install new brake components.

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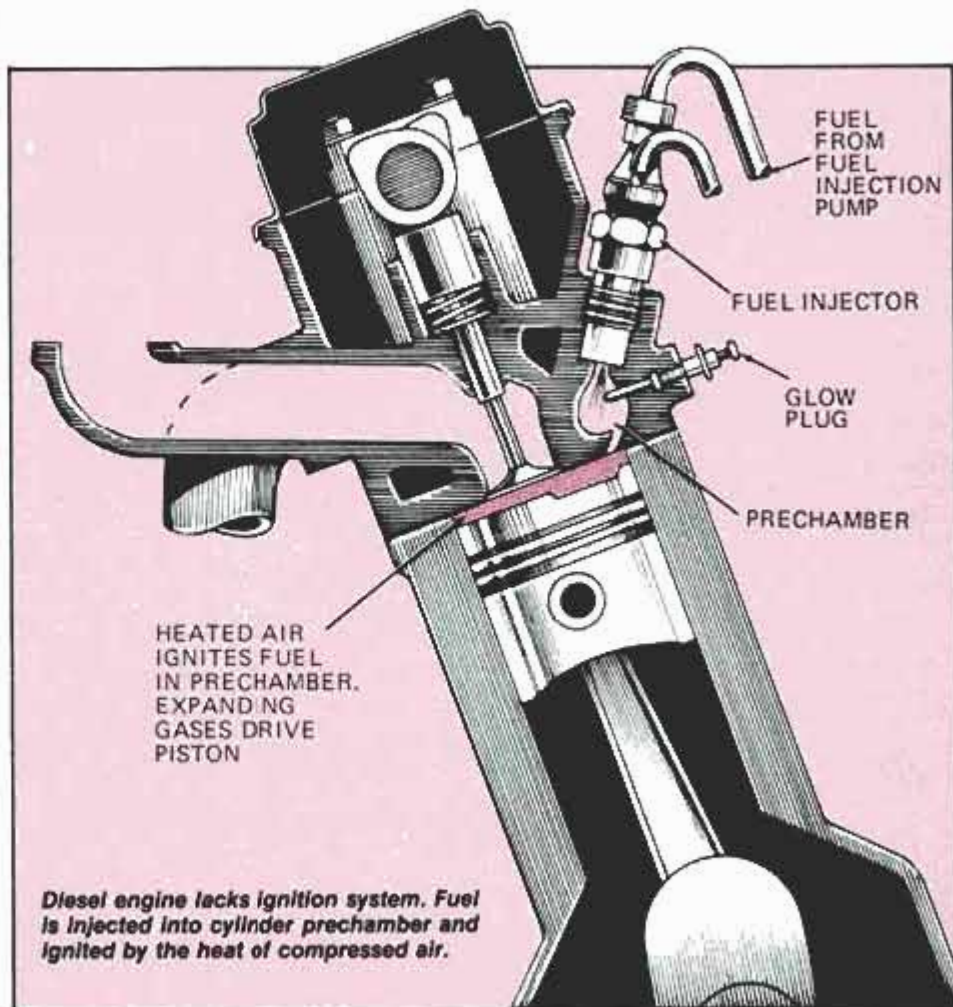
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CAR CARE

SECTION 14

"Why Won't My Diesel Engine Start?"



Diesel engine lacks ignition system. Fuel is injected into cylinder prechamber and ignited by the heat of compressed air.

A diesel engine that won't start may not crank at all, may crank sluggishly; or may crank briskly, but won't fire up.

Suppose ambient temperature is above 0° F, and your diesel engine cranks fine, but for some reason won't start. Each of these conditions is apt to cause this problem:

- Inoperative glow-plug control system.
- Restricted fuel filter.
- Low compression.

Diesel fuel and intake air do not mix. Rather, air is the source of ignition. It is highly compressed to cause the extreme heat that ignites diesel fuel.

The fuel in most gasoline engines is mixed with air, fed to an intake manifold by a carburetor and distributed to the cylinders. In a diesel, fuel is injected directly into each cylinder. Air ingested through an air intake is distributed through an intake manifold. Thus, many

causes for a gasoline engine not starting do not apply to diesels.

Battery bits

Undercharged batteries can keep both diesel and gas engines from starting. But this is not included in the above list, since an engine with a weak battery won't crank briskly. Cranking will be too sluggish to start the engine, or the engine won't crank at all.

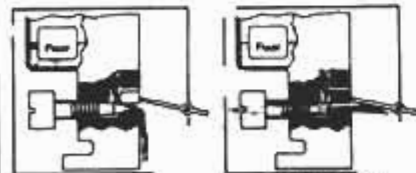
Conditions that cause a battery for a gasoline engine to weaken are the same as those affecting a battery for a diesel. They include loose or corroded cables, loose alternator drive belt, inadequate alternator output due to an internal defect, undetected short draining the battery, and engine oil not of a viscosity recommended for the ambient temperature conditions.

General Motors uses two 12-volt batteries

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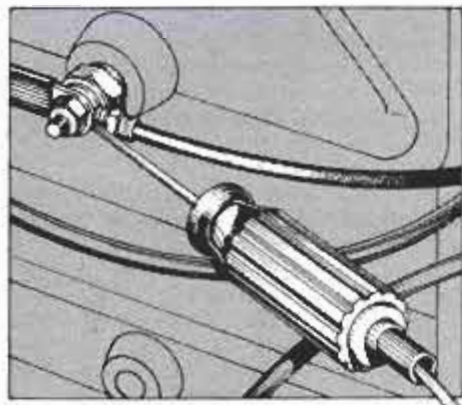
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GUIDE

DIESEL NO-START



Check for current at glow plugs with a 12-volt test light. Make sure key is on.

for six- and eight-cylinder diesel engines to double amperage output and eliminate need for a double-size battery. Generally, diesel engines use more amperage to serve a starter motor and glow-plug circuit.

In GM diesels, batteries must give a minimum cranking speed of 100 rpm when the engine is cold; 240 rpm when the engine is hot. The one battery in a Volkswagen four-cylinder diesel must give enough current to achieve 150 rpm under all starting conditions.

If the two batteries of a GM diesel discharge so the engine won't start, they can be "jumped" the same way as one battery can. Connect jumper cables to the battery on the driver's side, since it's nearer the starter motor and will lower resistance.

Note: Pushing or towing to start a diesel-engine car is a waste of time. Never use charging equipment or jump-starting power packs

exceeding 12 volts. You'll burn out the glow-plug system and other electrical units.

Glow little glow plug

A glow plug is an electric element that preheats the prechamber (GM's term) or swirl chamber (VW's). These small chambers lie on top of the main cylinders. Fuel injected into them is ignited by heat. Expanding gases force the piston downward to turn the crankshaft and provide power.

A diesel engine has a glow plug and chamber for each cylinder. Glow plugs are needed only for cold-engine starting to heat these chambers so fuel will ignite. They then switch off automatically. It's unlikely that failure of one glow plug will prevent engine starting. However, failure of all the plugs will—because the glow-plug control system breaks down.

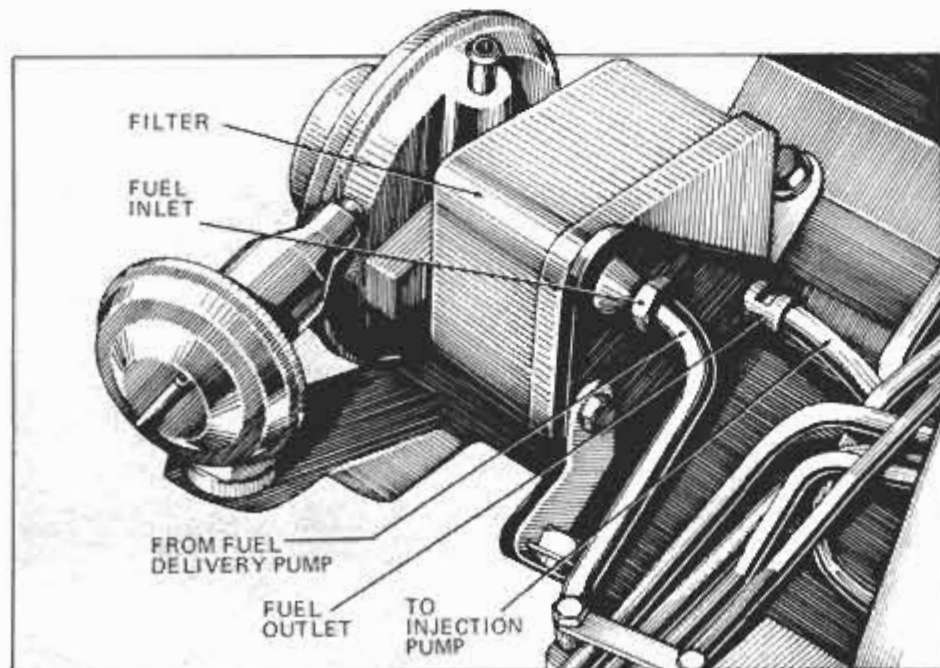
Repair of a glow-plug control system varies from maker to maker. But it's easy to see if the system has failed. Just connect the lead of a 12-volt test light to ground, turn on the ignition key and hold the light probe to a glow-plug lead bus (terminal). If the light comes on, glow plugs are getting current. On GM diesels it will come on intermittently. Do not apply 12 volts of steady current to GM glow plugs or you'll burn them out. If no light shows, there's a control-system breakdown.

With a VW diesel, failure is with the glow-plug relay or warning light. GM diesels have three different glow-plug control systems, depending on car and year. Consult a repair manual or a professional if your system fails.

A restricted fuel filter

A clogged fuel filter causes the same problems in diesel and gasoline engines. One is

(Please turn to page 194)



Clogged fuel filter will stop the engine. To check, disconnect fuel outlet line and crank engine. Use a receptacle to catch fuel. A forceful fuel spray means filter is okay.

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CAR CARE GUIDE

SECTION 14. DIESEL NO-START

(Continued from page 193)

that the engine fails to start. Use the following procedure to determine if a fuel filter is clogged. It applies specifically to GM diesel engines, but can be adapted to other makes.

The GM fuel filter is mounted on the right side of the engine near the rear of the air intake. The fuel-inlet line from the fuel-delivery pump is at the top of the filter. The fuel-outlet line to the fuel-injection pump is at the bottom of the filter.

1. Disconnect the fuel-outlet line at the fuel filter. Plug the open end of the line to keep out dirt.

Caution: Foreign matter in the fuel system can damage the fuel-injection pump and nozzles, causing expensive repairs. Kent-Moore Tool Corp. kit No. J2B438 contains plastic plugs to seal disconnected fuel lines, nozzles and injection pump parts. Ask your auto parts and accessories dealer about it.

2. Hold a receptacle near the open fuel-filter fitting to catch fuel that will spray during the test.

3. Have someone crank the engine. If fuel sprays energetically from the open fuel-filter fitting, the filter is not causing your starting problem.

Important: Diesel fuel can damage rubber parts. Wipe up spills on hoses, wiring and rubber steering- or suspension-system boots.

4. If fuel does not spray from the open fuel-filter fitting, reconnect the fuel-outlet line and disconnect the fuel-inlet line. Hold a receptacle to catch fuel spraying from the inlet.

5. Have someone crank the engine. If fuel sprays from the inlet line, it means that fuel is getting to, but not through, the filter. The filter is plugged. Replace it. If fuel doesn't spray from the inlet line, the blockage is to the rear of the filter, probably in a faulty fuel-delivery pump or fuel sending unit. If it's below 20° F., the problem is probably due to fuel waxing at the pickup in the tank. GM's retrofitted fuel warmer and check-valve system can prevent this. It's standard on some newer GM diesels.

Note: You can usually avoid a problem with the fuel filter by following the maker's replacement recommendations. With GM, replace the filter every 24,000 miles. With a VW diesel, replace it every 15,000 miles.

Engine compression test

Testing compression of a diesel engine is not like checking a gasoline engine. There's a testing procedure that applies generally to all gasoline engines. Not so with diesels, since makers lay down different rules. Thus, we give GM's procedure and show major differences between it and VW's.

1. See that the batteries are fully or nearly fully charged.

2. Remove the air cleaner and install a cover over the air crossover to keep loose objects and dirt out of the engine. Don't use a rag as a cover. GM suggests you get a Kent-Moore air-crossover cover (part No. J26996-1), which bolts on.

Note: For data on Kent-Moore diesel tools

for GM or Datsun diesels, write to 29784 Little Mack, Roseville, Mich. 48066.

3. Disconnect wire from fuel solenoid terminal of the injection pump.

4. Disconnect all glow-plug wires and remove all glow plugs.

Note: For VW, remove all injectors.

5. Screw compression gauge into a glow-plug hole and crank the engine until you count six "puffs." Each "puff" is one revolution. Test each cylinder. (For VW, screw the gauge into injector ports.)

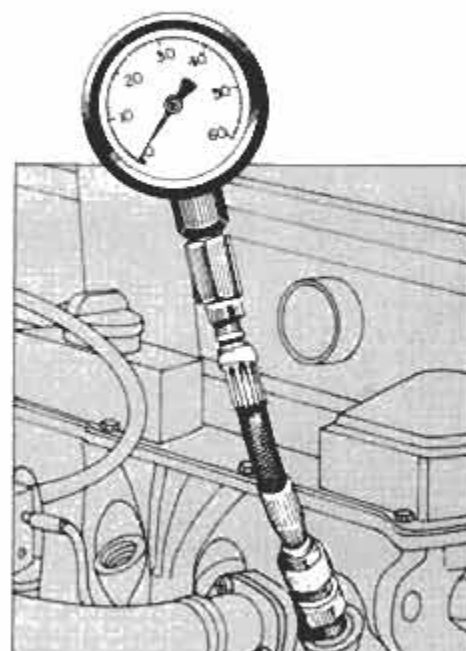
Note: You have to use a diesel-engine compression gauge, capable of recording very high readings. GM recommends Kent-Moore gauge J26999, which can read up to 1,000 rpm. VW recommends gauge VW 1323 or US 1011, used with adapter VW 1323/2.

Compression should build up quickly and evenly. A low reading on the first "puff" followed by readings that build up gradually but don't reach the acceptable minimum indicate piston rings in the cylinder are leaking. The acceptable minimum for each cylinder in a GM diesel is 275 pounds per square inch (p.s.i.). For VW, it's 398 p.s.i.

The cylinder with the lowest reading should be at least 70 percent of the cylinder with the highest. (VW's limit between highest and lowest reading is 71 p.s.i.). Variations indicate worn valves in the low-reading cylinder.

GM warns you not to inject oil into any cylinder to see whether worn valves or piston rings are causing low compression, as you would with a gas engine (see Section 4). Extensive engine damage can result.

VW permits injection of a "small quantity" of SAE 40 oil into low-reading cylinders. If readings become significantly higher, piston rings are probably worn. If they remain the same (low), valves are probably worn.



A diesel-engine compression test varies from make to make. Use right procedure.

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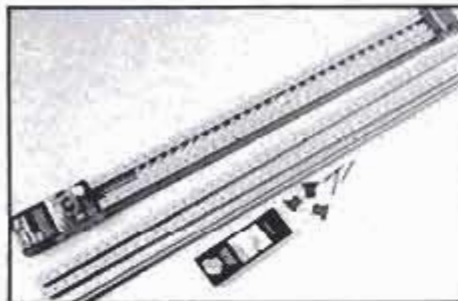
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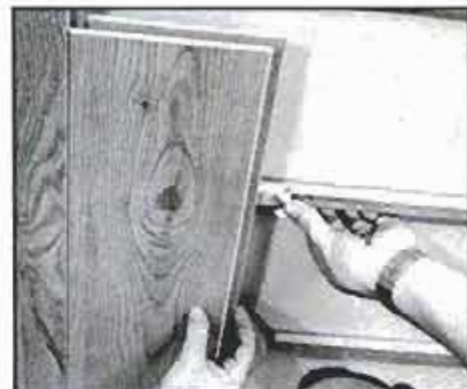
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Secure planks by snapping a clip onto the track and sliding it over the lip of the plank.

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based on weight alone will not keep some small but high-performance airplanes from technically becoming ultralights under the FAA's proposal. This was borne out dramatically by the recent appearance of the French-designed Cricket, a tiny, 160-pound, aerobatic speedster that comes close to qualifying as an ultralight by the FAA's definition (see *12 Hot, New Sports Planes You Can Build*, page 79, Jan. '82). The Cricket is decidedly *not* what the FAA has in mind for untrained, unlicensed neophytes.

More weight, more safety?

Ultralight makers contend that a more liberal weight allowance is needed for safety—that in meeting the 155-pound limit, the necessary sacrifices in strength, power and fuel might well jeopardize reliable operation. Ironically, the 155-pound limit could also rule out float-equipped ultralights—just when they would no longer have to maintain the fictional pretense of foot-launchability.

But all this scrambling to influence the FAA may fall on deaf ears. Federal regulators have already re-



Twin 7-hp mills give Kolb Flyer speeds up to 45 mph. Craft has three-axis control.

jected wing loading as too complicated a formula for easy enforcement. And they don't seem likely to grant the full 220-pound hike being pushed for, although some form of compromise is possible.

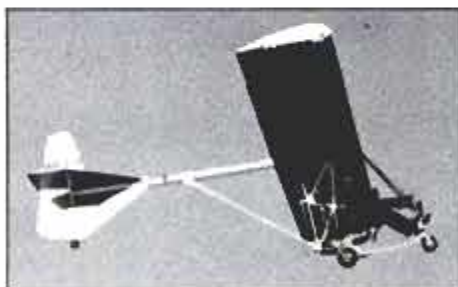
Of the 14 ultralights shown here, only five are within 155 pounds. The rest weigh up to 200 pounds. The implication of this is obvious—and ominous. If the FAA sticks by its original proposal, a lot of manufacturers could be in trouble.

Fancy new designs

Meanwhile, ultralight makers are showing little concern. Faster, slicker and more sophisticated than ever, their latest offerings are trying very hard to look and fly like real airplanes—to the delight of pilots, if not the FAA. Most manufacturers have given up the primitive use of weight shift and now provide true, three-axis control (rudder for yaw, elevator for pitch, ailerons for roll). Other exotic refinements include

spoilers, anti-stall canards, twin engines, brakes, cockpit enclosures, even ballistically deployed parachutes.

Surprisingly, three of the lightest new designs feature twin engines. These are the 142-pound Lazair, 155-pound Kolb Flyer and 163-pound Hummingbird. Advantages claimed for twins are more uniform distribution of weight and airflow, no prop blast in the pilot's face and backup power if one engine quits. A minor drawback: Engine throttles must be closely synchronized or the craft will yaw because of unequal thrust.



Nomad DS-26A has true aircraft-style tail plus ailerons, takes engines up to 28 hp.

All three twins have ailerons, but the Kolb Flyer has a conventional rudder and elevator, while the Lazair and Hummingbird use "rudder-elevators"—combination rudders and elevators. The Hummingbird and Kolb Flyer have both a joystick and rudder pedals, permitting independent control of yaw, pitch and roll.

In the Lazair, the rudder, elevator and aileron functions are linked to a single stick with no foot pedals. This produces automatically coordinated turns (rudders and ailerons acting together), but doesn't permit "cross-controlling" (rudders and ailerons opposed for use in crosswind landings and takeoffs). Though some disagree, proponents argue that no one in his right mind should want to cross-control an ultralight anyway.

The Lazair has a total of 12 hp and a top speed of 55 mph. The kit is \$3,700 from Ultralight Sales Ltd., Box 370, Port Colborne, Ont. L3K 1B7. An info pack is \$10. The Kolb Flyer does 45 mph on 14 hp and is \$2,495 from Kolb Co., R.D. 3, Box 38, Phoenixville, Pa. 19460. An info pack is \$2. The Hummingbird does 50 mph on 16 hp and is \$4,495 from Gemini International, 75 Bank St., No. 13, Sparks, Nev. 89431. An info pack is \$5.

A radical departure

Startlingly different in concept is the 150-pound Kasperwing, a tailless flying wing with no elevator. Although it requires weight shift for

pitch control, an ingenious reflex wing, said to generate vortex lift, is combined with pivoting "winglets" that can be deployed individually as rudders for yaw control, or collectively as spoilers for glide-rate control.

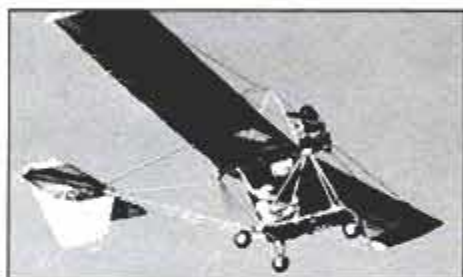
The Kasperwing system is claimed to permit near-vertical descents and zero-speed landings with no tendency to stall. Top speed is 60 mph on 23 hp. The kit is \$3,750 from Cascade Ultralites, 1750 12th N.W., Issaquah, Wash. 98027. An info pack is \$5.

More conventional are the 135-pound Rotec Rally 2B and 152-pound Nomad DS-26A. Both have a standard rudder, elevator and ailerons with independent stick and rudder-pedal controls. The Rally 2B has a 30-hp engine, does 45 mph and sports a twist-grip throttle on the control stick—a nice touch. The kit is \$3,850. A float-equipped version, called Rally Marine, weighs 220 pounds and is \$5,250. An info pack is \$5 from Rotec Engineering, Box 124, Duncanville, Tex. 75116.

The Nomad DS-26A cruises at 36 mph on 10 hp, but can take larger mills. Kits start at \$2,995. An info pack is free from Delta Sailplane Corp., 13161 Sherman Way, North Hollywood, Calif. 91605.

The canard caper

Among the latest innovations in ultralights are "tail-first" canard designs like the Catto Goldwing, Tomcat and Pterodactyl Ptraveler. A small, pivoted stabilizer ahead of the wing, the canard provides both lift and pitch control. Because it stalls out first as speed decreases, dropping the nose automatically and restoring speed and lift before



Mirage features front engine, rear drive for good CG stability and has full controls.

the main wing can stall, canards are theoretically stall- and spinproof.

The Goldwing has wingtip rudders combined with both ailerons and spoilers linked together. The idea: The spoilers give added roll control at low speeds when ailerons lose effectiveness. The craft does 70 mph on 30 hp, weighs 240 pounds and is

(Please turn to page 200)

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14 NEW ULTRALIGHTS

(Continued from page 199)

\$4,295. An info pack is \$6 from Goldwing Ltd., Box 1123, Jackson, Calif. 95642.

Like the Goldwing, the Pterodactyl Ptraveler uses a canard for pitch control and has wingtip rudders. The rudders can also be deployed collectively as spoilers to vary glide rate. The Ptraveler does 55 mph on 30 hp, weighs 200 pounds and is \$3,900. An info pack is \$5 from Pterodactyl Ltd., Box 191, Watsonville, Calif. 95076.

The 198-pound Tomcat has an unusual all-moving canard that tilts up, down and sideways to serve as both rudder and elevator. Angled vanes under the wing, called dihedral stabilizers, give lift, stability and an automatic rolling action in turns. Top speed is 60 mph on 30 hp. Kits start at \$3,695. An info pack is \$4 from Waspair Corp., 1881 Enterprise Blvd., West Sacramento, Calif. 95691.

New drive arrangements

Many ultralights use rear-mounted pusher engines because they put the prop blast behind the pilot and direct the airstream at the



Jaunty twin-tailed P-38 Lightning, named after WWII fighter, does 55 mph on 30 hp.

tail surfaces for enhanced control response. But an inherent disadvantage is that pilot weight must counterbalance engine weight to maintain a proper center of gravity (CG). When pilot weight changes, the CG shifts forward or back, upsetting the aircraft's trim.

Now several makers have come up with new drives aimed at overcoming this. In the Vector 600, Mirage, Quicksilver MX and Rotec Rally, the engine is moved forward, either ahead of the wing or at the midwing position, with the prop behind the wing on a long driveshaft. This maintains the advantages of pusher drive, with the CG less sensitive to changes in pilot weight.

The Quicksilver MX and Mirage both have conventional tails, while the Vector 600 uses a V-tail with ruddervators. All three employ "spoilers"—spoilers acting as ailerons—to give positive roll control at low speeds.

In the Mirage, the rudder, elevator and spoileron functions are independently controlled by a stick and foot pedals. In the Vector 600, these are combined in a single stick—but in a novel way. Moving the stick slightly activates the rudders before the spoilerons. This permits "crabbing" in crosswinds without undesired roll.

The Quicksilver MX has both a stick and pedals, but with still another twist—the pedals control the spoilerons instead of the rudder. This clever arrangement lets you apply the spoilerons separately for roll control, or together for glide-rate control.

Top speed is 50 mph on 30 hp; weight is 200 pounds. The kit is \$4,195 from Eipper Formance, 1070 Linda Vista Dr., San Marcos, Calif. 92069. An info pack is \$3.

The Vector 600 does 50 mph on 22 hp, weighs 195 pounds and is \$4,495. An info pack is \$5 from Vector Aircraft, 394 Somers Rd., Ellington, Conn. 06029. The Mirage does 65 mph on 37 hp, weighs 200 pounds and is \$4,595. An info pack is \$6 from U. F. Sales & Distribution, Box 645, Windsor, Conn. 06095.

Ultralights or airplanes?

How do you tell a genuine ultralight from just a very light airplane? It's not easy. Two fancy new featherweights, the Mitchell P-38 Lightning and Striplin Lone Ranger, were never intended to be foot-launchable and license-free, but, at around 200 pounds, they just might qualify as ultralights depending on how the FAA rules.

The P-38 Lightning is a sporty, twin-tailed affair named after the twin-boomed P-38 fighter of World War II. It cruises at 55 mph on 30 hp and has conventional aircraft-type controls. The kit is \$4,845. An info pack is \$7 from Mitchell Aircraft, 1900 South Newcomb, Porterville, Calif. 93257.

Looking even more like a full-fledged airplane is the Striplin Lone Ranger, a slick enclosed-cabin job that, from a distance, might be a Piper or Cessna. It, too, has full aircraft-type controls, can do 80 mph and comes with a 12- or 20-hp engine. Kits start at about \$4,500. An info pack is \$7 from Striplin Aircraft, Box 2001, Lancaster, Calif. 93539.

Are ultralights an endangered species? Probably not. Ultralight makers are a tenacious and inventive breed. However the FAA ruling goes, it's a good bet that most designs will still be around—still pretending to be real airplanes and hoping no one will notice that they almost are. **PM**

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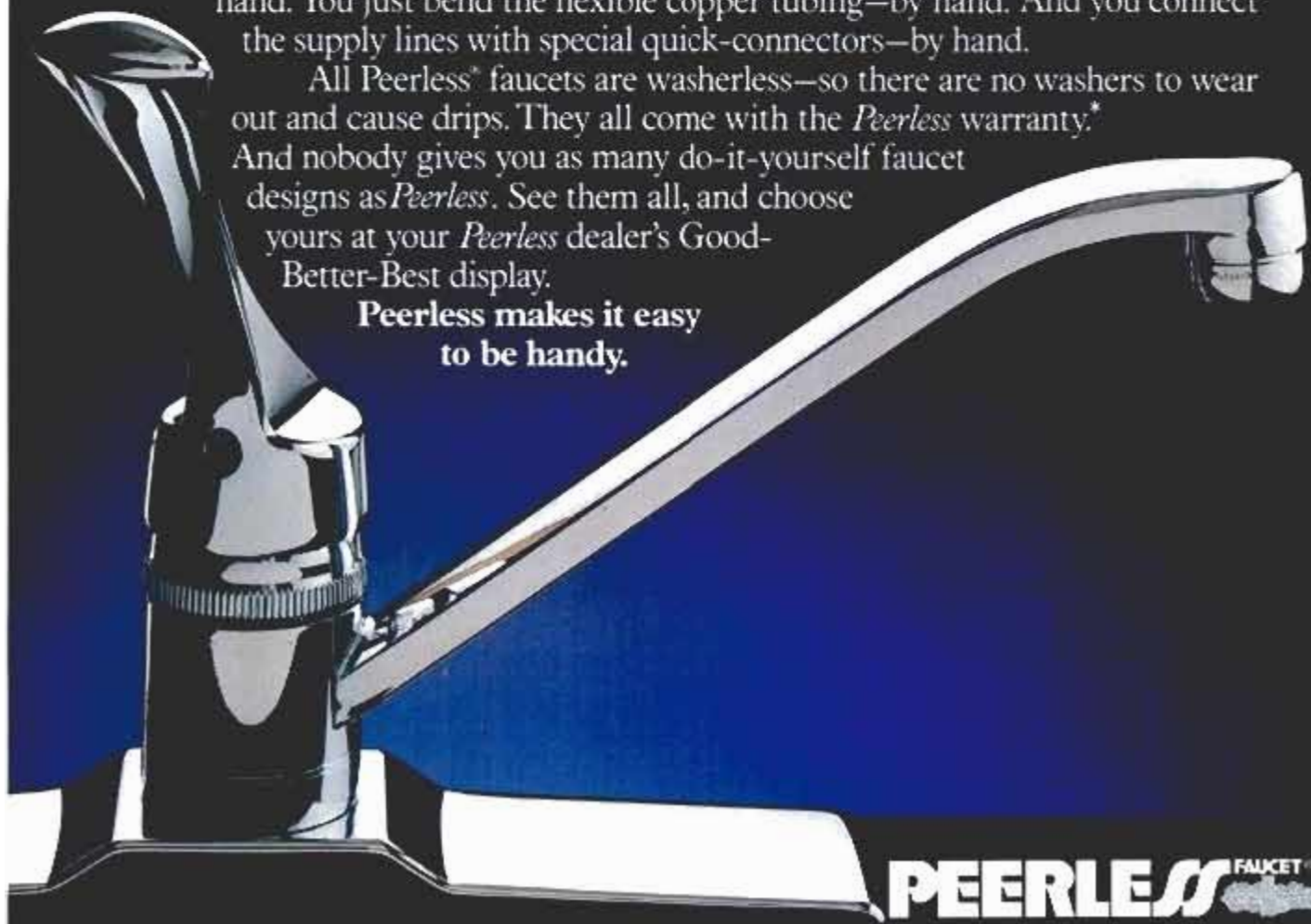
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NEW RECEIVERS

(Continued from page 99)

quencies to 30 MHz. and receive a variety of international broadcasts.

Following are our first impressions of the three receivers. Then, we'll get to the scanners.

■ **The Kenwood R-1000** is perhaps the hottest and certainly one of the most user-oriented receivers on the market. This radio has a modest list price of about \$495, yet it offers a great deal of performance. It's very easy to tune: One knob determines the general range, while another zeros in on a station. This radio "hears" the best of all receivers tested, as its signal-strength meter indicated. Granted, these meter readings are relative, but this was backed up by stronger audio.

■ **Drake R7:** An example of the shortwave radio "high end" in price, the \$1,499 Drake R7 receiver is jam-packed with bells and whistles. It's a state-of-the-art receiver, but its audio quality and hearing ability test weaker than the hotter R-1000. Tuning is via a knob and pushbuttons.

■ **Sony ICF:** Another example of a low-priced receiver—about \$400—this radio is no longer than a coffee-table book. It will run on both house current and batteries. It relies on its microprocessor to run its display and set up the frequency.

The specific features of this radio look interesting, but are cumbersome. Tuning to a frequency is easy, but tiresome, using stiff pushbuttons. The radio will search for a frequency, but the user must follow an awkward programming method.

Not only does the receiver hear one weak station well, but it may hear three or more simultaneously, which is confusing. You can't zero in on one. Yet, audio quality is good.

These "general-coverage" receivers all shared certain features. As a rule, most modern receivers are controlled by microprocessors. This provides them with digital readouts and excellent station-holding power, correcting a problem which troubled older receivers—"drift."

Most general-coverage receivers can also hear the popular voice modes of AM radio and single sideband (SSB), along with Morse code. On the Cadillac-type rigs, it isn't unusual to find notch tuning, by which a user can "notch" out interfering stations, or passband tuning, which allows much the same thing.

The scanners

While tunable receivers like the three we tested open the whole world of shortwave, a new genera-

tion of scanners opens up the "action" bands. The public service frequencies feature police, fire, aircraft, weather and other "local" broadcasters.

These scanners were made possible by the microprocessor, which controls the tuning and method of generating a frequency. Older scanners were limited to single channels. The new scanners are broad ranging, covering huge slices of the radio spectrum. Generally, they feature many channels of memory storage and can seek out and find new frequencies.

Most scanners have a number of features in common. A user can program specific stations into the push-button channel selectors or he can



Popular line of shortwave accessories is from MFJ Enterprises. Active antenna (on top) for indoor reception and preamplifier both maximize receiver ability.

use automatic search to find new stations. Most battery-operated units also operate on house current.

During our testing, PM looked at eight state-of-the-art scanning receivers from \$250 to \$550.

■ **Bearcat 350:** Perhaps the best known scanners today are made by Bearcat. The 350 is a highly user-oriented scanner with a bright green digital readout and slanted keyboard. It's an easy-to-tune radio, with pushbutton entry, and it can hear distant signals, even with an indoor antenna. The audio quality is very good.

This scanner has 50 memory channels and the ability to search for new frequencies. Searching lets you find unlisted or even "secret" frequencies. This feature is limited, however, because, when a search is stopped, it must be reprogrammed.

■ **The Bearcat 100** is the first programmable, handheld scanning receiver. It features a large display and 16 memory channels. It operates on either house current or rechargeable batteries. Its hearing ability is somewhat limited by its stubby antenna and this is its primary drawback. Rather than using a standard antenna connector, Bearcat uses a screw-in type that's incompatible with other radios.

■ **Realistic 2002 and 2020:** Rating almost as high as the Bearcats, Radio Shack's scanners are easy to use. They would have rated higher if they "heard" as well as the Bearcats and if they scanned their memory channels as quickly.

Featuring easily seen slanted readouts and keyboards, they are user-oriented. The top-of-the-line 2002 has 50 channels, while the 2020 has 20 channels. Its primary drawback is its lower hearing ability.

■ **The J.L. SX-200** had the best hearing ability and widest coverage. The broad range of this new entry in the scanner market should allow listeners to find many frequencies not covered by other scanners. It has another advantage, too: It can set different levels of "signal lockout." In other words, it determines automatically which channels are just noisy and which have activity.

The SX-200's failings are its limited 16-channel memory capacity and its cumbersome programming features. Audio output is excellent.

■ **Regency D810 and D100:** Although Regency claims fairly good hearing ability, it didn't seem that way in our tests. Another poor feature is the keyboard: A flat plastic affair that lacks the positive feel of buttons. The only indication of a correct entry is a beep. The keypad is also horizontal, requiring the user to stand over the rig to program it. Its display is set at a nearly unreadable angle. Its audio output was tinny.

These items detract from some laudable features. For instance, with a push of a button, a user can listen directly to police, fire, rescue, marine and other stations.

■ **Fox BMP 10-60:** This scanner suffers from a number of limitations. Although its listed frequency range seems comparable to other scanners, it only hears 60 preprogrammed channels within those ranges. So, scanning a preprogrammed police band might result in fewer calls heard. On the other hand, searches are faster, as fewer frequencies are looked over. The manual search function, however, is cumbersome and programming requires an awkward three-button sequence. It also suffers in comparison to other scanners, when it comes to hearing ability. It hears its own internal signals and tries to listen to itself. Though billed as a portable, it isn't very small and requires a large shoulder belt.

All these radios will bring excitement and new listening pleasure. Whether you try shortwave or the "action" bands above 30 MHz., you find a new world waiting.

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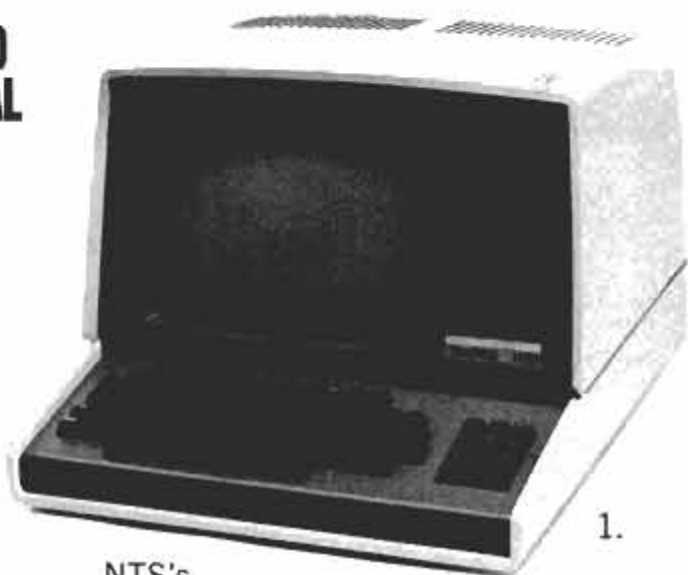
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And in NTS's Master Course in Electronics and Industrial Technology, you'll work with the NTS/KIM-1 Microcomputer (#3). This unit features a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. It's a 6502-based microcomputer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

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PM OWNERS REPORT: DE LOREAN

(Continued from page 101)

5,500 rpm) or turbocharging this one.

One Californian—a 28-year old project engineer—made an excellent point. "Other owners might comment on the De Lorean's lack of power, but I, for one, am very happy with the V8 engine and its blend of economy, power and durability."

And he went on: "I could mention some items I do dislike about my De Lorean, such as the dreadful windshield antenna or the black, heat-absorbing interior, or the failure of the doors to latch properly if I park with the car's nose pointed up or downhill. However, DMC has retrofitted door-latch guides and door gaskets, they've incorporated an automatic mast-type antenna into later production cars and you can now get a silvertone interior. Obviously, John De Lorean listens and is trying to satisfy his customers."

And to counter the relatively high initial repair record, I have to add, in fairness, that 47.2 percent of the owners we queried rated dealer service *excellent*. That's a fine showing when compared with other recent Owners Report data. Another 35.8

The Steak Or Just The Sizzle?

It's a funny thing about the De Lorean. We've yet to see a write-up that actually blasts the car for its poor quality control. We were awed from the start by the planes of its stainless-steel flanks and tended to gloss over the many shortcomings in the finish of the cars we drove in Ireland last year.

Since then, the car has generated an onslaught of words, but very few of them dealt with how it stacks up as a car. It's almost as if the De Lorean has transcended the realm of mere automobile to become some sort of symbol, the essence of what top executives, oilmen and international traders of the world buy a car for.

So let's set the record straight. Every De Lorean we've driven leaks. We couldn't get half the instruments to work in the last one we drove. Every nut and bolt on the car seemed to be shaking itself loose. There were rattles everywhere. And this car

only had logged 2,500 miles on the clock.

You could put up with all that if the car compensated for it with thrilling, eyeball-sucking performance. It doesn't. Instead, it accelerates with a lackadaisical attitude that tells you you'll get there in due time. The car isn't slow. But you could blow its doors off with a Dodge Charger 2.2.

So what's left? The beautiful Giugiaro-designed skin? It *is* gorgeous. Just don't touch it, or you'll spend the afternoon figuring how to remove fingerprints from stainless steel. And it ain't easy.

But the way a car handles, accelerates and transports people is really just the surface of it. For \$25,000 you're buying more than the thing itself.

How much longer you'll be able to buy "the dream" we don't know: At press time, De Lorean Motor Cars Ltd. was struggling for its financial life.—T.A.

percent marked De Lorean service *good*—more hard evidence that DMC dealers are truly trying.

As an aside, a California pharmacist interjected this rather surprising note.

"I'm answering your questionnaire based on my second car. The first one was an early-production De Lorean that came with too many little problems. These were repaired,

but remained nuisances, so I phoned De Lorean and asked the factory to replace the car.

"Just one week later, DMC told me to take my first car back to my dealer, who provided me with a later production model. This second car has been a joy."

We've all heard talk of the De Lorean's start-of-production quality. Yet despite the California pharma-

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cist's experience, not all early De Lorean owners wanted to trade in their cars. In the area of workmanship, 39.1 percent gave the Belfast-built sport coupe a rating of *excellent*, with another 43.7 percent putting it in the *good* column. That's better overall than most American cars we've examined lately.

However, some people *did* note quality and workmanship lapses. A Texas metals executive, for example, told us that, "... the stainless-steel bonding on the roof between

the doors has started to buckle. That plus too many small problems have cropped up. All should have been corrected at the factory."

With regard to price, one self-employed Californian confided that he'd paid \$5,000 over sticker for his De Lorean and then added, "... but where else could I go at the time?" Most other owners paid retail or just above it, and many waited patiently for delivery. "I put my reservation payment down in June 1979 and finally took delivery in September

1981," wrote a New York engineer, "but the car has proved well worth the wait."

When we pinned owners down and asked for specific complaints, poor rear visibility headed the list, followed by engine weakness and imperfect workmanship. A Georgia physician opined, "The transmission is sometimes balky, rear vision is poor, and acceleration isn't in keeping with the car's styling or price. It's also hard to keep the body

(Please turn to page 210)

SUMMARY OF 1982 DE LOREAN OWNERS REPORTS*

Total miles driven 405,970	Performance 12.8	Good 25.0	Number of vehicles owned:
Average miles per gallon:	Ride 11.2	Average 5.5	De Lorean only 3.1%
Manual five-speed	Specific dislikes:	Poor 0.8	Two cars 29.7
In town 19.1	Poor rear vision 26.9%	Had any mechanical trouble?	Three cars 33.6
Long trips 25.0	Not enough horsepower 16.0	Yes 63.0%	Four or more cars 33.6
Automatic three-speed	Flawed workmanship 14.3	No 37.0	Makes of other cars owned:
In town 18.8	No complaints 10.1	What type of trouble?	Chevrolet 28.0%
Long trips 24.1	What changes would you like?	Electrical 21.3%	Cadillac 27.2
Transmission choices:	More powerful engine 16.4%	Fuel pump 17.5	Ford 17.6
Manual five-speed 69.4%	Better rear vision 12.9	Fuel gauge 12.5	Oldsmobile 13.6
Automatic three-speed 30.6	Windows that open wider 9.5	Speedometer cable 11.3	Pontiac 12.8
Why did you choose the De Lorean?	Turbocharger 7.8	Dealer repairs satisfactory?	Mercedes 12.8
Styling 74.6%	Change radio aerial 6.0	Yes 85.3%	Age distribution of owners:
As an investment 17.8	Workmanship opinion:	No 14.7	15-29 years 9.0%
"Because it's different" 11.0	Excellent 39.1%	Dealer service opinion:	30-49 years 68.8
Stainless-steel body 7.6	Good 43.7	Excellent 47.2%	50-plus 22.2
Specific likes:	Average 13.3	Good 35.8	Would you buy another De Lorean?
Styling 84.8%	Poor 3.9	Average 9.8	Yes 63.7%
Handling 45.6	Comfort opinion:	Poor 7.3	No 36.3
Comfort 27.2	Excellent 68.7%		

*Percentages might not equal 100% due to rounding or insufficient data.



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PM OWNERS REPORT: DE LOREAN

(Continued from page 209)

clean and the radio antenna is worthless!"

And a Florida investor: "There's no oomph on the low end and no speed up top. Turning radius is very bad, especially since there's no power steering available. And there's absolutely no visibility to the sides or rear."

Handling came in for mixed reviews. A Michigan physician noted, "Light front end decreases steeraability in snow." An Illinois salesman: "Too much understeer. I prefer more neutral handling. And the gearbox ratios in low, second, and third could be a bit wider for city driving."

"It handles well," stated a North Carolina private detective, "is quick to respond and has a good ride." A California chiropractor agreed: "It's a fun car to drive, relatively fast, and it goes around corners like it's tied to rails."

Owners agree, too, almost unanimously that the De Lorean's one of the most comfortable cars they've ever driven. Seating comfort, legroom and controls come in for solid praise, but the high door sills, plus opening and shutting the doors, take some getting used to. And despite a ventilation system that was generally rated good, many drivers voiced annoyance with the hard-to-open side glass.

Owners don't seem quite ready to rush out and buy another De Lorean. Only 63.7 percent said they'd buy the car again. That's quite a low figure, but you have to realize why. A good many owners told us that repurchase would depend on what else is available at the time.

Another reason, as an Illinois dentist insisted, is "because I don't ever intend to replace this De Lorean." And there were people who simply felt that one sports car was enough for a lifetime.

And a Florida interior designer put the cap on it when she explained, "I believe in a man trying to fulfill his dream. Mr. De Lorean didn't have to do this to further his career or for financial gain. He wanted to build a better product. He found he had to make concessions, but don't we all?"

"I think his first attempt is good, and I've demonstrated my faith by buying his car. He and his people were intimately involved in the production process from beginning to end. There's continuity and inventiveness on his side. John De Lorean put himself on the line and his heart in the car."

PM

OAK WINE RACK

(Continued from page 107)

position, trace around both rabbeted ends, using a pencil. Remove the rack and set up the base piece for routing with a straight cutter. Make a test cut in scrap to check the dado for width and depth. Also, stop the router in the scrap and mark the outermost edge of the shoe on the scrap. Remove the router and measure the distance from the mark to the cutter edge.

Use this dimension to locate the fence (guide) for your router to ride against when routing the dados in the bottom (and top). Remember that you will only cut halfway across, and then the guide must be moved $\frac{1}{8}$ in. to finish the other half of the dado. Clean out the rounded corners, using a sharp narrow chisel. Make certain you test-fit the mating members frequently as you do this dado-shaping step.

Repeat the procedure to create the top piece. Make certain that you mark the top, using the *top ends of the module*. Remember that there is almost always some warp or cup in a piece of hardwood; thus, it is very likely that your rack and top and bottom pieces will only stack one way—the way they were laid out originally.

Finishing the rack

When all carpentry is completed, you can proceed with the finish. *Note:* You can rout the rabbets in the sides freehand if you are experienced with a router. If you have reason to doubt your control of the tool, clamp a stop block to keep you from routing beyond the rabbet center point.

Sand the entire rack with 150-grit paper, dust or vacuum off the sawdust and apply the oil stain of your choice. The rack shown was stained with Carver Tripp's Spanish Oak oil stain. Apply the stain, following label instructions. After wiping the piece, let it dry for 24 hours.

The rack shown is sealed with 3-lb.-cut, water-white shellac thinned 50 percent with denatured alcohol. Use a quality bristle brush to apply it and allow the shellac to dry for at least four hours.

To finish, lightly rub the shellac with 180-grit paper wrapped around a felt block. Rub lightly, and with the grain only. Dust off the piece and wipe thoroughly with a tack cloth. Apply one coat of varnish, as it comes from the can. The rack shown on page 104 was finished with McCloskey's Heirloom semigloss varnish, which dries to a "hand-rubbed waxed" look.

PPM

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THREE WINE RACKS YOU CAN BUILD

(Continued from page 107)

1/4-in. strips. You won't need clamps to glue on the strips; use masking tape instead to apply the necessary gluing pressure. Cut the strips 3/8 in. wide to permit some leeway in gluing. They are trimmed flush to the panel surfaces with a block plane after the glue has set. Don't skimp with the tape; use 6-in.-long strips at 3-in. intervals to obtain good contact throughout. A word of caution about masking tape: Some brands of tape leave a sticky residue when removed; this type must be avoided. Test the tape on scrap to make sure yours comes away clean.

The diagonal cross panels are assembled with edge half-lap joints; 1/2-in.-wide notches are cut halfway through the mating pieces. You can make these notches in one pass on



4 Fence is repositioned and the blade is elevated for the second series of cuts.



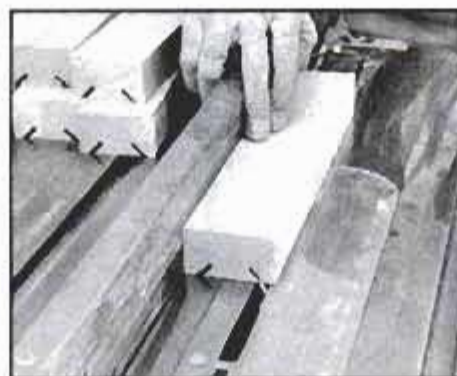
5 Masking tape must be used to hold glued joint together; clamps won't hold.



1 Use a block plane to trim edge banding flush with panel surface, then sand surface.



2 Make double kerf cuts to form notches. Do all first cuts, shift block for second cuts.



3 Two 45° bevel cuts are made first on the lower part of the joining blocks.

the radial-arm (or table) saw, using a dado head. If you don't have a dado head, simply make two kerf cuts with a smooth-cutting, regular saw blade.

Here's how to obtain uniformly spaced cuts: Clamp a stop on the radial-arm fence 12 3/4 in. from the blade. Cut 6 in. into the panel to make the first cut for a notch, then flip the panel over, end-to-end, and make the first cut for the second notch. Do this with the eight panels, then shift the stop block so the second kerf cut will be 1/2 in. from the first one, measured outside to outside.

Don't automatically shift the block 1/2 in. from the first position, or you will have an error equal to the saw blade thickness! Repeat the sawing on the eight panels, alternately flipping them over for the second notch cut.

A quick way to drop out the notch waste is to bore a 1/2-in.-dia. hole at the inside juncture. Otherwise, use a sabre saw with a narrow blade and work it across the corner. Sand the faces of all the panels. This tends to loosen the fit of the panels in the notches, but the slight looseness is okay. In fact, a tight fit will cause assembly problems.

Making the joining blocks

Now, you make the angled joining blocks. These can be made on either

(Please turn to page 214)

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THREE WINE RACKS

(Continued from page 212)

a table or a radial-arm saw. Here's how it's done on the table saw: Tilt the blade for a 45° bevel cut. Make two passes in each block to cut the shallower bottom kerfs first. Then raise the blade and reposition the fence to make the second series of cuts, which will drop out the waste. These deeper cuts are made last so a nontippable wide surface is always on the table.

If you should have a molding cutter head for the saw, with a suitable small-radius shape, use it to cut the small corner-round on the blocks. Otherwise, do the rounding over with a block plane and sander. Sand all of the exposed surfaces of the blocks before assembly.

The blocks are glued to the panel ends for the first stage of assembly. Here, masking tape is an absolute necessity because ordinary clamps simply can't get a proper hold. Two strips of tape pulled taut will suffice. To make sure you join the blocks to the correct faces of the panels, join the panels in advance and mark the block locations. One slip-up will mess you up.

How to Interlock panels

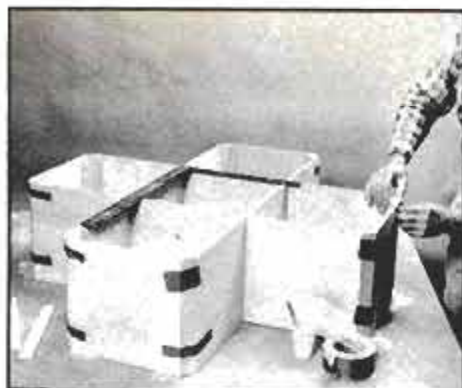
After the glue has set, interlock the panels (they won't need glue), then cut the smaller end panels to length. Working on a flat work surface, glue them in place. Since many plywood panels have some degree of warp, it is advisable to use a stronger tape for this gluing operation to ensure against the parts popping apart. Duct tape is a good choice. Again, check the product first for clean sticking and removal.

Wood screws and glue are used to attach the side members. The heads are then concealed with wood plugs. Clamp the top and bottom members in place and bore 1/16-in. pilot holes for the screws. Remove the clamps, bore the shallow larger hole for the plug, then rebore for the screw body and shank diameters, respectively. Glue and screw the top and bottom panels in, repeat the steps and attach the left and right side members. The abutted corners are secured with glue and 1 1/2-in. (4d) finishing nails. When both sections are completed, stack them one atop the other and drill the screw holes for the mending plates. These plates will serve to keep the sections from shifting.

If you have paint spray equipment and a suitable place to work, you can apply practically any kind of finish. But brush application of a regular top-coat finish will be particularly



6 Test-fit panels together; do this work on a flat surface to ensure accuracy.



7 To obtain tight joints when gluing in end panels, hold them with duct tape.

difficult in those angled corners.

A good solution is to use a penetrating Danish oil finish such as Deftco (made by Deft Inc.). This pro-

vides a tough satin finish and is easy to apply. It is available in Natural, Medium, Dark and Black Walnut. We used the clear Natural finish.

Mediterranean Wine Rack

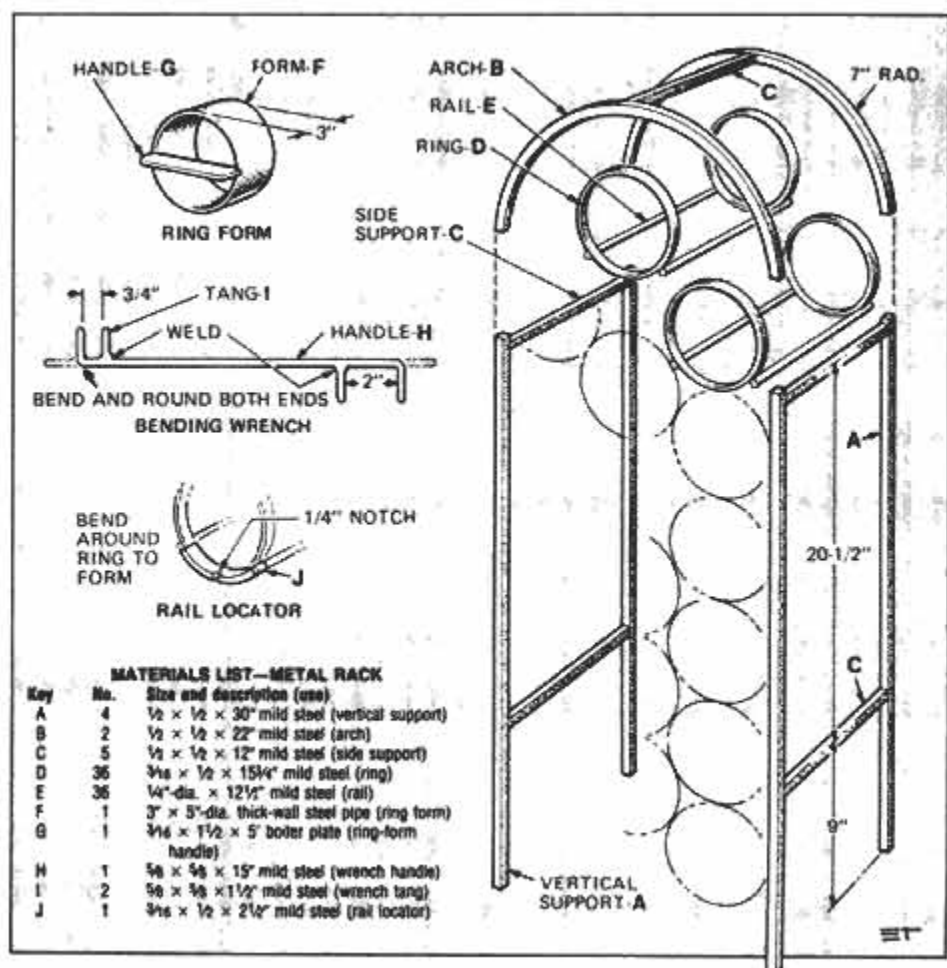
A solid furniture accessory, this metal wine rack is 36 in. high, weighs 35 pounds and holds 18 bottles of wine. Each bottle is held within two rings, one at the neck and one at its base. A number of blacksmithing and welding techniques are utilized in its construction.

Begin by shaping the rings. If you have a power hacksaw, you can slice 1/2-in.-thick sections of a 5- or 6-in.-dia., thick-wall pipe.

An alternative method, shown

here, is to make a form around which to bend the rings (see the ring-form detail in the drawing). A section of 5-in.-dia., thick-wall pipe can serve as the form. Weld a strip of steel across the bottom of the form to secure it in a vise.

A bending wrench shown in the drawing helps shape the rings. One other shopmade tool, a rail locator (see detail J), is used later to locate the rails supporting the wine bottles. Since it has the same contour as



the rings, shape it when you bend them.

Use a hacksaw to cut the strips for the 36 rings to length. Grind all ends smooth if needed. Secure the form in a vise. Lock one end to the form with lever-jaw pliers and bend the ring by pulling and bending with the bending wrench. Close the rings with a C-clamp and weld the inner and outer



1 Form the rings around the ring form, held in a vise. Clamp an end of the steel with lever-jaw pliers; use the bending wrench.



2 The C-clamp, in turn secured to the table with a clamp, keeps the ends of the ring together while they are being welded.



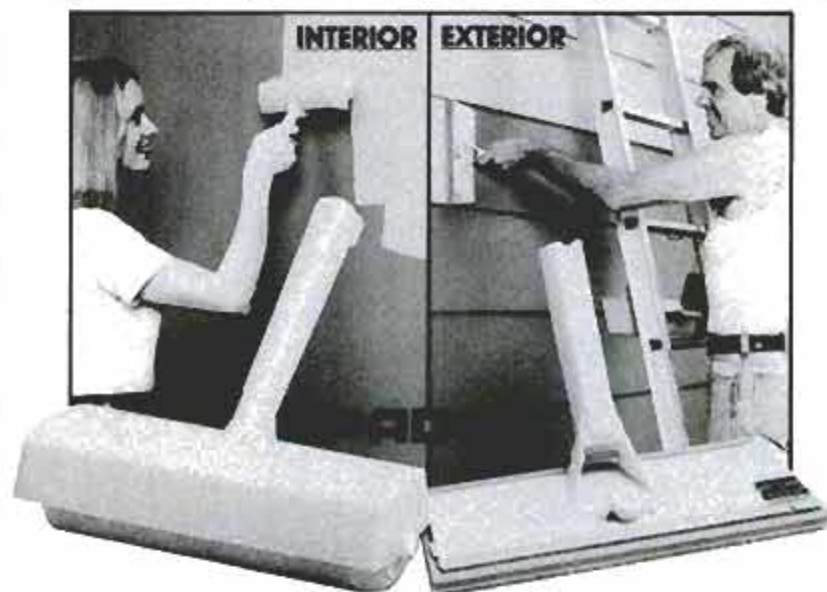
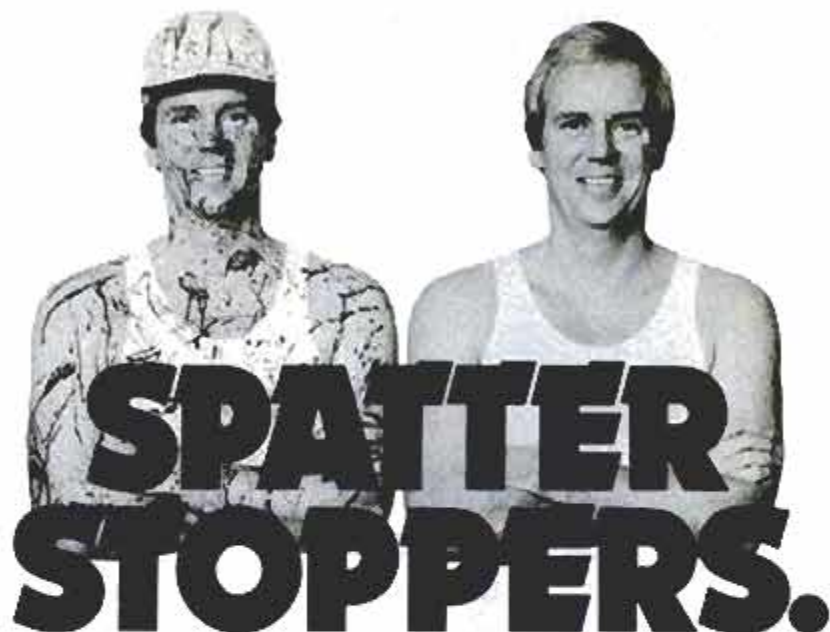
3 Clean the outside of the ring weld on a bench grinder. Hold ring vertically, being careful not to grind a concave spot.



4 Clean hard-to-reach welded spots such as inside of rings with small portable grinder, or grinding stone chucked in a drill.

surfaces together. Grind the weld clean. True up the ring in a vise with a hammer. The main arches of the wine rack are 14 in. in diameter. One way to shape them is to use an automobile wheel as a form. Heat the length of 1/2 in. square steel in a forge or with an

(Please turn to page 216)



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THREE WINE RACKS

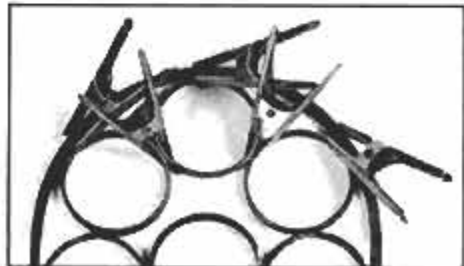
(Continued from page 215)

oxyacetylene torch to cherry red.

To avoid heating the steel, you can also bend the arches, using a vise and the bending wrench. First lay out the arch shape on cardboard. Then secure the bending wrench in the vise, tangs upward. Place one



5 To bend the main arch, insert the steel between tangs of bending wrench, secured in a vise; apply pressure to bend.



6 Lay out the rings within the arch to test fit. Then clamp first three rings to arch and to each other; weld parts together.

end of the steel between the tangs and begin to bend; continue bending the length of the steel, occasionally removing the work and checking the shape against the arch layout.

After bending both arches, check to see that they are identical. Cut



7 To weld the rails, turn rack upside down and clamp it to 2x4s. Clamp rail at previously located spot and weld.

the vertical supports and grind smooth the ends that will rest on the floor. Weld supports to the arches.

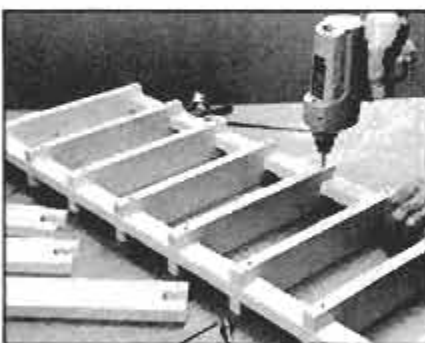
Next, position the three top rings within one of the arches; test-position the rest of the rings, then remove them. Clamp the first three rings to the arch and to each other and weld them in place. Clamp and weld the remaining rings. Attach rings on the second arch to line up with their mates; clean welds. Join arches by welding the side supports. To keep arches plumb and square, clamp several flat pieces of steel bridging the 12-in. gap between arches.

To find the position of the rails that hold the bottles, first find the exact bottom of each ring. You can do this by placing a piece of shot, a dried pea or a pencil inside each ring and marking the spot where it settles. Line up the notch of the rail locator with this mark; mark the ring at each end of the locator. Turn the rack upside down and weld a rail onto the bottom of the ring directly above these two outer marks.

Finish by spray painting black with a rust-resistant metal paint.

screws. Rip stock to required widths: 2½ in. for shelves, 1½ in. for verticals and 1 in. for horizontal support strips. Joint edges smooth, cut parts to length.

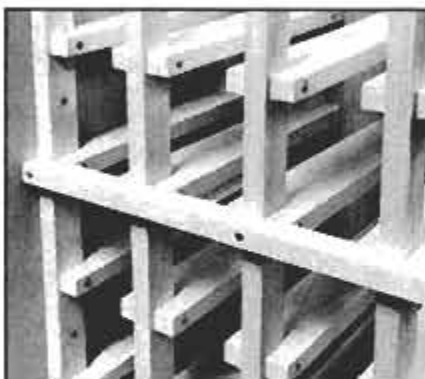
Use a table saw with dado head and tenoning jig to cut end slots in shelf members. The front slot is ¼ in. deep; the back slot is ½ in. deep. Insert front and rear verticals into shelves and bore screw holes 1¼ in. deep. Countersink holes. Bore wall-attaching screw holes in vertical side and back members, then mark hole locations on vault's walls. Bore screw pilot holes. After assembly, attach unit to wall with screws. Use offset screwdriver on last end wall section. **PH**



Bore countersunk holes for oval-head screws, then assemble vertical units.



Notched floor strip snugs into projecting vertical strips, is screwed to floor.



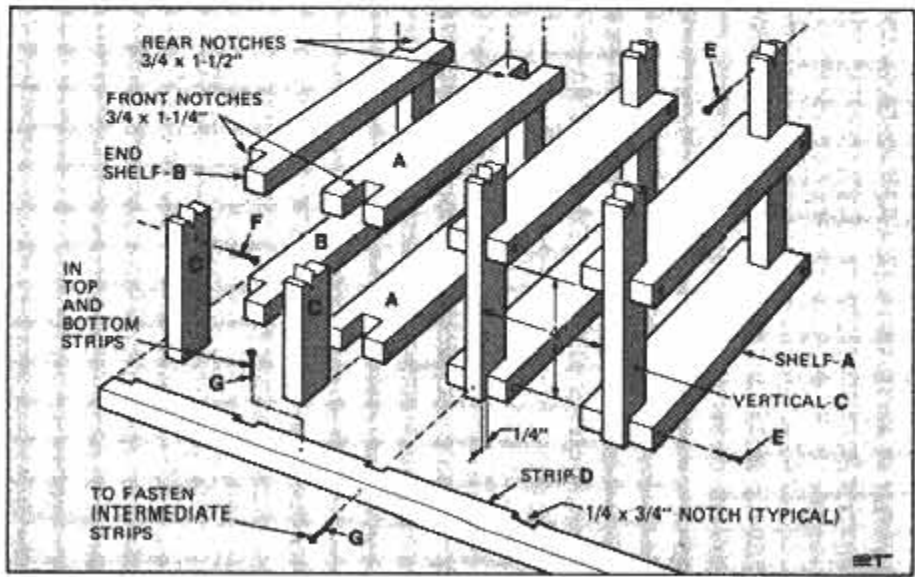
Intermediate support strips are same as floor strip, but screw lengths differ.

Closet Wine Vault

Though not actually a "vault," this design lets you store a lot of wine in a cellar closet. Wine-accessory firms, such as Cramer Products (381 Park Ave. S., New York, N.Y.

10016), offer temperature-humidity control equipment.

All stock for rack members is ¾-in. clear pine. Assembly is with No. 8 oval-head wood



MATERIALS LIST—VAULT RACK

Key	Size and description (use)
A	¾ x 2½ x 13' pine (shelf)
B	¾ x 1½ x 13' pine (end shelf)
C	¾ x 1½ x length to suit (vertical support)
D	¾ x 1 x length to suit (horizontal strip)
E	2" No. 8 brass oval-head screw
F	1½" No. 8 brass oval-head screw
G	1¼" No. 8 brass oval-head screw

Amount of each item as required.

FITNESS AND THE MACHINE AGE

(Continued from page 93)

rent physical condition, specific activity interests and even, to some extent, your outlook on life. First of all, if you haven't been exercising regularly, regardless of age, don't start in on a resistance machine of any kind without a physician's examination. If you intend to work to near exhaustion, in order to build cardiovascular endurance or skeletal-muscular strength, and you are over 35 years old, a maximal stress test (usually administered on a treadmill) is advisable. If the idea of a maximal cardiac performance test scares you, inquire at exercise clinics, hospitals or other institutions about alternatives. There is electronic equipment now available that offers a computerized projection of peak cardiac performance from sub-maximal effort. Not all doctors consider it reliable, however.

Conditioning synthesis

Until recently, fitness enthusiasts have tended to belong to either one of two distinct camps: aerobic conditioners (joggers, swimmers and so on) and strength freaks. The home resistance machines are helping to bring about a synthesis. One-sided exercise programs, whether on the track or in the gym, have one thing in common: They're boring. But lately, statistics have accrued showing that they also may prove counterproductive. Sooner or later, most one-dimensional fitness fanatics overdo their particular routines; joggers pile on the distances, weight lifters add poundage. Fitness, technically, is not a static condition—you're either improving or deteriorating—because the body acclimates rapidly to incremental demands. Too often, the result of onward, upward movement in one regime is injury, usually chronic.

Home exercise equipment, therefore, should be assessed on the basis of versatility, as well as the basic parameters of construction, compactness, safety and so on. Can you do exercises easily to train both the upper and lower body? How wide is the range of resistance? If cardiovascular conditioning is your primary goal, does the machine permit rapid adjustment between exercises so that pulse-rate elevation can be maintained?

It should be noted that no multi-station resistance machine will offer anyone, except a member of the Chinese national acrobatic troupe, as effective an aerobic routine as a machine designed specifically for aerobics—such as an exercise cycle.

Yet by combining a pure aerobic program, such as jogging or swimming, with resistance training, you can progress with multiple benefits.

On the other side of the coin, free weights—the traditional barbell with graduated plates—are also a desired adjunct to resistance machines. Why do you need a set of weights after you've bought an expensive machine that's supposed to replace them? Because they provide a yardstick. Hydraulic cylinders, friction plates, elastic cords—even fairly simple mechanical linkages—can deteriorate or go out of adjustment in time. A hundred pounds next year, however, weighs the same as 100 pounds did at the time of the Flood. So, as long as your technique is consistent, free weights can provide an index of performance—that positive reinforcement—for both you and your machine.

In addition, exercise with free weights adds factors of balance and what biomechanics people call "ballistic motion." These may be more valuable in training for various sports than similar routines performed on a machine with the same strength-building potential.

Different designs

The Step One unit seemed better adapted to multiple-repetition, lower resistance routines (usually associated with toning and cardiovascular conditioning). The Soloflex, on the other hand, is designed more as a high-load system in which 8 to 12 repetitions will bring the user to near exhaustion (also producing added strength and, possibly, cosmetic benefits). Universal's conventional weight-pack system is still as convenient in terms of rapid and precise adjustment as anything on the market, offering both aerobic-type and high-resistance potential. Optional components needed for a full range of upper and lower body training, however, add considerable cost to a home system.

All three machines seem relatively expensive in terms of what components they entail. Our survey of the market, however, suggests that quality and utility tend to drop off drastically in lower priced equipment claiming to do the same thing. And there are far more expensive machines—stationary cycles, rowers, treadmills and so on—with far fewer capabilities in terms of overall, balanced fitness.

MANUFACTURERS LIST

Soloflex Inc.: Hawthorn Farms Industrial Park, Hillsboro, Ore. 97123.
Reneau, Relyea & Associates (Step One): 8222 Jamestown Dr., Suite C-131, Austin, Tex. 78758.
Universal: Box 1270, Cedar Rapids, Iowa 52406.

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WINEMAKING BECOMES A SCIENCE

(Continued from page 103)

where is that more in evidence than with the "late" grapes.

Most wines—red and white—come from red or purple grapes. The juice stays white until the grape starts to ferment on the vine and red plant dye mingles with it. Early-picked red grapes produce white wine; rosés are picked a little later, and reds last.

Since the yeasts that will transform the plant's sugars to alcohol grow on the late-picked plant itself,

the juice flavor already has become quite mature before crushing. With late grapes, the juice must be squeezed with care.

Several crushers designed for late grapes are expected on the market within the next two years. Also in the experimental stage is a machine that gently separates late-harvested grapes from harder, unfermented fruit hanging from the same cutting of vine.

In a related field, viticulturists at California State University in Fresno are using a computer to keep track of an experimental vineyard's

daily temperatures, sunlight, rainfall and other factors. In this way, they hope to select a perfect harvest day. "The program we're developing is just for one specific vineyard," Fresno researcher Carlos Muller notes. But he says master computer programs will eventually be available for all vineyards.

Cultural breakthroughs

Thanks to rapid breakthroughs in the science of "tissue culture," viticulturists will soon be able to do experiments on a scale never before envisioned.

"Tissue culture is opening up doors we once didn't even know existed," says Cornell geneticist Bruce Reisch. With tissue-culture techniques, instead of growing acres and acres of experimental vines, scientists can now grow scores of plantlets in a single test tube.

In the sterile field of the test tube, the pinky-sized plantlets are grown from chemically fed microscopic bits of tissue taken from a parent.

Before tissue culture, scientists had to grow thousands of vines to get mutations that *might*, for example, resist downy mildew. The chance of a mutation showing up was one in a million.

But with tissue culture, researchers are able to grow tens of thousands of plantlets quickly and in a small area, vastly increasing the odds of a desirable mutation.

A combination of breakthroughs in several areas of viticulture has led to the introduction of vine growing in southern Arizona and west Texas, climes once believed inhospitable to the nectar plants.

And, wine scientists predict, the new technology will spread the American crop across ever-expanding reaches of farmland in the next 20 years. **PM**

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Artificial Wine Is Here

Skepticism and outrage greeted representatives of France's Bordeaux-region winemakers when they told a New York audience of connoisseurs that the "bad year" has been virtually eliminated in Bordeaux. A bad year is usually associated with especially wet or very dry weather that produces grapes good only for the most ordinary-tasting wines—or even worse.

Later, Pierre Tari, a French spokesman, did acknowledge that he may have overstated his case a bit. But enologists around the world are seriously investigating new techniques that promise to change winemaking forever.

"Not that wine tasting will be eliminated," says Cornell researcher Terry Acree. "An educated taster will always

appreciate and understand the nuances of very fine wines.

"Still, there will come a time when beverages that taste just like excellent wine will be available on the market. And they will fool some palates."

The technology is practically here already. Current distillation technology permits winemakers to separate flavor-producing chemicals; they can virtually "freeze-dry" qualities of good wine. The remaining fraction of juice is concentrated for later fermentation.

Winemakers—whose wares are federally inspected to make sure that the label is telling the truth—don't acknowledge using the advanced technology.

"Some salesman from Canada recently offered me what he said was flavoring for Johannesburg Riesling," says Domenic Corisetti, winemaker for Taylor in New York. "I really didn't even care to investigate."

Corisetti says winemakers—including middle-of-the-roaders like Taylor—sense that the American drinker is getting more sophisticated and wants more care put into winemaking. Taylor is among the half-dozen middle-line wineries currently experimenting with vinifera grapes from Europe to make a limited number of very high-quality bottles—no more than 10,000 per year.

None of the winemakers contacted by PM acknowledged considering any of the very newest enological advances that speed up the process to a dizzying degree. The most advanced is a "continuous fermentation tower" developed by the Eckes Co. of West Germany. It ferments grape juice to wine within three hours, as opposed to 40 days.

Acree says that even if the fermentation tower doesn't become a mainstay of any winemaker, it may eventually come into use in the production of alcohol for fuel.

New yeast strains

At the Fresno campus of California State University, enologists have been experimenting with new breeds of yeast. But here, the purist needn't worry about the future elegance of good wines.

"This research is geared to finding strains of yeast that won't stop the fermentation process," says Fresno's Carlos Muller.

Yeast is used to convert wine sugars to alcohol. When the alcohol reaches a certain level, it kills off the yeast. The California enologists are trying to raise strains that will survive up to a specified alcohol level under controlled temperatures.

The biggest advances being made by enologists today, Acree asserts, are in quality control. Using mass spectrometers and gas chromatographers, enologists are carefully weighing the chemicals that contribute to various flavors and aromas in wine.

"We've identified about 10 volatile chemicals that contribute substantially to the flavor," says Acree. "The arduous work is in identifying the chemistry of aromas."

One experiment in progress at Cornell places wine tasters at a mass spectrometer/gas chromatography device that can identify the chemicals present in a vapor at a specific time. The tasters are asked to use a select group of words to describe what they are smelling at different points in the experiment. By correlating their responses with the readout of the wine's chemical makeup, Acree hopes to help develop a scientifically

valid vocabulary for describing sensory qualities of wine.

"The things that make for the flavor and aroma of wine are very complex," Acree notes. "Like the nice corky odor once present in a popular European wine. After analysis, it was discovered that this odor was the result of washing the cork in bleach." The company had to stop washing them that way to avoid possible wine contamination.

Results such as that will keep the Terry Acrees of the wine world in business for a long time. But the artists of wine tasting are also here to stay—at least for the foreseeable future.—D.E.

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OWNERS REPORT: CONTINENTAL

(Continued from page 111)

tioned that they thought they ought to get better mileage.

Most owners told us they were happy the Continental isn't such a dinosaur anymore. "I'm glad it's a foot and a half shorter," beamed a Minnesota retiree. An Illinois insurance broker: "Passengers with GM cars are amazed at the space in the back seat."

On the topic of workmanship, nearly 90 percent rated it *good to excellent*. That's about 15 points better than last year's Cadillac, but slightly below the '81 Imperial's rating. An Illinois chemical engineer wrote, "Workmanship and quality are excellent; much better than my '81 Sedan deVille diesel."

Relatively few owners encountered mechanical problems—only 28.2 percent. And of those who did, nearly 90 percent marked their deal-

ers' service as *good to excellent*.

When it came to suggesting changes, 15.2 percent shouted, "Leave the Continental alone!" But there were a few drivers who did have recommendations.

A self-proclaimed "goof-off" from Kansas, aged 65, suggested putting a grille or screen over the windshield defroster vents so pencils and coins wouldn't drop down into the ducts.

A Louisiana motorcycle product

(Please turn to page 223)

SUMMARY OF 1982 LINCOLN CONTINENTAL OWNERS REPORTS*

Total miles driven 484,935	Specific dislikes	Comfort opinion (rear seats):	Number of vehicles owned:
Average miles per gallon:	No complaints 28.6%	Excellent 67.0%	Continental only 25.2%
In town 15.1	Not enough horsepower 14.3	Good 28.0%	Two cars 54.2
Long trips 20.9	Fuel mileage below expectation 7.7	Average 5.0	Three cars 10.3
Engine choices:	Poor workmanship 7.7	Poor 0.0	Four or more cars 10.3
232-cu.-in. V6 1.9%	What changes would you like?	Had any mechanical trouble?	Makes of other cars owned:
302-cu.-in. V8 98.1	No changes 15.2%	No 71.8%	Chevrolet 18.8%
Why did you choose the Continental?	More powerful engine 12.0	Yes 28.2%	Ford 17.5
Styling 37.6%	Better radio 7.6	What type of trouble?	Lincoln 16.2
Past experience 28.7	Better fuel mileage 6.5	Electrical 20.7%	Oldsmobile 16.2
Riding qualities 12.9	Lower price 6.5	Fuel-intake system 20.6%	Cadillac 15.0
Comfort 10.0	Workmanship opinion	Transmission 13.8	Age distribution of owners:
Size 9.9	Excellent 50.9%	Dealer repairs satisfactory?	15-29 years 1.0%
Specific likes	Good 33.0	Yes 81.5%	30-49 years 34.1
Styling 61.9%	Average 15.1	No 18.5	50-plus 65.0
Riding qualities 50.5	Poor 0.9	Dealer service opinion:	Would you buy another Lincoln?
Comfort 45.4	Comfort opinion (front seats):	Excellent 57.1%	Yes 90.6%
Handling 23.7	Excellent 72.8%	Good 37.9	No 9.2
Economy 21.6	Good 24.3	Average 7.7	Would you buy another Ford product?
	Average 2.9	Poor 3.3	Yes 93.8%
	Poor 0.0		No 6.2

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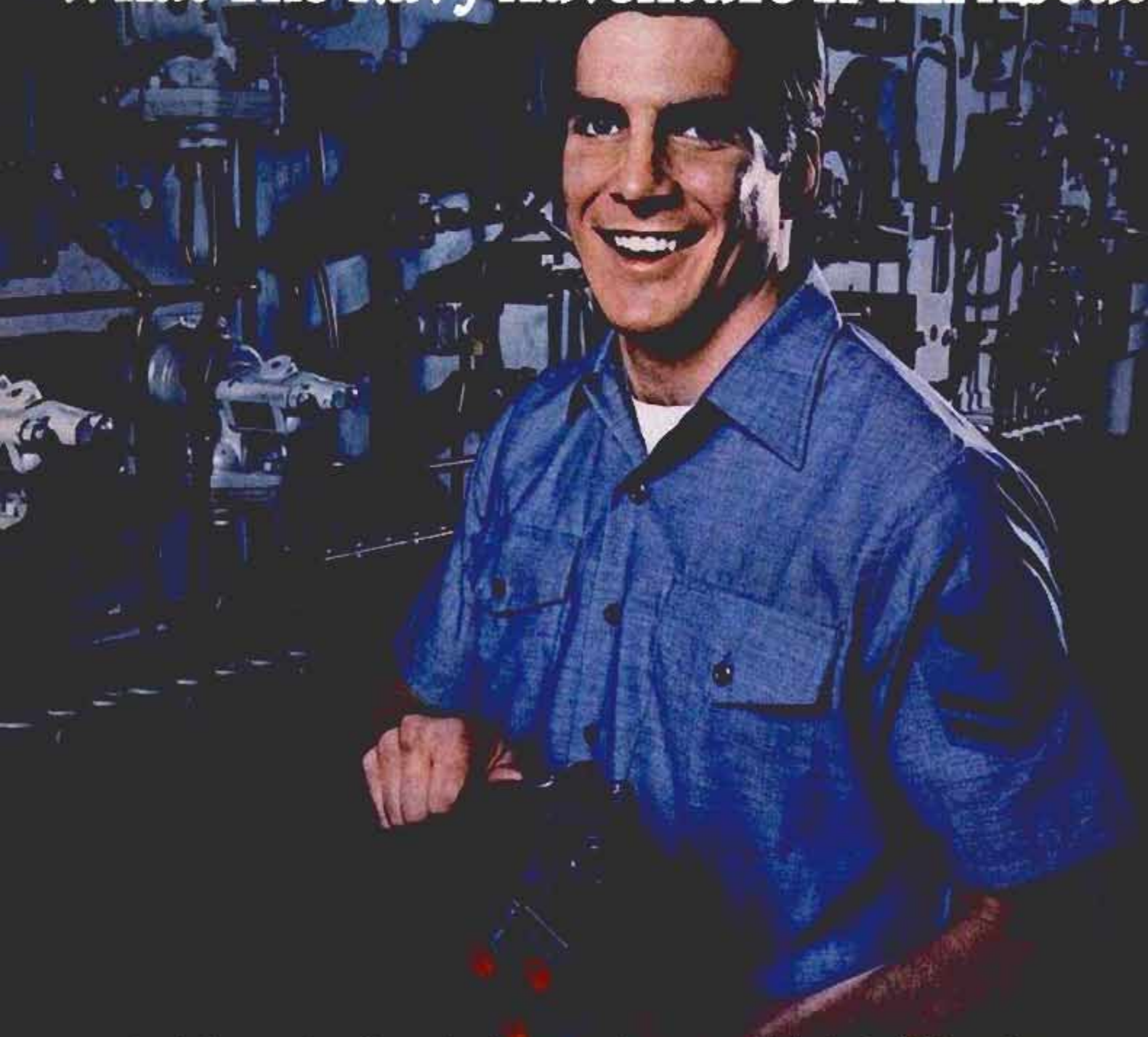
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Navy. It's Not Just A Job, It's An Adventure

OWNERS REPORT: CONTINENTAL

(Continued from page 221)

manufacturer recommended, "The horn, which is on the turn-signal lever, is hard to get used to. Put the button back on the wheel."

And a Florida jeweler: "I wish I could have gotten some of the features offered by Cadillac, like the deck-lid pull-down, automatic temperature control, telescoping steering column and an automatic dimmer."

Several drivers mentioned that the gas pedal rests too near the console, and a significant number would prefer a more powerful engine (at no



Most owners chose the optional V8 engine, but still complained it was underpowered.

sacrifice in fuel mileage, of course). "And lower the price!" ordered an Arizona retiree.

But when you come to the bottom line, namely, "Would you buy another Continental," 90.8 percent said "yes" emphatically. So there you have it. This latest Continental pleases the great majority of its owners in all ways, and those include ways no Continental ever pleased owners before—in terms of handling, size, maneuverability and fuel mileage. It's a car headed in the right direction. **FME**

Restrained opulence and handling, too

I'm not a fan of big, luxury cars. The billowy ride and insulation from road feel make me uneasy. These cars have always felt to me like they were driving themselves. But this new Continental is surprisingly seductive.

The Continental doesn't wallow or pitch, it transmits a decent amount of road feel and it can be driven quite hard, pleasurably. The engineers and stylists in Dearborn have done themselves proud. The black-plastic dash and console light up like a pinball game when the key is turned. The digital gauges, high-quality radio and on-board computer will keep you endlessly entertained and the power seats let you assume any position from go-kart to nearly horizontal. The fit, finish and quality of assembly is excellent, rivaling anything I've seen this year. There's really no fault to find with the car, except perhaps a lack of power—even with the V8. But that's a common problem now.

For those who have arrived, or who would like to think they have, the Continental will make the statement quite well.—T.A.

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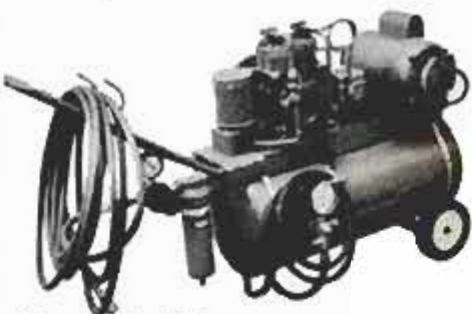
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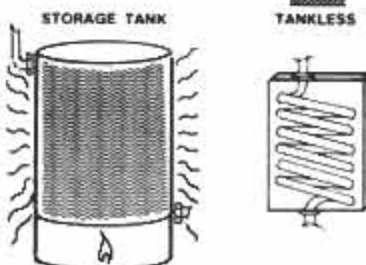
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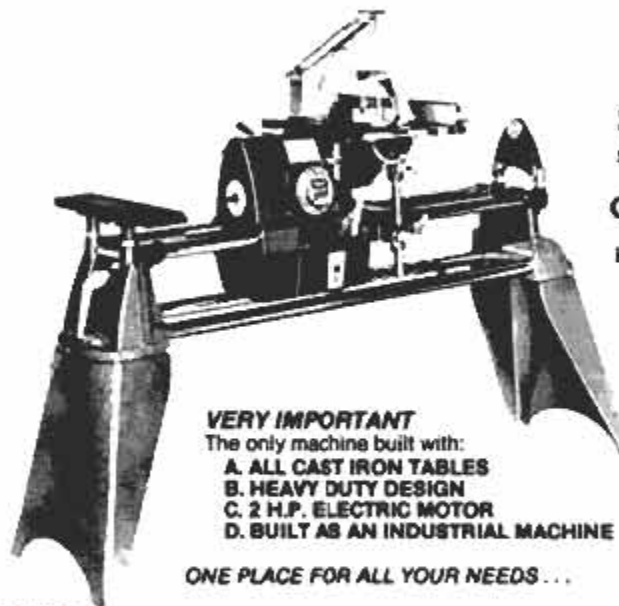
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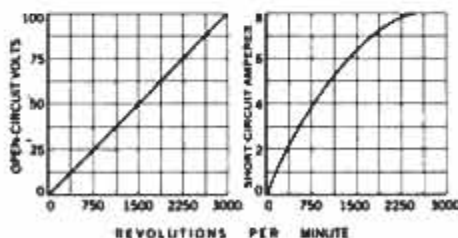
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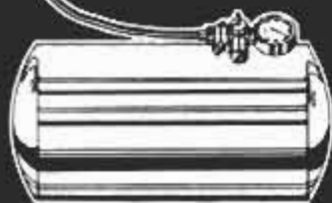
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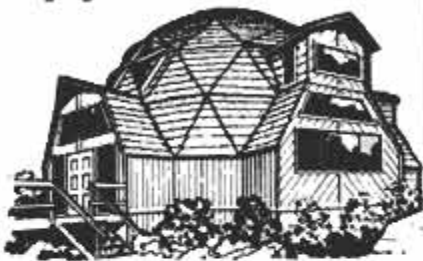


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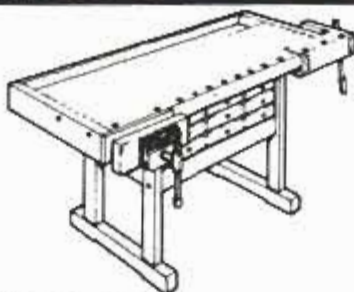
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(Continued on next page)

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GARDENING & LAWN CARE

(Continued from preceding page)

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AUTHENTIC ENGLISH RECIPES, Yorkshire-Pudding, Lancashire Hot-Pot etc. Send \$5.00 for 25. "Recipes," 69 Otaway Ave., Barris, Ontario L4M 2X1.

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Let me show you how to make more money than you ever thought possible as a professional Chimney Sweep

Read my story, if you like the idea of earning \$150 per day part time, \$700 or more weekly in a business of your own . . .

My name is Tom Risch. I'm 28 years old, own my own home, a 22 ft. sailboat and an antique Morgan sports car. I suppose more than anyone, I'm the person responsible for "re-inventing" the chimney sweep business — as I'll shortly explain.

Don't get me wrong. I'm no genius. You could have stumbled into this as easily as I did. And my story is one you should know, if what you seriously want out of life is greater personal freedom, satisfying work — and a lot more money than you're earning now.

A dead-end road

When I got out of school, I thought I had it made. I loafed around that first summer, then went to work for a house painter. But I didn't like the boss breathing down my neck, so I went out on my own.

For the next few years I tried to make it as a house painter and general fix-it man. I had plenty of independence but I was going nowhere fast.

One day in 1973 I found myself in a lady's attic fixing her chimney. An old top hat was lying on a trunk, so I put it on and started singing that great song from *Mary Poppins* — "Chim-chimney, Chim-chimney, Chim-chim-chimney, a Sweep is as lucky as lucky can be. . ."

Wondering what all the racket was about, the lady climbed the stairs and when I'd finished the chorus, asked me a fateful question: "Whatever happened to the old Chimney Sweeps?"

No Sweep in town

I didn't have an answer, but the question aroused my curiosity. At that time the Arab Oil Embargo was on. The incredible boom in heating with wood was just getting underway. Folks everywhere were starting to use their fireplaces and new woodstoves around the dock.

And suddenly, dangerous chimney fires were breaking out all over town. I knew the reason: woodsmoke produces creosote, a highly flammable substance that condenses on chimney flues. Unless the chimney is cleaned regularly, a fire is almost inevitable.

Starting over

My local fire chief convinced me my services as a Chimney Sweep were urgently needed. But I had a lot more to learn — most of it the hard way.

Everything that happened next is told in a booklet I want to send you, free. Just let me say here that I made plenty of costly mis-



Heart of the System

takes and wrong moves — mostly because nobody was around to help me get started right. I realized I needed better tools. It took many months of hard searching to find the right equipment. I designed and built my own vacuum system — the first ancestor of the amazing SootSweeper¹ we use today.

\$45 for an hour's work

My System makes it possible to complete a typical chimney cleaning job in less than an hour. My standard fee was \$40 (most Sweeps now charge \$45 to \$50) — and people were glad to pay it. I found myself earning more money than I ever dreamed possible — \$150 to \$200 a day, \$700 or \$800 a week. And almost all of that was clear profit, for there's very little overhead in this business.

I realized there were more chimneys in my town than I could ever hope to clean, not to mention in my state and the whole U.S.A. I realized my success didn't have to be unique. I had friends all over the country who could profit from this wonderful opportunity. So I began sharing my experiences with them through AUGUST WEST SYSTEMS[®] — the first nationwide organization to provide training, equipment and start-up guidance for independent Chimney Sweeps.

A wide-open field

Since then we've helped over 5,000 men and women begin new, highly profitable businesses of their own as professional Sweeps. Yet they've just begun to answer the need: there are over 25 million fireplaces in American homes. Since 1974 woodstove ownership has leaped from 200,000 to over 5 million, and the end's nowhere in sight. The more the economy worsens, the higher oil prices go, the greater the need for your services. . . . But what's it really like to be a Chimney Sweep?

Today it's a lot different than many folks imagine. First, with The August West System you clean most chimneys from below instead of on the roof. Your cleaning tools are brushes attached to our exclusive Flex-Rods[®] that let you do a quick but thorough job. The dust from the chimney instantaneously disappears into the SootSweeper in-



"Last year with a helper for 5 months I did 1200 jobs, this year I'm trying for 1500. Needless to say I feel very good about what August West Systems has helped me do with my life." — Paul Sheehan, Sandwich, MA.

stead of seeping into your lungs or all over your customer's rug.

If you're ambitious and a good planner, you can easily clear \$150 a day, maybe a lot more. You can work full-time, or start part time while you keep your current job until your new business is firmly established.

I want to be straight with you: chimney cleaning is no lazy way to quick riches. It's hard work, you do get dirty. But the rewards can be great. Paul Biskner, a real dynamo from Garden City, Mich. says: "I've already had plenty of \$1,000.00 weeks. Now I'm shooting for a \$1,000.00 day!"

The perfect bootstrap business

You don't need special skills, business experience, a college degree or a big investment. The August West System gives you everything you need to start earning money almost right away — and we keep on helping you with advice and answers to your questions as your business grows.

But you are the boss. You can work as many or as few hours as you want. You'll enjoy wearing a top hat (and the response it inspires). You'll like the feeling of knowing you are performing a needed service. Here's what Isaac Watts of Madison, Va. recently wrote us:

"Every job is different — a new challenge. When I come through the door in my top hat I get first-class treatment — it's not like being a plumber or repairman. And I know my work is saving these folks from dangerous chimney fires. It's work you can take pride in."

Ask for free proof

Find out more about the high earnings potential and other wonderful benefits you can enjoy as a professional Chimney Sweep. Just call me TOLL-FREE at 800-243-5166 and ask for extension 214. Or mail the coupon below. I'll rush you a detailed INFORMATION KIT with the complete August West Story. Call or write today!

YES, send me your FREE INFORMATION KIT telling me how to make up to \$150 or more per day as a professional Chimney Sweep.

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State _____ Zip _____



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Box 603 - Dept. 2104
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