

SPECIAL 48-PAGE CAR TUNE-UP MANUAL: BEST TOOLS TO USE

OCTOBER 1981 \$1.25

# Popular Mechanics

'82 CARS  
IN COLOR:

- Chrysler
- GM ■ AMC

PLUS: Preview of  
Pontiac Trans Am

HOW TO INSTALL  
A COAL STOVE

Now: Portable  
video for away-  
from-home movie



BUILD THIS  
SPORTY KIT CAR

12 COMPLETE PLANS

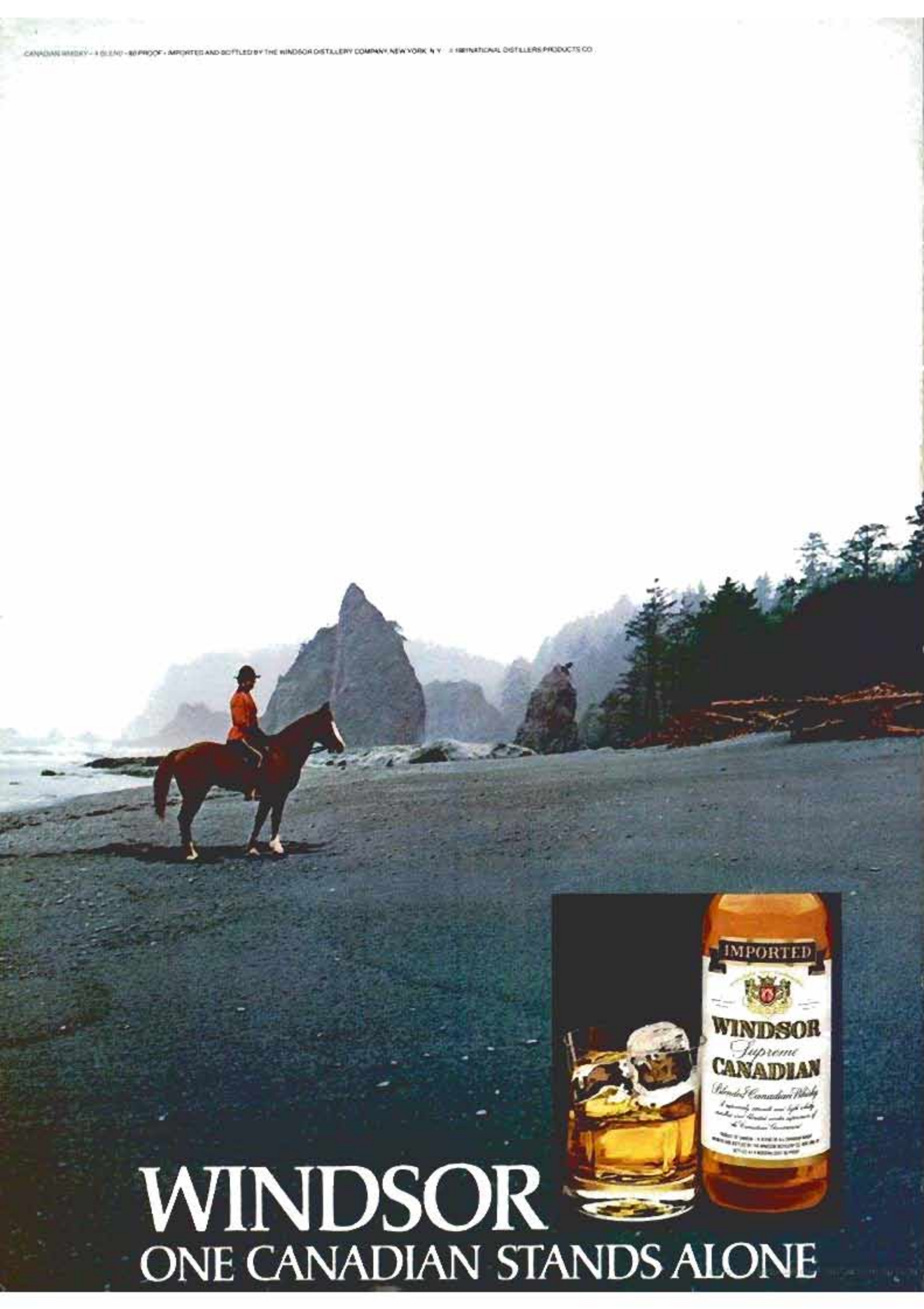
- 7 handy shop tools you make
- 2 oak plant stands to build
- 3 mobile car-care islands to construct



## BUILD PM's ALL-FUEL STORAGE SHED

SAFE FOR ■ KEROSENE ■ GASOLINE  
■ FIREWOOD ■ CAMP FUELS ■ AND MORE





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## DODGE TRUCKS ARE RAM TOUGH



9BAJ-F30-9J9D

\* With standard Slant Six engine, optional automatic transmission. Use EPA est. mpg number for comparison. Your mileage may vary depending on speed, distance and weather. Actual Hwy mileage will probably be less. Calif. est. lower.

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8 mg  
tar



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





### On the cover

Energy economics are leading more of us into home use of multiple fuels. PM's storage shed provides safety, security and a convenient home fuel center that is also attractive. Complete plans begin on page 114 in this issue.

—PM photo by George Ancona

# Popular<sup>®</sup> Mechanics

OCTOBER 1981

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## Armstrong introduces a great new look in ceilings and a system that makes installation easier than ever.

The great new look is the Armstrong Masters Collection™. Dramatic ceilings with the realistic look of oak, pine, marble, and cork.

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2. Position tiles.



3. Snap in place.

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so nice  
to come  
home to™



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\*Estimate based on manufacturer's survey of retail pricing.



# LETTERS TO THE EDITOR

## Battle over battle tanks

In your article *Can Tanks Still Win Wars?* (page 66, July '81), your conclusion that the U.S. M-1 is the best battle tank in the world is a lot of nonsense. Most military men not biased toward the United States will tell you that the German Leopard II is the best.

The Leopard has a larger gun than the M-1 and a better power-to-weight ratio. Its diesel engine is also more durable than the M-1's high-revving turbine.

DAVE BARNETT  
WICHITA, KAN.

You seem to downplay our M-1 and play up the Russian T-72. While the M-1 does have high fuel consumption and somewhat short engine life, it is fast, roomy and, with a good crew, can fire four times in 15 seconds. The T-72 can fire only five times a minute. The M-1 is a very fine tank.

JAMES C. LACINA  
PHILLIPS, WIS.

One tank you should have included is the new Israeli Merkava. It has some interesting features. The engine is in the front to absorb the shock of a hit and protect the crew. An access door at the rear allows reloading during combat and provides an emergency escape hatch.

MIKE METTRY  
ELK CITY, OKLA.

*While we did give the M-1 good marks, we indicated that it is expensive and heavy. We also pointed out that its gun, though currently smaller than those of the German Leopard and Russian T-72, is scheduled to be upgraded to 120 mm in 1984. The Israeli Merkava is a fine tank for desert warfare, but was considered too specialized for comparison with the heavier MBTs we were discussing.*

## Tribute to Tesla

Thank you for the terrific article on Nikola Tesla, honoring his 125th birthday (*PM Electronics Monitor*, page 58, July '81). He is one of history's greatest scientists.

ALLEN DAVIDSON  
ELMA, WASH.

I'm glad PM saw fit to give Tesla such a tribute. For some time, I and other "Teslites" have been urging

Congress to issue a gold commemorative medal in Tesla's honor. Those who feel as we do may add their support by writing to Congressman Edward Roybal, House of Representatives, Washington, D.C.

EDSON ANDRE JOHNSON  
LA CANADA, CALIF.

## A great Christmas present

Enclosed is a picture (below) of the Victorian dollhouse I built for my daughter from your plans (*Two Enchanting Dollhouses You Can Build*, page 116, Dec. '76).

I added tiny electric lights, mahogany floors and two oak stair-



Happy youngster shows off PM's Victorian dollhouse, built by father, Dave Phillips.

ways. My mother made the window curtains and crocheted the rugs. We gave the dollhouse to our daughter for Christmas last year and she enjoys it very much. Thanks.

DAVID R. PHILLIPS  
BEAVER FALLS, PA.

*We're glad your daughter likes it. For others who may want the plans, they are \$8.70 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101 (request plan No. PL-1710).*

## Real people speak up

I really enjoyed your article *PM's Real People Road Test of Economy Cars* (page 65, Aug. '81). But I was disturbed that the Datsun 310GX didn't score better. I question the

validity of having a Honda Civic owner participate in the test because of her partiality. After all, as a happy owner of two 310GX coupes, I would have been very biased toward the Datsun.

KERRY FINK  
ATLANTA

The test was a farce. You turn uninformed opinion into statistics and then into ratings and recommendations, all to overturn the American dream.

M.M.  
CRARYVILLE, N.Y.

The article was very interesting in that I purchased a Toyota Tercel SR-5 and a Ford Fairmont station wagon in the past year, the latter in a burst of "Buy American" fever. Lord, what a difference! The Toyota has not been back to the dealer yet; the Ford has been back 10 times!

MACK J. KALAHAR  
SALINAS, CALIF.

*The tests were admittedly—and intentionally—not scientific. But the fact that all the participants drove all the cars, and arrived independently at surprisingly similar conclusions, suggests that neither ignorance nor prejudice figured strongly in the results.*

## Beware of termite poison

A very dangerous situation could exist with the termite-control device you showed in your July '81 issue (*PM Looks at Do-It-Yourself Termite Treatment*, page 132). No mention was made of an antisiphon valve to prevent poison from backing up into the water line.

Last year, here in Roanoke, men were treating an area and the water went off, permitting the poison to back up into a dozen or more homes and making a number of people seriously ill.

BOWEN I. SHRADER  
ROANOKE, VA.

*The particular system we reported on (Ross Soil Injector) has a built-in antisiphon valve for exactly this reason.*

*However, readers considering other makes should check to be sure such protection is included. If there is doubt, a separate antibackup fitting should be installed between the faucet and injector hose.*

PM





FESTIVE EVENINGS  
OFTEN START WITH RED.

JOHNNIE WALKER RED  
THE RIGHT SCOTCH WHEN ALL IS SAID AND DONE





# THE PM GARAGE

## CAPSULE REPORTS ON NEW AUTO PRODUCTS

### Door-switch holder

Any auto repairs that require opening a door can be a real nuisance on a car with warning buzzers. If you leave the door open, the buzzer keeps going.

Why doesn't someone come up with a way to keep the door-switch button depressed? Well, someone has—surprisingly, a company that specializes in body repair tools,



Spring clip holds in button, shuts buzzer when you need to leave car door open.

Steck Manufacturing Co., 1319 West Stewart St., Dayton, Ohio 45408. It's a simple spring clip that you attach in a second, and when you clip it on, the switch button stays in. It works on GM and Chrysler products and many imports; just don't forget it when you close the door. A set of three is about \$2 from most parts stores.—Paul Weissler

### Allen-screw kits

If you've ever worked with the aluminum case screws on motorcycles, you probably stripped the soft Phillips slot or at least chewed 'em up a bit. R.C. Engineering has a way to end the stripped-screw blues forev-



Chrome-molybdenum Allen screw set replaces Phillips screws on motorcycles.

er. It offers complete chrome-moly Allen-head replacement screw kits for Kawasaki KZ 900/1000, Suzuki GS 750 and Honda 750 sohc motors. Kit number is 4130.

The kit for my Kawasaki included enough Allen heads to replace all the oxidized aluminum screws from the valve cover to the points cover. The KZ 900/1000 kit retails for \$16.50 at most motorcycle shops or contact R.C. Engineering directly at 13300 Estrella Ave., Gardena, Calif. 90248.—Joel Breault

### Window-tint film

To cut glare, beat the heat and let your car's air conditioner work easier—or just for fashion—black-out windows are the latest look. Gila River Products offers a complete selection of window tinting films for vehicles, or home use.

Applying the tinting requires a steady pair of hands. It also helps to have an assistant. Careful procedures must be followed for this project to turn out right. Window



Window-tint film, which is illegal in some states, is applied on exterior of glass.

templates and hand-cutting the film with a razor blade must be exact. Extreme care must be taken when you squeegee the air bubbles from the tint—and don't scratch the film.

Contact Gila River Products at 6615 West Boston St., Chandler, Ariz. 85224.—Joel Breault

### Wheel-cylinder clip remover

If you ever have to pull the wheel cylinder on the rear drum brakes of most late-model GM cars, you'll see it's held by a retainer clip from the rear. You can pry off the old retainer with a pair of screwdrivers, and you can drive the new clip back on with a 1/4-inch socket—if you have a socket that size and enough clearance.



This clip remover makes fast work of taking off most rear cylinder retaining clips.

But best way is with a new, caliper-like tool that expands the old retainer by just turning a knurled knob. Reverse the procedure to install a new one. Of course, this tool is so easy on the retainer that you probably can reuse it. From Lisle Corp., Clarinda, Iowa 51632. The tool is \$9.25 in auto-parts stores (no mail orders).—Paul Weissler

### Barometric dipstick

If you pump your own gas, you probably also check your car's oil. Messy, isn't it? There's now a cleaner way, namely the Oil Level Index.



Oil-level indicator mounts inside the car and gives reading with the push of a button.

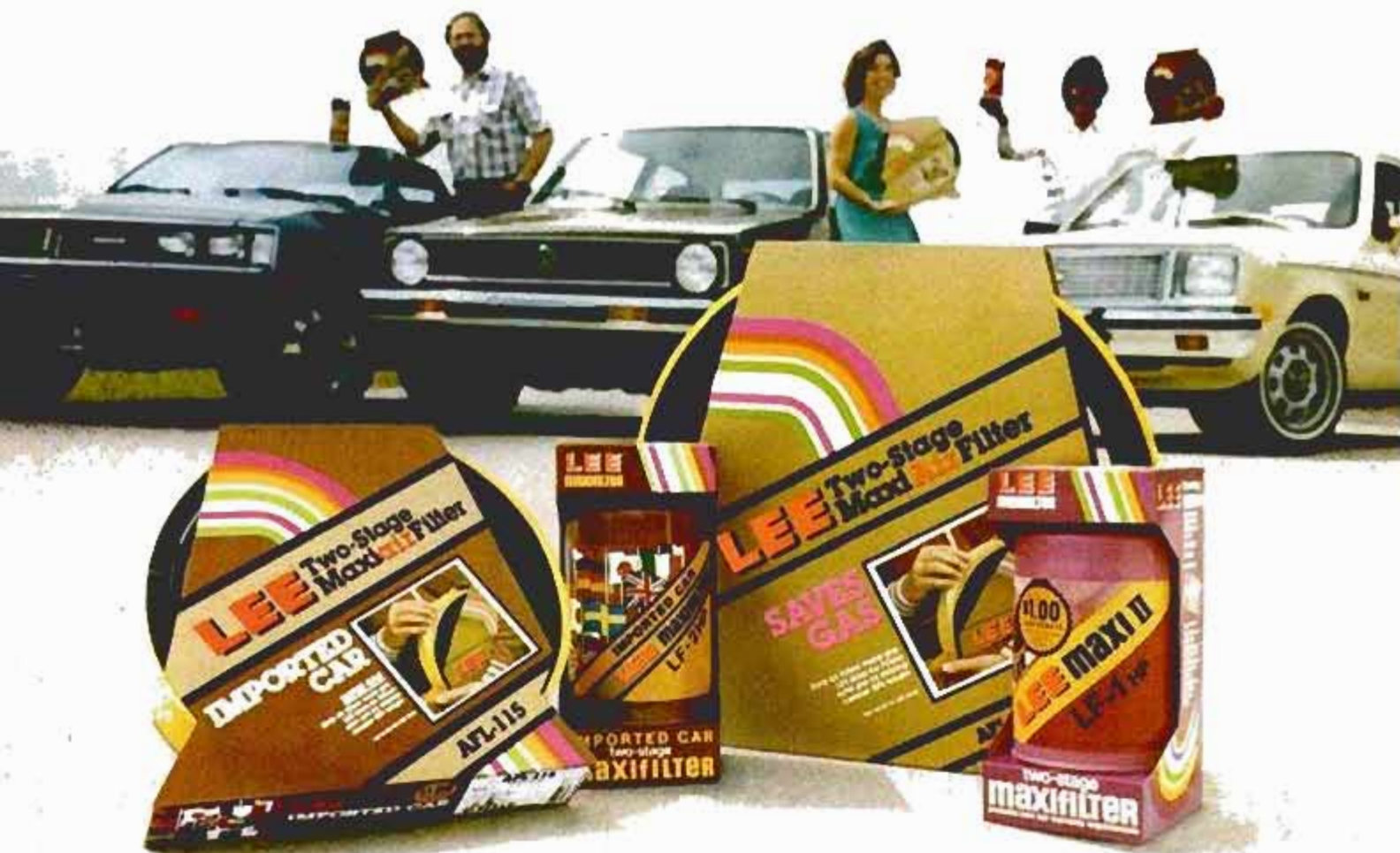
I installed one in the engine compartment of our 1974 Merc. It works fairly well, although it's not so accurate as a dipstick. It works on the principle of equalized air pressure. You press an air bladder, which moves fluid in the meter at the same time it creates a pressure balance according to your engine's oil level.

Price is \$19.95 plus shipping from Index Industries Inc., 9145 151st Ave. N.E., Redmond, Wash. 98052.

—Mike Lamm



# Mini engines need MaxiFilters.



Small engines work harder, run hotter, run at higher rpm's than big engines.

At 55 mph, your 4-cylinder engine revs as fast as a V-8 at 75 mph.

Oil flow is faster. Oil filters are smaller. Pressure builds. So small engines need special protection. That's why you're using the new SF motor oils. And that's why you should be using LEE.

## LEE TWO-STAGE MAXI-OIL FILTER.

LEE Maxi-Oil Filters are needed now more than ever because they meet the tougher demands of smaller engines. They trap up to twice the dirt of ordinary single-stage filters. MaxiFilters last far longer — and bypass oil less often. All single-stage filters bypass dirty unfiltered oil under pressure. LEE's second stage keeps on filtering so you know your engine's protected.



Now, think about why you bought your small car. Economy! So why pass up the cheapest, easiest way to save money by saving gas.

## LEE TWO-STAGE MAXI-AIR FILTER.

A dirty air filter wastes gas. It chokes the air supply, forces your engine to burn more gas. Expensive gas.

That's why it pays to have an air filter that stays cleaner longer. The LEE Two-Stage Maxi-Air Filter stays cleaner up to 50% longer so your car breathes easier. You burn less gas. You buy less gas.

Mini engines need LEE Two-Stage MaxiFilters even more than big engines — for protection and economy. Buy them at your favorite discount, chain or auto store.



# LEE Two-Stage MaxiFilters

FOR U.S. AND IMPORTED CARS.



# PM ELECTRONICS MONITOR

## A grand gaming mansion

Imagine yourself walking along the road—and then passing by a spooky, old, many-storied mansion. From behind its curtained windows come numerous groans and screams, mixed with maniacal laughter.

That's the image the new GameMaster computer network is striving for—and it has been amazingly successful so far. Like all computer networks, you call GameMaster on the telephone, using your own home computer. (See our article *Now Your Home Computer Can Call Other Computers on the Telephone*, page 130, Mar. '81.) Then you can move from room to room—playing various games.

Many of the existing computer networks offer gaming along with numerous other activities. But no other network offers anything quite like the GameMaster.

This futuristic service not only allows you to play the usual computer games against the GameMaster computer, it also lets the individual callers play against each other—in real time.

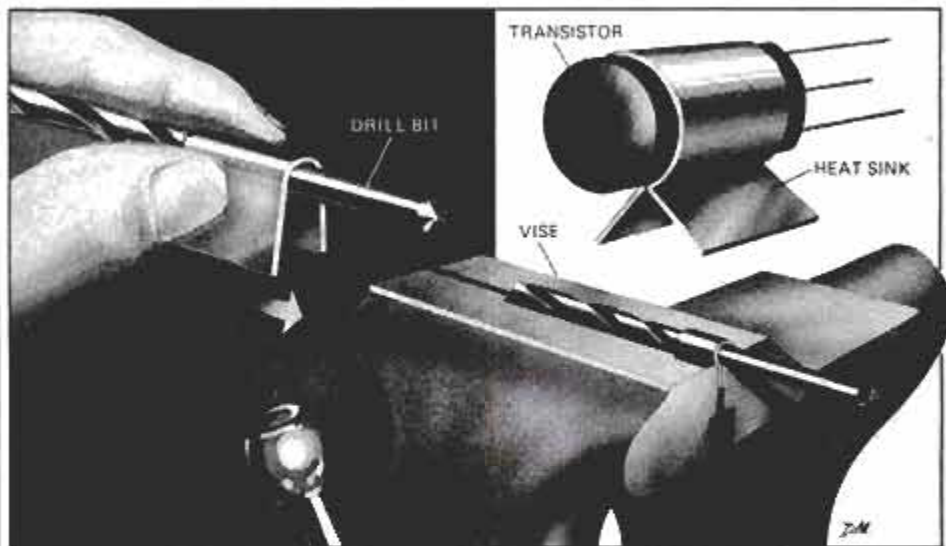
This type of game playing, which is called "interactive," points to a whole new way of using these popular computer networks. When people begin communicating computer-to-computer, some remarkable things can happen.

## Trucks and spaceships

One of GameMaster's most popular interactive games puts you in the position of running a national fleet of trucks. You must use maps and strategy to plan your long-haul routes to get where you are going in the best time—and reap the points for your cunning. Meanwhile, the other players are doing the same thing. You can block loading docks with your own rigs, choose dangerous cargoes—anything to win. (We entered one game, but were done in by a particularly evil and wily opponent.)

GameMaster gave us a preview of some of its future games and we were amazed that the technology had advanced so far. The company is planning one game which is a starship simulator. The participants, while seated at their own home-computer consoles, will be able to voyage on an interactive, intergalactic journey.

Using the high-resolution display capabilities of the Apple II home computer, various players will be



## Do-it-yourself heat sinks

If you want to build any transistorized power-supply circuits, or power output amplifiers, first you'll probably have to make a heat sink for your transistors. Heat sinks have a very important function: They help a delicate transistor

dissipate its own heat without burning up. You can use a drill bit, as shown in the illustration above, to shape sheet aluminum, tin or almost any workable metal. Remember: Installed heat sinks must not touch any other components.

seeing different things on their screens depending on what post of duty they have chosen. Star displays, instrument readings, communications from other players, all this and more will be included. It looked to us as if the planned game may prove to be almost as exciting as being there.

## The new merchants

GameMaster, which was developed by Harlow Stevens Jr. and Sr., is a perfect example of what is being referred to as an "electronic cottage" industry. Many people feel that the advent of the home computer, and of smaller minicomputers, will create new fields of endeavor to replace many of today's more conventional occupations.

In colonial times, old-style cottage industries consisted of households spinning cloth and raising farm goods. The new, electronic cottage also involves a family working out of its home—but in this case, producing its own means of support electronically.

The Stevens family is a prototype of this emerging industry. Mrs. Stevens has not been left out, either. One of the GameMaster's rooms is the kitchen area, which she runs. Many home computerists call from all over the country to exchange recipes there.

Right now, GameMaster is a unique service, and families like the Stevenses can be considered happy

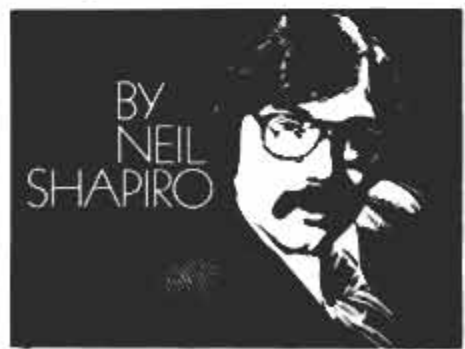
pioneers. But it's just a matter of time before other families follow suit.

As usual in computing, games have begun to point the way to the future of the whole field.

If you'd like to walk around the mansion and enjoy everything from adventure games or blackjack to new and surprising interactive games, the cost is reasonable. The rate per hour is \$2.50. GameMaster also sells various membership packages. The most popular membership is \$75—this includes documentation on all the mansion's games and six hours of time-credit. Membership is not required, but it's the best way to join in the fun.

GameMaster's address is: Box 1483, Evanston, Ill. 60204. Or—if you have a computer—you can dial your way to the mansion's front door at 312-864-0516; 312-328-9009 will put you in contact with a human.

Enjoy this electronic cottage—or rather, electronic mansion. **PM**





# RCA SELECTAVISION 650

## NO VCR LETS YOU GET MORE OUT OF TELEVISION

### RECORD YOUR FAVORITE SHOWS ON VIDEO TAPE.

If you don't own a video cassette recorder, you're not getting the most out of television. And no VCR lets you get more out of television than RCA's new SelectaVision 650.

Now you can watch what you want, when you want. With SelectaVision 650, you'll be able to record up to six full hours of your favorite TV shows on a single cassette.

Your recording sources are virtually unlimited. SelectaVision 650 has a new *Cable-Ready Tuning System* that can be set to include any of up to 35 CATV channels—12 VHF, 9 mid-band and 14 super-band channels.

That's a lot of entertainment. But then, SelectaVision 650 is a lot of VCR.

It records automatically, too. A *14-day memory* lets you program selections to be recorded when you're not at home. Preset it to tape as many as eight different shows. Or set it to record the same show every day.

With SelectaVision 650, prime time television is yours any time.

Simulated TV picture.

For the complete line of SelectaVision VCR models and color video cameras, write to: RCA Consumer Electronics, Department 32-312, 600 North Sherman Drive, Indianapolis, IN 46201.



### PLAY THEM BACK WITH SPECIAL EFFECTS.

Ever slow down a rocket launch? Stop a stampede of buffalo? Or run a mile in less than two minutes? SelectaVision 650 lets you do all this, and more.

A new *Infra-Red Cordless Remote Unit* gives you the freedom to control special effects like *slow motion*, *stop action* and *fast motion*—from almost any point in a room. It also lets you *advance the picture frame by frame*. And *freeze it* whenever you choose.

That's not all. The new cordless remote also has a *picture search mode* that enables you to locate footage at 9X normal speed without having the screen blank out. And a *remote pause* for editing out unwanted material while recording.

SelectaVision 650. When you see it at your RCA Dealer's, you'll see why no one gives you more VCR than RCA.



**RCA**  
**VCR**

No one gives you more



RCA—Video Supplier to the NFL.



# IMPORTS & MOTORSPORTS

## Speed and safety



AP photo

Danny Ongais hit the wall in the Indy 500, but was not a holiday weekend fatality.

Twenty-five people died during the running of this year's Indy 500—none of them on the Speedway. All 25 died on our nation's highways. During the 78-hour Memorial Day weekend, 560 people were killed in traffic accidents. No one died in the Indy classic, which was run in just over 3½ hours with the winner averaging 139 mph for 200 laps of the 2½-mile oval.

Of all the accidents that weekend, only one, as far as we know, was televised, and that was Danny Ongais hitting the wall in turn 3 at Indy in his race car at close to 200 mph; he lived (and is getting ready to race again). Hundreds of people in passenger cars, many going no faster than 55 mph, died.

This news is not meant to be so much a defense of motorsports—the tragic death of Patrick Jacquemart in the Renault Turbo in July is proof enough of the real dangers of racing—as it is a desire to see our roadways just as safe as they can be—yes, as safe as the racetrack often is. It's on the track where race drivers exhibit their *control* of speed; it's this poise and balance—and brains—in the control of a race car that we admire and cheer. True motorsports fans don't want these

drivers to "lose it"; we want them to dazzle us with their skill and daring just as two astronauts did when they brought in the first space shuttle, slowing from *thousands* of miles per hour to a triumphant rolling stop in their "victory circle" at Edwards AFB.

So, check your car and yourself; drive with unflagging concentration, as if you were among the 33 drivers starting an Indy 500—and like them, securely buckled up behind the wheel. Buckled up... just in case.

## Vegas venue



New GP circuit is 2.2 miles with 16 turns.

The dicing in Las Vegas on Oct. 17 is going to be among Formula 1 racers on an all-new track. If anything can shut down the gambling tables in that town, the spectacle of a Grand Prix race is it. Cars and drivers will arrive after the Sept. 27 GP of Canada and start practice for the concluding race of the season. The Caesars Palace Grand Prix, which replaces the Watkins Glen venue on the '81 calendar, is expected to result in unprecedented coverage for a U.S. Grand Prix race.

## Shooting for 75 mpg

Not content to have the most fuel-thrifty line of cars on the market, with highway mpg figures in the 50s, Volkswagen is now going after the 75-mpg mark. Its three-cylinder turbodiesel (still in development) in the right car would do the trick. The car could be a smaller, lighter Rabbit, or the Polo, which has never been sold here.

VW engineers will make a 75-mpg Polo a reality by '84 or '85, but can VW marketing people predict that it would sell here?



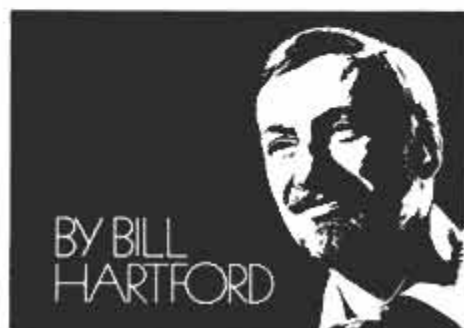
European VW Polo is wagonlike for '82

The unanswered question for VW, and all automakers who are trying to balance fuel economy, comfort, performance, safety and size, and still sell cars to American drivers, is: How small is too small?

## The top two

Meanwhile, Toyota and Datsun still reign supreme in the imported car wars. Latest from Toyota are new Celica and Supra models (story next month). Toyota has also set up "Quality Connection" parts centers at dealerships, where do-it-yourselfers can get parts complete with how-to instructions. Bravo Toyota!

Datsun now has a diesel in its lineup—a 2.8-liter Six for the Maxima. Also new is a fwd replacement for Datsun's 510 models. The three-door and five-door hatchbacks—already shown in Japan—will come here as Stanza models. And we might as well start calling it Nissan Stanza since the parent company seems to be going ahead with phase-out here of the very familiar Datsun name. Inscrutable. **PM**



**Indy Car** is a treasure of info on the racers from 1911 to now. PM contributor Roger Huntington makes the nuts and bolts come alive. It costs \$12.95 plus 75¢ postage from HP Books, Box 5367, Tucson, Ariz. 85703.



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# THE GLOVE RUSH OF '81



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## NOTES FROM THE EDITOR

John A. Littleton

It sure looks good from the air, wrote PM's Robin Nelson (page 83) when he saw the vast expanse of Edwards Air Force Base—the landing site of our space shuttles. That dry lake bed, offering, as it does, an almost unlimited stretch of runway for powered and unpowered high-speed aircraft, has been the home field for planes that have shattered sound and altitude barriers ever since World War II.

Flying those previously untried planes has been a dangerous business. We're sure many returning pilots have looked down at the Edwards giant, 12½-mile-long rollout strip and breathed something similar—with an even greater fervency: Yes, it really *does* look great from the air.



"It sure doesn't look great from the ground," commented Robin Nelson in reference to the Joshua trees (right) that abound on the desert airfield. "They're a totally useless, vertical colony of thorns in search of a victim," he observed. Robin appears above, safe from thorns in the cockpit of an F-15 stationed at Edwards Air Force Base.



PM photo: Alan Kendall



PM's Gary Witzenburg (right) stands with the three other first-place team drivers and their Porsche 924. Left to right are: Catherine "Cat" Kizer, Akron, Ohio; Bob Nickel, Sewickley, Penn.; Fred Baker, Bedford, Ohio; and Witzenburg.

Taking a relaxing break from testing Detroit's 1982 offerings during "long-lead" previews (page 90), Detroit Auto Editor Gary Witzenburg helped drive a Porsche 924 to first place in the Longest Day 24-Hour Race at Nelson Ledges, Ohio. The contest is a "showroom stock" event, now considered the second most important 24-hour race in the country. Stopping about every two hours for fuel and a change of drivers, the team covered 1,838 miles over punishing bumps and high-G turns. Talk about a busman's holiday!

PM

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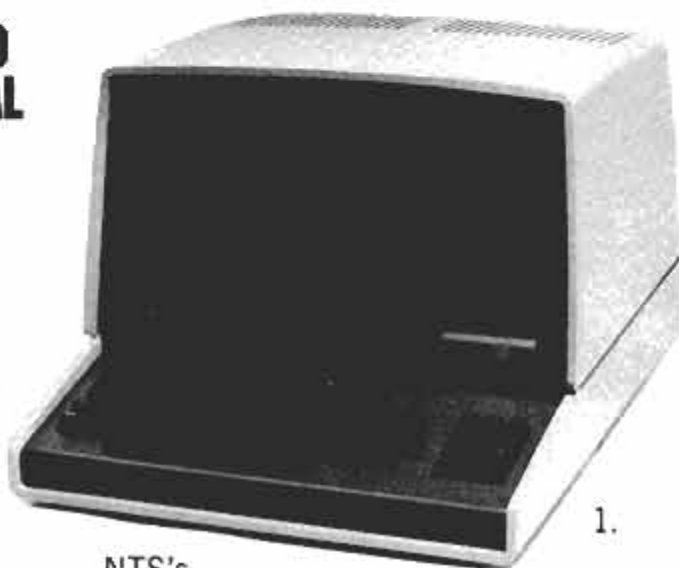


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for you to learn BASIC high level language programming and assembly language programming.

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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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# SCIENCE WORLDWIDE

## Natural laser on Mars

Scientists have discovered a powerful natural laser in the atmosphere of Mars.

Researchers at NASA and the University of Maryland made the discovery with a highly powerful spectrometer, some 10,000 times more sensitive than similar instruments which are used in terrestrial research.

The natural laser is similar to man-made carbon dioxide lasers used on Earth for bloodless surgery and industrial welding. On Mars, the laser is solar-powered. Sunlight striking the upper layers of the carbon dioxide atmosphere pumps the gas to a higher energy state. Then, in moving from this higher state back to a lower state, molecules of the gas emit the infrared laser.

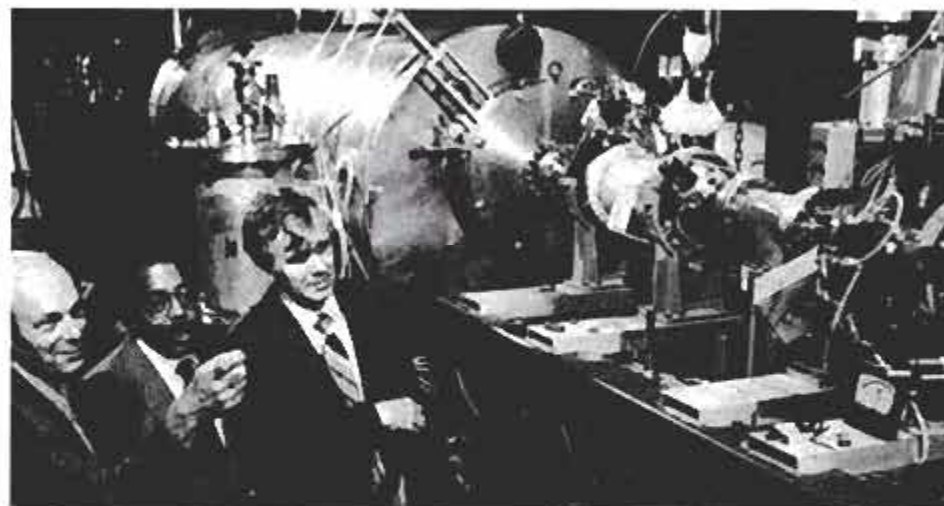
The power output of the natural laser exceeds 1,000,000 megawatts—roughly equivalent to the power generated by 1,000 large hydroelectric power projects on Earth. In fact, the Martian laser puts out more than five times the total power that can be generated in the United States from all sources at any one time.

The discovery may affect the outcome of several lawsuits now pending about whether laser systems can be patented. According to one of the investigators, Michael J. Mumma of NASA's Goddard Space Flight Center, it could be argued that if lasers occur naturally, even on Mars, they cannot be patented on Earth.

Now that this "energy in space" has been discovered, it won't be long before ideas are generated as to how power from the Mars laser can be tapped and beamed to Earth from orbiting satellites.



Wild bees produce plastic: Waterproof sac (inset) made by *Colletes* bees is polyester.



Argonne's accelerator, with supercooled components, explores atoms and saves energy.

## ... And plastic from bees

At the same time NASA announced the natural laser, a U.S. Department of Agriculture researcher reported the discovery of natural plastic.

Wild bees of the *Colletes* species produce a polyester sac to contain larvae, according to Suzanne Batra, an entomologist. The thimble-sized sac "resembles a Ziploc sandwich bag," she says. It's waterproof. And like the polyester made from petrochemicals, it won't degrade.

Batra says the plastic comes from a gland in the bee's abdomen. The female builds the sac by spreading the clear secretion with her tongue and legs.

No one yet knows how the tiny plastic factory works inside the bee. But chemical companies are certain to explore the question as they try to take the sting out of raw materials' price hikes.

## A cold look into the atom

Scientists have set out on new explorations of the atom using a recently developed device that operates at temperatures of about 459° below 0°F.—near absolute zero.

Researchers at Argonne National Laboratory are probing forces that hold atomic nuclei—centers of atoms—together. The new tool in this study is a 46-foot-long linear accelerator that uses about one-tenth the energy of a comparable, room-temperature atom smasher. Cooled coils in the accelerator, which moves charged atoms up to speeds where they can be analyzed, offer no resistance to electricity running through them. So the chief cost in operating the device, the first of

its kind, is the money spent for chilling its components.

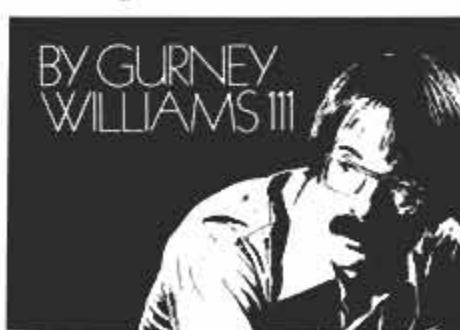
The Argonne system also takes up less space than room-temperature systems, which are normally spread out to guard against heat buildup. And it can be built for 50 to 70 percent of the cost of conventional accelerators.

## Prescription for paranoia

An elderly person loses hearing slowly, imperceptibly. People seem to be whispering, or maybe playing a joke by mumbling. Gradually, the person begins to develop vague fears: Are the whispers about me? Why are people taunting me?

Then, according to Stanford University psychologist Philip Zimbardo, the fears can turn into paranoia.

To research the phenomenon, Zimbardo hypnotized volunteers, and suggested to them that they were partially deaf. When they were placed in a social setting, many of the students became paranoid, according to a variety of standard tests. Zimbardo later rehypnotized them and removed the deafness—and the paranoia. His prescription for paranoia in some elderly people: a hearing aid.



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You don't have to have special talent or years of woodworking experience to build Emperor's Model 120-K. All you need is the do-it-yourself kit and a few basic tools. You'll be working with solid 3/4" black walnut — selected by generations of craftsmen for the beauty of its rich grain and color. It is kiln-dried to prevent warping and shrinking and hand-matched for uniform appearance. Each kit piece, including miters, mortises and tenons, is pre-cut. (If you prefer, kit may be ordered unmitered for \$10 less.) All pieces are sanded smooth on both sides. Divided swan neck and finial, waist and dial face doors, dial frame and basefront pre-assembled. Complete assembly instructions, all screws and hardware included. Due to possible breakage, glass not included. Each piece may be reordered separately.

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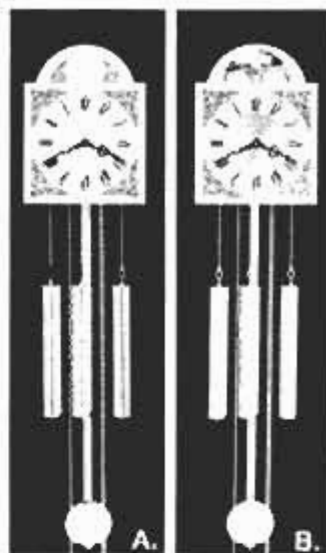
Emperor 101-M dial faces are manufactured in West Germany by Johann Jackle, the world's largest dial-making firm specializing in brass. Each dial is a quality product and is made exclusively of solid brass. Emperor does not sell steel or aluminum dial faces coated to look like brass.

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# DETROIT LISTENING POST

## P-car postponed

Sources indicate that GM has put a hold on Pontiac's mid-engine, two-seater P-car, originally scheduled for '83 introduction. Cash flow problems, due to continuing slow sales and a development glitch involving the engine subframe, are cited as reasons for the delay.

We'll bet there are political overtones, too. Arch-rival Chevrolet has invested millions in its all-new Corvette sports car, also due for '83, and certainly doesn't want its thunder stolen by simultaneous introduction of the sexy little Pontiac—which has been generating much excitement. We caught a glimpse of one on test at GM's Michigan Proving Ground, and its styling is dynamite! In short, it's just what Pontiac needs to rebuild its once-proud image as a maker of youthful, exciting cars—and each day it's delayed is one too many as far as we're concerned.

Similar in concept to Fiat's mid-engine X1/9, the fiberglass-bodied P-car has a wheelbase of about 93 inches, weighs around 2,000 pounds and is powered by Pontiac's Iron Duke, the 2.5-liter, four-cylinder engine. In the P-car this engine will benefit from the addition of throttle-body fuel injection. As we hear it, this will be an optional power plant. Base engine will be the 1.8-liter J-car mill.

## Wind tunnel to showroom

Star of the GM Technical Center's recent 25th anniversary celebration was a superslick aerodynamic concept car called Aero-X. You saw it last month in our aerodynamics story, *Searching for the Perfect .10* (page 75). Since then, we've learned that GM considers the Aero-X to be



If you guessed Mercedes, you're wrong. Would you believe an '83 Ford T-Bird? A 3.3-liter Six and rounded nose certainly help to enhance its personality.

## Pontiac's P-car



Cost overruns and technical setbacks are delaying its planned 1983 introduction date.

an extremely successful experiment.

Based on today's popular X-cars (Citation/Phoenix/Omega/Skylark), the four-passenger, front-wheel-drive Aero-X has been carefully massaged in the new Tech Center wind tunnel to a remarkable drag coefficient (Cd) of 0.285 at its present state of development. That compares to a Cd of about 0.45 for a typical current X-car.

"The Aero-X," said GM Design vice president Irvin M. Rybicki on the occasion, "represents the latest example of the aerodynamic studies which are a normal part of our look into the future. These studies indicate that efficient cars can be designed without sacrificing aesthetics or comfort. We consider the Aero-X a step along the path of product improvement which we intend to pursue vigorously." In other words, don't be surprised if family-type cars start looking something like this in the next few years.

A full-scale fiberglass model, the Aero-X features a gently sloping curved hoodline with retractable headlamps and under-the-nose air inlets for engine cooling. Flush glass is used all around, the windshield is severely raked, wipers are recessed, and there are no exterior badges or moldings. The fastback rear window blends into a high, blunt rear deck, and the flush wheelcovers and tires line up exactly with the body sides for smooth, turbulence-free airflow.

Also demonstrated during the 25th anniversary activities were a pair of turbine-powered vehicles that ran on powdered coal and the latest GM technology in robotics, including some fascinatingly accurate and versatile computer-controlled robot painters.

The Tech Center is a massive, beautifully designed 330-acre facility in the Detroit suburb of Warren, Mich., with some 42 buildings hous-

ing GM's research laboratories; design, engineering, manufacturing, and environmental activities staffs; the wind tunnel, a small test track and dozens of related shops and facilities.

## Trick Mustangs, Capris coming

About a year from now, Ford and Lincoln-Mercury dealers should have modified Mustangs and Capris. Prepared by Ford's Special Vehicle Operations (racing) group, these pocket rockets will come equipped with very special suspensions, five-speed transmissions and turbocharged, fuel-injected versions of an all-new, 2.3-liter four-cylinder engine that will debut for '83. Forget everything you ever heard about the old 2.3 Turbo Ford engine—we got a sneak preview of the new one this summer, and it'll knock your socks off. Cost of these modern-day hot-rods should be about \$12,000.

## Minivans in the works

If Ford can complete a deal with Japanese automaker Toyota, a joint venture between them could produce a small, fuel-efficient van by 1985. Under the proposed plan, Toyota would design and develop the vehicle and supply major parts, and Ford would assemble it in a U.S. plant. Both companies would then

(Please turn to page 26)







The Dick Van Pattens with their 1982 Delta 88 Royale Brougham.

## "Families deserve the nicer things in life, too."

DICK VAN PATTEN

"Believe me, I know families. And we deserve more than just *room* in a family car. We'd like some *luxury*, too.

"That's why we're crazy about our Delta 88. Sure, it's roomy. (It had better be. My three boys are all six-footers.)

"But more than that, this car pampers us. It's nice and luxurious inside. Super comfortable. Lean back—it's like sitting in your living room.

"Incidentally, the Delta 88 comes with a standard V6 gas engine. But we picked the diesel.

"Room. Luxury. And an available diesel. No wonder I call our Delta 88 'The family car that didn't forget the family.'"

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



"I bought my first Olds in 1947."

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

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## DETROIT LISTENING POST

(Continued from page 24)

market commercial and passenger versions here under separate names.

Another ongoing Ford project involves a front-drive minivan code-named Sierra. Looking like a scaled-down Econoline or Club Wagon, Sierra would carry five or six passengers and deliver 25 to 30-mpg fuel economy with a choice of gas or diesel four-cylinder engines coupled to a five-speed manual transmission. It would share some components with

the new Ranger mini pickup due for a mid-'82 introduction.

In addition to downsized conventional vans, GM continues to work on a small, multipurpose fwd vehicle based on X/A-car mechanicals, that resembles a cross between a station wagon and a van and combines the best features of both—good cargo and passenger capacity in a fairly aerodynamic shape to help it achieve small-car-like fuel economy. Presumably, it would be marketed by four, or even all five, passenger-car divisions and perhaps GMC Trucks, as well.

All those are in addition to Chrysler's slick-looking T-115 fwd minivan (*Detroit Listening Post*, page 44, Aug. '81), now scheduled for the '84 model year.

### More future Chrysler plans

Chrysler Corp. has reached an agreement with Peugeot-Citroen of France to purchase 450,000 four-cylinder diesel engines over a five-year period, and to co-develop a new small car for 1986.

Little is known about this car, but it is likely to be a subcompact Omni/Horizon (L-car) replacement slightly larger than the current European Peugeot 104. It will be built in U.S. Chrysler plants and sold here under different names by both firms.

### Opportunity for Detroit

Detroit should consider offering an "over-55-mph" option on its new cars because Smokey may soon have another weapon in his speed-enforcement arsenal. According to a recent government publication, the Department of Transportation has been investigating various forms of Automated Speed Enforcement (ASE) devices.

These devices work on the same principle as radar guns—microwave Doppler effect. The main difference, though, is that they use a very low power beam and don't need a policeman around to operate.

The ASE system clocks your speed as you enter the microwave cone and, if you're speeding, will take a picture of you and your car. You will be traced through your license plates and a ticket will be mailed to your house.

Theoretically you could rack up hundreds of dollars worth of tickets and not be aware of it until you get a surprise in the mail. And, if your state has a point system for violations, you could lose your license in a matter of days.

The government report goes on to say that the ASE cannot be detected by radar detectors. But, according to Mike Valentine, president of Cincinnati Microwave, a maker of super-heterodyne detectors, even the weakest signal can be sniffed out by one of his units, which sell under the brand name of Escort.

"I'm not afraid of this system," he says. "Our equipment is sophisticated enough to pick up the scatter waves of low-power transmitters."

Just to be sure, though, Detroit should get a "stealth" car on the market, one invisible to microwave detection like the Department of Defense top-secret fighter aircraft. We bet that they would have a hot seller.

FM



7:23 A.M.



3:57 P.M.



7:48 P.M.

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## PHOTO HINTS

Easy as cake



If you ever wanted a professional print-drying rack, the answer may be in your kitchen. Two cooling racks (used in baking) can be stacked as shown here. We used empty, plastic film cans to support the four corners of the top rack.—*Michael Hooyman*

### Shot-glass graduate



Unless you're lucky, you won't find a marked graduate that measures all your darkroom needs. The answer—make your own. We found a shot glass to be ideal for small amounts. Use a glass scribe to mark needed chemical levels.—*Willard H. Waltner*

### Tight-top tip



If you notice your developer turning brown after only a few days in the bottle, odds are the top's not fitting tightly. Airtight storage can be yours by covering the mouth of the open bottle with waxed paper before screwing the cap back on.—*Robert Hertzberg*

NO. 1 IN A SERIES

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To learn about other reasons— from benefits to new skills—contact your local Guard recruiter, or call toll-free 800-638-7600.

\*In Hawaii: 737-5255; Puerto Rico: 723-4450; Virgin Islands (St. Croix): 773-6438; Maryland: 728-3388; in Alaska, consult local phone directory.

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What you may not know is the Kero-Sun Monitor 20 kerosene heater is 70 to 80% more efficient than the average wood or coal stove. Wood or coal stoves draw warm air from your room and send it up your chimney. The Monitor 20 uses only outdoor air for combustion. Then, it heats your room air and *circulates* it out



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And, needless to say, the Monitor 20 is a lot more conve-

nient than wood or coal stoves. There's no wood to chop, or coal to haul. And no smoke, sparks, ashes or soot to worry about.

For a full color brochure and the name of the Monitor 20 dealer nearest you, write to: Vented Heaters, Kero-Sun, Inc., Dept. A, Kent, Ct. 06757



The good news in home heating.



# PM LOOKS AT A WASHERLESS FAUCET

**W**ith four sinks in my house, replacing washers in leaking faucets was a headache, until I discovered Nibco's convenient washerless faucets.

The units have a number of fine features. Instead of washer valves, they have cartridges with only one moving part. Because the cartridges are made of Celcon plastic, they offer years of trouble-free service, according to the company.

You'll doubtless appreciate the feature I enjoyed: the easy installation. After removing the old faucet, clean the sink of any deposits that may have collected. If you find your sink deck is uneven, as I did, apply a bed of silicone sealant around the faucet's underside. Wrap Teflon tape around the threaded shanks and position the faucet on the deck. Secure it with the locknuts provided and connect the supply lines using the coupling nuts that come with the unit.



Just a quarter turn of either knob provides precise water flow control—fast or slow.

The 4-in. Simpson Street lavatory faucet shown retails for about \$18 at hardware and home-supply stores. For purchasing information, contact Nibco Inc., Box 1167, Elkhart, Ind. 46515.—Rosario Capotosto



Wrap Teflon tape around threaded shanks before positioning faucet on sink deck. Apply silicone sealant to the underside of the faucet if the sink surface is uneven.



Plastic locknuts secure the unit to the sink and the water supply lines to the unit.

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Diesel Pickup

# BIGGEST NEWS EVER IN DIESEL-POWERED LIGHT-DUTY CHEVY TRUCKS.

A totally new V8—the 6.2 Liter (379 Cu. In.) Diesel. Available in 2WD and 4WD full-size Chevy Pickups, Suburbans and Chassis-Cabs, and 4WD Blazers.

This made-in-America V8 engine, designed and manufactured specifically for trucks, has the traditional fuel-economy advantages of diesel over gasoline. And extensive testing also indicates that the 6.2 Liter Diesel can handle heavy loads, as well as stop-and-go traffic. Simply put, this new V8 presents a powerful case why you should go diesel.

**Economy.** You get more miles per gallon, using traditionally lower priced fuel. For example, a full-size '82 Chevy Pickup with this V8 diesel engine has higher projected mileage ratings than any 1981 6-cylinder or V8 truck.

**Power.** The new 6.2 Liter V8 Diesel delivers plenty of torque or low-end power. A properly equipped full-size '82 Diesel Pickup or Suburban, for example, can haul as much as 13,500 lbs. including itself, trailer, passengers, cargo and equipment.

**Test drive it.** The 6.2 Liter Diesel—379 cubic inches of tough-towing, big-hauling, hardworking, fuel-sipping power. It is big news, and it gives Chevrolet the widest selection of light-duty diesel-powered trucks in the industry.

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

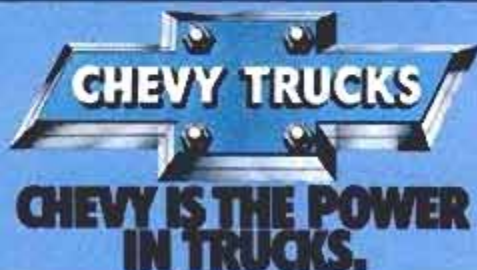


## Excellent V8 Diesel mileage ratings

|     | Pickup<br>(Manual Overdrive)   |  | Blazer<br>(Automatic Overdrive) |  | Suburban<br>(Automatic Overdrive) |  |
|-----|--------------------------------|--|---------------------------------|--|-----------------------------------|--|
| 2WD | 31<br><small>EST. HWY.</small> | 23<br><small>EPA EST. MPG (CITY)</small> | —                               | —  | 27<br><small>EST. HWY.</small>    | 19<br><small>EPA EST. MPG (CITY)</small> |
| 4WD | 27<br><small>EST. HWY.</small> | 20<br><small>EPA EST. MPG (CITY)</small> | 26<br><small>EST. HWY.</small>  | 18<br><small>EPA EST. MPG (CITY)</small> | 26<br><small>EST. HWY.</small>    | 18<br><small>EPA EST. MPG (CITY)</small> |

Chevrolet projections of 1982 EPA estimates. See your dealer for actual EPA estimates. Use estimated MPG for comparisons. Your mileage may

differ depending on speed, distance, weather. Actual highway mileage lower. Mileage will be less in heavy city traffic. Lower in California.





# APPLIANCE CLINIC

## QUESTIONS ANSWERED

### Electric burner repair

I have a General Electric range, model No. J785003AV. The right front burner doesn't work. I've checked out the three burner elements and they're all okay. I changed the automatic surface unit switch. I changed the control switch in the middle of the burner. I checked the coil-selector switch and it's fine. I checked the surface unit transformer and it puts out the 12 v. needed. Can you suggest something?—Donald Plys, Chicago

Seems to us that you've done just about everything possible. However, did you check the transformer on actual load? With your voltmeter, it must be no less than 12 v. when under load. You can't just test passively across the leads.

Also, check the wire connections for loose or burned ends. Check each wire for continuity. Wiggle it around (a wire could be broken inside the insulation). Also, be sure that you reconnect all wires correctly. Finally, check the temperature control switch one more time. It could be defective.

### Dryer with a new wrinkle

My Sears Kenmore clothes dryer no longer tumbles the load at the end of the dry cycle to prevent wrinkling. This "wrinkle-guard system" used to work fine. What's wrong?—Joseph A. Szvalek, Lincroft, N.J.

First, your timer may be faulty and in need of replacement. Second, you may have a loose or intermittent connection. Third—and this is where we bet the trouble is—the knob on your control may be slipping on the shaft so you're not getting the setting indicated. Check the set-screw which tightens the knob to the shaft.

If this doesn't do it, there's one final chance: Your motor could be overheating and kicking out prematurely. Time your heating cycle with a watch and make sure it lasts as long as it's supposed to.

### Condenser brush update

Who says Yankee ingenuity is dead? As a result of our May '81 invitation to share refrigerator condenser-cleaning techniques with us, PM's Appliance Clinic editors were swamped with replies. Here are a few (remember that the first step in cleaning refrigerator coils is to unplug the unit):

We sell an Empire Energy Saver

brush for just this purpose. It's \$7.49 postpaid, plus tax for New York residents.—All Appliance Parts, Dept. PM-1, 1345 New York Ave., Huntington Station, N.Y. 11746.

I jam my vacuum crevice tool around the coils, loosening the dirt at the same time with a brush from Colonial Garden Kitchens, 270 West Merrick Rd., Valley Stream, N.Y. 11582.—E. Alexander, Waynesburg, Pa.

I use a bottle brush fastened to a dowel along with a spiral-brush vacuum attachment made by flattening a secondhand attachment.—John C. Richardson, Cerritos, Calif.

Use the fiber cores from paper-towel rolls. Tape them onto the vacuum crevice attachment and squash them



Empire Energy Saver brush cleans a refrigerator's condenser coils, both on back (as shown) or the bottom of refrigerator.

to fit around the coils.—Mary Koenig, Maspeth, N.Y.

Use a .22-caliber rifle-cleaning rod to push a small brush through the coils.—Fred Smartschan, Emmaus, Pa.

Connect a piece of woven aluminum air filter used in airconditioners to a retainer made of bent coat-hanger wire. Put it in front of the condenser tubes; it catches the fuzz before it gets to the coils.—Henry Bourne Jr., Ponca City, Okla.

Slip a length of 1/2-in. garden hose into the vacuum and tape the air space between them. This size lets you get the hose into the condenser.—John A. Lowry, Oshawa, Ont.

If you blow the condenser clean,

first put damp towels on the floor to catch the lint.—Dave Coffin, Georgetown, Del.

I tape a soda straw to the vacuum nozzle, then lying on the floor, I guide the straw across the condenser with both hands.—James Mahan, Piscataway, N.J.

### Having fits

My Sears automatic dishwasher model No. 587.797300 has an intermittent problem. Though the float seems to work freely, the front-door gasket leaks because of high water level. It's giving me fits.—David Peil, East Syracuse, N.Y.

First, the door gasket leak has nothing to do with whether the float works freely. The gasket shouldn't leak in any event. You may have damaged the door when installing the unit. First, level the feet using a good carpenter's or mason's level. When you slip the unit in place, be sure the two slotted screws at the top that catch the counter bottom are backed off. Then, tighten the slotted screws. Otherwise, you will wrench the door out of plumb and it will leak.

One other thing: Sometimes the gasket in the soap dispenser in the door leaks. This makes it look as if the door is leaking. Check the soap-dispenser gasket.

### Elemental problem

The elements in my Tappan oven, Model EO 16B, seem to burn out every two years or so. I've replaced them four or five times since 1972, when we moved into this house. Why do they burn out so often? We use the oven, but not excessively.—W.S. Beckwith Jr., Jackson, Mich.

You should check for loose wire connections all the way back to the thermostat. Loose connections can cause or aggravate the problems you describe. Also, be sure you are replacing items with genuine manufacturer parts and not appliance aftermarket parts.

We don't suspect a voltage problem here. If there were one, it would be affecting the overall performance of the unit. We think the problem centers around the connections. **PM**

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.





The image features two bottles of Hiram Walker Canadian Club whisky and two glasses of whisky on the rocks. The bottle on the left is labeled "Club Whisky 1879" and "Manufactured by Hiram Walker & Sons, Walkerville, Ontario". The bottle on the right is labeled "IMPORTED" and "Canadian Club Blended Canadian Whisky". The glasses are filled with whisky and ice cubes. The background is dark, and the bottles and glasses are reflected on the surface they sit on.

**"The Best In The House" for over a century.**

Hiram Walker's unique, light-tasting whisky earned its reputation as the finest whisky in exclusive clubs from the time it first appeared. That's how it became "Club Whisky."

In 1891, a new U.S. law required the country of origin to appear prominently on a product's label. Hiram Walker proudly added "Canadian" to Club Whisky and people just as proudly began ordering "Canadian Club."

Today people enjoy Canadian Club so many ways: on the rocks, smoothing out sour or Manhattans and with favorite mixers. Because it's lighter than Scotch, smoother than bourbon. And it's still "The Best In The House"® in 87 lands.

*Canadian Club*



# 7 shop-built tools that work for PM craftsmen

Our readers continually come up with better ways to handle a job. This roundup proves the point.

## Marking gauge

**T**his marking gauge uses a common utility knife to score parts. It's made of walnut, but oak, cherry, rosewood or any other hardwood you select will work as well. The metal parts are brass, except for the thumbscrews. Get brass thumbscrews or make your own for an all-brass look.

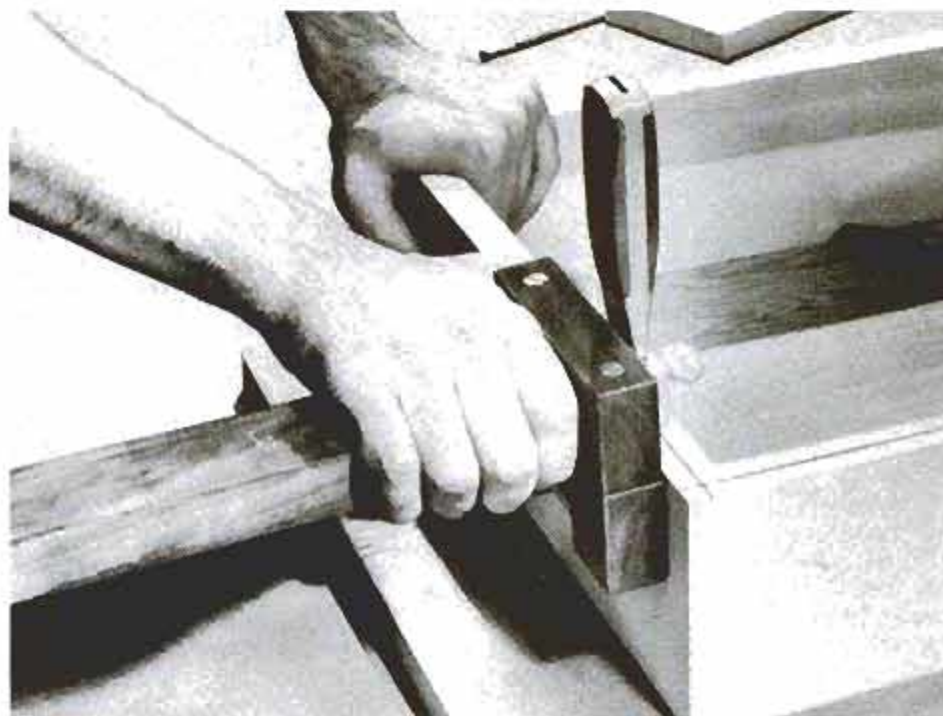
The gauge is large and heavy enough for easy control. You can make light scores as well as deep cuts with it. For example, in pine or other softwoods you can cut a 1/2-in. rabbet accurately without resorting to a saw, plane or power tool. Simply make a series of passes, each time cutting at least 1/8-in. deep.

To make the gauge, cut the parts

### MATERIALS LIST—MARKING GAUGE

| Key | No. | Size and description (use)  |
|-----|-----|---|
| A   | 1   | 1 x 2 x 10' walnut or other hardwood (post)   |
| B   | 1   | 1 x 1 7/8 x 4 1/2" hardwood (lower fence member)  |
| C   | 1   | 1 x 1 3/4 x 4 1/2" hardwood (upper fence member)  |
| D   | 2   | 1/4 x 1 x 2" sheet brass (post screw plate); 1/4 x 1 x 1 5/8" brass (fence screw plate) |
| E   | 2   | 1/4-20 x 2" thumbscrews   |
| F   | 2   | 3" No. 10 fh brass screws (fence fasteners)   |
| G   | 4   | 3/4" No. 8 fh brass screws (plate fasteners)  |
| H   | 1   | Utility knife   |

Misc.: Carpenter's glue; boiled linseed oil.



Marking gauge is large and heavy enough for a craftsman to control it easily in use. Besides scoring, its blade can be used to make rabbets and other cuts in softwood.

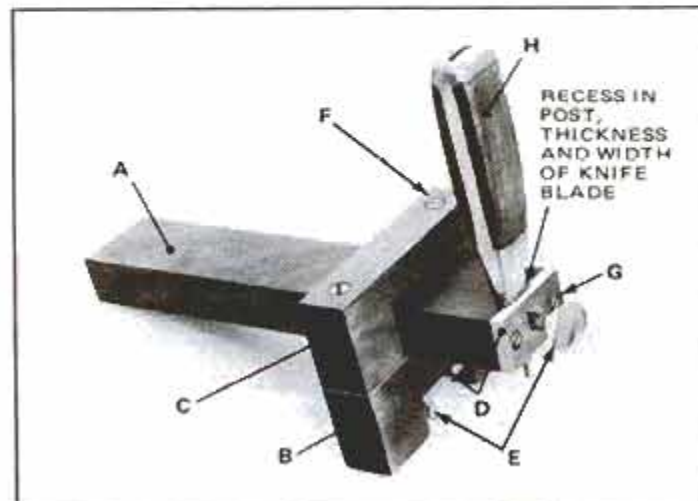
to size. The fence is composed of two members to facilitate cutting the post notches. The notch in the lower fence member is 1 x 1 1/4 in. on center. Cut the notch in the upper fence member so it accepts the post neatly without play.

Sand all wood parts smooth with successive grades of 80-, 150- and 220-grit abrasive. Dust and wipe off with a tack cloth between sanding and after the final sanding. Apply boiled linseed oil or other finish according to directions on can.

To assemble the parts, locate the center points and drill holes for screws; then drill and tap threads in the brass plates for the thumbscrews. Prebore holes in the wood for all fasteners.

Test-fit the brass plate on the post. Cut a recess in the wood post end to the width and thickness of the utility-knife blade. Assemble all parts with carpenter's glue.

—Robert Beasmer



### SUPPLIERS BY MAIL

**Hardwood**  
Robert M. Albrecht, 18701 Parthenia St., Northridge, Calif. 91324; catalog, \$1.  
Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461; catalog, \$1.  
Craftsman Wood Service Co., 1735 West Cortland Ct., Addison, Ill. 60101; catalog, 50¢.  
M & M Hardware, 5344 Vineland Ave., North Hollywood, Calif. 91601; no catalog, write for information.

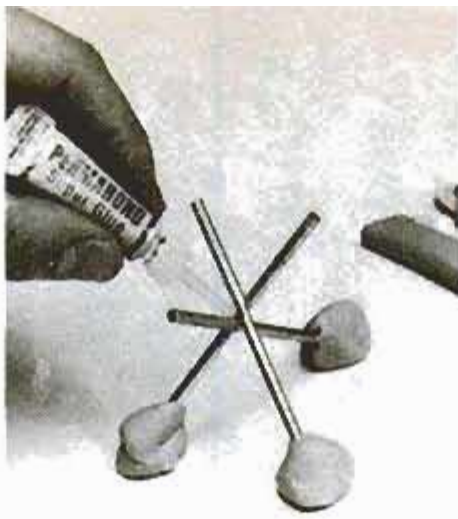
**Sheet brass**  
Brass .250 in. thick in 3 x 6-in. sheets and larger is available from Campbell Tools Co., 1424 Barclay Rd., Springfield, Ohio 45505; request the tool catalog, \$1.



## Third hand

This workshop idea can help you keep small objects in position while you're gluing them together. The workshop team is made up of Fun-Tak, a moldable, reusable adhesive that looks like clay, and Perma-bond Super Glue, a strong glue which sets in 10 seconds.

To use the technique, position the objects to be bonded on your work surface and secure them in place with Fun-Tak. You then have both hands free to use while applying the Perma-bond glue. Its quick-setting characteristics greatly reduce the chance of an accident occurring before the parts are joined. Both products are available at hardware and housewares stores. Each is priced under \$2.—*Doug Eisman*



Equal lengths of 1/4-in.-dia. dowel embedded in Fun-Tak remain as placed, leaving both hands free to apply glue and to do last-second maneuvering of the parts.



Remove the adhesive from the dowel ends and display a shell on the tripod support.

## Bionic retriever

If you've ever had to retrieve a screw from inside a washing machine, you probably know that the problems of inner space can be as aggravating as those of outer space. You can make your own version of a mechanical arm for retrieving and assembling small parts in hard-to-reach places for less than \$10.

Begin by boring 1/8-in.-dia. holes in a 2-in. alligator clip (see drawing). To prevent the tension line from chafing against rims of the holes, insert the collar of a 1/4-in. Pop rivet into the bottom hole. Remove the stem by placing the rivet in a vise and tapping the stem with a hammer.

If the clip has no handle, slip a short metal shaft onto the end of the bottom jaw for this purpose. I soldered on a TV fine-tuning shaft.

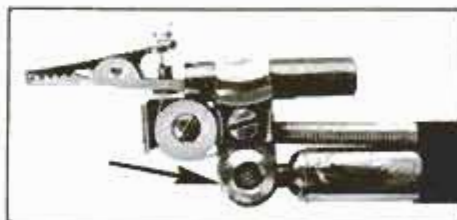
Next, complete the tension assembly, a modified corner brace with a tension guide and a plastic bushing with a fastener. Place the clip handle into the ball-joint clamp and tighten ball joint and guide assembly with the lamp-joint bolt.

Attach the lamp joint to a 1/2-in.-dia. curtain rod of desired length



The length you make the mechanical arm should be governed by the assembling or retrieving application you want it to perform. Model shown is 1 1/4 in. wide, 14 in. long.

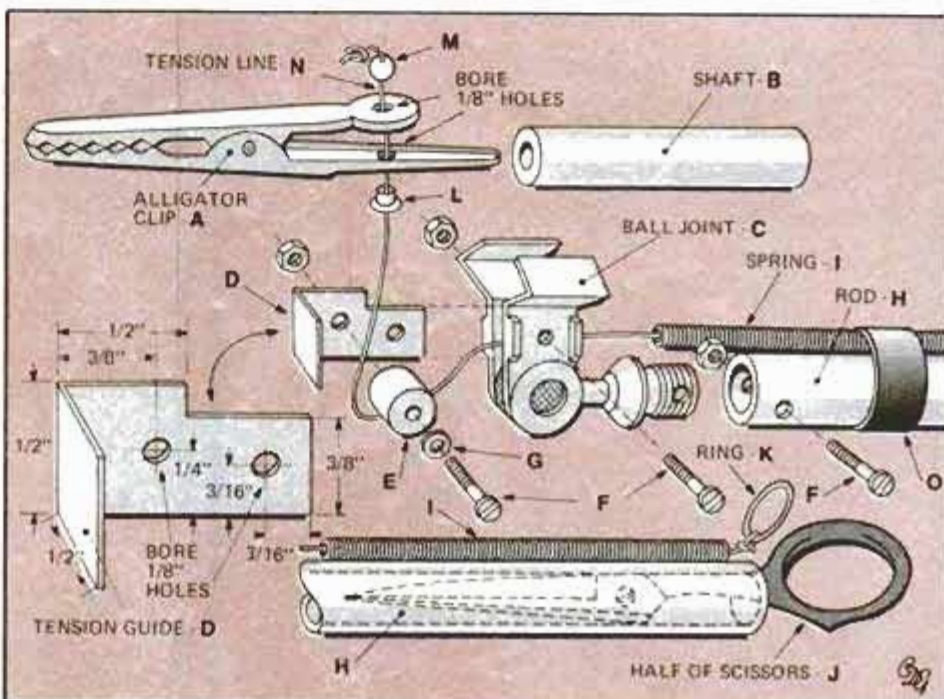
with a bolt. Use a spring or copper tubing slightly shorter than the curtain rod as housing for the tension line. Thread the tool as shown with 40-lb.-test monofilament fishline, securing the handle end to a key ring. You can make a finger grip on the curtain-rod handle from half of a pair of scissors. Secure housing to the handle with tape.—*R. Barreto*



Ball joint (arrow) from clamp-on lamp supports guide assembly and alligator clip.

### MATERIALS LIST—BIONIC RETRIEVER

| Key | No. | Size and description (use)                        |
|-----|-----|---|
| A   | 1   | 2" alligator clip (retriever)                     |
| B   | 1   | TV tuner shaft (retriever handle)                 |
| C   | 1   | Ball joint from clamp lamp                        |
| D   | 1   | 1/2 x 1" corner brace                             |
| E   | 1   | 1/4" i.d. metal or plastic cylinder (bushing)     |
| F   | 3   | 1" x 1/8"-dia. bolts with nuts                    |
| G   | 1   | Washer for F                                      |
| H   | 1   | 1/2" o.d. curtain rod x length to suit (handle)   |
| I   | 1   | Spring or copper tube (tension-line holder)       |
| J   | 1   | Half scissors (finger hold)                       |
| K   | 1   | Key ring (pull)                                   |
| L   | 1   | 1/4"-dia. rivet collar                            |
| M   | 1   | Chain or necklace bead                            |
| N   | 1   | 40-lb.-test monofilament fish line (tension line) |
| O   | 1   | Electrical tape                                   |





## Welding vise

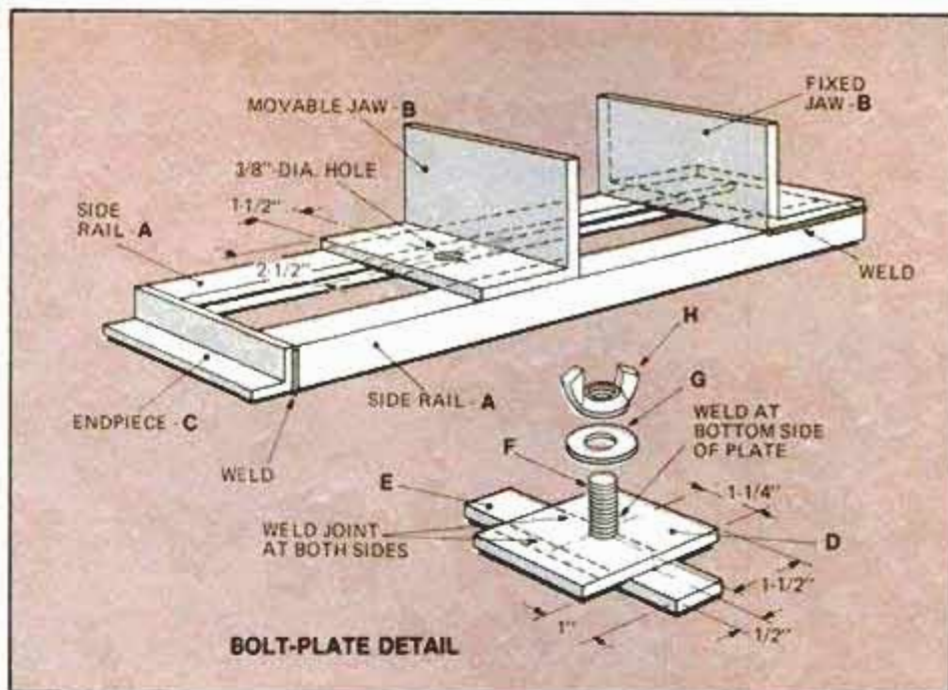
**Y**ou can hold parts for various arc-welding projects in this simple vise. To construct it, cut the parts according to the list below. Weld the fixed jaw to the ends of the side rails. Don't weld a fillet along the junction where the inside of the jaw meets the rails; you'll want this corner clear for setting up pieces. Weld the endpiece to hold the side rails parallel and act as a base for clamping to a steel welding table.

The bolt plate consists of two pieces of steel welded together. Bore a hole in the middle of the assembly and pass the machine bolt with head cut off through the bottom side. Weld the bolt in place to prevent its turning during use. For most jobs, a  $\frac{1}{2}$ -in. wingnut will be more than adequate to hold the movable jaw firmly in place. If not, replace it with a standard hex nut tightened by a wrench. Using a single bolt allows the movable jaw to swivel and line up with angular pieces or with parts that weren't cut perfectly straight. When weld splatter builds up on this inexpensive vise, you can simply discard it and build a new one the next time.

—Parry C. Yob

### MATERIALS LIST—WELDING VISE

| Key | No. | Size and description (use)   |
|-----|-----|--|
| A   | 2   | $\frac{1}{4} \times 1\frac{1}{4} \times 1\frac{1}{4} \times 18"$ angle iron (side rails) |
| B   | 2   | $\frac{1}{4} \times 3 \times 3 \times 5"$ angle iron (jaws)                              |
| C   | 1   | $\frac{1}{4} \times 1\frac{1}{4} \times 1\frac{1}{4} \times 5"$ angle iron (end piece)   |
| D   | 1   | $\frac{1}{4} \times 2\frac{1}{2} \times 3"$ steel (plate)                                |
| E   | 1   | $\frac{1}{4} \times 1 \times 4\frac{1}{2}"$ steel  |
| F   | 1   | $\frac{3}{8}$ -16 $\times$ $1\frac{1}{2}"$ steel bolt with head cut off                  |
| G   | 1   | $\frac{3}{8}$ -I.D. steel washer   |
| H   | 1   | $\frac{3}{8}$ " steel wingnut  |



The vise holds three steel parts ready to be tack-welded into a U-shaped channel. The two channel sides are held to the vise jaws with C-clamps. The bottom rests on the side rails, perpendicular to the sides.



An angle-iron V-block is welded near one end of a  $\frac{1}{4} \times 3 \times 3$ -in. steel plate to hold round stock. You can rotate the plate end for end or on its side as needed.



This paper-boring tool used with a backup board of softwood also cuts cork, cardboard, canvas and other soft materials.

## Paper-boring tool

**Y**ou can shape this tool on a lathe and use it to cut holes in paper, leather, rubber, canvas and other soft materials. The main part is a short length of steel tubing with an outside diameter equal to the hole you want to cut. If the walls are thin



A V-cutting bit makes an internal bevel in the tube end. Place the bit in the toolpost so it cuts a 45° bevel in the tube.

enough to bend under pressure, turn a rod to fit inside the tube end that will be chucked in use. The rod should have a through-hole in its center to clear waste. Glue the rod in place.

Square the other end of the tube on a lathe. Then make an internal bevel in this end with a boring tool or a V-cutting bit turned on its side in the toolholder as shown (photo, near left). If you use the V-cutting bit, set it in the toolpost at a 90° angle to the travel of the compound rest. Set the compound rest at 45° to the workpiece. Lock the saddle to the bed. Make light cuts by advancing the compound rest and retract after every cut until you have a full bevel. File off burrs by hand.

Use the boring tool in a drill press at high speeds and work with a softwood backup board.—R. Andronica



## Perforating stamp

A perforating stamp personalizes stationery and books; also marks checks. Perforations cannot be erased—the pattern can be obliterated only by punching more holes.

You can make the stamp with a monogram, initial or simple design using common steel straight pins, cardboard, epoxy resin or patching compound and a scrap of hardwood.

Draw the design or letters with a pencil in the center of an  $1\frac{1}{16} \times \frac{7}{16}$ -in. rectangle of paper. Cut a rectangle the same size out of  $\frac{1}{32}$ -in. cardboard. Divide the line forming the design with dots spaced  $\frac{1}{16}$  in. apart. Place the paper rectangle over the cardboard one; at each dot force a steel pin through both layers until its point emerges from the back. Use a small hammer and needle-nose pliers to drive in the pins. Keep them as perpendicular as possible.

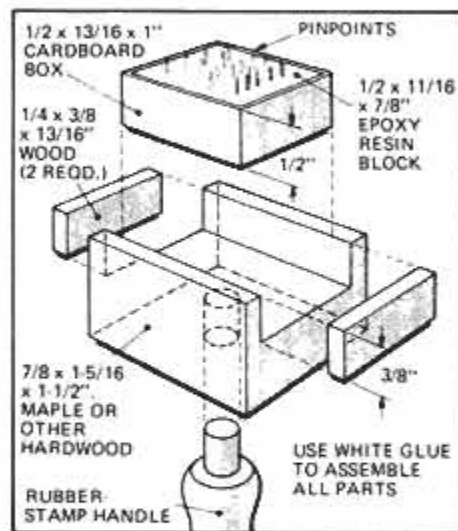
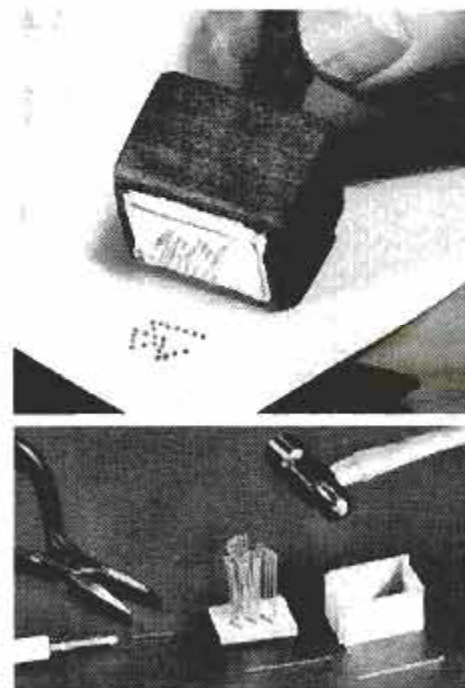
From thinner cardboard, make a little box to fit around the rectangle carrying the pins. Glue the assembly and fill this box with epoxy resin. Upon hardening, the resin will anchor the pins. Use a jeweler's saw to cut off pinheads so the shanks are

flush with the top of the epoxy block. Strip the cardboard rectangle, layer by layer, from pinpoints. Trim the projecting edges of the box sides even with the bottom of the epoxy block.

Mount the pinpoint assembly in a grooved maple block having a rubber-stamp or similar handle. The epoxy block should project slightly

beyond the wood. To use the stamp, place paper to be marked on a soft rubber backup pad such as a scrap of inner tube. The pinpoints will go through the paper into the rubber. You can ink the points on a stamp pad to accent the perforations.

—Walter E. Burton



When you stamp a design in paper, use a piece of inner tube as a backup pad (photo, top left). To make a perforating stamp (left), force pins through paper and cardboard rectangles. A teasing needle makes starting holes. Slip a cardboard box over the rectangles, glue the assembly together and fill the cavity with epoxy resin.

## Cardboard stamp

Inexpensive, easily made cardboard stamps mounted on wood blocks are a good substitute for custom-made rubber stamps. You can use them to apply duplicate designs on more than one item—for example, to print decorative borders around posters, on box lids, in albums, on letters; to stamp patterns for identical mechanical parts such as hinges and model parts; to form repeat designs to be carved or jigsawed from wood or other material. Use white cardboard about  $\frac{1}{16}$ -in. thick to make a stamp. Draw a mirror image of the design to be stamped on the cardboard. With a sharp utility knife and punches, if needed, cut out the design. Glue the cutout on a wooden block. (Those in the photos are about  $1\frac{1}{2}$  in. high.) You may want to apply shellac or lacquer to the cardboard to lessen ink penetration.

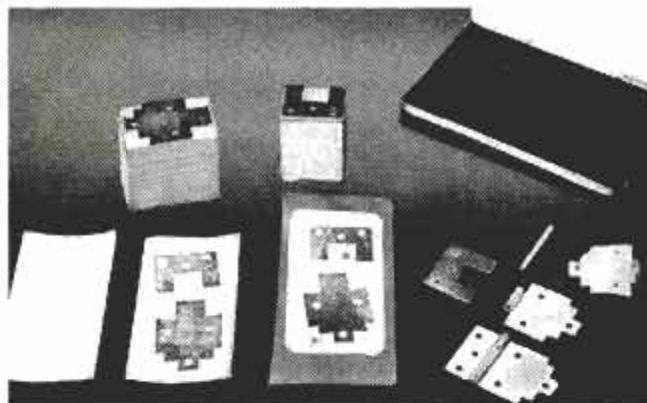
To use the stamp, ink the cardboard surface by pressing it against an inked stamp pad. Position the stamp over the spot where the design is to be printed and apply even pressure. Quite a bit of pressure may be required to produce a black enough impression. A C-clamp

or bench vise can help apply pressure.

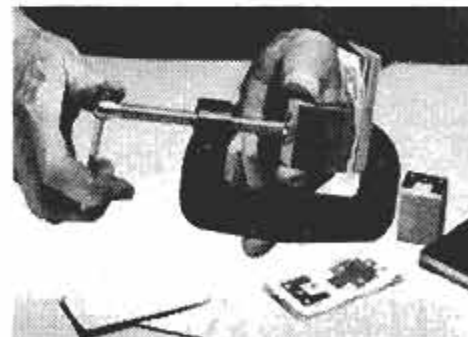
If you use stamped design only as a guide to cut parts, it doesn't matter if some of the surrounding block makes an impression. But if you want to make a decorative design on paper, cut back exposed block areas to eliminate block printing.

The entire pattern needn't be uniformly printed as long as the edges are distinct. Simply fill in the light areas by hand.

The photos show how a cardboard stamp is used to stamp hinge patterns on metal. Initial steps in making the stamps are as described above. Ink the cardboard surfaces by pressing them against a stamp pad. Transfer the inked designs onto self-adhering paper labels, and apply them to sheet-metal blanks. Cut out the designs using metal snips and a jeweler's saw. Leave the paper label on while smoothing the edges. Bend the knuckles to accommodate the hinge pins and bore screw holes. Finally, peel off the paper and polish before joining hinge leaves with pins.—Walter E. Burton



Cardboard stamps on wood blocks (in background) stamp a pattern for identical items. In foreground, from left: self-adhering label; stamped label; stamped label on metal; cut-out parts; finished item.



Apply pressure with a C-clamp when transferring a cardboard-stamp pattern such as this hinge to a gummed label.



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# CAR CLINIC

SOLUTIONS  
FOR MECHANICAL  
HEADACHES

BY  
MORT SCHULTZ



## Choking on my advice

I couldn't believe what I read in your June column (page 49, June '81). Did you really mean it when you recommended disconnecting the electric choke wires of a 1976 Ford Torino and 1979 Ford Bronco? I don't know much about either vehicle, but I do know that with my Datsun you either heat an electric-choke element by that wire or the choke plate stays closed. Were you just putting us on?—Capt. Paul H. Davis, USN-Ret.

There's a difference between an electric choke and an electric-assisted choke, Captain. I failed to make the distinction in June, and I thank you for bringing the matter up, so I can make the point now.

The '76 Torino and '79 Bronco have electric-assisted chokes. They are equipped with thermostatic elements, which are controlled primarily by engine heat diverted from the exhaust manifold. The electric charge is added to reduce the time it takes for the thermostatic element to open the choke plate by engine heat alone. With both Fords, the electric charge was causing the choke plates to open too soon, bringing about cold-engine acceleration problems. The decision was made to remove the wires and allow the chokes to operate as conventional nonelectric-assisted chokes.

In the case of a straight electric choke, the choke plate thermostatic control element is activated only by electricity. Disconnecting the electric wire of one of these assemblies would, as you point out, keep the choke plate closed and keep the engine constantly overchoked. Captain, if I had recommended this for your Datsun, which has an electric-only choke, you would have ample justification for telling me to go stuff my head in a ditty bag.

## Lighting up the Horizon

One night, the instrument panel lights of my 1978 Plymouth Horizon turned off by themselves, and I haven't been able to get them to go on since. The dealer has installed four

headlamp switches and numerous fuses. Can you tell me, with certainty, where my trouble lies?—J. Ignaczak, Quantico, Va.

I can tell you, with certainty, where your trouble doesn't lie. It doesn't lie with the headlamp switch or with the fuse. "Four" of one and "numerous" of the other proves that.

So what's causing the instrument lights to make nighttime driving uncomfortable? A short circuit, that's what. In Horizons and Omnis with automatic transmissions, the wiring harness for instrument-panel lights runs under the console cover. The harness may be rubbing against the shift mechanism, which wears away insulation and allows the bare wire to short out. In your 1978 Horizon and the Omni, a short circuit would blow fuse No. 2. In 1979 Omni and Horizon models, a short would blow fuse No. 5. In 1980 models, it would blow fuse No. 13.

To repair the trouble if your car has a console, do this:

1. Remove the console.
2. Inspect the harness for a bare wire. Fix it by taping.
3. Reroute the harness, so it avoids contact with the shift mechanism and console retaining screws.
4. Replace the fuse.

If your model has manual transmission and, therefore, no console,

the instrument wiring harness runs down the center of the floor pan. It could be pinched under the seat track or affected by the operation of the gearshift mechanism.

## Taking Honda's pulse

I'm having a problem with the braking system of my 1980 Honda Accord four-door. When brakes are applied, the steering wheel vibrates severely, especially around 30 mph. The trouble started at 3,000 miles, and the dealer replaced brake pads and rotors. This fixed the problem until the car reached 6,500 miles. Once again, brake pads and rotors were replaced and, once again, the trouble disappeared. Now, at 7,500 miles, it's back. The dealer says other people don't have this problem. How can I get this fixed once and for all?—Reinhold Jung, St. Joseph, Mich.

The trouble is fairly widespread. One theory holds that rotors and pads aren't compatible. Another theory is that there is excessive thickness variation in the circumference of the rotor. Theories aside, I think I have a solution for you.

First, I would replace the Honda pads with Bendix or Repco Semi-Metallic Friction King pads. Apply the brake pedal lightly the first six or seven times you make stops to allow pads to burnish themselves to the rotors. These pads will do a good job, but more braking effort may be needed than with the original Honda pads to stop the car at low speeds.

If brakes still pulsate after installing new pads, have rotor thickness variation measured. If it isn't too severe, have the rotors turned on a brake lathe. If thickness variation is severe and too much metal has to be shaved off, replace the rotors.

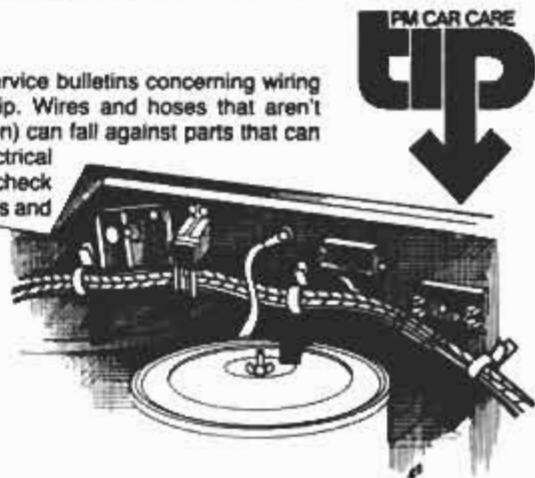
## Misplaced perseverance

When I turn on the air conditioner in my 1979 AMC Concord, which has a

(Please turn to page 44)

## Right route

Several recently issued manufacturer service bulletins concerning wiring and hose routing have prompted this tip. Wires and hoses that aren't attached to retaining clips (see illustration) can fall against parts that can damage them. The result may be an electrical failure or loss of a vital fluid. Therefore, check your car to see that wire harnesses, cables and hoses are routed away from other parts and are firmly attached to retaining clips (if clips are provided). If a wire harness or hose passes near or falls against an engine part and retaining clips aren't provided, tie back the harness or hose so there's no danger of it being damaged.





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## CAR CLINIC

(Continued from page 42)

four-cylinder engine, there's a vibration all through the car. The dealer said the motor mounts were bad, so he put in new ones. No charge, but no cure either. Then he said the car needed new rear springs. Again, no charge—again, no cure. Then he pointed a finger at the left front coil spring. You guessed it: No cure. Now he wants to computerize the car, whatever that means. Please, can you tell me what has to be done?—Willard Phillips, Rotonda, Fla.

Your dealer is obviously trying his best to solve your problem, but I'm surprised he's not confining his investigation to the air conditioner itself. If motor mounts and springs were causing the trouble, the car would vibrate with the air conditioner turned off, as well as on. Suggest that he check for: a loose drive belt; bad idler pulley; excessive pressure in the air conditioning system because of an overcharge of refrigerant; misrouted high-pressure hose; loose compressor-attaching bolts.

### Do-nothing policy

My 1978 Mazda RX-3 is in excellent shape, but I fear it's beginning to lose

its sealing ability. It's giving starting problems, wetting the plugs and pouring out exhaust smoke. Rather than rebuild the rotary engine, I'm thinking of replacing it with a Mazda piston engine. I suppose the transmission bell housing and rear-end gear ratio would have to be changed, among other things. But what else is there?—Harold F. Elliott, Pacifica, Calif.

"Among other things" is putting it mildly, Harold. You haven't even touched on modifications you'll need to make if you proceed with your

plans. To stick a straight mill in your RX-3 you'll have to install a whole new driveline, from engine to differential, including all new mounts. That costs three or four times more than to rebuild the rotary engine. If rebuilding costs \$1,000, let's say, converting to a straight engine will cost \$3,000 to \$4,000. A bit rich, hey?

### The Suburban diet

No one can tell me why my 1978 Chevrolet Suburban 350-cu.-in. engine seems to have shrunk. It no longer

### Stuck up

Some readers of Car Clinic have asked us to give them an idea of how to unstuck a stuck distributor, so they can set ignition timing or remove the distributor. One way *not* to do the job is to bang on the distributor with a hammer. You'll crack the housing and ruin the unit for sure. Instead, place an adjustable oil-filter wrench on the distributor and spread some heat-riser solvent or penetrating oil where the housing enters the engine. Let the solvent or oil do its penetrating job for a while. Then, try turning the housing with the oil-filter wrench. You may have to give the distributor several shots of solvent or oil.



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takes five quarts of oil when I change the oil and oil filter, as called for by the manual. Last October and again in January, it took only four quarts. The oil pan isn't damaged. How do you account for this reduced appetite?—Jim Garni, Ely, Minn.

I see two possibilities. First, are you preparing the engine properly for an oil change? Unless you take out all the oil you put into it, the engine isn't going to be able to take in all the oil called for by specification.

This holds true especially as an engine gets older. You should drive the pickup at least 10 miles before changing oil and filter; also, allow old oil to drain completely.

However, there's another factor—the oil filter. The filter recommended for your 350-cu.-in. engine, and also for GM 305-, 400- and 454-cu.-in. engines, is the AC PF-35. It is 5½ in. high. The filter recommended for pickups equipped with 250- and 292-cu.-in. engines is the AC PF-25. It's also the filter recommended for passenger cars equipped with GM 305- and 350-cu.-in. engines. This filter will fit the engine in your Suburban. However, it's only 4¼ in. high. Get the picture? You could have picked up the wrong filter.

### Pin-a-Ford

Have you had any reports of Ford truck or van shift-lever pins popping loose? I had this happen with my 1978 Econoline 150. While shifting into second gear, the pin fell out. I was left with the shift lever in my hand. Luckily, I was able to pull the truck to the side of the road and stop.

I talked the matter over with my Ford dealer, who suggested I replace the whole housing on the steering column. However, since the pin doesn't seem to be worn and sits tightly in its crevice, I've come up with my own fix. I've coated the pin with epoxy glue and stuck it back in place. What do you think of this idea?—Andy Kyle, Liberty, Tex.

Not much. You may continue to be lucky, and the pin may hold tight. Sooner or later, though, your luck may run out. My advice, Andy, is the same that you got from your Ford dealer: Replace the shift collar, lever and pivot pin.

### 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

■ If you own a 1981 full-size Chevrolet or Monte Carlo, there are two specifications in early-published owner's manuals that should be changed to avoid mistakes when servicing these cars. The first error, on page 7-2, concerns the type of sparkplug to use in the Chevrolet and Monte Carlo. If your car has a 3.8-liter (231-cu.-in.) V6 engine without a turbocharger, you should be using AC Type R45TS8 plugs. If the engine has a turbocharger, use AC Type R45TS plugs. The second change you may have to make concerns only the Monte Carlo. It is also on page 7-2 of the owner's manual and concerns the recommended air cleaner element. If your car is equipped with a 229-cu.-in. V6 engine, use AC Type A773C or equivalent. If the engine is a 231-cu.-in. V6, use AC Type A178CW or equivalent.

■ Honda advises you to replace the oil-pump driven gear if you have to replace the cam gear, and vice versa. The driven gear is above the cam gear. When you replace one, chances are you'll damage the other. If you don't replace them both at the same time, you may have to go back into the engine to do the job again. This advice applies to all Honda engines.

■ You can get rid of howling from the rear brakes of 1978-1981 Dodge Omnis and Plymouth Horizons. The repair involves cleaning and lightly sanding support-plate platforms and the lower anchor; lubricating these areas with multipurpose grease; and lightly sanding the rubbing surfaces of brake linings and drums. The procedure is discussed in detail in service bulletin 05-01-81.



# HOMEOWNERS' CLINIC

## QUESTIONS ANSWERED

### Frozen faucet handle

I'd like to replace the washer in my dripping bathtub faucet. The handle is frozen on the stem, however, and I can't remove it. I've tried penetrating oil as well as brute force. I've seen gear pullers which cost about \$40, but I'd probably only use one once. The last time I had this problem, a plumber charged me \$200, and I had to replace the stall panel. If I ever get it off, I promise to remove and clean the handle monthly.—Mike Schrink, Seymour, Ind.

The screw that holds the handle really tightens the handle to the spline. That, coupled with the extra soapy water from the shower can cause a handle to freeze in place. A large screwdriver, with tape wrapped over the working end to prevent marring the faucet handle, can sometimes be used with a prying motion to ease the handle off the spline.

Bill Rauker, who works at the shop where I sometimes rent tools, says that small gear pullers are one of his biggest rental items. You can rent one for about \$2.50.

### Filling the void

Have you any suggestions on filling hairline (1/16-in.) cracks where my two white countertops butt? The gap has become very annoying to me.—Paul Barrese, Miami

Seamfil, by Kampel Enterprises, Wellsville, Pa. 17365, comes in kits and tubes of various colors for filling cracks and joints in plastic laminates. The kits include a color matching guide and directions that must be followed. Basically, the mix is forced into the cracks and the excess wiped off with a cloth and solvent. If shrinkage occurs, repeat the process in one hour.

Seamfil is available in 26 solid colors and in a special woodgrain kit. Individual tubes cost about \$2.20, in stores that carry plastic laminate.

If you're filling the space between two separate counters, however, the counters themselves must first be fastened together securely so there is no movement whatsoever. If you can't locate Seamfil, write to the above address for the source nearest you. A brochure of the various colors is also available.

### Shingle materials

What are the merits of fiberglass and asphalt shingles? Can fiberglass be

installed over asphalt shingles?—Arden Powell, Findlay, Ohio.

It may surprise readers to learn that both fiberglass and asphalt shingles contain asphalt. The main difference is their base: Asphalt shingles have an organic-felt base; so-called fiberglass shingles have a fiberglass mat base. Both bases are covered with asphalt, into which granules are embedded for more protection against fire and weather. The fiberglass shingle weathers longer, is more resistant to fire. The asphalt shingle holds up better dur-



This fiberglass shingle of Johns-Manville has an inorganic fiberglass mat topped by asphalt and ceramic-coated granules.

ing installation. Yes, you can install fiberglass shingles over asphalt ones.

### Muggy inside

I added 6 in. of insulation and a bathroom exhaust fan to the house I purchased nine months ago. The house is heated by gas-fired warm air. Although I keep the temperature at 65° F. during the day and 55° F. at night, the humidity stays between 80 and 90 percent without a humidifier. Moisture is causing mold on all the walls, ceilings and window frames. Where is the moisture coming from and how can I eliminate it?—Michael Sniogowski, Jackson, Mich.

"House Too Tight?" (Homeowners' Clinic, page 70, June '80) mentions several causes and methods of eliminating your problem, along with

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

"House Too Vapor Tight?" (Homeowners' Clinic, page 32, Sept. '78).

Basically, cooler, dry air must be introduced into your house.

You can duct fresh outside air into your plenum, but it should be dampered and connected to a humidistat to go on when your furnace does. You can also preheat this air, but if you wish to do so, you should first consult a licensed mechanical engineer.

### Painting plaster walls

Our plaster walls were originally painted in 1940 with an earlier-type water-base paint. Can you suggest how to treat them prior to painting? The old, casein paint bleeds through other paint.—Minnie Lennon, Norfolk, Va.

According to a chemist at Sherwin-Williams, water-thinned (they are not really water-based) paints were casein-based prior to 1945. Later, latex-based paints were produced.

Casein-based paints may be treated with a solution of water (1 quart), household ammonia (1 cup) and a wetting detergent such as Pine-Sol (¼ cup). Then wash with clear water and let walls dry.

Readers whose walls were painted between 1945 and 1955 have a 50-50 chance the paint was latex-based. After that, latex was almost always used.

If walls were painted with latex paint, wash as described above. When the walls are dry, you then feather the edges of any remaining paint.

Whether the initial paint is casein or latex-based, apply a barrier coat of an alkyd primer such as Sherwin-Williams Wall Primer and sealer to separate the base coat from the top coat. Follow with a top coat of latex- or alkyd-based paint. See "Painting over Plaster," (Homeowners' Clinic, page 11, June '79), for more information.





# IF FUEL BILLS ARE PUTTING YOU IN THE RED, THINK PINK.

If you haven't added an extra layer of Owens-Corning's pink *Fiberglas*® Insulation up in your attic in the last five years, you probably should.\*

Estimates are that fully half the houses in America are underinsulated for today's high fuel bills. Not to mention tomorrow's!

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Then put your house in the pink—with America's best-selling insulation.

\*Savings vary. Find out why in the seller's fact sheet on higher R-values mean greater insulation power.

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**FIBERGLAS**  
INSULATION

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Manufactured by Owens-Corning Fiberglas Corp., Toledo, Ohio



# CANADA AT ITS BEST

Light. Smooth. Imported Canadian Mist.  
The whisky that's becoming America's favorite Canadian.



*Share some tonight.*

IMPORTED BY B-F SPIRITS LTD., N.Y. N.Y., CANADIAN WHISKY—A BLEND, 80 PROOF, © 1979  
Photographed at Bow Lake, Province of Alberta, Canada



# NEW NOW for home and shop

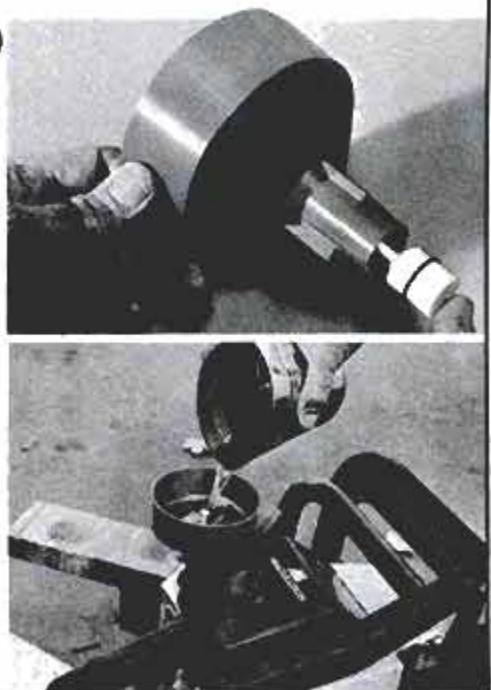
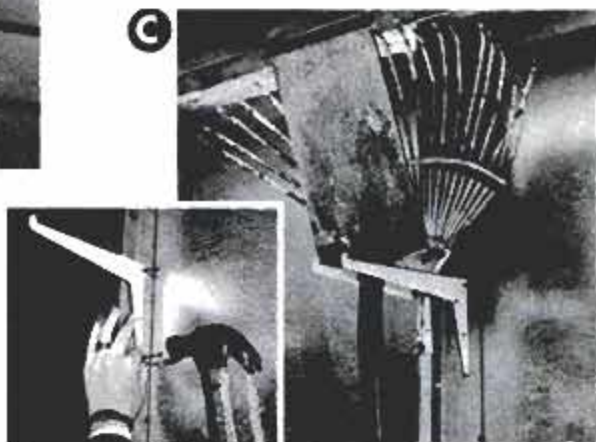
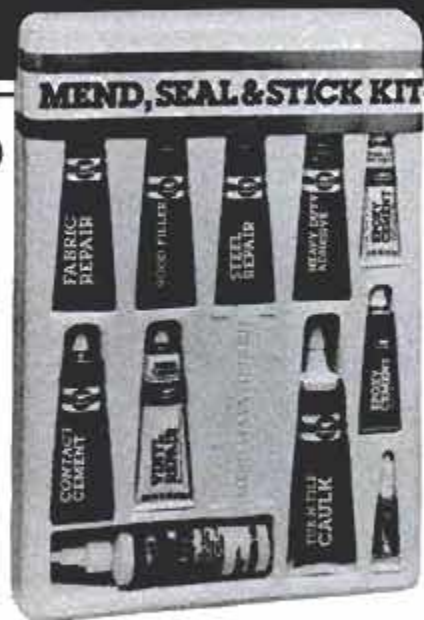


**A** Glacier is an all-white, matte-glazed ceramic tile from American Olean Tile Co., 1000 Cannon Ave., Lansdale, Pa. 19446. Uses include counter and vanity tops, and interior and exterior walls. Because of superior slip resistance, it can be installed on moderate-use residential and commercial floors. It costs from \$6 to \$8 per sq. ft. and comes in 4 x 4-in., 4 x 8-in., 8 x 8-in. and 8-in. hexagonal shapes. Bull-nose and outside-corner trim pieces are available in each size from local tile distributors.

**B** A new kit is now available that combines 10 different adhesives, sealers and fillers commonly used around the house. Called Mend, Seal and Stick Kit, it contains the following: household glue, vinyl repair, contact cement, fabric repair, wood filler, steel repair, tub and tile caulk, heavy-duty adhesive that both fills and bonds, some instant glue and a two-stage epoxy. According to the maker, each product was named by use to make selection easier and to prevent misuse. The package sells for \$9.95 at home centers and is made by Gulf Oil Chemicals Co., Box 10911, Overland Park, Kan. 66210.

**C** The Do-it-Your-Shelf Bracket is a new easily installed L-shaped bracket designed to be nailed or screwed on the sides of exposed studs. Two, used as shown, will hang garden tools. They're made of 14-gauge mild steel plated with zinc dichromate to prevent rust. The three sizes are for 8-, 10- and 12-in.-wide shelving and cost \$1.49, \$1.79 and \$1.99, respectively, at home centers. Made by Wrought Washer Manufacturing Inc., 2100 South Bay St., Milwaukee, Wis. 53207.

**D** Accu-Fill Liquid Gauge is a small plastic funnel designed to prevent overfilling when transferring fluids from large containers to smaller ones. It comes in two colors: red for shop use and white for kitchen use. A float positioned in the spout moves up as liquid rises in the container being filled. It stops the flow when an O-ring meets the spout. By pulling the float up, the ring seats firmly and the funnel is removed. The extra fluid is then poured back into the original container. The funnels cost \$2.95 each (2 for \$5) postpaid from the maker, Accu-Fill Inc., 1590 Gulf Rd., Elyria, Ohio 44035.



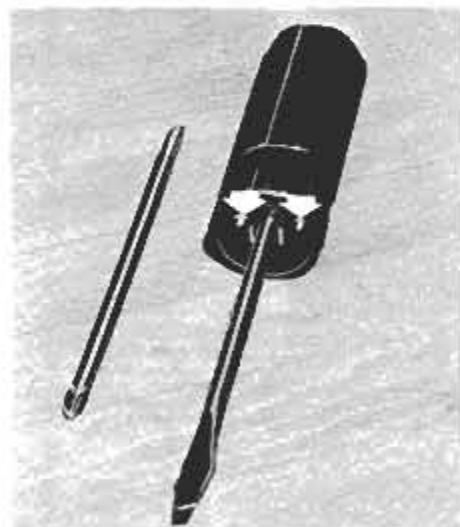


# PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

## Flashlight screwdriver

The Toolite is a 9-in. screwdriver and flashlight rolled into one that's ideal for use in poorly lighted areas. Powered by two penlight batteries, the light is turned on and off by



Toolite has interchangeable flat and Phillips blades. Bulbs (arrows) provide light.



With bulb on both sides of the blade, poorly lighted areas get shadow-free light.

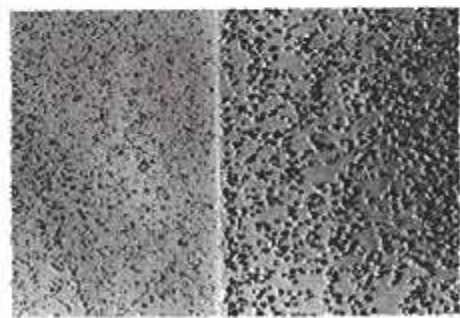
twisting a screwcap on top of the handle. It costs \$7.95 postpaid, from NuWave Products, 2850 East Appalachian Ct., Westlake Village, Calif. 91362. A replacement kit of four batteries and two bulbs is \$2.50.—S.W.

## Long-life sanding blades

Carbide Grit Sanding Blades are new, long-wearing abrasive plates for use in Surform tools. They work well on wood, plastic and metal; their lacquer coating resists corrosion. If grit becomes clogged from sanding paint or varnish, it can be cleaned with a solvent or wire brush.



Carbide sanding blades are available for both 5½-in. and 10-in. Surform tools.



Chips are brazed to tungsten blades: 80-grit medium (left), 46-grit coarse (right).

Coarse and medium 10-in. blades cost \$2.99 each; 5½-in. blades are \$2.49 each at hardware stores and home centers. Made by Stanley Tools, Dept. PID, Box 1800, New Britain, Conn. 06050.—S.W.

## A book and a booklet

*Adhesives and Glues: How to Choose and Use Them*, by Robert S. Miller, is a comprehensive 192-page book



Book explains proper selection and use of adhesives. It contains 350 illustrations.

written for do-it-yourselfers. It offers advice on when to use which adhesive, and explains in detail the proper method of application.

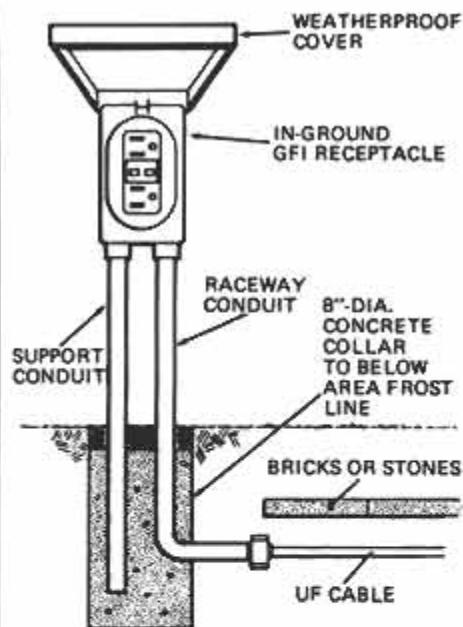
The book includes such topics as furniture repair; installing wall, ceiling and floor coverings with adhesives; and general advice on gluing and clamping. It's sold nationally at home centers for \$6.95 and is

also available at the same price, postpaid, from Franklin Chemical Industries, Box 192, New Ringgold, Pa. 17960.

The 16-page booklet, *Selecting a Heating System*, discusses the advantages of hydronic heating systems and provides information on system layout and operation. The booklet is directed primarily to those choosing a heating system for a new home. It costs \$1, postpaid, from the Better Heating-Cooling Council, Box 262, Berkeley Heights, N.J. 07922.—S.W.

## Specifics from the NEC

Concerning our article, *5 Conveniences You Can Add to Your Yard* (page 114, June '81), information recently received from the National Fire Protection Assn., publisher of the National Electrical Code (NEC), indicates that freestanding outside receptacles *must* be supported by a second conduit. This must be threaded into the receptacle box and anchored in the concrete collar, as



According to NEC, freestanding outside receptacles need supporting conduit.

shown in the drawing. In addition, be sure all grounding procedures for the fixtures are carefully followed. Improper grounding can render a GFI (ground fault interrupter) ineffective.—M.S.

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.



# NEW STANLEY ENERGY-SAVERS ALL AROUND THE HOUSE



Weather seal your windows and doors.  
Remember door bottoms, too!



Special new seal for your home's foundation perimeter.

Stanley, The Do-It-Yourself Company, keeps coming up with products and ideas that can help you reduce home energy loss. They can help you save real money, too.

Stanley now offers a wide variety of door and window weather seals, weather stripping tapes, water heater insulation blankets and more – including special new "Our Best" products. If you've seen them advertised on TV, you know that all of these items are easy to install yourself. All packages have detailed "how to" instructions. These items are extremely effective in making your home more energy efficient. And they're ready for you now at your local hardware department.

At the same time, Stanley would like to share with you a lot of basic, easy to do, energy-saving tips – some cost you no money at all! Read about them in Stanley's new, illustrated booklet called "200 WAYS YOU SAVE MONEY BY CUTTING ELECTRIC, GAS AND FUEL OIL BILLS." A \$1.98 value, it's yours free, for sending this coupon. Get your copy. And start saving yourself money as you save home energy – and, yes, have the satisfaction of doing it yourself!



Send for free booklet from Stanley, The Do-It-Yourself Company that makes Stanley weather stripping, hardware, fasteners, tools, garage door openers and replacement entry doors.

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The Stanley Works  
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New Britain, CT 06050



# Star-shaped candles you can



This year, get a head start on holiday gift making and decorating with these colorful candles. We show you how to make the molds, so you can create your own.



# make for a bright holiday

As far as we know, you can't buy candles of this shape in stores. But on these pages, we show you exactly how to make them.

by Rosario Capotosto and John Gaynor

The star-shaped candles shown here are far removed from the milk-carton-shaped variety many of

us have made at one time or another. What's more, the star molds can be reused for many holiday seasons

of enjoyment. And if you follow the instructions for making the molds carefully, you'll learn some introductory tinsmithing techniques along the way.

The aluminum you need to make the mold is .020 in. thick—heavier than flashing. You can purchase Reynolds Do-It-Yourself, plain alu-

*(Please turn to page 54)*

## Making candle molds



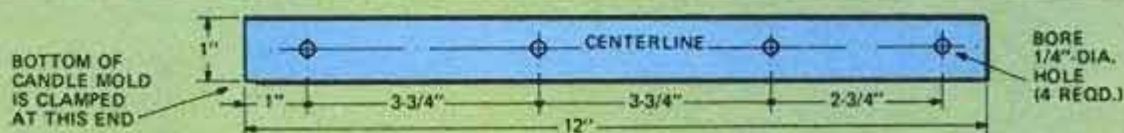
**1** Use a divider to mark equally spaced intervals on the curve. Score bend lines with awl and metal straightedge. Don't scribe so deeply that the seams split.



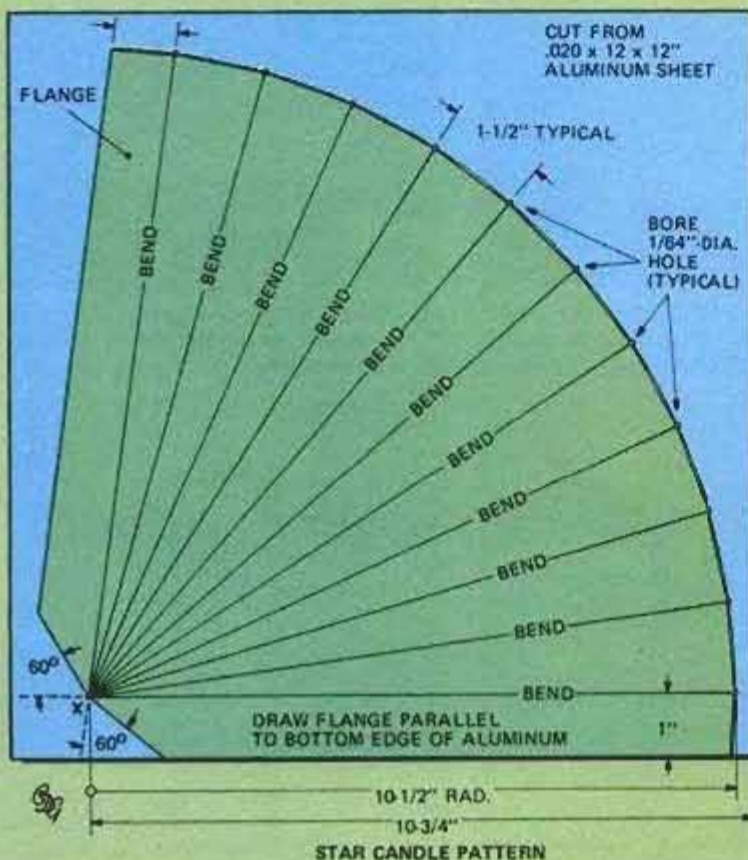
**2** Bore small holes on the radius to spot the lines on underside of the aluminum. Then lightly score the underside.



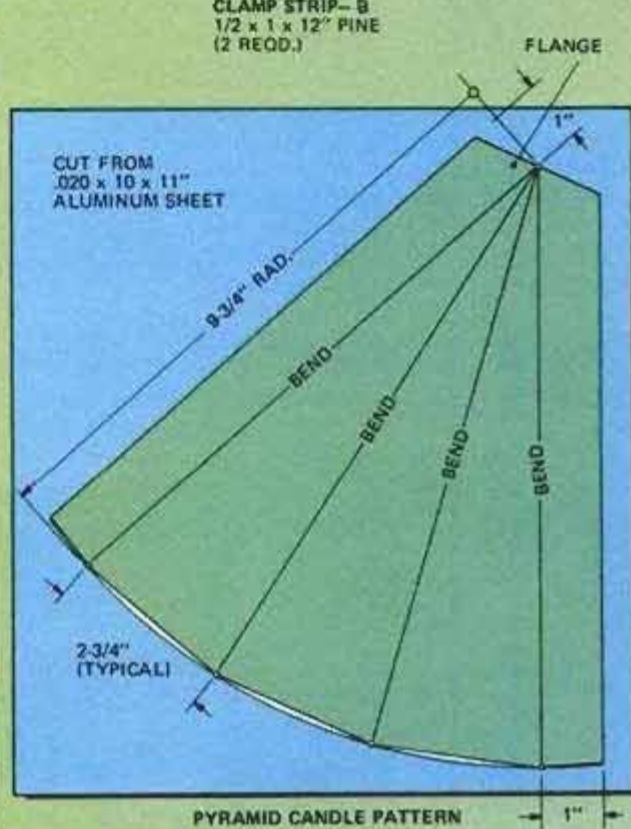
**3** Clamp the work over the table edge under some 1 x 2 stock. Press along the edge with your fingers to start the bend.



CLAMP STRIP—B  
1/2 x 1 x 12" PINE  
(2 REQD.)



STAR CANDLE PATTERN



PYRAMID CANDLE PATTERN



## STAR-SHAPED CANDLES YOU MAKE

(Continued from page 53)

minum for the job in a hardware store. Although you'll only need a 1-ft.-sq. piece, you may have to buy a minimum-size 2x3-ft. section. You can use the leftover to make a pyramidal mold (see drawing on page 53) or to form tall, narrow, cylindrical molds.

You'll also need: two  $\frac{1}{2}$  x 1 x 12-in. wood strips for clamps; four  $\frac{1}{4}$  x  $1\frac{1}{2}$ -in. thumbscrews with washers and wingnuts; a 5x6-in. steel shelf bracket with screws; and a  $\frac{3}{4}$  x 6 x 10-in. wood base for the mold.

### Fabricating the metal

Refer to the drawings on page 53 when you lay out the shapes. To make the star, locate point "X" in the corner of the aluminum sheet. Draw a 1-in.-wide flange along the bottom edge of the sheet from that point. Then from "X," draw an arc having a  $10\frac{1}{2}$ -in. radius. Use a divider to mark off  $1\frac{1}{2}$ -in. intervals on the arc. Later, you will make scores from these points back to "X"; these are the projected bend lines. Locate the top flange parallel to the last section of the star.

The trick to bending the star sections accurately is to score the aluminum on both sides along the projected bend first. With an awl, score one side using moderate pressure. To locate the score line on the other side of the sheet, bore  $\frac{1}{16}$ -in. holes at the top of the score. Then turn over the sheet and score this side from each hole to "X."

It pays to experiment by scoring and bending on a scrap piece of aluminum. Practice will help you avoid scoring too heavily and splitting the seams. You can apply friction tape to the underside of the straightedge to keep it from slipping while scoring. Once you've bored the aluminum

and scored both sides, cut the mold to shape with metal shears. Cut the clamping flanges at the tips as shown.

To ease the bending, you can clamp a length of 1x2 stock flush with the edge of the table. Start the bend by slipping the aluminum under the wood and pressing down on the metal with the fingers of both hands. Complete the bend with the flat of your hand; cover as much metal as possible to prevent crimping. Use the photos as a guide in making the bends. Alternate the directions of the bends to shape the star. If the score marks are adequate, the bends will appear at the proper points. To achieve a true star shape, clamp the flanges together after the bends have been made. Then shape the star by hand.

The clamping strips are two pieces of pine,  $\frac{1}{2}$  x 1 x 12 in. Bore holes in the clamping strips and the mold flanges. To do this, you can start with a  $\frac{1}{8}$ -in. bit and step up to the final  $\frac{3}{16}$ -in. bit.

A small amount of wax, rubbed on the insides of the clamp strips and on the outsides of the flanges, will let you slip the mold in and out of the bracket holder with ease.

The mounting stand is a  $\frac{3}{4}$  x 6 x 10-in. wood base. Screw a 5 x 6-in. shelf bracket into the base and bore

a  $\frac{1}{4}$ -in. hole in the top of the bracket for an attachment thumbscrew. Also notch one side of the bracket to allow clearance for the bottom thumbscrew on the clamp.

### Molding a candle

You can try out the star-shaped candle mold by mixing wax and pouring your own candle. Although the formula suggested here isn't what professionals use, the results are quite satisfactory.

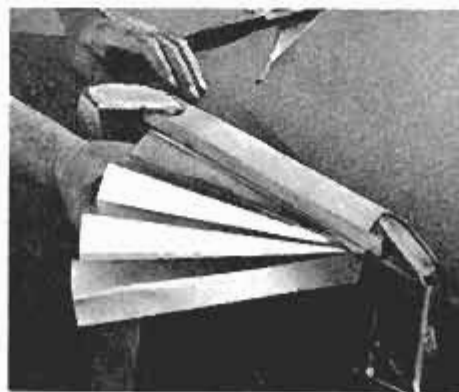
The star-shaped candle mold you just made holds about 1 pound of wax. Here's a fairly simple formula for making one star candle:

- 1 pound paraffin (bulk wax)
- 5 tablespoons stearic acid
- $\frac{1}{2}$  x 1 x 1-in. block of beeswax
- Wax crayon of the desired color
- No. 3 candle wick
- $\frac{1}{4}$  x  $\frac{1}{4}$  x 4-in. wood stick with a  $\frac{1}{8}$ -in. hole bored in the center.

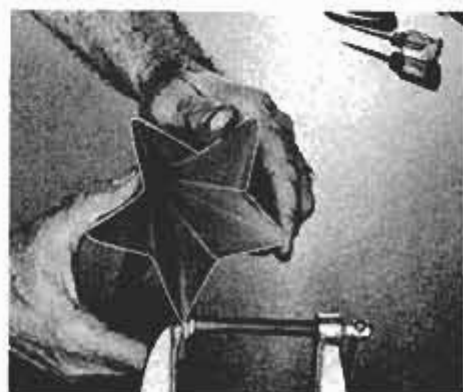
You can purchase paraffin at a grocery store. Wick, stearic acid and beeswax are available at hobby shops. Fashion the wick-holding stick from a scrap piece of wood.

The paraffin supplies bulk to the candle; stearic acid gives it hardness and slows the rate of burning; beeswax adds luster to the candle. In addition to these materials, you'll need a straight pin and masking

(Please turn to page 56)



**4** Use the flat of your hand—not your fingers—for best leverage in finishing the bend, or the metal will crimp.



**5** Clamp the flanges together. Then try to refine the star shape by manipulating the aluminum with your hands.



**6** Clamp wood strips to metal flanges; bore the holes, ending with  $\frac{3}{16}$ -in. bit.

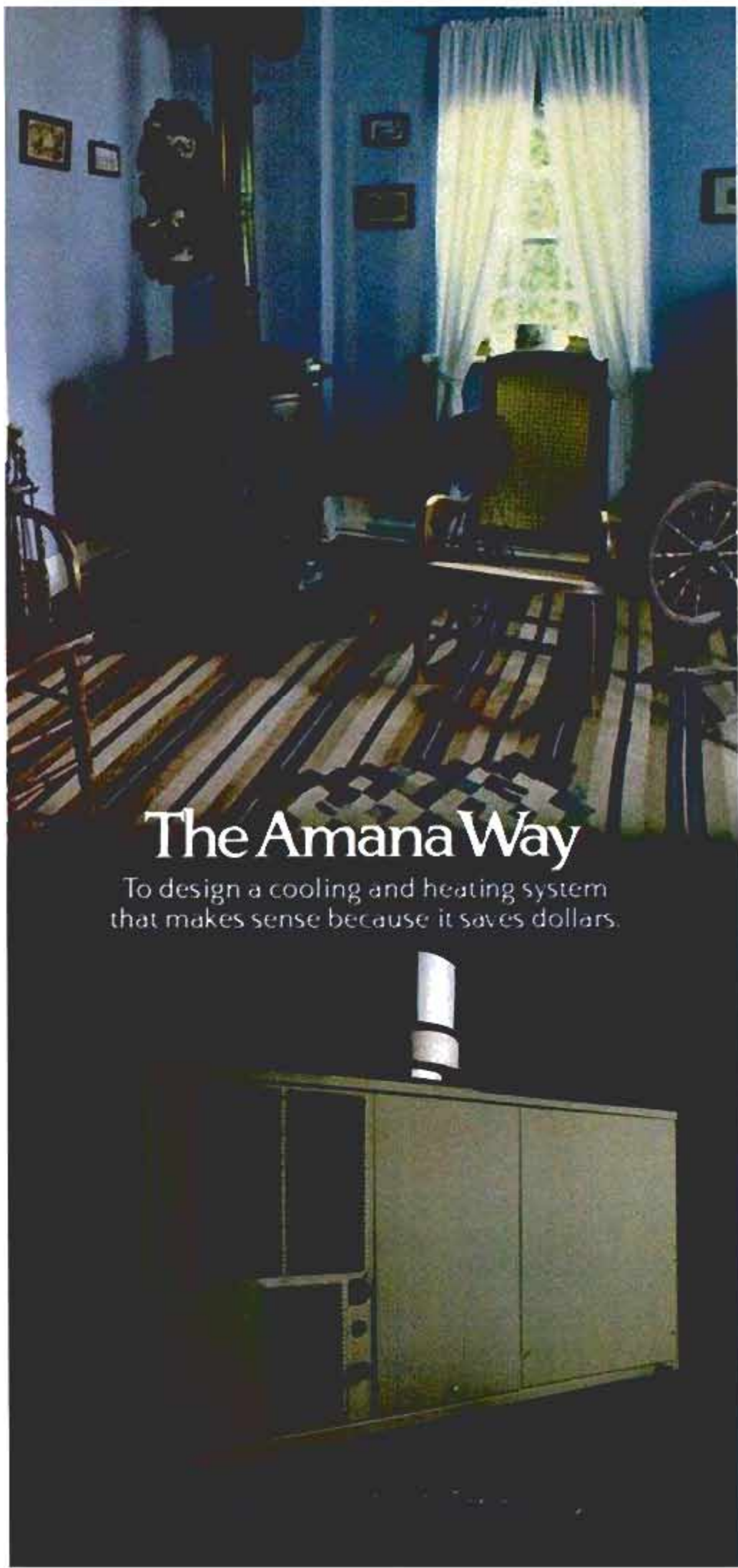


**7** Clip openings in the flanges with tin snips. Thumbscrews, wingnuts and washers hold the flanges together.



**8** You can tilt the mold to achieve slanted patterns using wax of more than one color. The shelf bracket of the stand is notched to allow thumbscrew clearance.





## The Amana Way

To design a cooling and heating system that makes sense because it saves dollars.

Frugality. The folks who founded Amana, Iowa, considered it a virtue. Today, the folks who design Amana® products still do. Which is nice to know if you're in need of a new cooling and heating system for your home.

Ours uses electricity to cool. And gas to heat. And the way it works, it can cut your costs year-round.

The air conditioning compressor is the new high-efficiency kind. It's 14% to 34% more efficient than our standard cooling units.

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And the way it's built, you know it's going to last. The coils are seamless copper tubing. The fins are ripple-edged aluminum to resist bending. The paint is bonded to the surface electrically. So it's almost impossible for rust and corrosion to even get started.

Frugality. For us, it's just another way to say quality. And that's The Amana Way.

### **Amana.**

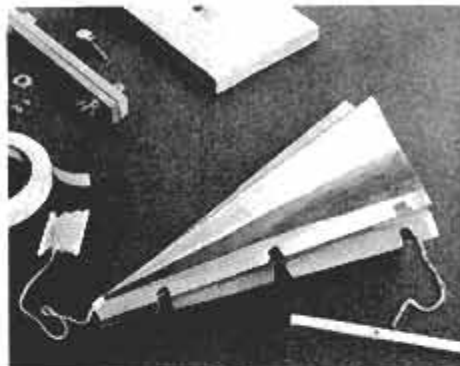
\*Figures are based on D.O.E. information and requirements. Savings will vary with model selected, weather conditions, and use. For more information, write to: Dept. 869, Amana Refrigeration, Inc., Amana, Iowa 52204.



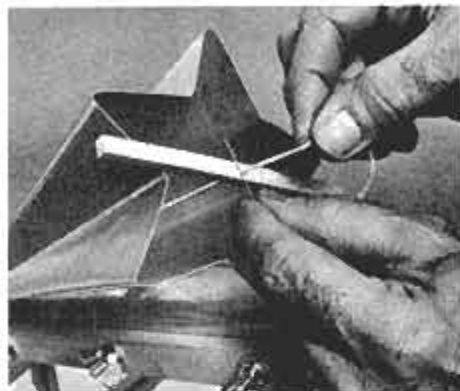
## How to mold your own candles



Supplies you'll need to make a candle include: bulk wax, beeswax, stearic acid, wick, color crayon(s) and dip stick. A straight pin and masking tape are helpful.



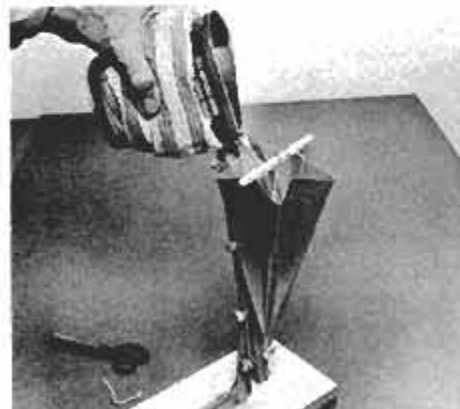
**1** Begin by inserting the wick through the mold center. Clip the wick near the tip and tape the end to prevent leaks.



**2** Pull the wick taut through a hole in stick; secure wick with straight pin.



**3** Heat the wax in a can set in a pan of water. Never put a can directly over flame—it may rupture and cause a fire.



**4** Use cloth wrapping to handle the can of molten wax. Pour to the desired level.



**5** When candle has cooled, remove the mold from the bracket; pull the stick.

### STAR-SHAPED CANDLES YOU MAKE

(Continued from page 54)

tape. Unless you have pots with pouring spouts, use a clean, 2-pound coffee can, squeezed into a spout at the top, to melt the paraffin.

#### Making the candle mixture

Keep in mind that the concoction you're going to make is flammable. Take care that the wax doesn't drip onto the burner as you work.

Place the can on the stove in a pot of heated water. Although you can melt and store wax in a coffee can, don't use it directly over the flame without a water pan. The seam could fail, causing the leaking contents to ignite.

Break the paraffin into pieces that fit in the can. Add the stearic acid and beeswax. You may have to wait until some of the wax melts to fit it all in the can. Set the burner for a moderate heat. A 3/8-in. dowel makes a good stirrer.

If you plan to use several different colors in the same candle, keep a second can in another water-filled pan ready. After the mixture is melted in the first can, pour half of it into the second. Then color each batch to suit. While the wax is melting, set up the mold.

For a candle this size, use a No. 3 wick. Pull it tightly in at the tip of the star, leaving about 1/2 in. outside. To prevent leakage, cover the tip and the wick with masking tape.

Insert the mold in the wood clamp and tighten the bolts. Thread the free end of the wick through the wooden stick, pull it taut and secure it by running a straight pin through the wick.

After the mixture has melted, stir it gently while the water simmers for an additional five minutes. To prevent wax from dripping on the stove, have a paper towel handy to wipe the stirrer as it leaves the can.

#### Pouring the candlewax

Pour the mix into the mold to the desired level. Let it cool before pouring the second color. The wax is cool when it loses its sharp, clear look. In most cases, the edges will start to cool within 10 minutes.

If you pour the second color too soon, the colors will blend. If you wait too long, several hours for example, the colors may not bond. Worse yet, the candle may cool and pull away from the mold. After you've finished pouring, let the candle cool overnight.

To remove the candle from the

mold, first release it from the clamp. Remove the tape from the tip and cut the wick flush with the mold. Then remove the candle gently by pulling on the wick and wooden stick. Trim any feathered edges with a sharp knife.

Clean the mold before setting it up for the next pour. The best cleaning method is to pour boiling water in the mold while you hold it with a pair of pliers.

For further challenges in the art of candlemaking, we recommend experimenting and reading about others' ideas in the books below.

If you cannot find all the supplies locally, write: Cathy's Candle Cupboard Inc., 415 Highland Ave., Iowa City, Iowa 52240. For a supply list, send \$1 and a stamped, self-addressed envelope.

#### REFERENCE BOOKS

Following are several books with chapters on candlemaking that are currently on the market. If you can't find them in your public library or local bookstores, you can order them directly from the publishers:

■ *Arco Encyclopedia of Crafts*, by H.E. Lays Andrew; hardcover, \$20.95 postpaid from the publisher: Arco Publishing Co., 219 Park Ave. S., New York, N.Y. 10003.

■ *Crafts and Hobbies*, hardcover, \$19.95. For ordering information, write to the publisher: Reader's Digest, Pleasantville, N.Y. 10570.

■ *Creative Candlemaking*, by Thelma R. Newman; paperback, \$9.05 postpaid (New York residents add sales tax) from the publisher: Crown Publishers Inc., 1 Park Ave., New York, N.Y. 10016.



# 1981 U.S. Gov't Report:

THE COMMERCIAL APPEAL MEMPHIS, TENN

## Carlton Scores Best In Cigarette Testing

WASHINGTON (UPI) — The Carlton king-size filter cigarette sold in a hard pack had the lowest tar, nicotine and... rating of any cigarette tested in... Trade

# CARLTON IS LOWEST.

Today's Carlton has even less tar than the version tested for the Government's 1981 Report. Despite new low tar brands introduced since—Carlton still lowest.

Box—less than 0.01 mg. tar, 0.002 mg. nicotine.

Box: Less than 0.01 mg. "tar", 0.002 mg. nicotine av. per cigarette by FTC method.  
Soft Pack: 1 mg. "tar", 0.1 mg. nicotine av. per cigarette. FTC Report May '81.

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



# SUPER DOERS QUIZ #2

## How can one screwdriver do the work of four?



Permanent storage:  
Bits lock into barrel;  
barrel locks into handle

Extra strong  
steel barrel; zinc plated  
to resist rust



Famous Workmaster  
triangular shaped handle  
fits fist for maximum  
comfort and torque

4 tips fit  
most popular screws;  
two slotted, two Phillips head

### STANLEY 4-WAY WORKMASTER® SCREWDRIVER

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helps you do things right.®

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# HINTS FROM READERS

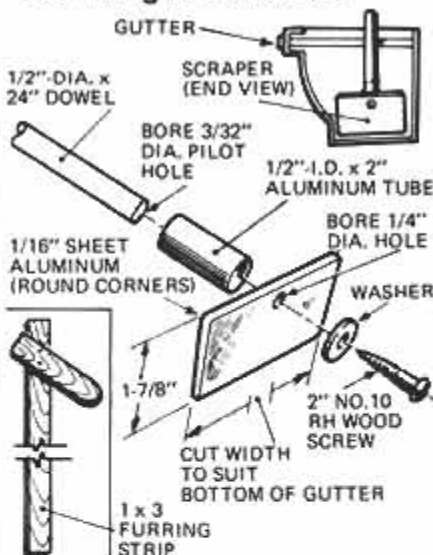
## Stick supports paintbrush



The bristles of a soaking paintbrush will bend out of shape if allowed to rest on the bottom of a can of paint cleaner. To prevent this, fasten the paintbrush to a paint stirring stick with a rubber band. The wooden stick will support the paintbrush and the bristles will retain their shape.

—Ken Patterson

## Two rain-gutter cleaners



Here are two tools for cleaning rain gutters. The tool made of a dowel and a scrap of sheet aluminum is from Guy Lautard, who writes that it cuts gutter-cleaning time in half or more. The user can reach farther from the ladder which doesn't have to be moved as often. E.D. Turner uses a cleaner made of furring strips (inset). He rounds the end of the segment that scoops out leaves from the gutter.

## CAN YOU SEE THE RAIN-X DIFFERENCE?



Without RAIN-X



With RAIN-X

Photographs of the windshield were taken on a drizzling, rainy day. No wipers were used.

**RAIN-X, THE "INVISIBLE WINDSHIELD WIPER" IS HERE . . . FOR RAIN, SLEET OR SNOW.**

- For AMAZING VISIBILITY all year round even in the worst kinds of weather, treat your windshield and windows with RAIN-X, a rigorously tested aerospace development.
- Actually makes rain, sleet and snow "bead" and roll off . . . Drive down the highway and simply watch water disappear like magic.

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- Because of its polymeric structure, RAIN-X even restricts the build-up of frost, bugs, salt, tree sap and road grime.
- Just remove SNOW and ICE with the rubber end of your scraper . . . Makes automotive glass (windows, lights, etc.) uniquely water and soil repellent.
- Excellent for your car, RV, boat, van or aircraft or any glass or ceramic surface in your home.
- Effective and long lasting

Order one year's supply of RAIN-X per auto (15 fl. oz.) for only \$9.95 plus \$1.00 postage and handling, and take advantage of our EMERGENCY LIGHT OFFER.

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Just squeeze the trigger and it lights up every time.

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Satisfaction Guaranteed

We help you see clearly



# MUST LIQUIDATE AT BELOW DEALER COST! Gasoline Operated, Emergency POWER GENERATOR

## FACTORY NEW! FACTORY PERFECT!

**DON'T** let a storm rob **YOUR** home of vital electric power! With this **4000 watt generator** you **ALWAYS** have a reliable standby source of **120V and 240V plug-in power!**

- 8 hp. Briggs & Stratton 4-cycle gas engine.
- Fairbanks-Ward model. Made in U.S.A.
- Manufacturer's limited one year warranty!

**IDEAL FOR EMERGENCY USE!** A serious storm could knock out electrical power for hours... or for days! Food could spoil in your refrigerator. Water pipes could freeze and burst in winter if the electric motor in your furnace stopped. (And think of your family shivering in their sleep on a cold winter night without heat!) Your basement could flood without electricity to keep storm waters pumped out. A well could stop pumping water vitally needed for cooking or bathroom facilities. The losses could run into many hundreds, or thousands of dollars!

**DEPENDABLE STANDBY POWER SOURCE!** You never have to worry about being without electrical power! Not when you have this portable generator standing by. With 4 outlets to plug in to (120V & 240V), you can run electric lights, or power tools, a sump pump, well pump, or furnace motor. Plug in your small kitchen appliances, a refrigerator, a freezer. Of course, you can't run everything at once (remember the 4000 watt total). But you **CAN** run enough things to keep vital functions operating as needed.

- 4-cycle, single cylinder, Briggs & Stratton engine.
- Air cooled. Recoil start. Manual choke.
- Produces 8 hp. at 3600 rpm.
- Two-pole, revolving field type.
- Solid-state field excitation.
- Chrome-plated piston and aluminum alloy cylinder help dissipate heat for cooler performance.
- 4-quart capacity gasoline tank.
- Four plug-ins: Two for 120V; two for 240V.
- 15 to 30 amp. service for all your household needs.
- Heavy steel base construction for rugged durability.
- Neoprene vibration isolators.
- Metal surfaces red oxide primed to guard against rust.
- All miscellaneous hardware is zinc plated.

|                              |                               |
|------------------------------|-------------------------------|
| Engine ... Briggs & Stratton | Frequency ... 60 Hz.          |
| Horsepower ... 8             | Outlets ... Two 120V          |
| Watts ... 4000AC             | Two 240V                      |
| Volts ... 120V/240           | Size 17½" W x 28" L x 17" H   |
| Amps ... 15.6/31.2           | Ship wt. ... Approx. 150 lbs. |
| Phase ... Single             |                               |



**IN THE FIELD!** A reliable source of portable power anytime, anywhere.

Four outlets for 120V & 240V. 15 to 30 amp. service.



**FOR HOME!** Keep sump pump, well pump, appliances operating in case of any power outage.



**ON THE FARM!** If power fails, use this generator to plug in a variety of necessary equipment.



**FOR CABIN or CAMP!** In the wilderness, you can enjoy comforts of electricity with this generator.



**FOR WINTER STORMS!** No freezups or burst water pipes when you have this generator on hand.

### PUBLIC NOTICE!

#### Bankruptcy and Financially Distressed Merchandise!

We are authorized liquidators of consumer products that must be quickly sold at sacrifice prices because of a variety of reasons, such as:

Overproduction... last year's models... economic recession... bankruptcy... plant closings... order cancellations... excessive competition... financial problems... discontinued lines, etc.

If you know of a company with surplus inventories that must be liquidated for immediate cash, call us Toll-Free: 1-800-328-0609. Only products in perfect operating condition will be considered.



**Wheel Kit only \$29<sup>00</sup>**

For easy-rolling portability. Big 10" dia. wheels. Sturdy, rugged!

We strongly urge you to compare all the features of this generator with any comparable model. Then compare prices! You will see what a tremendous bargain this is!

Compare at over  
**\$1,000.00**

OUT THEY GO AT ONLY:

**\$488**



Credit card customers can order by phone.

**Toll-Free: 1-800-328-0609**

If busy signal, or after business hours, or if in Minnesota, call **1-800-228-2606** 24 hours a day, 7 days a week.



**C.O.M.B. Co. / Authorized Liquidators** Dept. B-574-1180  
6850 Wyzata Boulevard / Minneapolis, Minnesota 55426

Item No. 1180 - Send \_\_\_\_\_ 4000 watt Generator(s) at \$488.00 each. I will pay shipping charge to driver upon delivery. (Allow 4-5 weeks delivery. Add 2-3 weeks extra if paid by check. Sorry, no C.O.D. orders.)

Item No. 1185 - Send \_\_\_\_\_ Wheel Kit(s) at \$29 each plus \$9.75 each, shipping & handling.  
 My check or money order is enclosed. (Minnesota residents add 5% state sales tax.)  
Charge to my:  Mastercard  VISA  American Express  Diners club

Account No. \_\_\_\_\_ Expires \_\_\_\_\_

PLEASE PRINT CLEARLY

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Nowadays, folks call these "coveralls", "overalls", or "bib overalls", but when I was a boy, we called them "hogwashers". This sturdy pair has Jack Daniel brass buttons, and snaps, a tailored Jack Daniel's label on the front, and a handsomely embroidered monogram on the back yoke. These durable, many-pocketed, blue denim Hogwashers® are great for chores or just kicking around. Give waist size (30-42) and inseam (34-36) when ordering. My \$26.00 price includes postage and handling.

Send check, money order or use American Express, Visa or MasterCard, including all numbers and signature. (Add 6% sales tax for TN delivery.) For a color catalog full of old Tennessee items and Jack Daniel's memorabilia, send \$1.00 to the above address. In continental U.S. of A. call 1-800-251-8600. Tennessee residents call 615-759-7184.

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# New Comfort for Drivers



The world's finest  
sheepskin brings new  
comfort to driving and  
it is washable.

My name is Archibald Mason. I am a wool merchant from New Zealand.

New Zealand has more sheep than people. Our lambswool rugs are the finest in the world. Every year thousands of Americans travel to New Zealand and buy our lambswool rugs and car seat covers.

I began selling lambswool rugs by mail in the United States in 1978. Since then I have supplied many rugs to American homes and offices, and every week we receive further requests for rugs from people who cannot visit New Zealand just yet. I have often been asked by Americans if we can supply car seat covers. New Zealand was the first country to use lambswool car seat covers and we have been making and using them for over 20 years. About three out of five new cars in New Zealand have lambswool seat covers fitted when new, and this figure is even higher for luxury cars. I am the largest single supplier of custom made car seat covers to New Zealanders. I am now ready to offer my seat covers by mail to Americans.

## STRONG FIBERS

If the wool in the photo seems too plush for your car seat, don't worry. We trim the wool to an even  $\frac{3}{4}$ " for car seat covers, so there is enough length for those springy resilient fibers to hold you off the seat and allow air to circulate behind and beneath you; and the  $\frac{3}{4}$ " wool is short enough for easy care and laundering. Yes, laundering! New Zealand tanners have perfected 'chrome tanning', which means your car seat cover can be thrown in the washing machine and washed like a woolen sweater. It goes back on your car seat as soft and resilient as new.

When you buy your car seat covers, you need to know they will last for years. New Zealand wool is the world's strongest — and the secret is in the nourishment of the sheep. We have an equable climate with adequate rain falling evenly through the year, so those lush, green pastures you have seen in our

tourist publicity supply plenty of food for the sheep all year. No summer droughts, no harsh winters. The wool grows into even,

strong fibers. When your friends run their fingers through the wool in your seat covers, they may find it incredible that the world's longest-lasting wool can be so soft. But you will know, as your seat covers give you comfort for year after year, that you have bought from the people who know how to make the best seat covers.

## THE BEST METHOD

But think about the fixing method. Some of the seat cover advertisements I have seen in the United States worry me — the fixing systems they are offering are clearly inadequate. As you slide in and out of your car seat, there is a tendency for the seat cover to move sideways on the seat, and it may move out of position. It took us many years of experience in New Zealand to develop the best fixing method, which holds the seat covers firmly in place without moving. We use expanding cords positioned in exactly the right places, and we even have light friction strips on the back of each cover to hold them in place.

Wool is a great insulator. When you enter your car on a hot day, the wool seat covers never feel hot, unlike the synthetic materials often used in car seats.

On a cold day, vinyl or synthetic materials drag the heat rapidly out of your body. Wool doesn't do this — wool adjusts slowly to your temperature, at the same time cradling you in thousands of soft, springy fibers. A great way to start any drive.

## LUXURIOUS

But the greatest benefit is the air circulation. No matter how heavily you sit on a sheepskin seat cover, there is always air between the wool fibers, separating you from the car seat. As the air moves behind you, it carries away the moisture given off by your body. No more sticking to the seats, or damp clothing on a hot day. You may even find you use your air-conditioning less, and thus conserve fuel. New Zealand cars seldom use air conditioning.

My seat covers cover the back rest and seat cushion, and they are strikingly beautiful. They will enhance the interior of your automobiles, and they will protect your car seats from scuffing and damage.

We have custom-made seat covers in stock for all makes of American and imported cars. They are in matched pairs, to suit the two front seats of your car. We hold our stock in Honolulu, so United States customs charges have been paid. UPS can deliver to your address within a few days of dispatch.

## MONEY BACK GUARANTEE

Follow the easy instructions to fit the seat covers in your car. Then drive with them and admire their smart appearance. Then decide if you don't feel you are driving in greater comfort, send them back to us within 30 days. We will refund your money in full, and thank you for the opportunity to bring a little of New Zealand into your life.

Call Toll Free 800-367-6002 Ext. PM 10  
(24 hour service).

Tell us the make, model, and year of your car, and tell us if your seats are high back or low back. Choose your color from white, honey or gray. The cost to you is:

|        |                            |
|--------|----------------------------|
| Pair   | \$149 plus \$5.50 delivery |
| Single | \$ 76 plus \$3.50 delivery |

We will charge to your credit card. Or, if you prefer to pay by check, please include your driver's license number for prompt processing of your order.

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"The rug in the photo is our white queen-size rug of never-shorn lambswool. It measures over 5 ft x 2 ft, and we are still holding our price for a few more weeks at \$95.00 delivered. Try our rug — it will be the nicest thing you ever did for your feet."



# NEW NOW



# OUTDOORS

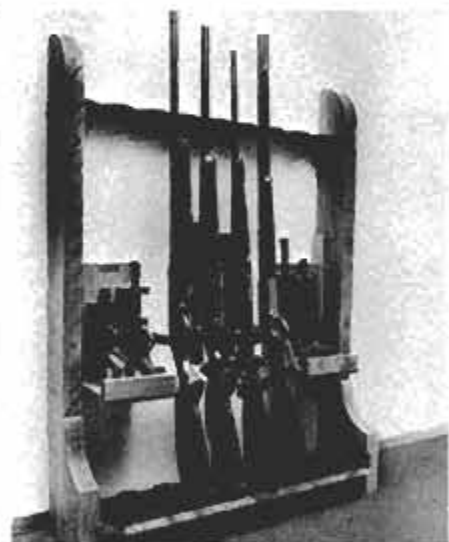
## Especially for autumn

For skeet and trap shooters, or those getting set for hunting, several upgraded shotguns have been introduced:

■ Remington has adapted the recoil-reducing advantages of its autoloaders to a new Model 870 Competition pump-action gun. The gas-assisted, shock-absorbing system simulates the softer, longer recoil curve of Model 1100.

■ Browning has also converted the sharp jab of recoil into a softer shove in the B-80. Interchangeable barrels take 2 $\frac{3}{4}$ - and 3-inch shells.

■ Smith and Wesson's Model 3000 pump-action shotgun is also chambered for both shell lengths. And Winchester has introduced a commemorative John Wayne Model 94 carbine.



## Lockup for guns

With hidden bolts that anchor to studs, Securityrac gun racks from Prairie Design, Box 925, Lawrence, Kan., display one to eight guns for \$29 to \$115.



## Pouch pack kit

The protective inflatable, floatable Sports Pouches from Sima Products for cameras and fragile gear can now be worn with a \$5.95 shoulder-strap kit.



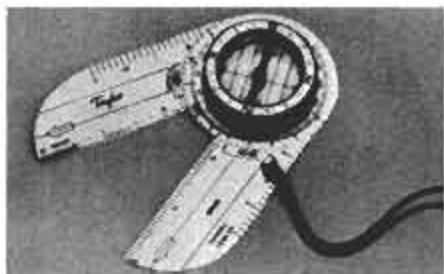
## All-purpose glasses

Developed first for anglers by fishing guide Capt. Frank Garisto, 360 Harbor Ct., Key Biscayne, Fla. 33144, these sunglasses are Polaroid, darken in sunlight, come in four tints at \$79 (\$119 in prescription), are available in bifocals.



## Puncture patcher

Leaks in valve-inflated balls can be cured by inserting Ball Doctor probe, depressing plunger, reinflating. It's \$1.75 from Unique Sports, Cleveland.



## Double-duty dividers

With arms that open to measure map distances in 1:24,000 and 1:62,500 scales, the \$12 Taylor Instrument 2918 Divider Compass is handy for hiking.



## Quick-change case

Sportsmen travelers, like others, often need extra hands for tickets and tackle. The new 28-ounce White Stag Travel Pack, from Henderson Camp Products, switches from duffel to backpack with hip belt. Of Cordura nylon, it's \$50.



## Silvered shooter

Corrosion protection and wear resistance are claimed to be up to five times better with chromium plating of Browning's Silver Chrome Hi-Power 9-mm.



## Padded protection

For the cyclist, snowmobiler, or climber who carries a camera, the Quick Shot Pack from Richmond-Merritt, Redondo Beach, Calif., straps it up front.



# THREE GREAT LOADS IN THE MOST RELOADABLE HULL



Winchester shotshells deliver the power, patterns and performance you're looking for.

They're custom-tailored to the kind of shooting you do:  
**Super-X®**—The all-purpose shotshell for waterfowl at normal range.

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**Upland®**—For smaller, lighter game and quick birds.

Each shell is a balanced blend of top quality components packed in a unique single-piece hull that *takes more reloads than competitive hulls!*

Winchester shotshells. Performance. Plus reloadability that will keep you coming back for more—less often.

**WINCHESTER.**

\* Based upon detailed results of tests performed by R. P. White Laboratory, Inc., Bel Air, MD.  
 ® refers to trademarks of Olin Corporation

## ELECTRICIANS average more than \$11.00 AN HOUR!

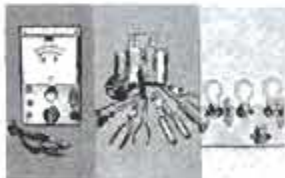
Don't count on getting into a union or earning union wages as soon as you graduate, but these figures from the U.S. Dept. of Labor Occupational Outlook Handbook show that electricians are among the highest paid construction workers. In 1978 wage rates in metropolitan areas for electricians averaged \$11.25 an hour after regular apprentice training program. Union wages were even higher.

*Employment of construction electricians is expected to increase faster than the average for all occupations through the mid-1980's.*



### Make extra money... save money on your own electrical work!

Even before you're ready to go after a full-time job as an electrician, you could be making extra money doing odd jobs for friends and neighbors. And think of the money you'll be able to save doing your own electrical repairs and installing new electrical outlets and lighting.



### You receive everything you need to get you off to a fast start!

Tools, materials, tester are all included with your course... plus the National Electrical Code—the "Electrician's Bible" that gives you all the requirements and do's and don'ts of proper electrical installations.

Here are just a few of the subjects covered in your course.  
 Principles of Lighting, Heating, Air Conditioning, • Conductors and Conduit  
 • Electrical Wiring • Lighting Control • Transformers and Storage Batteries  
 • Generators and Motors • Electrical Estimating • ... Plus much, much more.

**ICS** SINCE 1891 **ELECTRICIAN SCHOOL, Dept. PB091**  
 ICS Center, Scranton, PA 18515

MAIL COUPON FOR FREE FACTS!

**NOW** you can train at home in spare time...  
 No previous experience needed. Experts show you what to do, how to do it...guide you step by step to

# Be an Electrician

Even before you finish your course, you'll understand how to specify and install wiring, how to operate and control electric motors and generators, and how to use and maintain basic electrical equipment like transformers and storage batteries. You'll learn how to use electrical instruments to check voltage and current, how to trouble-shoot for short circuits, overloads and open wires, and you'll be ready to take almost any electrician licensing examination offered by state, city or county. Because opportunities vary from time to time and from one part of the country to another, we encourage you to check on the job market in your area. Mail coupon for free facts and results of survey showing employment success of our graduates.

### NO NEED TO QUIT YOUR JOB OR REGULAR SCHOOL

Everything is explained in easy-to-understand language with plenty of drawings, diagrams and photos. And you learn at your own pace... at home in spare time. No time wasted traveling to class. Consultants are as close as your telephone. No charge! Use our toll-free 24-hour home-study hotline as soon as you enroll!

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 ICS Center, Scranton, PA 18515

Rush free facts that tell how I can train at home in spare time to be an electrician.

NAME..... AGE.....

ADDRESS.....

CITY..... STATE..... ZIP.....



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#### STANLEY HARDWARE

Stanley Door Bottom Weather Seal. Easy to install; stops drafts, cold, heat and dust. Save \$2.33.

**\$3.66** # EV1332

#### TRUE TEMPER

A16 Rocket 16 oz. Nail Hammer with curved claw, octagonal polished head and tubular steel handle. Save \$4.26.

**\$10.93** # GA16

#### ILCO UNICAN

Bright brass Single Cylinder Tubular Deadlock with steel hardened rotating pin and reversible bolt. Save \$5.05.

**\$7.94** # E560-03-35KA2

#### SHOP-VAC

6 Gal. Wet/Dry Vacuum with variable air flow, 1 1/4" hose and three nozzles. Save \$25.07.

**\$54.88** # G700-02-1

4 Pc. Bulk Dry Pick-up Kit \$12.95.  
# G801-01-9

#### LUFKIN

3/4" 25' Power Return Tape Rule with high impact styrene case and positive toggle lock. Save \$3.62.

**\$6.57** # G8325

#### GENERAL ELECTRIC

Circlite 44 watt fluorescent light, saves energy, lasts 10 times longer than equivalent standard 100 watt bulb. Save \$3.29.

**\$16.66** # HFCA44 SW

22 watts \$10.66  
16 to 44 watts \$21.66



**SERVISTAR**  
SportsCap  
**\$1.99**

Durable, good looking two-tone SportsCap, with vented back and adjustable tab. A \$3.95 value, you get it for less — only \$1.99 — just for stopping by your ServiStar dealer's Do-It-For-Less Sale! See him today!



# DO-IT-YOURSELF PROJECT WITH IT-FOR-LESS SALE



## STANLEY TOOLS

Mini-Hacksaw,<sup>SM</sup> cuts like a big saw; convenient for small, tight areas; uses regular blades. Save \$1.65.

**\$2.34** # 515-2114M

## WARP'S COVERALL

Heavy duty 4-mil plastic. Water-dust- and acid-proof. Hundreds of uses. Save \$2.72

10' x 25'

**\$4.87** # E4DN10-15-00

15' x 25' \$6.87 Save \$4.72

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## BLACK AND DECKER

$\frac{1}{8}$ " Electric Variable Speed Drill with infinite speed lock and reversing switch. Save \$11.02.

**\$33.97** # 62190

(LESS \$5.00 MFR'S REBATE)

## FORMBY'S

Complete Refinishing & Care Kit Includes furniture refinisher, tung oil finish, lemon oil and steel wool pads. Save \$13.

**\$13.99** # 00029

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## VERMONT AMERICAN

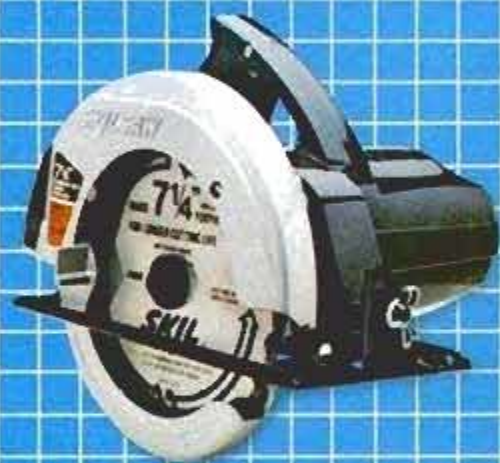
27 piece all purpose Screw/Nut-driver Set. Assorted bits, sockets and adapters combine to make 35 different tools. Save \$9.11

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# ALL OUTDOORS

## Autumn action

If you're planning to head out through fall fields, hills and marshes, here are some recent products that add new comforts to old-time pleasures.

■ For hunters, as well as hikers who don't want to look like targets during deer season, Woolrich has introduced a Mackinaw coat, pants and shirt in a wool-nylon blend of hunter-orange fabric called Wool-Blaze. The rugged material is reported to combine wool's warmth and quietness with high visibility.

■ Camouflaged clothing, and even luggage, using the distinctive Maynard Reece/Ducks Unlimited pattern, is available from sporting-goods dealers carrying the Bob Allen line. Bags, packs and duffel made of Ballistic Nylon, called one of the toughest of all fabrics, has also been developed by the Des Moines, Iowa, sportswear firm.

■ We can't show an in-use photo of the Camo Porta-Blind from Buck-Spin Products, Manitou Beach,

Mich., because its camouflaged fabric sides blend into the background to hide hunters, photographers and bird watchers. The \$50 enclosure has 13 feet of 4-foot-high material surrounding it and comes with mounting rods in a 5-pound shoulder bag.

## Futuristic forked stick

Remember when all you needed for a slingshot was a Y-shaped stick and a piece of inner tube? That arrange-



Large pellets or short arrows can be fired from high-powered, high-tech slingshot.

ment still works fine, but now there is a high-tech model that can fire large ball bearings or special stubby arrows. It's called a Com Bow Sling, and costs a hefty \$40 from Non Fire Arms, 687 Calabasas Rd., Watsonville, Calif. 95076. Light-, medium- or heavyweight lengths of surgical-type elastic tubing are threaded forward through side tubes, around nylon wheels, and back for a draw of nearly 30 inches, with 200-feet-per-second velocity for short arrows and a 300-yard range for 1/2-inch steel balls. The grip angle can be customized to personal requirements, and the unit used for indoor target practice or outdoor varminting. The model we tested packed a lot of power into its compact aluminum frame.

## Where it's at

The present price of gold is enough to encourage any hiker, resting by a stream, to look around for a little pay dirt. Outdoorsmen in North Carolina and Virginia, as well as travel-

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ers along the Appalachian Trail through these states, can now buy maps showing where gold has been found and more is likely to be. Prepared by a retired NASA engineer and available for \$6 from Big Ten, Box 1231, Cocoa Beach, Fla. 32931, the maps also give panning instructions and prospecting information. Gold-locating maps for additional Eastern states are in preparation.

Where to fish in any of the 50 states is well covered in the new *Daiwa/Rand McNally Guide to Fishing America*. Colored maps and detailed instructions are included, as well as license fees. It's \$2.95 at tackle shops or direct from Daiwa, 14011 South Normandie Ave., Gardena, Calif. 90249.

Quick and useful suggestions for protecting your home while you're away; safeguarding your hotel room, luggage and money along the way and finding a doctor if you get sick are explained in a new free booklet. Called *Have a Safe Trip*, it comes from the public affairs department of American Express, 125 Broad St., New York, N.Y. 10004. Just send a stamped, self-addressed envelope.

A close-up look this time of year at

the fall colors of New England? For bicyclists, 25 different tour routes have been mapped out and a packet on any one of them, listing places to stay, eat, camp or get a bike repaired, is \$8.95 from Green Mountain Holidays, Box 207, Rutland, Vt. 05701. A brochure is free.

#### **Out of danger**

It's no secret that the growth of cities, civilization, urban sprawl and housing developments—not hunters—is the threat to wildlife today. Market hunters are long gone, and present legislation controls game hunting quotas. The result is that there are now many more deer, elk, prong-horn antelope and wild turkeys than there were 80 years ago, and without proper wildlife management, many would be overpopulating and starving to death. Two recent studies take a good look at the problems involved. A film strip called *The Un-endangered Species* has been prepared for schools and clubs by the International Assn. of Fish and Wildlife Agencies, Box 59, Riverside, Conn. 06878, and is available from them for \$6.25.

And a hopeful look at fish, birds and animals that might become

extinct is provided in a definitive new book, *These Are the Endangered*, by wildlife expert Charles Cadieux, from Stephen Green Press, Box 1000, Brattleboro, Vt. 05301, at \$15. Thirty-one species are examined in detail, and Chuck Cadieux gives revealing case histories. Here, also, is a report on the 407,000 alligators that were living in Florida and the 200,000 in Louisiana in 1973 when the Endangered Species Act was passed. Since then, their numbers have increased greatly, and residents in the two states, with 12-foot, 700-pound gators roaming their back yards, have wondered who was endangering whom. The reptiles have been moved over from the "endangered" to the "threatened" category. **PM**







Computer screen displays household records as information is keyboarded using Visidex.

# New computer program keeps all your records handy

Called Visidex, this new program may revolutionize the way we use computers in our everyday lives.

by Neil Shapiro  
ELECTRONICS EDITOR

**T**he Visidex computer program can help anyone who wants to keep information at his fingertips. The program (which can run on the Apple II computer) is advertised as an electronic index-card system. But we found it to be much more than that.

## Remembers it all

Using Visidex is as simple as typing the information you want to recall later into your computer keyboard. Information is stored in screenfuls and recalled the same way.

If you have a recipe to store, just type it in, the same as you would on an index card. But Visidex lets you center a line (with one keystroke), type white on black (inverse), or correct a mistake instantly. You can even save a line or entire paragraph in memory and type it again later with just a touch of a key.

Of course, you will want to retrieve the stored information later. To do this, Visidex lets you choose certain words on each screen as "keywords."

Suppose you have just entered a screen of information listing the telephone numbers of all your out-of-state relatives. Now you sit back, look at the screen and decide which words you would like to be "keyed" to that screen. Later, you can get the whole screen presented to you

again by just typing one of the keywords.

You might want to make each of your relatives' names a keyword. Each time you pick a word as a keyword, the computer lists your choice on the bottom of the screen, so that you can keep track.

Once you've picked all the keywords you think you'll need, the entire screen display is saved to disc. (The information is stored electronically on your computer's floppy disc. A floppy disc is like a thin record made out of audio tape materials; it can store hundreds of screens.)

Let's suppose that you had also entered screens of information on each of your relatives' birthdays, and also on their addresses. If you type in your mother-in-law's name,

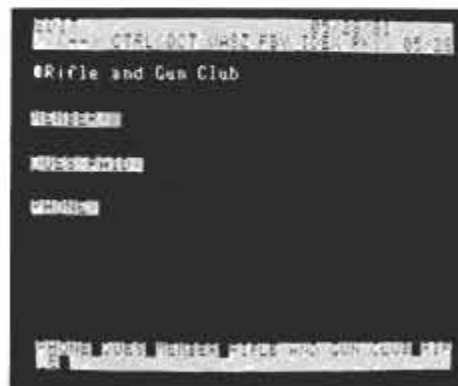
the computer will find all the stored screens that contain her name as a keyword. So, if her name was a keyword on the birthday screen, the address screen, and the telephone screen, you would get each screen of information, one after the other. But, if you just wanted her birthday, you could enter her name as a keyword as well as the keyword "birthday."

## A formal secretary

While Visidex lets you enter screens as informally as you would like, it can also function as what is called a formal database.

You may have information to store that is contained in repetitive categories. Suppose you want to list

*(Please turn to page 71)*



Visidex can store screenfuls of information in two styles. The formal style (left) is for screens with discrete categories. Informal style (right) can be typed in any format.



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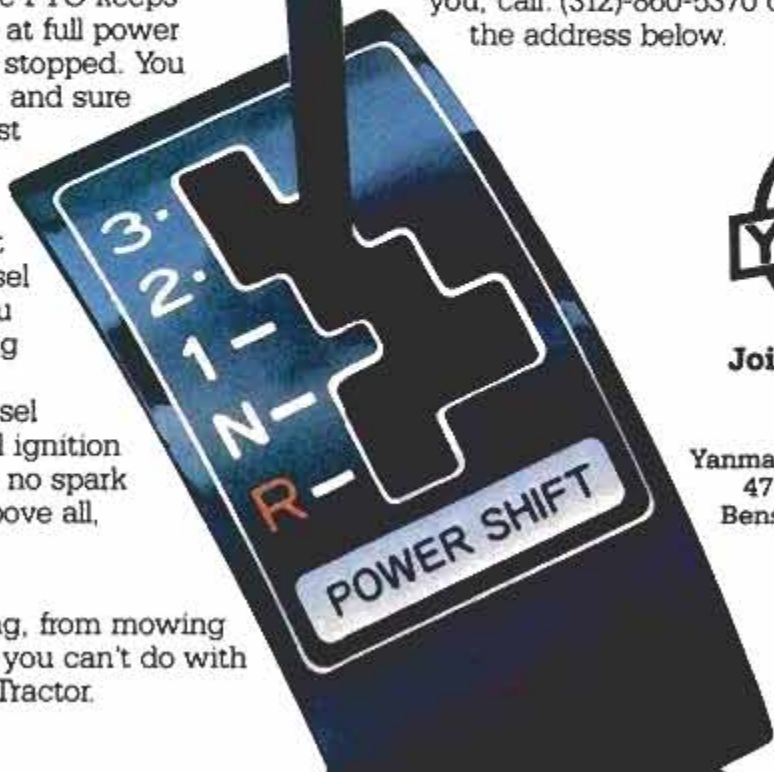


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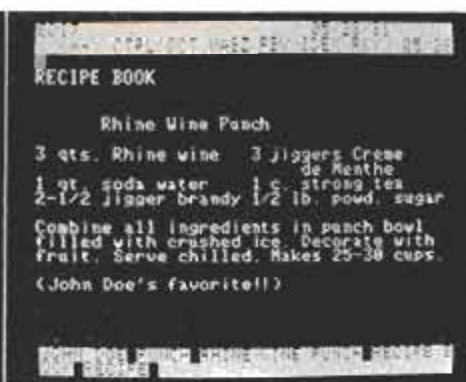
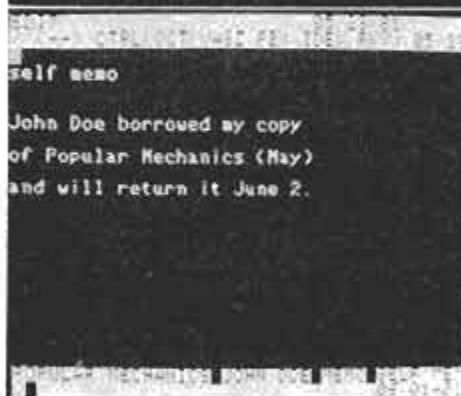
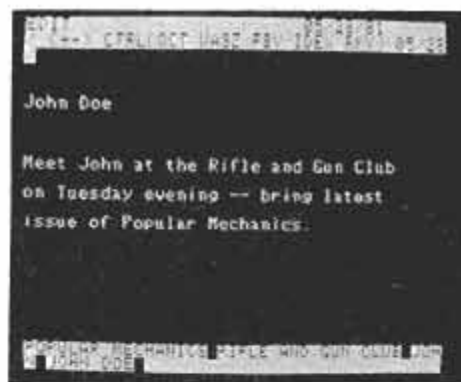


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Visidex recalls screens of information by searching for keywords. The screens which are shown here all contain the name John Doe. During the retrieval session, just typing the name "John Doe" presents you with each of these screens, one following the next. If you want to, you can limit the search by typing "John Doe" and another keyword, such as "recipe." Doing that, in this case, would lead the computer to the recipe (marked as John Doe's favorite), which it would then display on the screen. The Visidex program is capable of handling hundreds of interrelated keywords.

#### COMPUTER PROGRAM KEEPS RECORDS HANDY *(Continued from page 68)*

each member of your bowling club along with dues payment records and bowling averages.

Rather than typing the words "average" and "dues" dozens of times, you can define these as formal categories. Then, the computer will help you to design your screens.

First, you design a template. A template is a blank form on the screen that you can fill in each time it is displayed. For your bowling club, you might have the blank form set up with spaces that are labeled "Name," "Dues," and "Average Score."

If you wanted to enter information about a member, you would call that template onto the screen. Then all you would have to do is fill in the blanks. You can still define and recall any word on the screen as a keyword. You can even mix and match! A keyword can recall both formal and informal screens. Each time you start the program, you enter the date.

#### Memory jog

You can program any screen as a reminder-screen. Once it is so programmed, the screen will appear automatically for as many days as you want before a given date (such as a birthday) whenever you use your computer.

You can also get a calendar for each month, with the days you have things to do marked. Then one glance at the calendar on the screen will prepare you for each busy day's activities.

If you have a printer, Visidex also lets you print any of the screens you want on paper. It will also print out the calendars.

#### Pros and cons

Visidex is not the program to use if you require printouts such as balance sheets and inventory orders that add columns to each other. For that, you would need a more formal database.

For the most part, Visidex is the prime choice for a program to store and retrieve written information. It doesn't try to be a program that works on mathematical information.

#### A preview of tomorrow

Many science-fiction stories in the early '50s featured a towheaded hero who, while walking under the Martian moons, would whip out a small, pocket-sized computer. This little device would keep track of all his appointments, memos and diary entries, along with his schoolwork and even more. Usually, the computer seemed to be a bit smarter than the hero.

Visidex is pretty close to achieving that dream. It will do just about everything those fictional computers were supposed to do, though you can't keep your Apple II in your back pocket. (Though someday soon, who knows?)

Meanwhile, you will find that Visidexing your life on a home computer can save you endless time and trouble.



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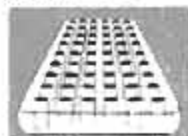


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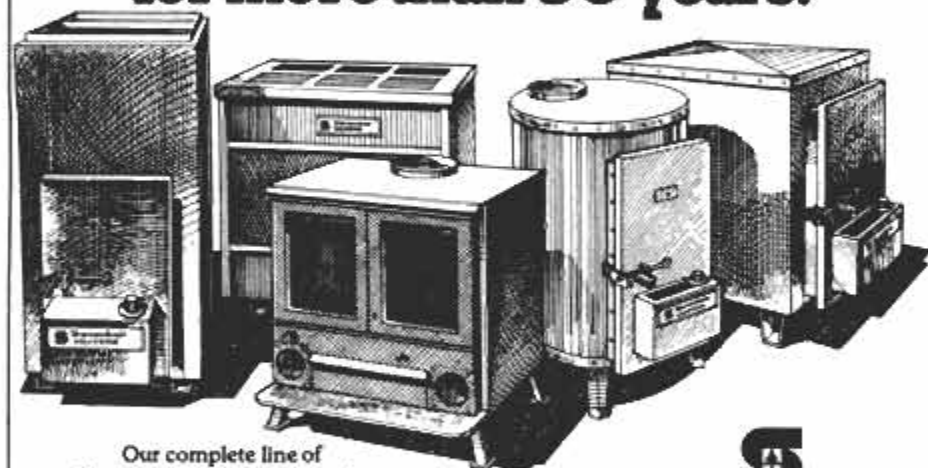
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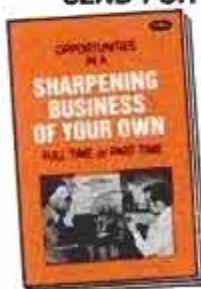
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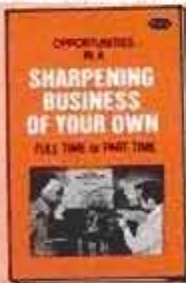
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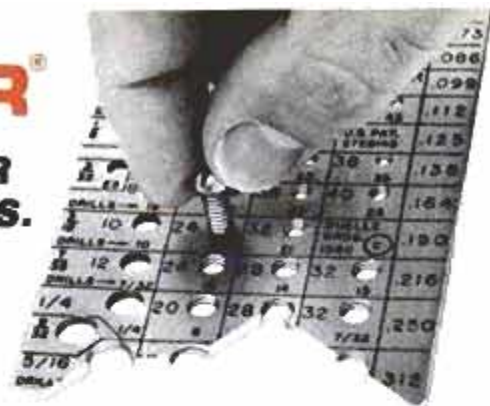
STATE \_\_\_\_\_ ZIP \_\_\_\_\_

AREA CODE \_\_\_\_\_ PHONE NO. \_\_\_\_\_



# SCREW CHEK'R®

**THE ONLY COMPLETE SYSTEM FOR IDENTIFYING INCH AND METRIC SCREWS. PRECISION MACHINING MAKES THE DIFFERENCE!**



**"IT'S THREADED"**

SCREW CHEK'R INCH

FOR INCH SCREWS No. 1 thru 5/16"  
Ruelle Brothers Company

| SIZE          | INCH | TAPING | TAPING | TAPING            | INCH        |
|---------------|------|--------|--------|-------------------|-------------|
| DRILLS → 48   | 54   | 72     | 32     |                   | .073        |
| 2             | 56   | 91     | 64     | 50                | SCREW .086  |
| 3             | 48   | 56     | 45     |                   | CHEK'R .099 |
| DRILLS → 32   | 40   | 48     | 36     | 43                | .112        |
| 5             | 40   | 44     |        | U.S. PAT. 2728449 | .125        |
| DRILLS → 18   | 32   | 36     | 30     |                   | .138        |
| DRILLS → 16   | 32   | 36     | 40     |                   | .164        |
| DRILLS → 10   | 24   | 32     |        | RUELLE BROS. 1940 | .190        |
| DRILLS → 7/32 | 24   | 28     | 32     |                   | .216        |
| 1/4           | 20   | 28     | 32     |                   | .250        |
| DRILLS → 1/16 | 18   | 24     | 32     |                   | .312        |

## SAVE TIME & PREVENT COSTLY ERRORS!

SCREW CHEK'R completely identifies all types of screws, both inch and metric: machine screws, bolts, wood screws, and sheet-metal screws. Even cotter pins and rivets. Simple, and fast.

Also use SCREW CHEK'R to straighten bent screws and clean up rusty or damaged threads. It's the ideal tool for holding a screw while cutting, drilling, or altering the head.

SCREW CHEK'R is a quality tool, made of heavy-gauge steel, with satin-chrome plating. Precision machined threads provide accurate identification.

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\$8.95

### METRIC NO. 1

For ISO Metric Screws from 2 mm (0.079") thru 7mm (0.276")

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See your local Hardware Store, Home Center, or Industrial Distributor; or contact: Ruelle Brothers Co., P.O. Box 421, Drayton Plains, MI 48020 For the dealer nearest you PHONE: (313) 385-4431 or (313) 674-3019

# AIRGUNS YOU NEVER OUTGROW.

Crosman airguns have come a long way since you were a kid. Which explains why, today, we sell so many airguns to people *over 18*.

Take our Model 760 Powermaster® or 38T revolver, for example.

Each has a rifled, solid-steel barrel for dead-on accuracy, and a rear sight that's adjustable for both windage and elevation.

Each comes with authentic "big gun" features, too. Like a high-style checkered stock or

pistol grip.  
And a clean, crisp trigger pull.

With grown-up features like these, it's no wonder the 760

and 38T are two of the best-selling airguns in the world. There's nothing childish

about the power they deliver, either. With our 760 Powermaster, you can pump up velocities of up to 710 fps.

Our 38T revolver can punch out .177-cal. pellets at velocities of up to 360 fps.

Which means that, with a Crosman airgun, you get the kind of shooting pleasure you're never too old to enjoy. And you get it at a down-to-earth price. About \$40 for the Model 760. About \$45 for the Model 38T.

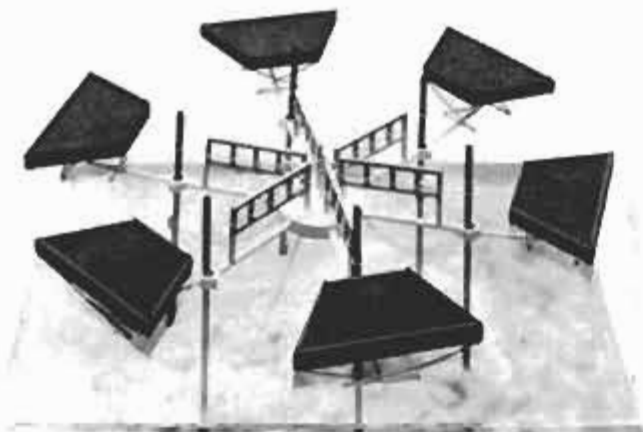
So why buy an airgun you're sure to outgrow? Buy one that's all grown up.

**Crosman®**  
**AirGuns**

Protect your valuable airgun. Shoot Crosman Copperhead™ ammo.

Crosman Airguns, 980 Turk Hill Road, Fairport, New York 14450





## PM's Whatsit

This is a model. Of what? You may well ask, but we asked you first. We'll tell you there is water involved. If you still haven't got a line on it, turn the page for the answer.



## For jeans, instant aging

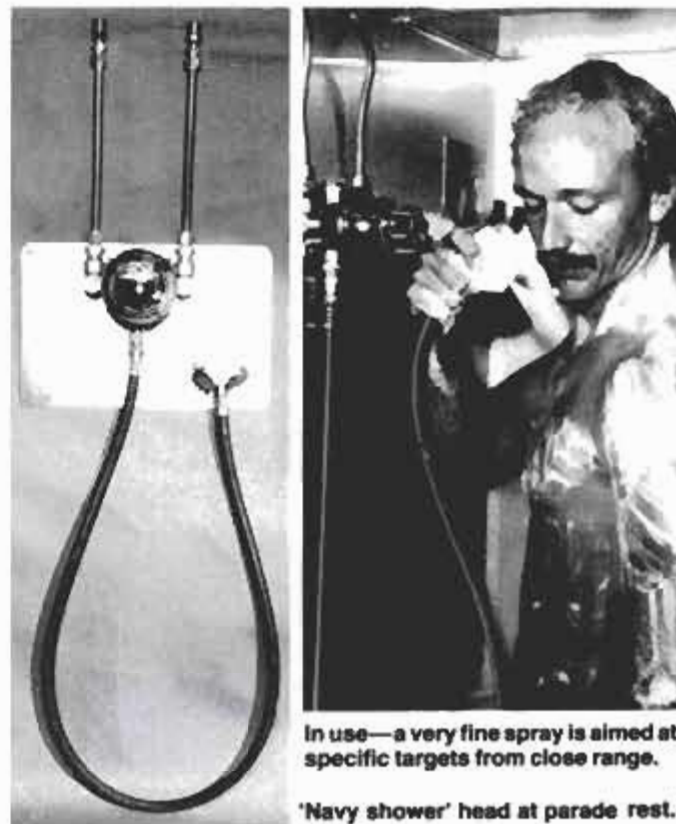
West German science is the latest institution to apply itself to the perennial problems of adolescence. Success has been reported in one critical area: You no longer have to suffer the embarrassment of wearing jeans that look, you know, like, too *new*. From one secret laboratory in the Federal Republic has come a working, commercially available *entfärber* (fader, decolorizer). The formula is designed to do nothing but fade jeans properly. Packaged in a small tube, it can be applied in varying strengths to produce anything from a medium to a very light blue color. The net effect, its developers claim, is indistinguishable from the roughly 20 washings jeans must have to acquire "the look" in the course of a natural life.

Hello, Stockholm? Put me through to the Nobel Prize committee.

## Sailor beware

*Some myths die hard. It turns out that a "Navy shower"—the old wet-down, soap-up, rinse-off, move-out routine—uses up anywhere from 15 to 20 gallons of water. That's according to the Navy's own estimate (compared to a civilian shower that consumes as much as 60 gallons). Since it costs the Navy from 4 to 8 cents per gallon to produce fresh water aboard ship, a new device that redefines the Navy shower is going to save that service millions of dollars.*

*Developed within the Naval Ship Research and Development Center, the new shower head employs a very fine spray and spring-loaded shut-off valve to provide the stingiest built-in Navy shower imaginable. It'll average only three gallons, if recent trials aboard a destroyer are indicative. The ship's shower-water use, through the low-flow, hand-held unit, was reduced by 85 percent. And that was in the tropics. A commercial version of the shower head will be marketed by Speakman Co., 301 East 30th St., Wilmington, Del. 19802.*



In use—a very fine spray is aimed at specific targets from close range.

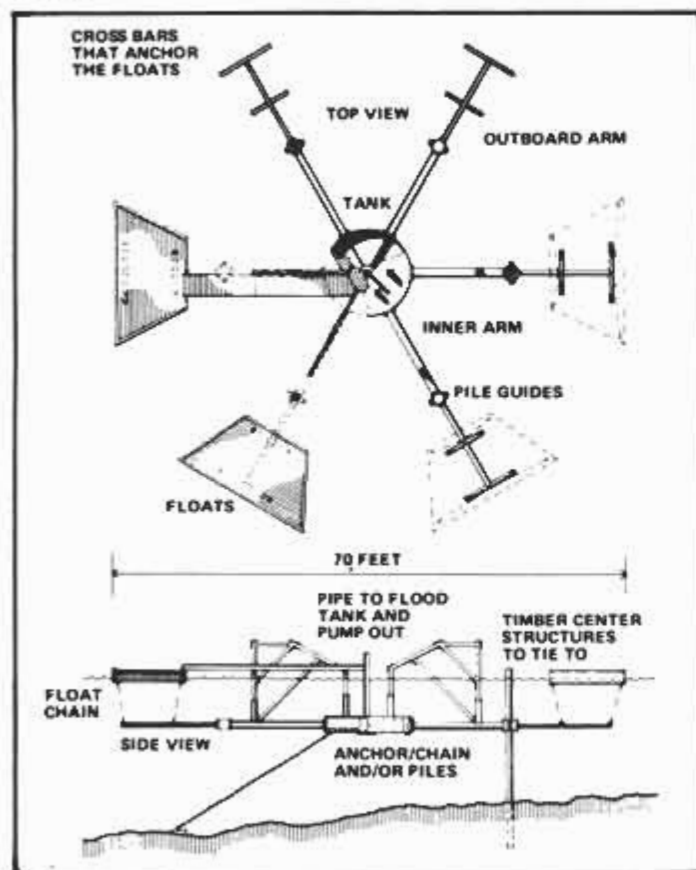
'Navy shower' head at parade rest.



# IPM BRIEFS

## Whatsit revealed

Downeast inventor Paul Brown of Vinalhaven, Me., calls his new-geometry boat-slip design simply "The Rig." The basic cell, says Brown, can accommodate six pleasure craft in slips 18 x 34 feet within a circle only 70 feet in diameter. The steel tank and arms that make up the hub and spokes of the wagon-wheel structure are sunk out of sight; bow lines tie to the forward timber structures, stern lines to floats. Pilings and anchors can position the rigs, in clusters, to afford boats the full draft offered in a given harbor.



## Portable airconditioning

Among the items awaiting the arrival of scheduled space shuttles to Edwards Air Force Base (see page 83) are some that will definitely never fly on their own. The one here, being delivered by the obligatory (because of its size) C-5A cargo plane, is a coolant transporter. It was accompanied in the giant Lockheed plane by a 132,000-pound purge transporter of similar configuration.

Due to the possibility that toxic fumes lingering within the combustion chambers and fuel system of the orbiter could actually endanger the astronauts as they debark the shuttle, the purge operation was widely noted in news coverage of the initial flight. But the cooling is just as important: Unless the shuttle is plugged into its air conditioner and cooled down within 15 minutes of landing, the residual heat from reentry could build up and literally fry its electrical system.

# Clipper Fortune

## A little irony there

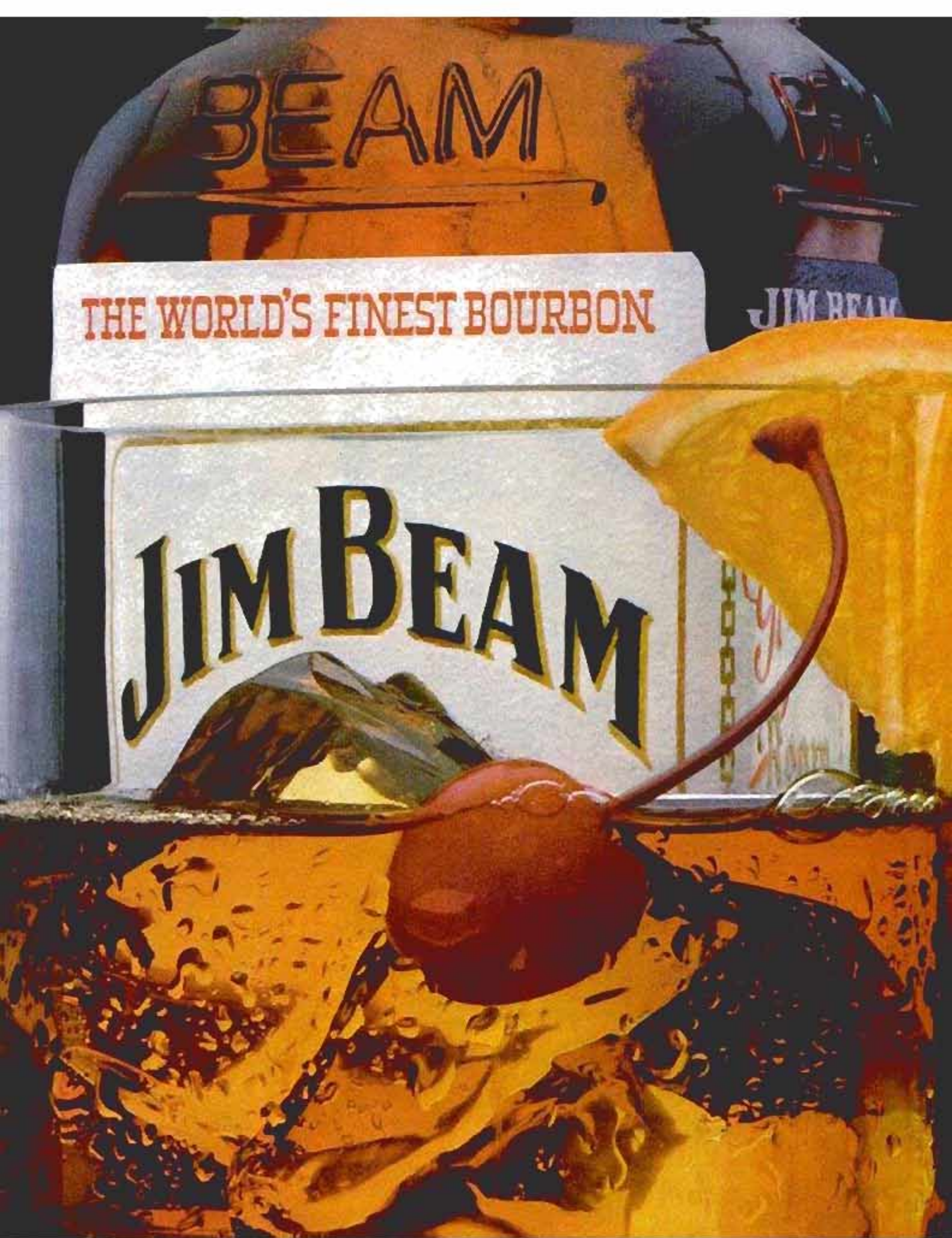
Although it is the U.S. airline with the most in the way of tradition to evoke, Pan American's past exploits have had little effect on its current balance sheet. Even competitors are shaking their heads in sympathy over its latest retrenchment. Still, all the other frills will have to go before the airline that hired Charles Lindbergh cuts back on tradition—like the individ-



ual Clipper appellations that get painted on every one of its aircraft. Mrs. Herbert Hoover christened the first one, a Sikorsky flying boat dubbed "American Clipper," 50 years ago this month.

In today's scheme, only Pan-Am's all-cargo 747s get commercial-sounding names like "Clipper Fortune." Its passenger airliners carry names alluding to romance, adventure, winged creatures and patriotism. That, in the opinion of some airline executives, pretty much sums up the business.





Taste is all it takes to switch to Jim Beam.

KENTUCKY STRAIGHT BOURBON WHISKEY. 40 PROOF. DISTILLED AND BOTTLED BY JAMES B. BEAM DISTILLING CO., CLERMONT, BEAM, KY.

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# TOO MANY LAY DOWN ON



**SPLIT SOLE**  
Construction Worker—Chicago, Illinois

**CRACKED LEATHER**  
Gas Station Owner—Troy, New York

**WATER DAMAGE**  
Mailman—Des Moines, Iowa

If you spend a good part of your day working in a pair of boots, obviously, you depend a lot on them.

Unfortunately, though, most boots don't deliver.

Their problems run from shoddy and uncomfortable construction on the one foot, to no waterproofing and no insulation on the other.

At Timberland®, we make what we think are the best work boots around.

Here's why:

**YOU HAVE TO WORK IN RAIN AND SNOW.  
SO DO OUR BOOTS.**

If there's one time people who save a few dollars on a pair of boots really pay the price, it's when it rains or snows. Because most boots won't keep you dry.

But it's in weather like this that Timberland boots really shine.

Our boots are made of silicone or oil-

impregnated waterproof leathers.

To resist rust, we use only solid brass eyelets.

And because any needle hole is a potential water hole, we seal every seam with not just one coat of latex but two.

How dry will Timberland boots keep you?

Well, on a machine called a Maser Flex that tests waterproof leathers, Timberland leathers must withstand a minimum of 15,000 flexes, twice U.S. Military standards.

**WE WON'T LEAVE YOU OUT IN THE COLD.**

It's been estimated that on extremely cold days, you lose 80% of your body heat through the top of your head.

Yet, inevitably, your feet are always the first things to go.

To prevent the inevitable, your feet are surrounded with a layer of nitrogen filled closed cell insulation that'll keep your feet warm to temperatures well below zero.



# WORK BOOTS THE JOB.

Our boots aren't just better insulated than most boots, they're better insulated than most houses.

OUR BOOTS ARE TOUGH ON THE JOB.  
NOT ON YOUR FEET.

One of the biggest qualifications a work boot must have is an ability to take punishment.

Timberland's stand up to whatever you dish out.

Thanks to little things like four rows of nylon stitching instead of cotton in all key stress points. And big things, like heavy-duty molded soles permanently bonded to the uppers so they can withstand a tremendous amount of abuse.

But there's a soft side to our boots as well.

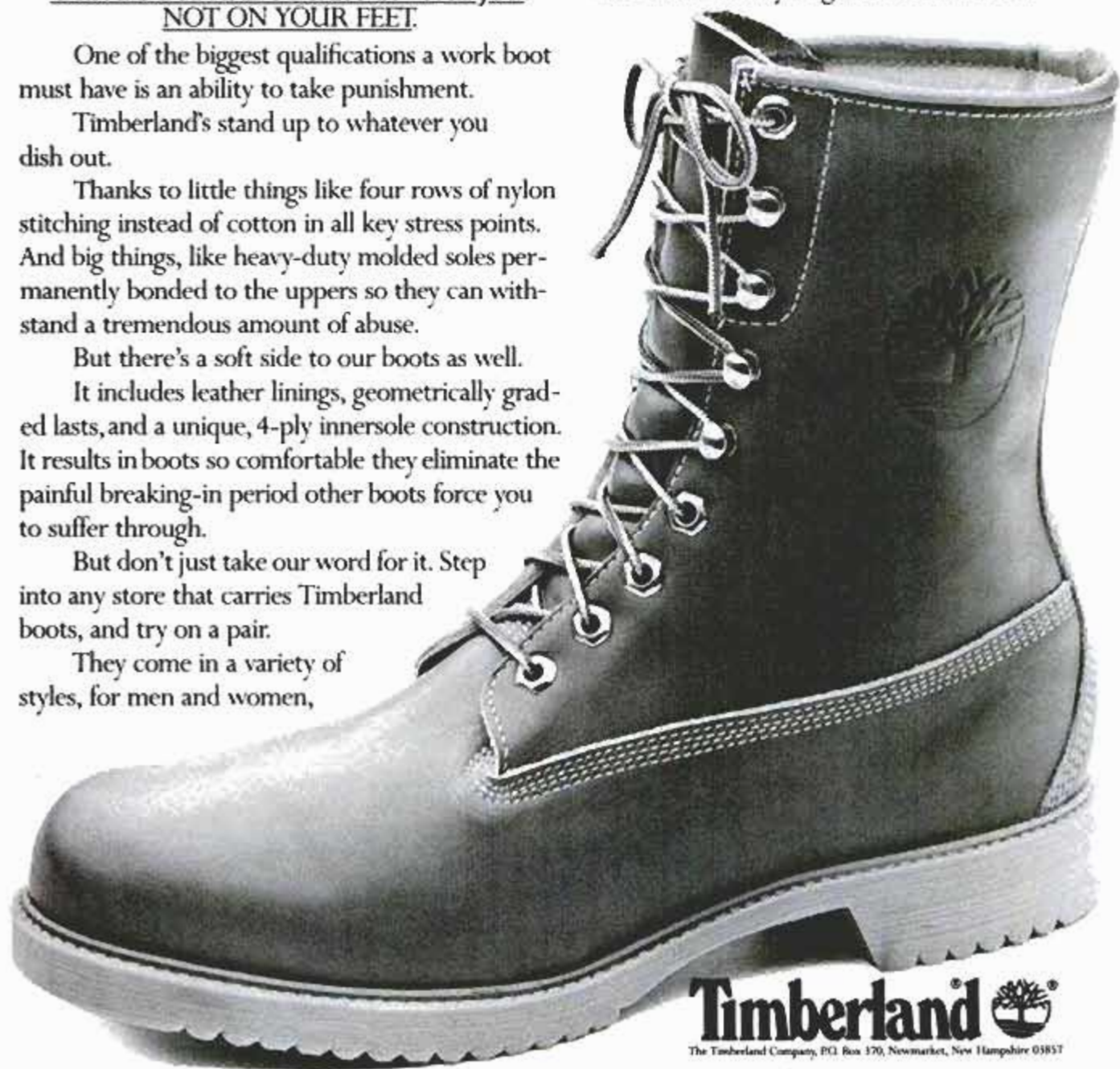
It includes leather linings, geometrically graded lasts, and a unique, 4-ply innersole construction. It results in boots so comfortable they eliminate the painful breaking-in period other boots force you to suffer through.

But don't just take our word for it. Step into any store that carries Timberland boots, and try on a pair.

They come in a variety of styles, for men and women,

starting at about \$60.00. Which, in all honesty, might be a few dollars more than you now spend.

But we think you'll find it's worth spending a little more money to get a lot more boot.



**Timberland** 

The Timberland Company, P.O. Box 170, Newmarket, New Hampshire 03857





# Marlboro



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

16 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Mar '81



# Edwards Air Force Base: IT SURE LOOKS GOOD FROM THE AIR

NASA (foreground) is one of Edwards' tenants; the test hangar section shown in the background is called "Contractor's Row."

If it's new and has wings, what goes up usually comes down—at least once—on a former lake in the desert.

by Robin Nelson



An Air Force captain in 1947, Charles E. "Chuck" Yeager (above) was first pilot to exceed Mach 1. Major (now Colonel) Pete Knight took the X-15 to a record speed of 4,525 mph (Mach 6.7) in 1967.

One interpreter sees it primarily as a place where men who talked like Hollywood cowboys and had hawk eyes and titanium nerves gathered as the result of some higher call to write aviation history with their deeds. In so doing, they affirmed each other's "right stuff" (a phrase, incidentally, which no one directly involved ever seems to have actually used). In another view, the site owes more to a primordial miracle that laid clay down on a lake bottom which

eventually dried so hard and flat you'd need a few thousand dollars' worth of equipment to find any variance over miles of its surface—something for which the Defense Department periodically tries to usurp credit from nature by pointing out that its existence has saved billions of taxpayer dollars (cost of a similar man-made facility, however inconceivable).

It's where the first four space shuttle flights will terminate, if all goes well, and maybe a few beyond



## Rollout ad infinitum

The epochal first space shuttle landing at Edwards was not exactly by the book; pilot John Young chose to "graze" Columbia onto Rogers Dry Lake's surface, dead center between the painted-on runway borders, but about 3,000 feet beyond the planned touchdown point due to the spacecraft's unexpected aerodynamic buoyancy. No sweat—Young had 7.5 miles of designated runway to work with and 65 square miles of "freelance" lake bed available in an emergency situation. Some 15 years ago, X-series rocket aircraft regularly used up to three miles after dead-stick landings at more than 200 knots.

NASA photos





Shuttle's ancestor was this M2 "lifting body," one of several configurations tested in mid-'60s. Dropped from a B-52, it glided at 350 knots—like a rock—and hit deck at close to 200.



that, if all doesn't. Situated at the southwest corner of the vast Mojave in California, in an area called the "high desert," Edwards is what every pilot who has had to get a sick airplane on the ground means when he says, "This must be the place."

Aircraft with damage or malfunctions that might drastically have altered their landing characteristics have even refueled in air, on occasion, to fly across the continent for the luxury of a landing attempt at Edwards. Jet fighters with hydraulic problems, or otherwise unable to deploy flaps and speed brakes, have flashed down onto Rogers Dry Lake at speeds well in excess of the 180 knots at which the lumbering shuttle kisses clay.

Rogers Dry Lake is the major emergency "strip" at Edwards with about a 12½-mile north/south landing rollout available—or, enough to land a space shuttle with almost 10 miles of "oops-way" built into the program. It's doubtful man will ever devise a winged object needing more.

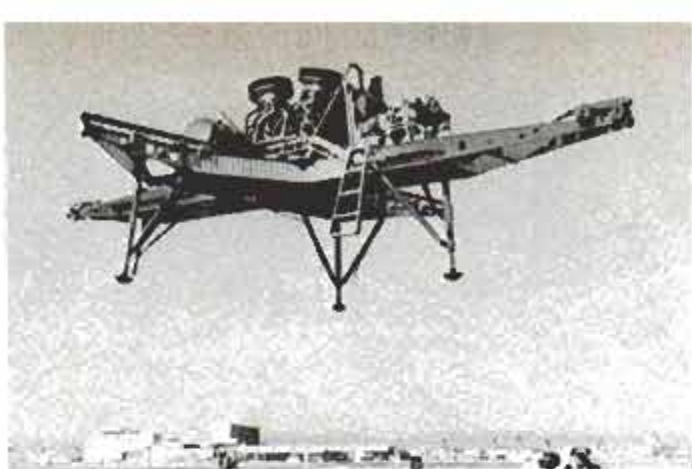
October somehow seems to be a supercharged month at Edwards. Military aviation's official discovery of the dry lake area goes back to a Lt. Col. Henry Arnold, nicknamed "Hap," who is credited with establishing a bombing and gunnery range there in 1933. But it was in October 1942 that the desert found its destiny.

On the first day of that month, the dummy propeller that had been tacked onto the nose of the XP-59A during its shipment by rail was removed, and the aircraft, America's first jet, made its initial flight.

Later Octobers would provide similar thrills: In 1947, Chuck Yeager followed orders to exceed Mach 1 for the first time, in the Bell X-1. Twenty years later, in October of 1967, Pete Knight set the world's absolute aircraft speed record of Mach 6.7 (4,525 mph) in the X-15.

But in October 1947, just a week after Yeager's feat, a strange-look-





### From 'bedstead' to LEM

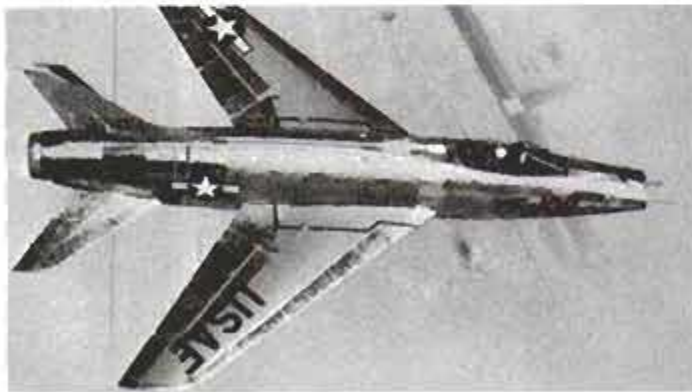
One of the weirdest pieces of equipment ever to leave the tarmac at Edwards, jet-powered "flying bedstead" (above) was one of several versions tested to develop the finer points of vertical thrust control—plus the limits of its stability.

USAF photos



### All things great and small

One-man "rotor-cycle" (top) was one of the smallest flying machines ever tested at Edwards; the YB-60 (above), a swept-wing, eight-jet-engined variant of the dinosaur-like B-36, was one of the largest. World-record gross weight of 798,200 pounds was lifted off an Edwards runway by a C-5A in 1969.



### Supersonic over Rogers Dry Lake

Chuck Yeager's X-1 flight exposed the "sound barrier" as a phenomenon that could be dealt with easily, and paved the way for the design of the Century Series fighters like the F-100 (above). It exceeded Mach 1 on its first flight over Edwards in 1953, and a later model caused the first supersonic bailout.



### They wanted wings

The Air Force spent the better part of a decade trying to get the "flying wing" concept off the ground, operationally. But the 1948 crash of the YB-49, a jet bomber prototype, killed Capt. Glen Edwards, for whom the base was later named, and ended the experiment in a sickening and fiery end-for-end tumble in the desert.



### Prop really was one

Even the paperwork covering the XP-59A was intended to make enemy spies think it was something else—as was the fake propeller tacked on for shipment to Edwards by rail. Under tight security, America's first jet flew on Oct. 1, 1942, but did not have the performance for immediate development as a useful combat aircraft.

ing aircraft designated YB-49, a "flying wing," arrived at Edwards to begin a test series. It lasted until June of the following year, when the wing crashed, killing its crew. Among the dead was a young pilot, Capt. Glen Edwards, a Californian. Muroc Lake Test Center was later renamed in his honor.

Edwards has been the last takeoff point for a lengthy list of pilots, but flight testing conditions tend to be more controlled these days: Hydraulic "shakers" on its wingtips may expose the B-1's structural limits in flight, for instance, but on-ground instruments collect telemetry, and the pilot is told when stresses are reaching the danger point in a given maneuver.

Today, testing continues for years after an aircraft becomes operational. When an A-10 flames out because of gun gas ingested into its engines, or an F-16 behaves as if it needs more elevator surface, these problems and their prospective "fixes" all report to Edwards in due time.

And somebody has to go up over that lake to see what works and what doesn't.

FM



## The B-1 bomber: Back from oblivion

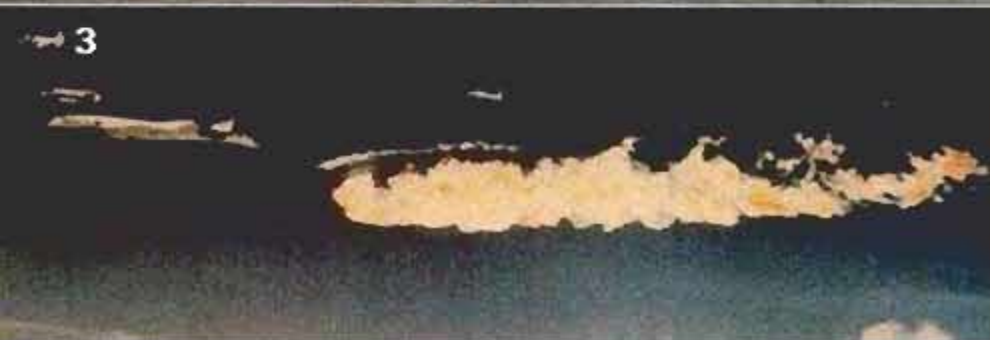
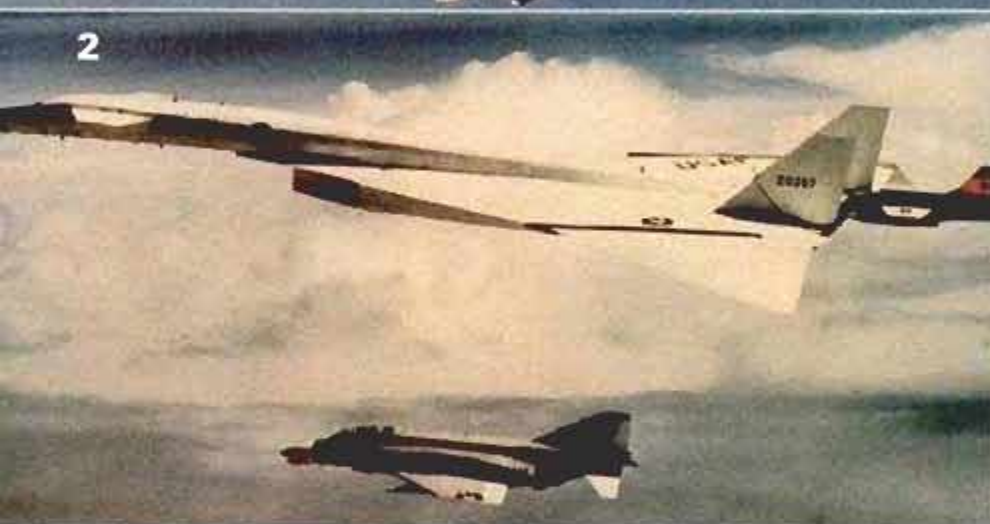
While its production status became a rejuvenated Pentagon issue, four prototypes of the B-1 bomber were being extensively test-flown at Edwards. "Smoothest big airplane I ever flew," says an Air Force test pilot who has a few thousand B-52 hours. Small forward fins are positioned by a computer (independent of main flight control system) in instantaneous response to turbulent air loads during typical, low-level B-1 mission. They damp longitudinal stresses; could be placed on the airliners of the future.



## The XB-70 incident: blackest day in Edwards AFB history


Perfect weather on June 8, 1966, calls for a close-formation photo session (1) to show off then "hot" military aircraft grouped around the XB-70 bomber prototype, which had flown at Mach 3. An F-104 fighter, flown by NASA chief pilot Joe Walker, gets too close and is suddenly sucked into a collision (2) with the bomber's tail assem-

bly. Walker's plane explodes (3), killing him instantly. The XB-70 momentarily flies on, minus stabilizers, then begins to tumble (4, 5) at high speed. Only one of its two pilots is able to eject safely before the doomed supersonic bomber disintegrates (6) on the desert floor after its wild, out-of-control plunge.





# New take-along video

A woman with blonde hair, wearing a beige turtleneck sweater, is holding a large black Panasonic video camera on her shoulder. She is smiling and looking towards the camera. In the foreground, a silver Panasonic video recorder is visible. The background shows a rocky landscape under a blue sky.

Take to the country with video equipment such as the Panasonic gear shown here. The PV-3200 recorder rides on a carry-along shoulder strap, while its matching tuner half stays at home. The camera is the PK-751, featuring an electronic viewfinder which may be adjusted for right- or left-eye operation.

PM photos: Steve Fay



# challenges home movies

The next time you film a family outing, you may not use film. New video recorders and cameras are lightweight, portable and easy to use.

by Neil Shapiro ELECTRONICS EDITOR

**N**ow you have a choice of how to remember your last vacation—you can preserve your memories on film or on the new videotape. Today's portable videotape machines are sleeker, easier to use and more affordable than ever before.

Some say that this year marks the beginning of the end for Super-8 film—that soon, all home movies will be home "tapes." If you are thinking of buying a new movie outfit, or of upgrading your current gear, the question of tape or film is more than just important: It's crucial.

The new video units are completely portable. They can go anywhere and need no more lighting than most outdoor films.

If you're familiar with the home video-cassette recorder (VCR), it's natural to wonder how such cumbersome units were trimmed down to carry-along size. The answer is... they were cut in half.

A VCR has two interdependent sections. The major section is the tape recorder, which records magnetic impulses on rapidly moving videotape. In the playback mode, the unit decodes these impulses into video signals. The other section of a VCR includes a tuner, with which you receive (tune) normal VHF, UHF or cable TV channels, and a timer-programmer that can turn the VCR on and off automatically.

Well, you don't need to receive normal TV when you're taping "on location." Nor do you need automatic on-off functions.

Portable VCRs have been split

(Please turn to page 173)

RCA portable equipment is both light and versatile. We show Model VFP170 (tuner on the left recorder on the right), along with Model CC010 camera. This unit also features an electronic viewfinder, which is really a miniature TV for through-the-lens views.



JVC video portable has handsome units coupled with high-performance electronics. HR-2200U units (tuner in middle, recorder to right) are flanked by the TV-22U adapter power supply (left). The camera, with optical viewfinder, is Model GX-66.



Technicolor's Model 212 take-along and matching camera is lightest, smallest and most portable of the units we saw. But it's so small, it uses a non-standard tape. Cassette is far smaller than Beta-style or VHS tapes. Recording time, however, still lasts for two hours.





## FIRSTHAND REPORT

by Gary Witzenburg  
DETROIT AUTO EDITOR



# Driving the 1982 Chryslers

Chrysler shuffles names and introduces two new versions of the K-car.



Dodge 400, like the LeBaron, is based on the K-car. It's 3½ inches longer than the K, and can accommodate six adults. The 400 is available as a two-door only.

If you liked last year's K-cars, you should love this year's Chrysler LeBaron and Dodge 400. Essentially, these two cars are gussied-up versions of the K-cars and use the same 99.9-in. wheelbase, same basic bodies and the same front-wheel-drive power trains. The only difference is that they're longer, by 3½ inches, plusher, softer, quieter, more luxurious and yes, more expensive than the basic K-cars.

Chrysler's new Super-K was "badge-engineered"—that's when an old, familiar name is

put on an all-new car—and is called the LeBaron, formerly Chrysler's luxury, mid-sized car. It sports a rich-looking, Imperial-like grille between quad rectangular headlamps and comes in two-door coupe and four-door sedan variations in high-line and premium (Medallion) trim. Convertible and Town and Country wagon versions are due for later introduction.

The Dodge 400 has a sporty, Mirada-style horizontal bar grille flanked by four individual quad headlamps, and is offered in a single two-door coupe.



Front seats of 400 can be had in either bench or buckets, in cloth, vinyl or leather.

Both are handsome, fuel-efficient, pleasant-to-drive and roomy (for their size) six-passenger automobiles, aimed at buyers moving down in size from conventional American intermediates or up in luxury from similar-size and smaller economy cars.

We have no reason to doubt their immediate appeal to both groups.

With all its full-size cars discontinued, those gas-guzzler names are transferred to the remaining 112.7-in.-wheelbase, rear-drive, intermediate four-





**Chrysler LeBaron** is essentially a gussied-up version of an '81 K-car. It's plusher and more refined to justify higher asking price.



**Peppy Dodge Colt/Plymouth Champ** continues to offer the Twin Stick transmission. This year a five-door is available, too.



**Dodge Charger 2.2** is the high-performance version of the TC3/024 sport coupes. The Plymouth version is called Turismo.

door sedans. Thus, the "down-sized" New Yorker is really a pushed-up version of the old LeBaron with a transplanted New Yorker-style grille and "limousine" roof, and the "down-sized" Gran Fury is a low-level variation of the same car.

Since the Dodge 400 Super-K (wisely, we think) gets a fresh name, the Diplomat moniker stays put for now on that division's rear-wheel-drive sedan.

Chrysler's only other domestic rear-drive cars, the Chrysler Cordoba and Dodge Mirada specialty coupes and luxury flag-



**Sapporo/Challenger twins** are greatly improved, have more standard equipment.

ship Imperial, are essentially unchanged for '82.

The fwd Reliant/Aries K-cars benefit from most of the Super-K improvements and new features,

except that the four-doors, regrettably, don't get the roll-down rear door windows as they do in the Super-K. They do, for '82, get the reclining bucket seats, the two-spoke steering wheel, optional power windows and upgraded interior and trunk trim.

In the smaller, fwd Horizon/Omni line, the 30/50-mpg Miser models are even better values for '82 with added standard equipment.

The TC3/024 sport-coupe versions also get added standard

*(Please turn to page 174)*



# Driving the '82 GM cars

This month, GM treats small-truck buyers, while fine-tuning its import fighters.

by Michael Lamm WEST COAST EDITOR



Pontiac's '82 Bonneville has 108.1-in. wheelbase. Standard engine is 3.8-liter V6; two gas V8s and diesel are optional.

Bonneville still seats six adults in complete comfort and luxury; this is the Durand-cloth, loose-pillow seat.

**A**s we mentioned last month, General Motors will be scattering its introductions over a period of months—beginning now with the S-10 mini-pickup and carryover cars, and running through December and January with the A (big cars), F (Camaro/Firebird) and Y (Corvette) cars.


The reasons for the delayed intros are many, but the most important one seems to be a large surplus of unsold 1981 cars. Other reasons for the delay are accelerated production schedules, coupled with new and untried tooling, and a great emphasis on quality control. Unlike its attitude in the past, GM now will sell no car before its time.

Although we won't be able to see our favorite cars as soon as we'd like, as consumers, we'll ultimately benefit from these delays—by having available cars that we hope have been screwed together lovingly, rather than dashed out on schedule.

The S in S-10 stands for small. With a wheelbase of 117.9 inches, the S truck is now the smallest pickup GM manufactures. The Chevy LUV pickup, which had almost the same wheelbase, has been phased out altogether. The LUV truck was manufactured by Isuzu of Japan. But, now that Isuzu has entered the American market with


*(Please turn to page 176)*





Chevy's new S-10 replaces the discontinued LUV in the '82 truck lineup.

Chevrolet Caprice (above) remains virtually unchanged for 1982. The Chevy Chevette (below) benefits from more standard features, as well as the availability of a diesel Four.



Pontiac TransAm, due for late '81 introduction, will have a 2.5-liter Four as a base engine. V8s, however, will still be available.

PM art: Jeff Mangiat

### 1982 Pontiac TransAm

GM's 1982 F-cars, otherwise known as the Chevy Camaro and Pontiac Firebird, are probably the most eagerly awaited cars of the last few years. Their success or failure will determine the direction of GM's high-performance ventures in the future. With any luck, we'll see the cars in the flesh by mid-December. If things don't quite go off on schedule, we might not see them until January, or later.

The '82 F-car will weigh some 600 pounds

less, and lose 7 inches from its wheelbase, compared to the current car. Standard engine will be the 2.5-liter Four. Optional engines will be a 3.8-liter V6, 4.4-liter V8 and a five-liter, fuel-injected V8.

The current front-engine/rear-drive configuration will be retained, but the rear suspension will be completely changed. Rear leaf springs will be eliminated and be replaced by coil springs, a torque tube, Watts linkage and trailing arms. This revision

finally takes the F-car out of the blunderbuss age and should make it a truly modern road weapon.

Visually, the F-cars retain their now classic look, most notably in the glass area. Purists won't turn away in droves. The car will also have pop-up headlights, optional four-wheel discs and optional Recaro bucket seats. There is also a rumor that a turbocharged V8 might be available if it passes the tough California emissions tests — T.A.



# Driving the 1982 AMCs

Plucky AMC offers up fuel-economy improvements it hopes will counter its fuel-wasting image.

by Michael Lamm WEST COAST EDITOR

**Y**ou've got to feel bad for little AMC these days. Here's a company that's really trying, really making the best of a bad situation, yet it's unable to make more than a small dent in its market share.

The amazing thing is that AMC has never had as diverse a product mix as now, and its corporate fuel economy number has never been higher. The problems, of course, are the economy in general, and the fact that AMC vehicles are perceived to be fuel inefficient. Realistically, though, given the unique position AMC occupies in the overall product spectrum—the 4x4 market segment—its vehicles aren't

all that inefficient. And in '82 they're even better.

AMC has made many changes in '82, some trivial, others quite significant. The most significant one is the availability of a five-speed manual transmission on practically all its passenger cars and 4x4 vehicles.

The five-speed has ratios of 4.03, 2.37, 1.50, 1.00 and .86:1, first

*(Please turn to page 201)*

**Jeep Cherokee now offers lockup automatic transmission.**



Jeep Scrambler mini-pickup, introduced in mid-year, remains largely unchanged in '82.







Sporty Eagle SX/4 will be available this year with five-speed manual transmission, a first for AMC. The Select-Drive transmission is standard on all five of the Eagle models in '82.

Renault Le Car benefits from a few evolutionary but minor changes. Revised gearing makes it somewhat less buzzy.



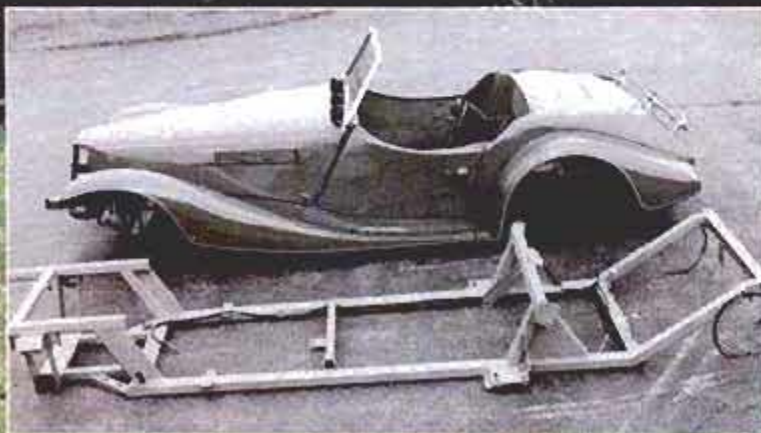
Jeep CJ-7 Limited offers a wider track than the standard CJ-7 for better stability on paved roads. It also has a bigger fuel tank.



PM builds a kit car to see if you can be a happy motorist without ever visiting a showroom again.



Bernardi body and the chassis (right) are bolted together for shipment by Blakely. Step 1 is to separate them. Doors, trunk, hood and windshield are already installed. Our Pinto parts car (far right), in its initial stages of dismantling, is a 1977 model that is equipped with the 2.3-liter Four.






## DO-IT-YOURSELFER'S DREAM:

# The real fun of building a kit car is driving it when it's finished!

by Tony Assenza AUTO EDITOR

**B**uild a kit car? No problem. After all, what secrets could it hold from me? Hadn't I done a full-tilt restoration on a 1957 TR-3? Hadn't I acquired the patience of a saint tuning Weber sidedraft carburetors while my buddies were still conjugating Latin verbs? After having conquered the erratic, almost schizophrenic, behavior of Lucas electrical systems, building a kit car from Ford components would be a piece of cake. Twist some wrenches, a little torch work and



Once completed, our Blakely Bernardi is absolutely stunning. Its appearance is matched by surprisingly quick performance and nimble, responsive handling.





Body preparation consists mainly of drilling holes in the fiberglass to accept the components. Here, the windshield washer and master cylinder are in place. Components are bolted to fiberglass with washers.

there you have it. Two months of weekends and evenings and that kit wouldn't know what hit it. Another notch in my ratchet handle.

That was a year ago.

We'll get to the obstacles later on. Right now, I think you need to know what a kit car is.

Kit cars have been around for approximately 20 years. The best known of all the early kit cars was the Meyers' Manx, the original Dune Buggy. The Dune Buggy was an open, fiberglass body built on a Volkswagen Beetle chassis and drive train.

To this day, most kit cars still use those venerable VW mechanicals and use bodies that resemble anything from a 1951 MG to a Porsche 935 race car.

#### A Ford in kit clothing

A Blakely Bernardi is a kit car. You build it with components you strip from a Ford Pinto and graft these components onto a chassis



When shipped, the door is mounted, but bare (top). Door finished with upholstery supplied with the kit is shown above.

## Popular Mechanics KIT CAR RALLYE



With engines running, cars built by kit-car rallyists are gridded and ready to tackle New York streets.

**A** kit car rally in the streets of New York? It sounds like the makings of a demolition derby. After all, those same streets managed to render null and void 600 brand-new Grumman Flexible buses by cracking every single one of their high-tech undercarriages. What chance could a bunch of home-built cars with born-again mechanicals have against such a tough set of conditions? As it turned out, the kit cars were apparently made of stronger stuff.

Nobody broke down and only one

car came back on the hook—because it ran out of gas.

The first annual Popular Mechanics Great American Kit Car Rallye was a coming-out party for our Blakely Bernardi, and we invited some very chic friends, the champagne and caviar set of the kit-car world. The nice thing about this set is that you can buy into it. All it takes is the price of a kit, generally cheaper than a bottom-of-the-line economy car, and some wrench twisting.

Our event was run like a conventional

rally with time cards, check points, tricky clues, puzzles and penalties. Our entrants came from as far as North Dakota, Florida and California, yet they did quite well in negotiating the unfamiliar, and sometimes treacherous, streets. The winner was Bill Schumer of Lafer MP, importer of the MG replica of the same name, who lives in California.

The other drivers and their final positions were 2. Tom McMahon, 3. Jim

(Please turn to page 178)



provided as part of the kit from Blakely—unlike some kits, which use a VW chassis pan.

The chassis is a ladder-frame affair made up of 2 x 3 rectangular steel tubes with a wall thickness of 5/16 inch. To say that the chassis is sturdy is an understatement. It looks, in fact, like it was taken from a section of the Golden Gate Bridge.

The drill for building the kit seemed simple enough: You take the engine, gearbox, driveshaft, rear end and suspension from a Pinto and bolt them on (with some modifications) to the chassis. There are also the related bits and pieces like steering column, brake cylinder, radiator, heater, most of the electrical system, steering rack and so on.

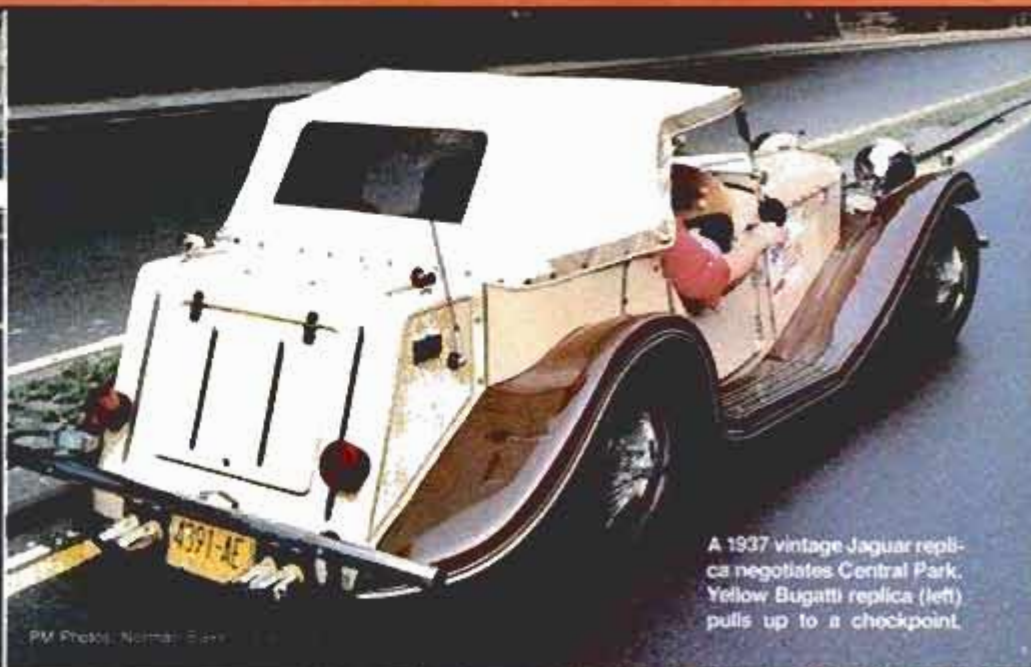


Hole for instruments (left) is cut using a template supplied with kit. Wiring harness and heater box are already in place. Instruments installed in the dash are shown at right. The high-quality instruments are part of the deluxe kit and come with necessary wiring.

Once you've got the running gear on the chassis, you bolt on the fiberglass body, another very rigid component. It's so rigid, in fact, that Art Herschberger, president of Blakely, never misses an oppor-

tunity to stand on the fenders of a car just to show how rigid it truly is.

The term fiberglass used in this instance is perhaps too simplistic. The Blakely body uses more than



A 1937 vintage Jaguar replica negotiates Central Park. Yellow Bugatti replica (left) pulls up to a checkpoint.

PM Photos: Norman Starr

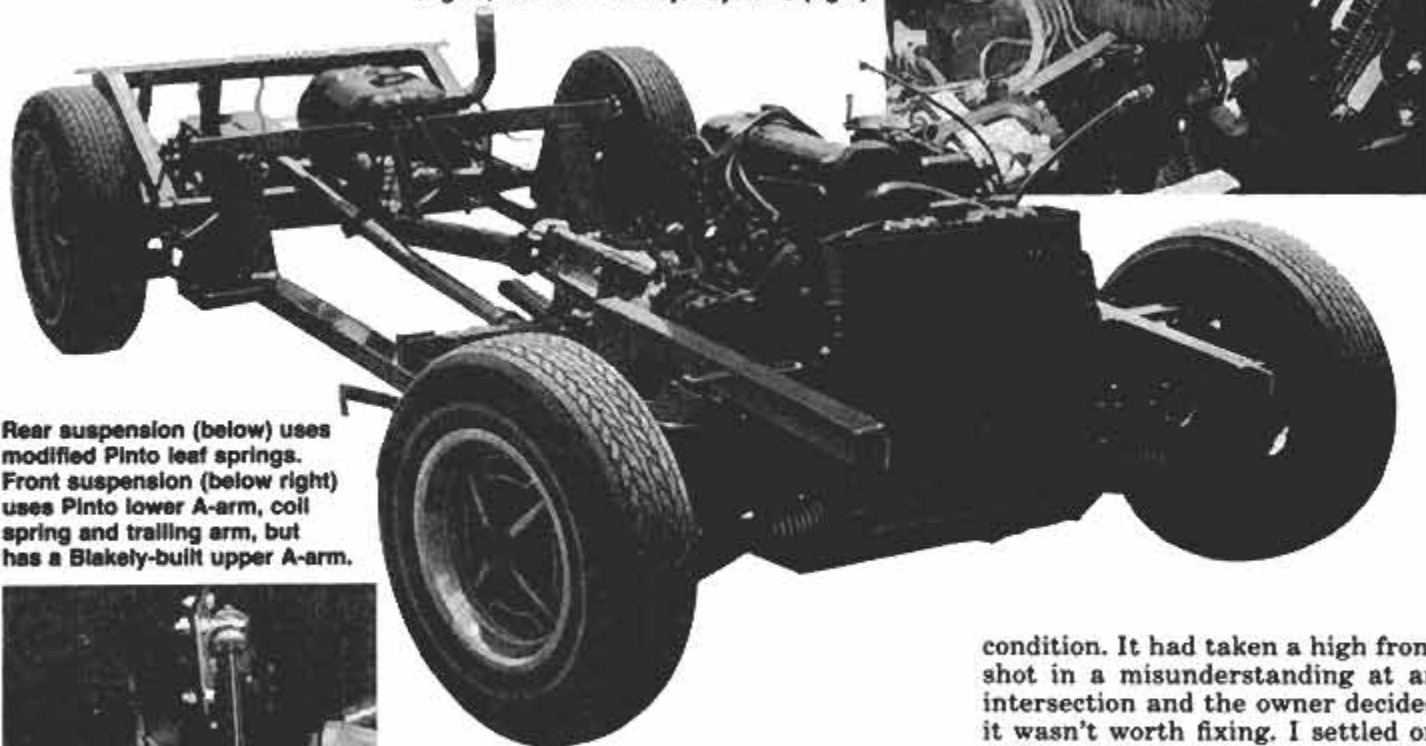


PM staffers clock cars at last checkpoint. Mike Santulli and crew (right) in Model A Ford replica got lost, but kept smiling. Winning Lafer team is flanked by PM's Dan Coleman and John Linkletter (bottom right).

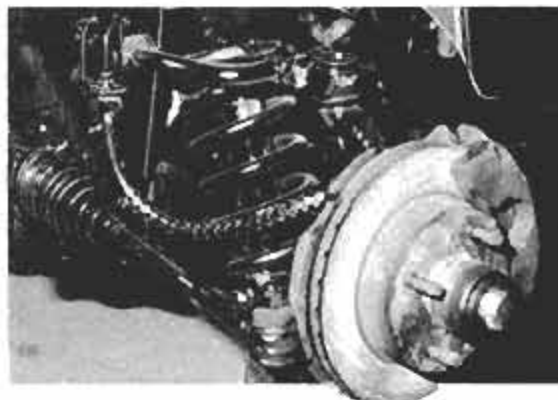
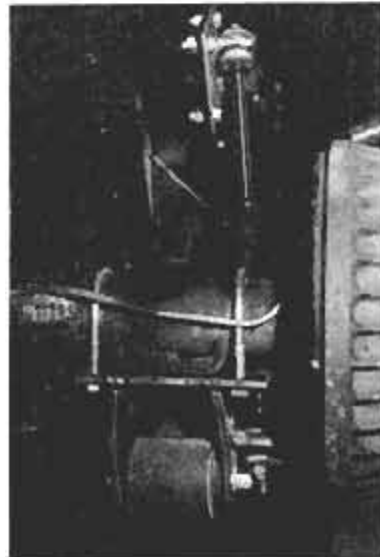




Rolling chassis (below) with all major components installed, is ready to accept mating with the body. The hood tilts forward for easy access to the engine, radiator and major systems (right).



Rear suspension (below) uses modified Pinto leaf springs. Front suspension (below right) uses Pinto lower A-arm, coil spring and trailing arm, but has a Blakely-built upper A-arm.



just mattes of glass fiber bonded with resin. It's actually made with a foamcore sandwich using a patented Klegecell process. If you're up on your hi-tech racing hardware, you'll know that foamcore construction is being used in the monocoque tubs of Formula 1 race cars. Race-car designers use it because it's light and extremely rigid.

The Blakely body comes with the doors already hung and the lock mechanism, windshield, trunk lid and hood in place. Body preparation requires only the drilling of holes for the gearshift, dash, heater core, headlights and a few other holes for electrical components. The body, in fact, is remarkably complete. It's already painted with gel coat, a process which bonds the paint to the body while it's still in the mold.

#### A suitable wreck

The first step in building this kit is finding a decent wreck. Ideally it should have a bad body and excel-

lent mechanicals. This is not the easiest thing to find, but not impossible. It took about a month of diligent searching to find one. Prices ranged from \$300, for a Pinto that was only good for a paperweight, to \$1,200, for a late-model wreck—very clean, but too expensive. I finally focused on a 1977 Pinto with 40,000 miles on the clock and in fairly sound mechanical

condition. It had taken a high front shot in a misunderstanding at an intersection and the owner decided it wasn't worth fixing. I settled on \$600 and had it towed to a garage rented for the duration of the project.

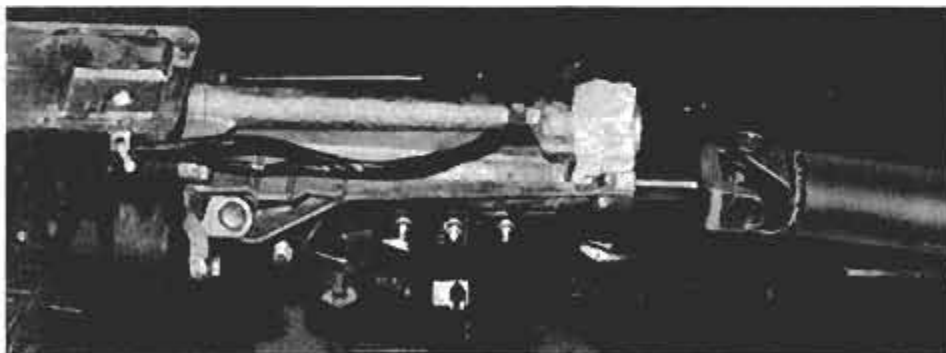
A welder was called in and we began cutting off the bent bits. During disassembly, I realized there was an awful lot that wasn't needed for the Blakely.

The front and rear glass wasn't cracked, for instance, so we took the glass off carefully and sold it to a junkyard—same thing for the doors and trunk. Body parts are always in demand, and it's a good way of recouping some of the original expense.

If you're thinking of doing up a kit car, I'd recommend you buy the whole wreck and take it apart yourself. Not only will you be able to salvage and sell what you don't need, but you'll become intimately acquainted with what you will need.

When you disassemble the Pinto,

*(Please turn to page 178)*



Gearshift lever is removed for modification and the hole must be taped up to prevent dirt from contaminating the works. The modified driveshaft is being installed loosely in the tailpiece of the gearbox prior to final bolt-tightening and balancing.



# New kits for outdoor action

**Y**ou save money, of course, but kit building or sewing also provides a chance to customize items to fit your own taste and requirements, and assure you of the best in careful workmanship. Usually a kit can save you up to 50 percent over the purchase price for a completed article. That's because you don't count your time. Add in the satisfaction of finishing off a product yourself and the extra work becomes worthwhile.

Outdoor gear, particularly, must be rugged and is often expensive. But now kit suppliers are offering the latest in new materials—Thinsulate, PolarGuard, Hollofil, Klimate, Velcro, Gore-Tex, Cordura and

Taslan—for garments, tents and luggage that often cannot be found in local stores.

Early Warning fabric using 3M's Scotch-lite Reflective Finish can be made up into jogging clothes, bike gear and youngsters' parkas and book bags for a valuable safety feature.

Best known clothing-kit supplier is probably Frostline in Denver, with retail stores around the country. Country Ways, 3500 Highway 101 S., Minnetonka, Minn. 55343, stocks clothing plus snowshoes and furniture, loom kits, musical instruments to make, skate sails, camping gear, and boats to 25 feet.



## Customize an air rifle

Called the world's first air rifle kit, the \$80 Beeman/Norica Model 61 from Beeman Precision Air Guns, 47 Paul Dr., San Rafael, Calif., has unfinished stock.



## Speed at sea

For half the price of some completed models, Heathkit now has a speedometer/log for sailboats (\$148) and powerboats (\$138) that reads out speed and nautical miles traveled.

## Traveler kit switches from handbag to backpack



Made of waterproof Cordura nylon, the Traveler Kit, when completed, zips open on three sides and has a rear pocket large enough to hold a tennis racket. A small side pocket can hold tickets. A leather grip encloses hand straps that adjust for backpacking. Kit is \$22, from Frostline.



## Thinsulate parka

Also from Frostline, at Frostline Circle, Denver, Colo., the parka is insulated with new, low-bulk Thinsulate, comes in blue, tan and rust in men's and women's sizes: \$59. Warmth retention allows slim cut.

## Boats that push the air



Plans for a single-seater airboat with kit parts for the power are \$10 from Rocky Mountain Airboats, Box 513, Morgan, Utah, for the HydroRat model at left. You can get most construction materials from a local lumberyard; Rocky Mountain supplies an 8-hp Briggs & Stratton or 10-hp Tecumseh. Propellers and hubs are also available for speeds over 20 mph. A two-seater airboat that claims from 30 to 40 mph is produced as a kit by Sports Craft, Box 6979, Moore, Okla. for \$1,995 plus about \$100 shipping. Power is from a Volkswagen engine with hubs and propeller from Sports Craft.



# Outboards '82-



Evinrude's and Johnson's V8 racing machines with 3.5 liter (214-cu. in.) displacement will be making their debuts in speedboat races in Europe.



The largest standard engine in Mercury's 1982 line, the Merc 200, and other models are now rated for prop-shaft horsepower.



Compact, but big enough to plane a bass boat, the Mercury 18 is one of the small, economical engines that are newly popular.

World's biggest ever teams up with 1982's minimotors.

by Bill McKeown  
BOATING EDITOR

**E**vinrude and Johnson have finally lifted the wraps from the biggest outboard ever. Their parent company, Outboard Marine, has unleashed a 300-plus horsepower motor—the world's largest. Initially for

the racing circuit, it will lead the way to a production model for mounting on any hull that can handle it.

This new muscle mill, as revealed in PM (See *All Outdoors*, page 62,



# a monster joins the midgets



Especially useful for windjammers and inflatables are two new Johnson Sailmaster models in 7.5 and 4 hp. Long, 20-inch shafts make them easy to mount on high sailboat transom brackets. Three-blade aluminum props give strong thrust. Evinrude calls them Yachtwins.

Aug. '81), has a V-design that uses displacement of 3503 cc to turn out nearly 400 hp — OMC still will not say how many. But it has seven more displacement inches than Mercury's 300-hp development engine, the previous power leader. Tuned for the showdown tests of racing, the new V8 is reported to use very high rpm, and will be turned loose initially at European racing events.

When will a production model be available? It's hard to say; one requirement is the development of

*(Please turn to page 203)*



Chrysler added new muscular 125-hp model; 3.5-, 25- and 50-hp engines also join line.

For skiing, the Johnson 75 has high torque. Also new are 25, 40, 55 Workhorse models.





Here are accurate reproductions of fine antiques—the "pillow" table (above) and the jardiniere stand (right)—now becoming popular again. Full building plans and how-to photos are on following pages.



## 2 turn-of-the-century plant stands you can build

PM's craftsmen show how to turn out oak tables.

by Ralph Wilkes  
and Harry Wicks

**P**lant stands were particularly popular around the turn of the century and earlier, reaching a peak during the early 20th century. Then, interest in such pieces of furniture waned for several decades.

Now, decorators and designers have once again discovered the joy of these charming tables. On these pages we present accurate reproductions of two of them. Both originals were discovered in antique shops.



## Jardiniere stand

This plant stand or taboret is a reproduction of an item which was popular more than 80 years ago. The dictionary defines a taboret as a stool or a small seat, and it can be used as that. But it is most commonly used as a plant stand. Books about antique furniture sometimes refer to it as a jardiniere stand.

It is most often made of oak or mahogany, but occasionally of other kinds of wood. With the right power tools for the job, you can build one in a surprisingly short time. Based on our experience, we rate this one as a two-evening project.

At the local lumberyard, try to select a kiln-dried oak board 7 in. wide. You may have to buy 8-in.-wide stock. A 1-in. x 7-in. x 12-ft. board (actually about 3/4-in. thick) will do the entire job.

For easy handling, cut your board in two pieces long enough to incorporate three, 17-in. side units each. This means 51 in. plus allowance for the saw cuts (kerfs). Tilt the blade to a 60° angle and rip both edges so the outer surface will be exactly 6 in. wide. It's safest to rip one edge at the 60° angle, then make a very short cut in the end on the other edge and measure it before proceeding; remember that it is much easier to take off a little more than to try to put it back in case of error.

After ripping, cut the sides to 17-in. lengths; then lay out and saw the curved design in one of the pieces using a band saw or sabre saw.

Sand all the edges smooth. You can do this by hand, but a drum

### MATERIALS LIST—JARDINIERE STAND

| Key | No. | Size and description (use)                                      |
|-----|-----|---|
| A   | 1   | 1 3/8 x 14 x 16" oak (top: two 7" pieces edge-joined and glued) |
| B   | 6   | 1 3/8 x 6 x 17" oak (leg)                                       |
| C   | 2   | 1 3/8 x 3/4 x 5" oak (cleats)                                   |
| D   | 8   | 1 1/4" No. 10 rh screws   |
| E   | 12  | 3/8" corrugated fasteners                                       |

Misc.: see below.

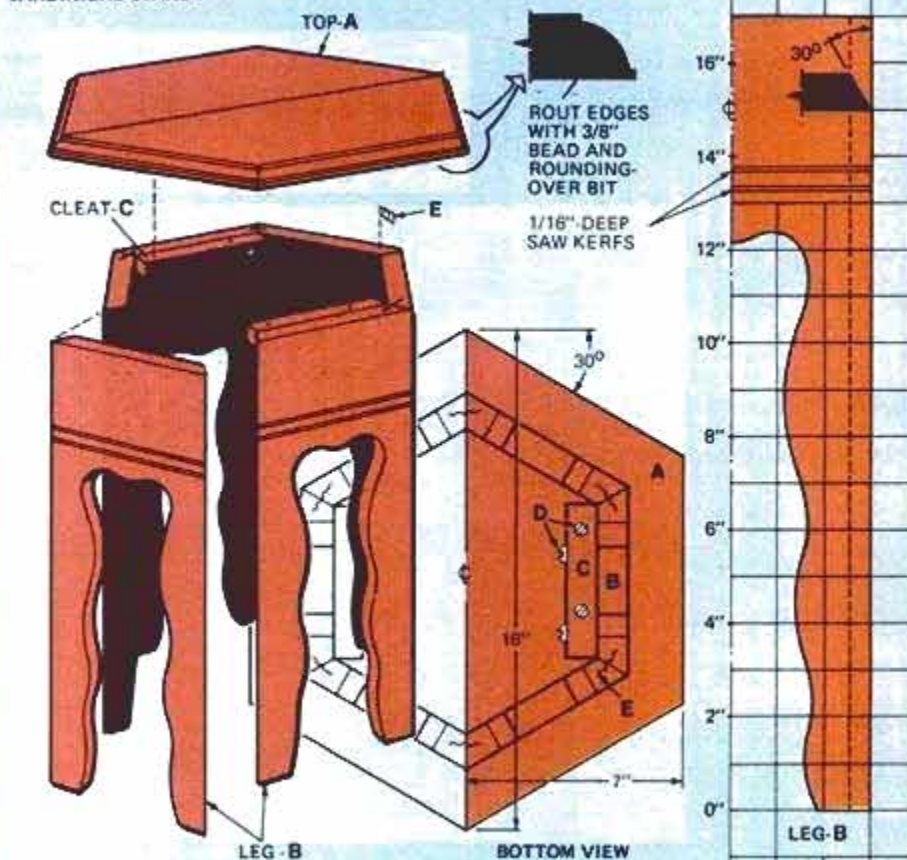
### MATERIALS LIST—PILLOW TABLE

| Key | No. | Size and description (use)  |
|-----|-----|---|
| A   | 1   | 1 3/8 x 14 x 14" oak (top: three 5" pieces edge-joined and glued) |
| B   | 4   | 1 3/8 x 2 1/2 x 10 1/2" oak (skirt)                               |
| C   | 4   | 1 3/8 x 2 3/4 x 17 1/4" oak (leg)                                 |
| D   | 4   | 1 3/8 x 1 1/2 x 3 1/2" oak (corner block)                         |
| E   |     | 3/8 x 1 1/2" dowels (as required)                                 |
| F   | 4   | 5/16 x 3 1/4" hanger bolt, flat washer, wingnut                   |
| G   | 8   | 1 3/4" No. 10 rh screws   |

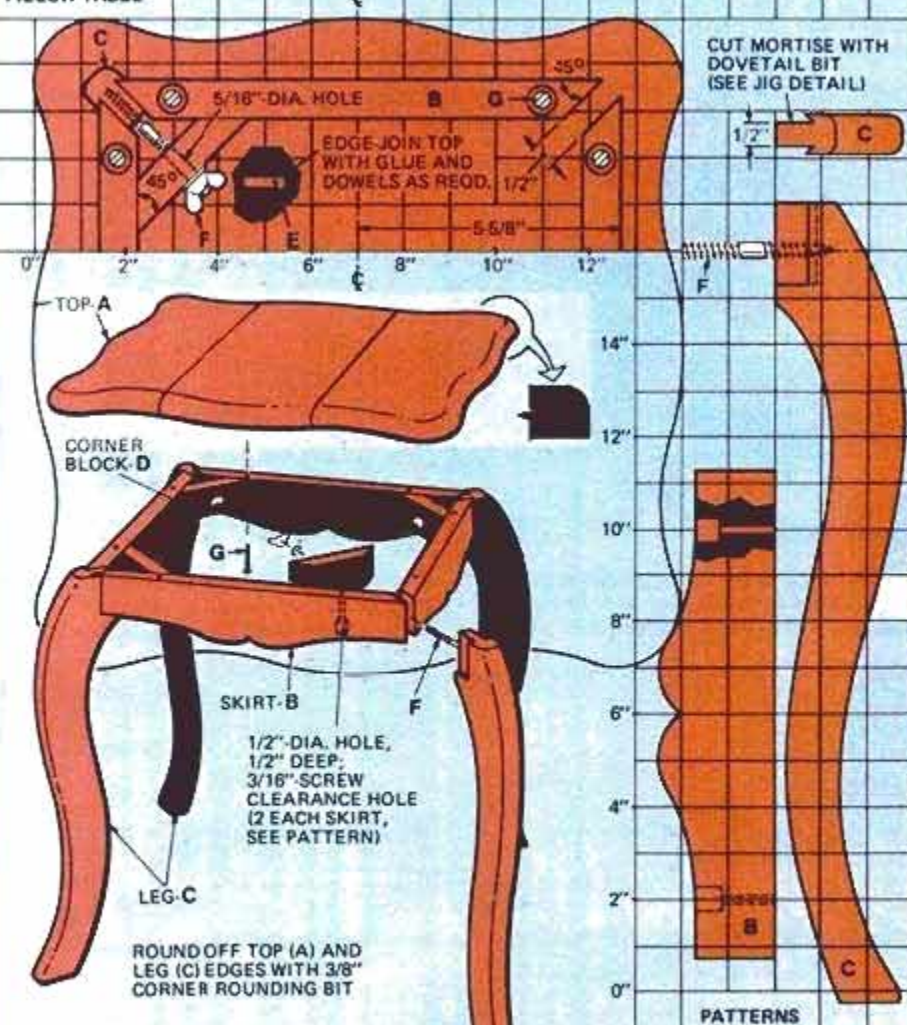
Misc.: glue, sandpaper, wood stain, paste wood filler, polyurethane varnish (3/4 x 16 x 16" scrap plywood for pillow table only).

Jardiniere table construction, color photos: Ralph Wilkes  
Pillow table construction and color photo: Harry Wicks  
Black and white photos: Rosario Capotosto, Harry Wicks  
Technical art: Eugene Thompson

## JARDINIERE STAND



## PILLOW TABLE





## BUILDING THE JARDINIERE STAND



**1** For the 17-in.-high sides, cut board in multiples of this figure plus an allowance for crosscutting to size. Then rip stock on both edges with blade set at a 60° angle. Keep board tight to fence while ripping.



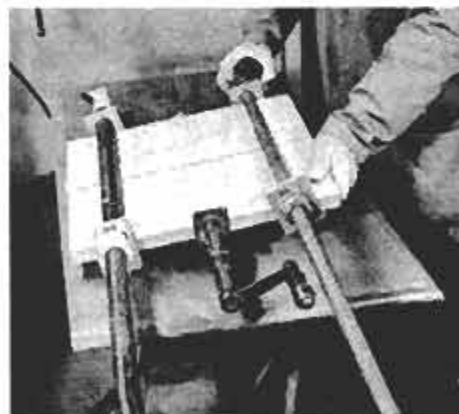
**2** Transfer the design to one of the side pieces and cut to shape with band- or sabre saw. After sanding, piece may be used to trace the pattern for other five sides.



**3** Some of the antique stands have 1/4-in.-deep parallel cuts all the way around. This is an optional decorative feature.



**7** Apply a "tourniquet" in the form of a flat strap around the mid-portion of the legs; tighten and set aside until dry. Better yet, use a web clamp if one is available.

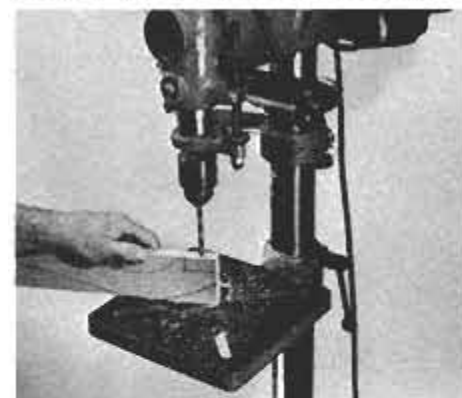


**8** Edge-glide and clamp stock for the top. Make sure surface is flat, then let dry.

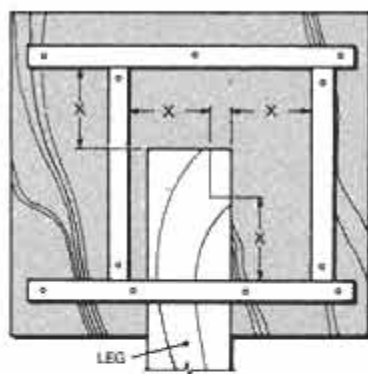
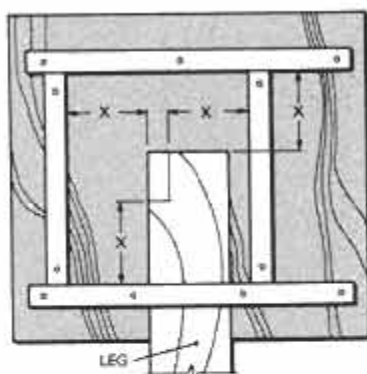


**9** Attach a block to the inside of two opposing legs for screws to secure top.

## BUILDING THE 'PILLOW' TABLE



**1** Start by tracing the leg outline onto leg stock. Carefully lay out the hanger-bolt location and bore hole using drill press.



**2** Make a jig such as this to cut mortises accurately on both sides of the legs to receive the aprons. On my router, X was 2 1/4 in. but this will vary depending on make of tool. Note that guide strips must be moved before mortising other side of leg.



**4** Guide strips are relocated so mortises on the legs' second sides can be made.



**5** Use a razor-sharp chisel to clean the round corners left in mortises by router bit.



**6** Also use chisel to remove tool marks, if present and to ensure good glue-surface contact between the mating pieces.





4, 5 It will be much easier if you sand all surfaces at this stage, i.e., before assembling. Curved surfaces can be sanded by hand, but a 1½-in.-dia. drum sander chucked in the drill press (or a portable drill) can save you a considerable amount of time and energy.

6 Check angles by fitting all six pieces together. Any slight correction may be made with a plane or on a jointer. Apply a thin coat of glue to the first edges to be joined and drive in fasteners at the top and bottom. Continue around the assembly.



sander on the drill press or in a portable electric drill is easier and saves time. This piece is then used to lay out the remaining five sides.

Next, decide whether you want to add the ¼-in.-deep saw cuts on the sides. This is an optional trim item that was quite commonly used on the original stands.

After the sides have been sawed and sanded, you are ready to assemble the base. Try the pieces to check the angle cuts. If they fit perfectly, apply glue to the edges to be joined on the first pair, press together and drive a ¼-in. corrugated fastener in each end. You may find it necessary to bend the fastener slightly to conform to the broad-V-shape of the joint to prevent splitting. (This technique spares you difficult clamping, and the fasteners in the end grain won't split the oak.)

Proceed the same way with the other base sections. As soon as all pieces are joined, apply a web clamp or tighten a rope or web tourniquet around the mid-portion of the base and leave it until the glue has dried.

Attach blocks on opposite insides at the upper edge to hold the wood screws which secure the top. You may find it easier to attach these to two of the sides before assembling the base.

The top is made of two pieces of 7-in.-wide stock, edge-glued and cut to hexagonal shape as shown. Decide which will be the upper surface and sand until smooth. (We assembled the stand with the decorative edge down because it is more traditional. If you prefer, place it up, as we have shown in plans.) To shape the edge, use a router with a ¼-in. bead and rounding-over bit. If you don't have a router, you may plane a ¼-in. chamfer around the edge.

Attach the top with four wood screws. Do your final sanding by hand, using fine sandpaper on a

block to remove any sharp edges on the six corners of the base.

Treat the wood with an oak stain that will harmonize with your other furnishings. We used Minwax golden oak stain. Follow this with two or three coats of polyurethane satin finish, sanding it lightly and dusting with a tack cloth between coats.

For a probable cost of \$20 or less, you now have a plant stand identical (except for years) to an antique listing at \$60 or more.

### The 'pillow' table

The original plant stand, like this copy, is of oak. It was found at an antiques fair on Long Island, and given its name by the dealer. "Because of its soft, shaped edges," she said, "such stands are customarily referred to as pillow tables." She added that shaping these edges was "particularly difficult and that is what makes this little table so valuable."

Shaping those edges may be difficult for many, but it won't be for PM readers. We figured out a method that works superbly, using only tools found in a typical woodworker's workshop.

The original table is valued in the \$50 range. You can make it for about \$15.

The table has surprising stability considering the fact that it has no stretchers. On the original the corner braces were dovetailed and let into mortises in the apron backs. This construction does add stability. We used this method on the first prototype we built in the PM shop. However, we reasoned that construction would be far simpler if we eliminated the dovetail joints and used glue to assemble the piece permanently. (The original can be taken apart—thus, the need for dovetails.)

Start by gluing the boards together for the top using dowels, glue and

10 Apply stain of your choice; follow this with a polyurethane satin-finish varnish.



3 Here, jig is set for making mortises on left side of legs (as you face leg). A dovetail bit is used to create the beveled edge, so you must start with a plunge cut in the center of the area to be routed.



7 Cut legs to shape using the band saw; blade should be on waste side of the line.

(Please turn to page 180)



# 11 chain-saw maintenance tips

Lumberjack Dave Geer, a perennial chain-saw contest winner, shows how he keeps his chain saw humming.

**K**eeping chain saws running properly is a growing concern of many homeowners who are turning to wood as an alternative source of heat. What better person to turn to for chain-saw tips than a professional lumberjack. So, PM asked Dave Geer, a consistent chain-saw cutting champ, to share his tips for keeping a chain saw in tiptop shape.

Often featured on network television programs, the 56-year-old Geer is probably one of the best known lumberjacks today. A regular competitor in Homelite's Tournament of Kings world saw-cutting championship held in Charlotte, N.C., each year, he is presently staging Dave Geer Lumberjack Shows across the country.

In Dave's opinion, the three most important rules to follow when getting ready to use a chain saw are: 1. read the homeowner's manual and the manufacturer's instructions; 2.



Wearing safety glasses, using a firm grip and ideal posture, lumberman Dave Geer zips through a 12-in.-diameter hardwood log.



**1** Reading the instruction manual is one of the three most important rules to follow in chain-saw use and maintenance. Safety hints are included in the manual.



**2** Remove the two hex nuts from mounting studs and remove drive-case cover. Check this area regularly to make sure all nuts are tight and parts are kept clean.

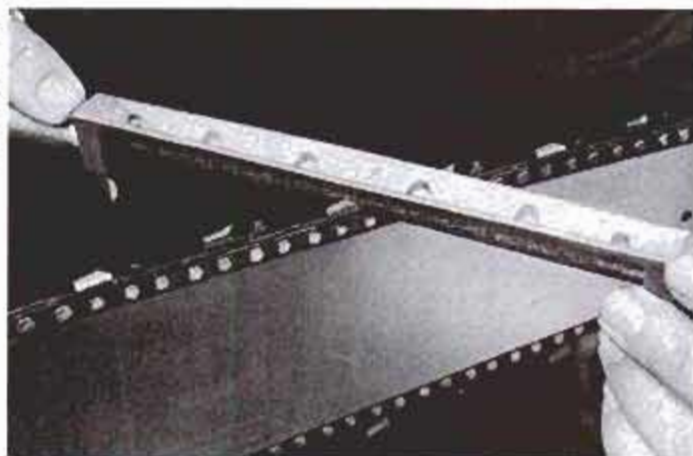


**3** When assembling your saw after a storage period, see that chain-drive tangs are set properly in guide-bar grooves. Work from sprocket to nose.



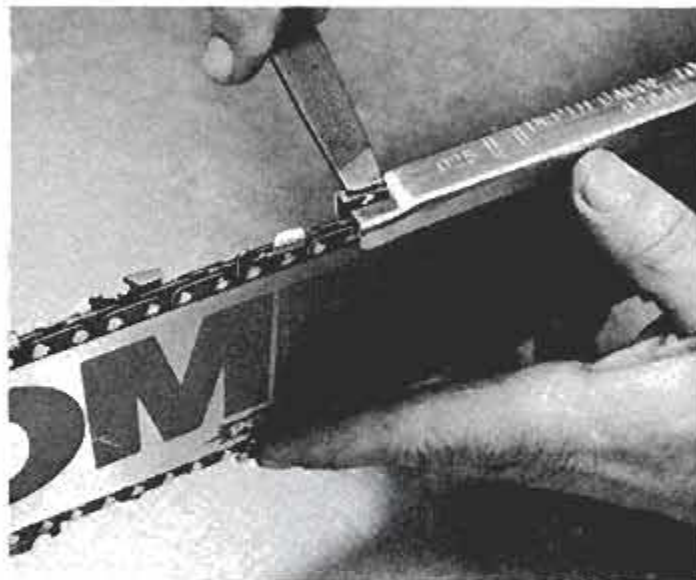
**4** Dave lifts the chain with right hand to check tension. Tension screw is then adjusted with a screwdriver. Tension should be adjusted before each use.

**5** Use a file holder to maintain a 35° filing angle when filing saw teeth. Holder also keeps file at correct height. Keep file level and stroke in one direction only.

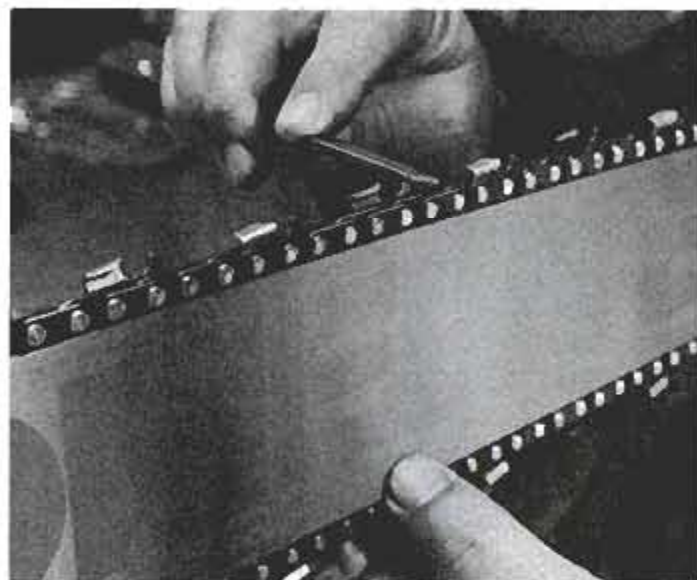




# from a master sawyer



**6** Use a depth-gauge jointer to true up chain's depth gauge (rakers). Fit the jointer over the chain with slot toward the bar nose (not shown) and then file rakers flush.



**7** Viewing guide bar and chain in Photo 6 from the other side, the front side of raker is then rounded over for a good sliding action. Mount the chain with the raker in front.

tighten all screws and bolts; 3. make sure the chain is properly filed.

In Photo 3, the correct procedure for mounting the chain is demonstrated. Saw owners must learn the technique when assembling a new saw for the first time. It's a good idea, however, to disassemble chain and guide bar when transporting the saw over long distances, or before storing, so it is a technique to remember. After the guide bar is mounted, straighten out any kinks in the chain and lay it out in a loop. Then, feed the chain into the grooves, as shown.

A good instruction booklet contains the information necessary to understand saw chain tension adjustment, as shown in Photo 4. Chains become warm or even hot when they are used, and you have to take this into account when tension adjustments are made.

Keeping your chain in good cutting condition makes sawing easier and safer, while prolonging the life of the saw. Photo 5 shows the first step in the sharpening process.

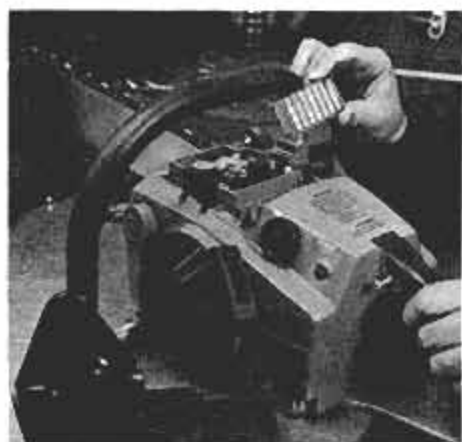
The raker, shown in Photos 6 and 7, controls the depth of the cut and acts like a runner guide for the cutting edge.

If you find a dirty air filter when checking the power head (Photo 9), tap the loose dirt free and then rinse out finer dirt with a nonoily petroleum solvent.

Finally, like all professionals, Dave cautions everyone to practice chain-saw safety rules. Always maintain good balance and never work when you are tired. **FM**



**8** Pull starter rope to check for proper recoil-spring action. Spring adjusts easily if necessary. Keep the air intake louvers clean around the starter.



**9** Start power-head maintenance with a check of the air filter. Make sure filter and area around carburetor are clean. Seat filter properly after cleaning.



**10** Screwdriver points to an area near combustion cylinder where carbon accumulation may occur. Remove muffler to expose area and clean away carbon.



**11** Check the sparkplug first when starting troubles occur, as a fouled plug is usually the cause. Clean plug by brushing, scraping, or sandblasting.



# Coal makes a comeback

Modern burners are designed to get best results from abundant coal. Here's what you should know about them, plus a bonus: plans for a back-yard coal bin.

by Conrad M. Stowers  
ASSISTANT HOME AND SHOP EDITOR

**M**ore than 300,000 coal stoves were sold last year, according to the Department of Energy. Coal distributors were swamped with orders from eager homeowners.

Assisting the central heating system with a space heater can save lots of money. Highly efficient coal is a natural choice of fuels for this purpose.

Bituminous and anthracite are the two major kinds of coal. Anthracite, in the size of "pea" or "nut," is the coal used in most space heaters and new home furnaces. It is celebrated for its high efficiency, low sulfur content and production of little ash and practically no smoke. Because anthracite is harder than bituminous coal, it is also relatively clean to handle. It was the soft, crumbly, bituminous coal used in home furnaces in the '40s (now largely used in industry) that gave coal its "dirty" reputation.

## Availability of coal

One of coal's most attractive features is the amount buried under our feet, rather than in the sands of some Arabian desert. Industrial engineers estimate that the nation's coal reserves are so abundant they will last for centuries, regardless of any marked increase in demand.

It is comforting to know that the fuel is domestically abundant, but the question of cost and economy is nevertheless complicated.

Coal is both mined and transported by labor-intensive industries. This means that supply and price can be affected by strikes and the state of the nation's economy.

Also, 90 percent of all anthracite



Emptying ash pan assures efficiency. Coal requires more attention than gas or liquid fuels, but less than wood. The model shown is Surdiac No. 508 from Classic Stove Works.

coal is located in a small area of northeastern Pennsylvania. Therefore, transportation costs are an important factor for this kind of coal.

One expert we contacted suggested this rule of thumb: Given the present price and wage structure in the industry, if you are located more than 700 miles from the mine, one of the other fuels is probably a better deal for your fuel dollar. (For a more thorough look at the economy of fuels, see *Which Fuel is Best For You?*, page 75, Nov. '80. If you're thinking about changing fuels, check on coal in the fuel comparison chart, found in *Five Ways to Put Heat Where You Want It*, page 122, Sept. '81.)

## How anthracite burns

Called "coking," burning coal actually becomes liquefied as it gives up its volatile compounds in the combustion process. The combustion

area may be very small, but the heat is intense, reaching temperatures in excess of 2,200°F.

Coal requires its primary source of air (80 percent) to come up through the bed from below, while the other 20 percent must come in over the top of the fire. As it burns, it produces a very fine ash which remains in the combustion area until the bed is shaken very gently to allow this ash to sift through the coals, the grate, and into the ash pan below. This is a delicate feature of coal, for improper shaking can disturb the bed so much that the flame is extinguished. In addition, if disturbed too much, ash may become mixed with the liquefying coal and form "clinkers." Clinkers look like volcanic rock and are a nuisance. They stick to grates and other stove parts and waste fuel.

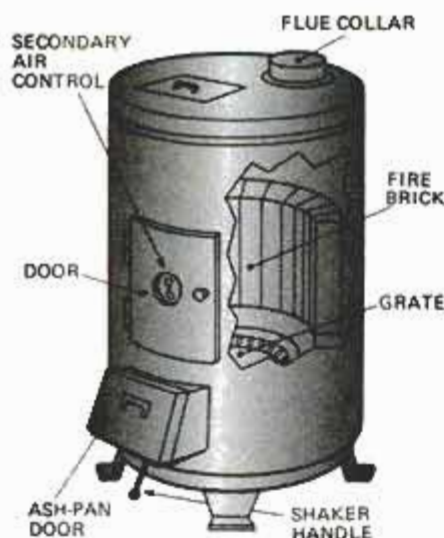
## Stove designs

Our knowledge of coking allows us to set some requirements for the

Photos: Ceramic Radiant Heat, Pleasant Dr., Rochmere, N.H. 03252; Classic Stove Works, 233 Main St., New Britain, Conn. 06051; Shenandoah Manufacturing Co. Inc., Box 839, Harrisonburg, Va. 22801; Tekton Corp., Conway, Mass. 01341.



## BASIC STOVE



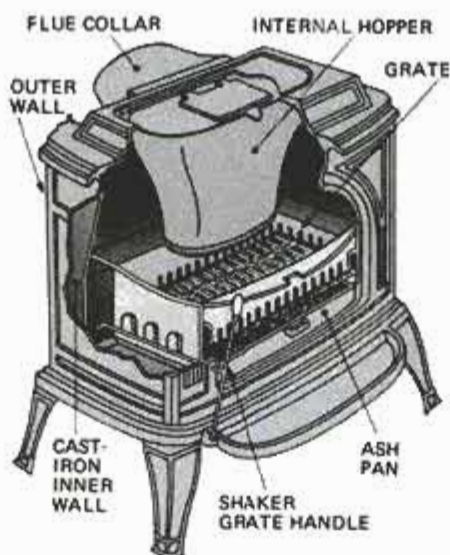
Because fuel is hand-fed directly into the fire chamber in simple coal stoves, these designs require the most attention.

well-designed stove. One essential feature is some form of baffle to help absorb and disperse the intense heat evenly in the immediate area of combustion. Most stove manufacturers insist this requirement is best met by a fire-chamber lining of fire-brick—very much like that used in industrial ceramic kilns. The immediate and apparent drawback is that any such stove is going to be very heavy. Some manufacturers claim that a lighter, double-wall stove with a cast-iron interior helps to do the same thing—air passing between the walls draws heat from the hot spot. In either case, the heat



This firebrick-lined stove from Shenandoah Manufacturing includes all features of basic design: Primary air control is usually built into ash-pan door. Ceramic-glass doors allow a view of the glowing coals. Depending mostly on styling of basic stoves, prices range from \$200 to \$1,000.

## INTERNAL HOPPER



Convenient internal hoppers are a popular feature in space heaters. This double-walled stove can hold a day's fuel supply.

must be drawn out efficiently or it will begin to melt the interior of the stove.

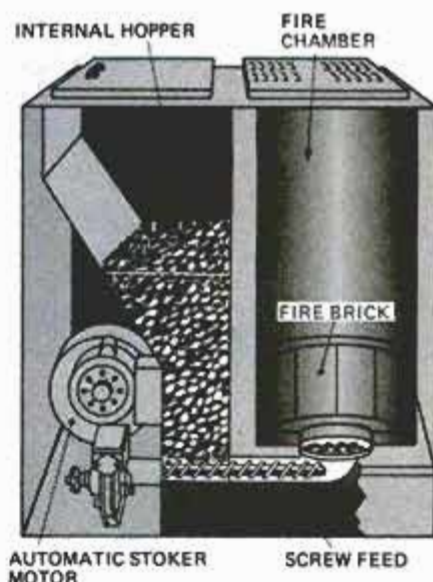
Because of the primary and secondary air requirements of coal, the grate design is also important. Usually composed of one stationary part and one movable part, it must allow for gentle shaking of the entire bed at once and be designed to support the coal, yet allow the unimpeded passage of primary air up through the bed.

Airtight construction is a must for burning coal efficiently. A well-designed stove will have controls for primary and secondary air supplies.



Internal hopper model by Ceramic Radiant Heat has ceramic face panels to distribute heat. Hoppers cost \$350 to \$1,200.

## AUTOMATIC STOKER



In the most convenient space heaters (not typical), and furnaces, an automatic screw feeds coal from hopper to fire chamber.

Modern technology has produced three basic designs of coal burners, which are shown in the drawings above.

Basic stoves come in a multitude of sizes and shapes. Depending on decorative features, prices can vary widely. The main drawback of the simple stove is that it must be stoked regularly.

For convenience, the most popular coal stove has an internal hopper (middle drawing) which can allow up to 1½ days' supply of coal to be fed to the stove at a time. Most internal hoppers work on a gravity-feed prin-

*(Please turn to page 190)*



In appearance, Tekton's furnace-boiler is typical of larger coal burners, whether fed by hand (as this) or fed automatically. Versatility of coal furnaces produces a wide price range: \$350 to \$3,000.



# Put in a coal stove and lower your thermostat

Installing a stove properly with a fireproof wall surround ensures safety and efficiency.

by Rosario Capotosto and Robert Wicks

**A**s coal continues to become a more attractive fuel for homeowners, particularly as an auxiliary source of heat for those wanting to lower their thermostats, we've put together a step-by-step plan for doing your own installation of a coal stove. We wanted more heat in a room with no existing flue, so we show how to install both flue and chimney right up through the ceiling and on top of the roof.

Fire-shield protection is required for combustible walls and floors in the immediate area of a coal stove. So we also show how to install Kem-Stone's noncombustible wall panels. Local building codes may be very specific on the kind of fire shields required, as well as procedures for installing flues. Be sure to check into this



Cut the carpet with a mat knife, using the floor panel as a template. Abut floor panel against temporarily placed wall panels.



After carpeting is removed, wall panels are placed in intended final position and holes are bored through for toggle bolts.

Tilt the panels back. Push the toggle bolts through lower holes first and engage wings on the other side. Work from bottom up, aiming the wings into the wall holes as panel is being moved back against the wall. Procedure is easier with two people working together, but one can do job.



Measure from panel to nearest point on the stove to position stove for minimum clearance allowed by your local building code.



After stove is positioned, use a plumb bob, as shown, to mark stovepipe center on ceiling. It's best to have a partner watch plumb bob while you move other end of string toward center position. Hold string in your hand and allow it to pass up and over your thumbnail. Use your thumb to point the way.



Cut a 14½-in. square out of the ceiling with a sabre saw. Bore a pilot hole in one corner of square to insert saw blade.



along with other requirements for installing coal stoves. The stove shown is made by All Nighter Stove Works Inc., Glastonbury, Conn.

Once you have decided on the general area in which you want to place the stove, make a preliminary check of the attic and roof to be sure you won't encounter any major architectural obstructions when installing the flue and chimney.

Prepare the wall area by removing any sections of baseboard moldings. If the floor has carpeting, put the wall panels in place, then butt the floor panel up to them. Use a sharp utility knife to cut through the carpeting and backup pad, using the edge of the panel as a cutting guide. Remove the carpeting so all panels will rest directly on the floor.

After removing the carpet, place the wall panels back in position. If the floor is uneven, true the panels with shims. Don't worry about the appearance of the shims as they will be concealed by the floor panel.

Bore pilot holes for toggle bolts through the wall panels and into the walls. Counterbore the holes in the panels to recess the bolt heads. Remove the panels and enlarge the holes in the walls to permit insertion of the toggle wings. Move the panels back into position. Tilt back and engage the lower toggles first, then the upper ones. Secure the toggles, then conceal the bolt heads with the special colored filling compound supplied with the panels. Now, replace the floor panel.

Move the stove into place and measure with a rule from the wall panel to the nearest point on the stove to obtain the minimum clearance prescribed by local code. Coal stoves are heavy, so it's best to remove doors and any other loose

components to reduce the weight for easier handling.

When the stove is in position, use a plumb bob to mark the stovepipe center on the ceiling. Then mark the position of the stove on the floor panel and move both stove and floor panel out of your way while cutting through the ceiling to install the flue. Around the center mark on the ceiling, draw a 14½-in.-square outline for the chimney support-box cutout. Before sawing, bore a hole through the center mark with an awl. Insert a stick through the hole to mark the location. Go to the attic and check carefully to be certain that the area of the cutout is clear of any electrical wires or other minor obstructions. Then bore a hole in one

*(Please turn to page 202)*

Coal stove (Pudgy Glo, Model 16-601C, \$543); All Nighter Stove Works Inc., 80 Commerce St., Glastonbury, Conn. 06033  
Fire shield panels (floor, Model KBC54R, \$95.95; walls, Model KB4848R, \$76.95); KernStone Mats Inc., 420 Quincy Ave., Shenandoah, Va. 22649  
PM photos: Rosario Capotosto



Place chimney support box in position from below and secure by nailing through joists, or headers, if necessary, in the attic.



Section of telescopic stovepipe has been placed in the chimney support box. This section allows for final flue adjustment, made by pulling down the lower section.

The floor panel and stove have been moved into final position and the flue pipe has been stacked to within 10 in. of the ceiling. Telescopic section is now pulled down to connect with the flue and complete interior installation.



Metal chimney sections are available with triple-walled construction. Air spaces between pipe walls act as insulation.



Cut a hole through the roof for the chimney with a sabre saw. Use the same method for determining center point on the interior side of the roof as used on the ceiling. Bore a hole through center point.



Gently lift roof shingles on upper side and slip the chimney flashing under shingles, as shown. Do not damage other shingles.



Run a bead of silicone sealant along side edges of flashing after it is nailed to roof. Before nailing, sealant was applied under upper edge and both sides of flashing. Lower side is not nailed or sealed.



Apply sealant between the top perimeter of the flashing and the chimney. Collar is then lowered and more sealant is applied.



The installation is completed with the chimney cap. According to most codes, cap should be at least 24 in. above roof.



# Build PM's energy shed to store all your alternate fuels

Locked compartment stores flammables safely out of children's reach while wood storage area keeps full cord dry. Kindling and charcoal fit on the shelf.



The 5/8-in.-thick Texture 1-11 siding (above) not only gives shed an attractive appearance, but also eliminates the need for sheathing.

The large storage compartment holds a 55-gal. drum of kerosene with ample room for other containers.

This attractive shed stores kerosene, gasoline, other flammables and firewood, too—all under one roof.

**M**ost of us store flammable materials around the house, even though they constitute a very real fire hazard. Flammable products are a necessity of modern life—and the number of them we use is growing all the time.

PM designed and built a fuel storage shed that will be an attractive addition to your backyard, while protecting your family and home from the dangers



of the volatile products it stores. And, as an added bonus, there's room for a full cord of firewood.

Safety measures of this structure are twofold. First, since the building is detached, you automatically put a healthy distance between your home and any potential problem. Second, the storage compartment is constructed so that no wood parts are exposed from the inside. Instead, the interior is completely sheathed with fire-retardant dry-wall, edged with aluminum. This treatment will slow a fire burning around the compartment for up to an hour—time enough to extinguish the fire or call the fire department. Complete building plans follow.

### Constructing the frame

Prepare the site by leveling the ground, putting down a sheet of black polyethylene plastic to keep weeds from growing, and spreading marble chips or other small stones. Then cut all base members to length and nail them together with 6-in., hot-dipped galvanized nails. These nails are large, so prebore  $\frac{1}{8}$ -in.-dia. holes through the outer members to ease driving them and to avoid splitting. After leveling the base, drive in support stakes. Rest floor joists on the stake shoulders and toenail the joists into the base members (A1). Next, nail on the plywood floor.

Cut studs that require notching to length and clamp them together face to face. Square the pile so all notches will be at the same elevation, then make the kerf cuts with a radial-arm saw as shown, or use a portable circular saw set to correct depth.

Begin the wall framing—front and back walls first—by toenailing the studs into the floor and base members using 10d galvanized nails; then nail studs to the doubled-up 2x4 plates at the top. Studs vary in length depending on where they are used, so follow the drawings and materials list carefully.

Once you've framed the walls, nail all corners where they join in several places to tie the frame together. At this point, check for plumb. Our shed was plumb as framed, so bracing wasn't necessary. But if yours isn't, rack (push) the walls until they are right and install diagonal braces on the inside surface. Nail one end of each brace to the top plate and the other to the bottom of a stud. Braces must remain in place until the siding task is completed.

Because this structure is so small,



After base is assembled and leveled, nail on compartment floor using 8d galvanized nails. Use scrap stud blocks to keep plywood  $1\frac{1}{2}$  in. back from front edge.



To make  $\frac{1}{4} \times \frac{1}{8}$ -in. shelf notches, clamp compartment studs together and make several kerf cuts. It's  $4\frac{1}{8}$  in. between stud bottom and lower notch and  $5\frac{1}{8}$  in. between stud bottom and upper notch.



Frame front and back walls, then sides. Toenail stud bottoms to floor and tops through plate as shown. Blocks (A, B) give nailing surface without using whole stud.



Rafter pattern is made by tacking board to top plate end. Mark position for bird's mouth cuts, then use level to make plumb cutoff lines for ridge and rear overhang.



Use sabre saw to cut rafters. When pattern is complete, use as template for others.



Rafter is ready for nailing. Drive one nail through top of both notches, into plates.

it's easier to make your rafter pattern by marking in place. Tack an uncut 2x4 to the ends of the front and back walls so that the bottom intersects the top front corners of both front and rear plates. Then trace the outline of the plates. Mark where both ends fall (take measurements from the drawing), and use a level to locate a plumb cutoff line on both ends. Remove the pattern, cut it accurately, then use it to mark the other back rafters and the shorter ones in front. The bird's mouth cuts don't apply on the front; just the end cuts. Nail the back rafters in place; then cut the ridgeboard to length and nail it to the rafter ends. Next, nail the front rafters in place and install the gussets.

### Siding and roofing

Use a similar marking technique for the siding on the two end walls.

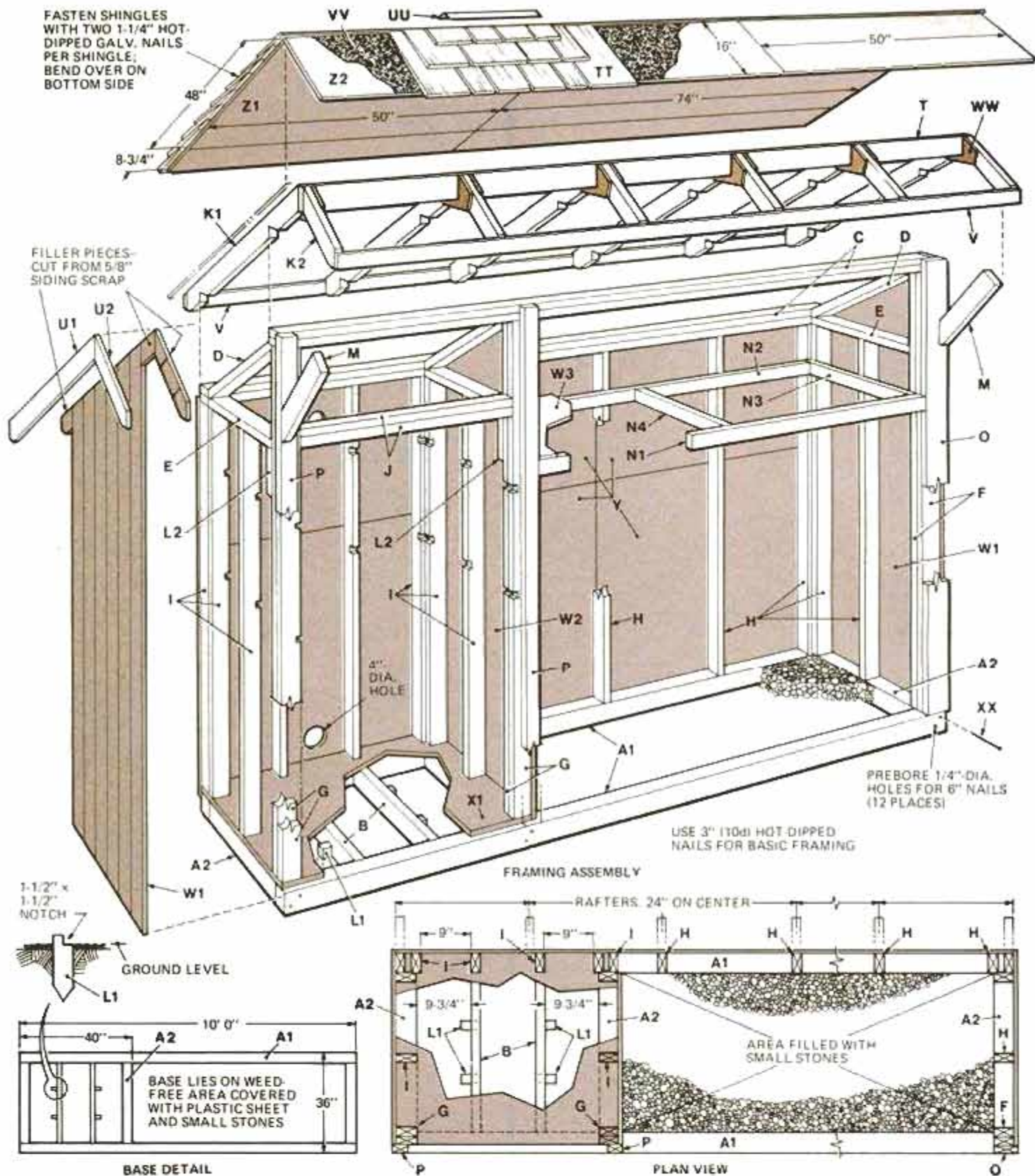
Cut the sheets to the required width, centering the grooves for neat appearance. Then rest each piece on two nails driven into the base members as shown. Mark the top while holding a sheet in place; then take it down and make the cut. Cut siding for the middle wall from measurements; cut sheathing on the back to minimize waste. To keep costs down, we used exterior-grade particle-board (made of wood chips and resins) for sheathing.

To maintain a craftsmanlike appearance, these cuts should be made using a straightedge, clamped parallel to your line, as a fence for your saw shoe.

Once the siding is nailed, cut the fascia and rake boards and nail them in place. Next apply the roof sheathing so it extends about 1 in. beyond the trim on all sides.

Using staples, install the 15-pound





felt beginning at the back bottom edge. Overlap the next back course 12 in., then add the front piece, folding the extra over the ridge onto the back.

By applying the cedar shingles as shown, you can cover the roof with two bundles. Use just two nails per shingle, regardless of width, and leave 1/4-in. space between shingles. Position nails 1/2 in. in from the edges and about 1 in. above the butt edge

of the following course. After shingling, attach the brown-colored aluminum drip edge, flattened slightly to conform to the roof contour.

Install front wall trim, door casing and furring strips above the door. Then piece the siding over the door from available scrap. With care, these butt joints won't show once the building is stained. Install furring inside the compartment in order to nail the ceiling in place.

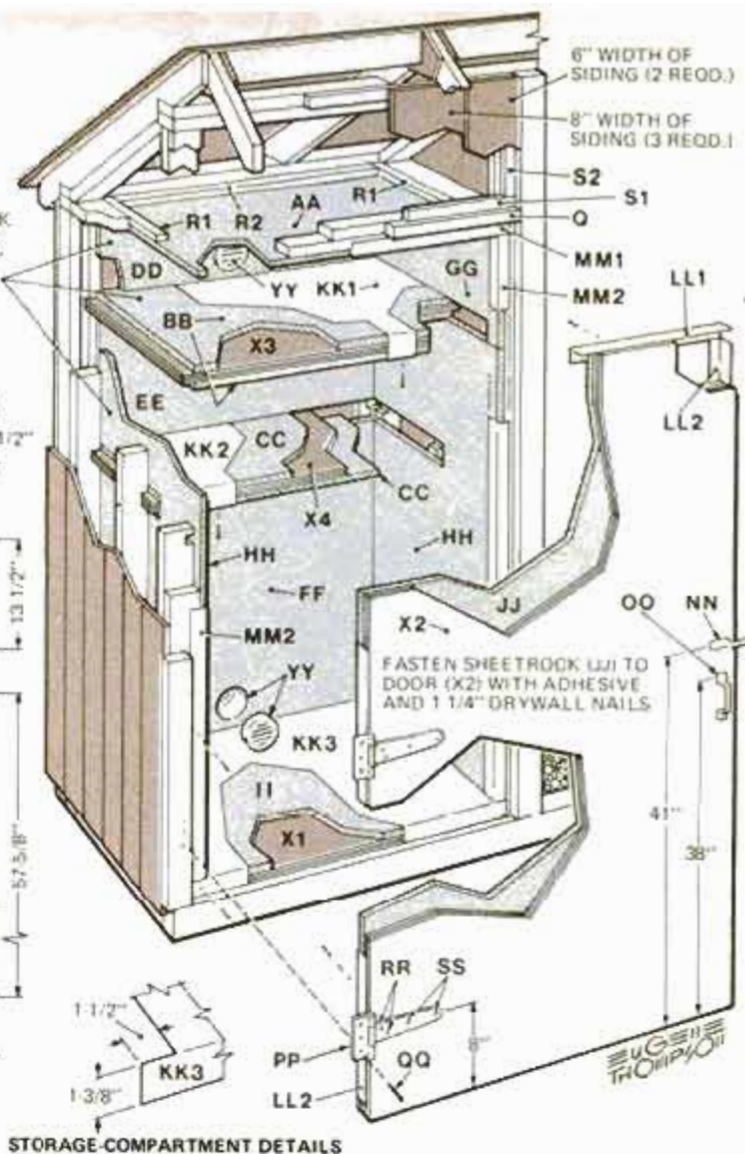
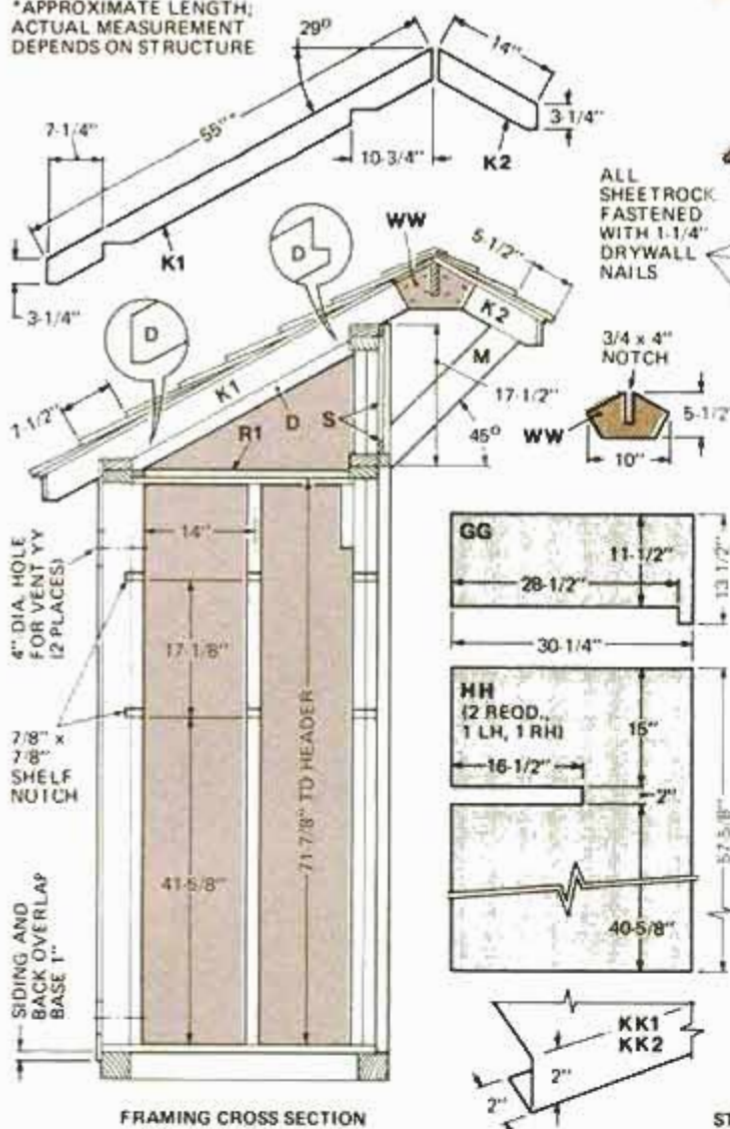
### The storage compartment

Fire-retardant drywall was used in the compartment interior to achieve slow-burn time. It is 3/8 in. thick and designed to prevent open flames from burning through the wall for about one hour.

All of the pieces can be cut with a utility knife. Simply score the board front, running the knife along a metal straightedge, and give the back a sharp blow with your hand. When



\*APPROXIMATE LENGTH;  
ACTUAL MEASUREMENT  
DEPENDS ON STRUCTURE



the board is "broken," complete the cut by slicing through from the back.

Install the ceiling first, using 1 1/4-in. drywall nails. Then cut the plywood shelves and cover them with drywall on both sides as shown. Slide these "sandwiches" into place, then install the two backpieces, sides and floor, in order.

Even though we supply dimensions for all pieces, be sure you take

actual measurements from the structure and cut drywall to match. Construction should be as tight as possible.

The door is constructed of 3/4-in.-thick, exterior-grade fir plywood, good on one side (A-D). Put the good side out, then glue and nail drywall to the inside surface. Use plenty of waterproof panel adhesive and nails spaced about 5 in. apart. Again, check the supplied dimensions

against actual measurements. Allow 1/4-in. clearance in both dimensions so the door will work properly.

Cover inside edges of the door with 1x1-in. aluminum angle. Then cut the aluminum sheet and edging for the floor, shelves and jambs as shown. Attach this with 2d aluminum nails.

Because the door is quite heavy, three 6-in. T-hinges are used. Install 1-in. wood screws in the two holes

Nail ridge board to the rafter ends, then nail front rafters into ridge, keeping peaks even. One nail angled from top will hold rafters until the gussets are applied.

Nail plywood gussets to both rafter sides with 4d galvanized nails. The two end rafters get gusset on the inside only.

To assure accuracy, mark top cutoff lines with siding in place. Use two 16d nails, driven 1 in. below base top, for support.





nearest the hinge knuckle and  $\frac{3}{16} \times 1\frac{1}{4}$ -in. bolts, with nuts and fender washers in the other two holes. If bolts were used in all four holes, the projecting nuts would strike the door jamb.

To make the kindling shelf, nail in supports, then attach shelving cut from siding scrap.

Install the vents (YY) as shown in the drawing—one just above the

floor, the other just above the upper shelf. They are made from 4-in.-dia. aluminum venting pipe—commonly used for installing clothes dryer vents—and 4-in.-dia. aluminum soffit vents. Force one soffit vent into the pipe and insert this through holes cut in the back wall sheathing and drywall. While someone holds this assembly in place, push the second soffit vent in from the other side.

If your drywall pieces fit well, there's no need for tape or joint compound. If not, apply at least one coat of compound and tape to all seams and corners, let it dry and sand smooth. If you wish, paint the inside of the compartment white like ours. Also, paint the outside of the door and roof trim white. Stain the siding and you're done. We used PPG's Rez Coppertone solid-color stain. **PM**



Cedar shingles are applied over a layer of 15-lb. felt. A  $5\frac{1}{2}$ -in. exposure to weather was used on front and  $7\frac{1}{2}$  in. on back.



Area above door is furred out with  $1 \times 2$  strips before siding is applied. Cut small siding panels from any leftover scrap.



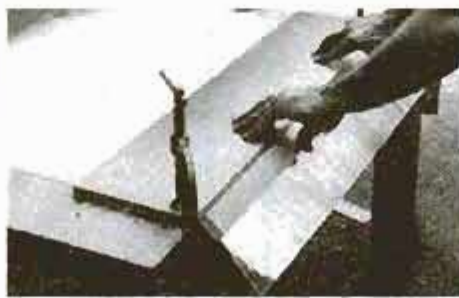
Furring is nailed to sides and back top plates to receive drywall ceiling. Bottoms of strips are at same height as door header.



With ceiling, shelf assemblies and back walls installed, cut upper sides to fit. Small tail in front covers notch in front studs.



Aluminum sheet is easily cut with a utility knife in a couple of passes. Clamp a metal straightedge in place for use as a guide.



Make right-angle bends by clamping aluminum between straightedge and work surface. Use second straight board to push.



Cut ears of floor sheet as shown in drawing. Install with aluminum nails driven through front edge and into plywood floor behind.



View shows completed metal-edging job. Fender washers and hinge bolts on door will clear jamb when door is closed.

## MATERIALS LIST—FUEL-STORAGE SHED

| Key | No. | Size and description (use)   |
|-----|-----|--|
| A1  | 2   | $3\frac{1}{2} \times 3\frac{1}{2} \times 120'$ Woimanzized lumber (base)                                       |
| A2  | 3   | $3\frac{1}{2} \times 3\frac{1}{2} \times 29'$ Woimanzized lumber (base)  |
| B   | 2   | $1\frac{1}{2} \times 3\frac{1}{2} \times 29'$ fir (floor joist)  |
| C   | 4   | $1\frac{1}{2} \times 3\frac{1}{2} \times 120'$ fir (plate)   |
| D   | 3   | $1\frac{1}{2} \times 3\frac{1}{2} \times 36'$ fir (plate-trim to fit)  |
| E   | 3   | $1\frac{1}{2} \times 3\frac{1}{2} \times 28'$ fir (plate)  |
| F   | 2   | $1\frac{1}{2} \times 3\frac{1}{2} \times 88\frac{3}{4}''$ fir (stud)   |
| G   | 4   | $1\frac{1}{2} \times 3\frac{1}{2} \times 88''$ fir (stud)  |
| H   | 7   | $1\frac{1}{2} \times 3\frac{1}{2} \times 72''$ fir (stud)  |
| I   | 10  | $1\frac{1}{2} \times 3\frac{1}{2} \times 71\frac{1}{4}''$ fir (stud)   |
| J   | 2   | $1\frac{1}{2} \times 3\frac{1}{2} \times 33''$ fir (header)  |
| K1  | 6   | $1\frac{1}{2} \times 3\frac{1}{2} \times 60''$ fir (rafter-trim to fit)  |
| K2  | 6   | $1\frac{1}{2} \times 3\frac{1}{2} \times 18''$ fir (rafter-trim to fit)  |
| L1  | 4   | $1\frac{1}{2} \times 3\frac{1}{2} \times 12'$ fir (shouldered stake)   |
| L2  | 2   | $1\frac{1}{2} \times 3\frac{1}{2} \times 8''$ fir (nailer)   |
| M   | 2   | $1\frac{1}{2} \times 3\frac{1}{2} \times 24''$ fir (brace-trim to fit)   |
| N1  | 1   | $1\frac{1}{2} \times 3\frac{1}{2} \times 76''$ fir (front shelf support)                                       |
| N2  | 1   | $1\frac{1}{2} \times 3\frac{1}{2} \times 73''$ fir (rear shelf support)  |
| N3  | 2   | $1\frac{1}{2} \times 3\frac{1}{2} \times 31''$ fir (end shelf support)   |
| N4  | 1   | $1\frac{1}{2} \times 3\frac{1}{2} \times 29\frac{1}{2}''$ fir (center shelf support)                           |
| O   | 1   | $1\frac{1}{2} \times 4\frac{1}{2} \times 91\frac{3}{4}''$ fir (front wall trim)                                |
| P   | 2   | $1\frac{1}{2} \times 2\frac{1}{2} \times 91\frac{3}{4}''$ fir (door casing)                                    |
| Q   | 1   | $1\frac{1}{2} \times 1\frac{1}{2} \times 36\frac{1}{4}''$ fir (door casing)                                    |
| R1  | 2   | $\frac{3}{4} \times 1\frac{1}{2} \times 27\frac{1}{2}''$ fir (ceiling cleat)                                   |
| R2  | 1   | $\frac{3}{4} \times 1\frac{1}{2} \times 30''$ fir (ceiling cleat)  |
| S1  | 2   | $\frac{3}{4} \times 1\frac{1}{2} \times 36''$ fir (siding nailer)  |
| S2  | 2   | $\frac{3}{4} \times 1\frac{1}{2} \times 13\frac{1}{4}''$ fir (siding nailer)                                   |
| T   | 1   | $\frac{3}{4} \times 4 \times 120''$ fir (ridge board)  |
| U1  | 2   | $\frac{3}{4} \times 3\frac{1}{2} \times 60''$ fir (roof trim-cut to fit)                                       |
| U2  | 2   | $\frac{3}{4} \times 3\frac{1}{2} \times 18''$ fir (roof trim-cut to fit)                                       |
| V   | 2   | $\frac{3}{4} \times 3 \times 120''$ fir (roof fascia)  |
| W1  | 2   | $\frac{5}{8} \times 35 \times 92\frac{3}{4}''$ Texture 1-11 (siding)   |
| W2  | 1   | $\frac{5}{8} \times 31 \times 91\frac{3}{4}''$ Texture 1-11 (siding)   |
| W3  | 1   | $\frac{5}{8} \times 32\frac{1}{2} \times 75\frac{7}{8}''$ Texture 1-11 (pieced)                                |
| X1  | 1   | $\frac{3}{4} \times 34\frac{1}{2} \times 40''$ fir plywood (floor)   |
| X2  | 1   | $\frac{3}{4} \times 36 \times 73\frac{3}{4}''$ fir plywood (door)  |
| X3  | 1   | $\frac{3}{4} \times 30 \times 34\frac{1}{2}''$ fir plywood (upper shelf)                                       |
| X4  | 1   | $\frac{3}{4} \times 18 \times 34\frac{1}{2}''$ fir plywood (lower shelf)                                       |
| Y   | 1   | $\frac{1}{2} \times 74 \times 120''$ Waterweid (sheathing)   |
| Z1  | 1   | $\frac{1}{2} \times 56\frac{3}{4} \times 124''$ Waterweid (sheathing)  |
| Z2  | 1   | $\frac{1}{2} \times 16 \times 124''$ Waterweid (sheathing)   |
| AA  | 1   | $\frac{5}{8} \times 30\frac{3}{4} \times 32\frac{3}{4}''$ fire-retardant gypsum—FRG—(ceiling)                  |
| BB  | 2   | $\frac{5}{8} \times 29 \times 32\frac{3}{4}''$ FRG (shelf)   |
| CC  | 2   | $\frac{5}{8} \times 17 \times 32\frac{3}{4}''$ FRG (shelf)   |
| DD  | 1   | $\frac{5}{8} \times 11\frac{1}{2} \times 32\frac{3}{4}''$ FRG (back)   |
| EE  | 1   | $\frac{5}{8} \times 15 \times 32\frac{3}{4}''$ FRG (back)  |
| FF  | 1   | $\frac{5}{8} \times 32\frac{3}{4} \times 40\frac{1}{2}''$ FRG (back)   |
| GG  | 2   | $\frac{5}{8} \times 13\frac{1}{2} \times 30\frac{1}{4}''$ FRG (side)   |
| HH  | 2   | $\frac{5}{8} \times 30\frac{1}{4} \times 57\frac{3}{8}''$ FRG (side)   |
| II  | 1   | $\frac{5}{8} \times 30\frac{1}{4} \times 31\frac{1}{2}''$ FRG (floor)  |
| JJ  | 1   | $\frac{5}{8} \times 36 \times 73\frac{3}{4}''$ FRG (door)  |
| KK1 | 1   | $31\frac{1}{2} \times 33''$ aluminum sheet (shelf)   |
| KK2 | 1   | $21 \times 31\frac{1}{2}''$ aluminum sheet (shelf)   |
| KK3 | 1   | $31\frac{1}{2} \times 34\frac{1}{2}''$ aluminum sheet (floor)  |
| LL1 | 2   | $1 \times 1 \times 36''$ aluminum angle (door edge)  |
| LL2 | 2   | $1 \times 1 \times 71\frac{3}{4}''$ aluminum angle (door edge)   |
| MM1 | 1   | $1\frac{1}{2} \times 1\frac{1}{2} \times 34\frac{1}{2}''$ aluminum roof edge (jamb)                            |
| MM2 | 2   | $1\frac{1}{2} \times 1\frac{1}{2} \times 70\frac{1}{2}''$ aluminum roof edge (jamb)                            |
| NN  | 1   | Stanley gate latch CD 1261, with padlock eye   |
| OO  | 1   | Stanley pull No. 1 SP 482  |
| PP  | 3   | 6" T-hinge   |
| QQ  | 9   | $1\frac{3}{4}''$ No. 10 fh wood screws   |
| RR  | 6   | 1" No. 10 fh wood screws   |
| SS  | 6   | $\frac{3}{16} \times 1\frac{3}{4}''$ machine bolts, nuts and fender washers                                    |
| TT  | 2   | 18" bundles, perfection red cedar shingles   |
| UU  | 1   | $2 \times 2 \times 124''$ brown aluminum roof edge   |
| VV  | 1   | 90 sq. ft., 15-lb. roofing felt  |
| WW  | 10  | $\frac{1}{2} \times 5\frac{1}{2} \times 10''$ fir plywood (gussets)  |
| XX  | 12  | 6" hot-dipped galvanized nails   |
| YY  | 2   | $4\frac{1}{2} \times 4'$ -dia. aluminum vent pipe with four 4"-dia. aluminum soffit vents, louvers and screens |

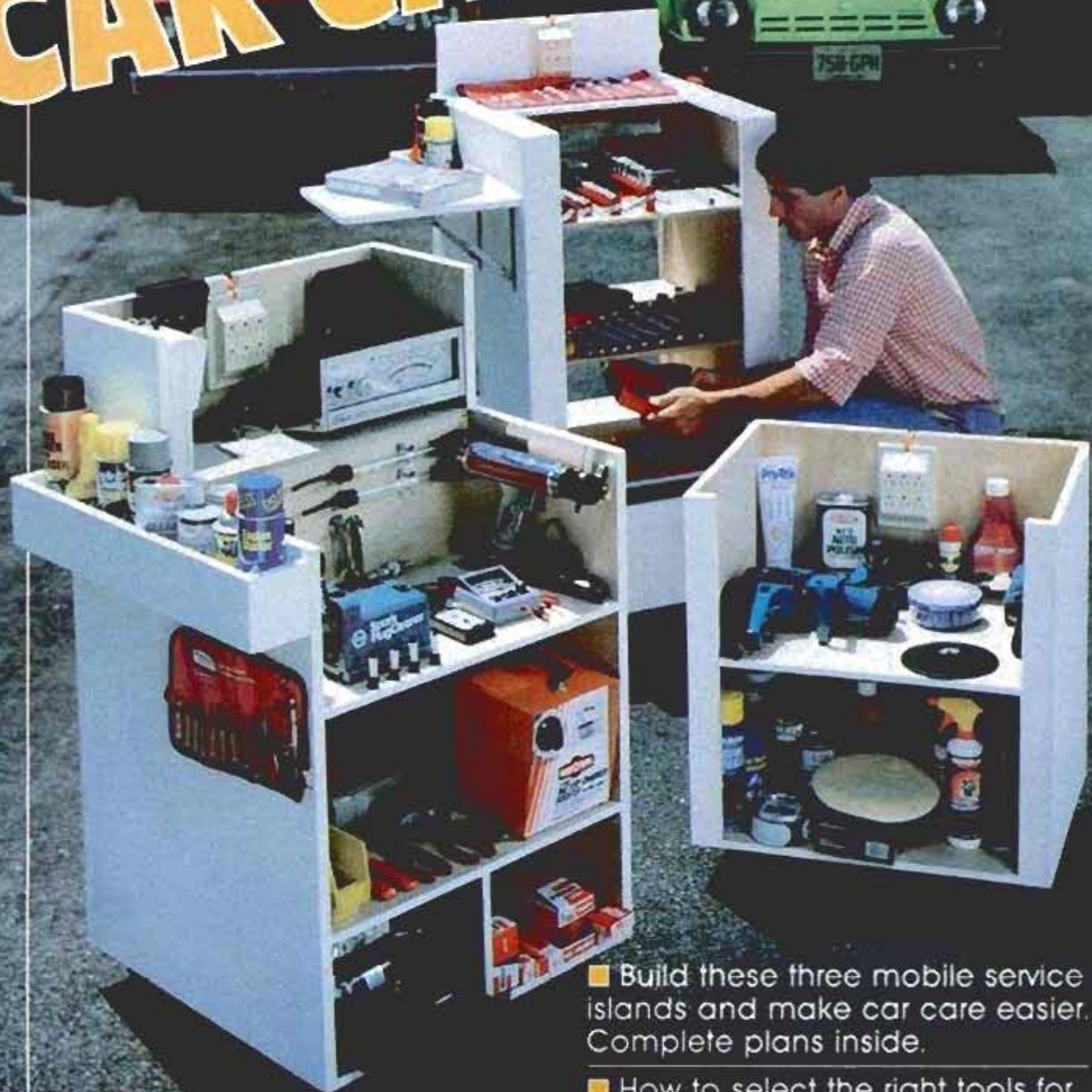
Misc.: paint, stain, panel adhesive, drywall nails, roofing nails, 2d aluminum nails, 4d, 8d and 10d galvanized nails.



Popular Mechanics

FALL 1981

# CAR CARE GUIDE



■ Build these three mobile service islands and make car care easier. Complete plans inside.

■ How to select the right tools for your car, and how to use them.

■ Take a look under the hoods of the 1982 GM, Ford, Chrysler and AMC models.



# STOP STALLING. PUT IN AUTOLITE, THE WIDE-HEAT-RANGE PLUG.

If, some mornings, your car refuses to leave the driveway, or hates saying goodbye to stop signs, you may well be the victim of something called "cold plugs."

Poor starting, misfiring, and hesitating are often caused by oil and carbon deposits on the spark plug tips.

To burn these off, you need what are called *hot* plugs.

But, for effortless high-speed running on the highway, you're better off with *cold* plugs. (That's what race cars use.)

So what should you put in your car?

Try putting in, not just new plugs, but a new *brand* of plugs.

Autolite spark plugs. With Power Tips.\*

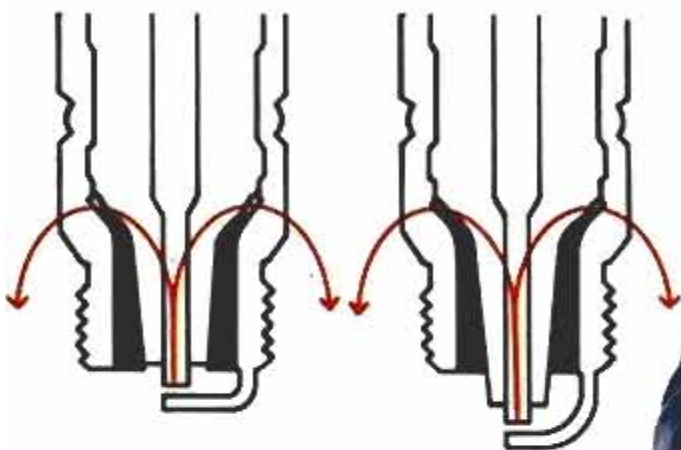
The Power-Tip Autolite is a remarkable plug. It has what mechanics call a *wide heat range*.

Because of its wide-heat-range design it works like two plugs—a hot plug *and* a cold plug.

It runs hot on short trips, to burn off carbon, and cold on long trips, for smooth driving.

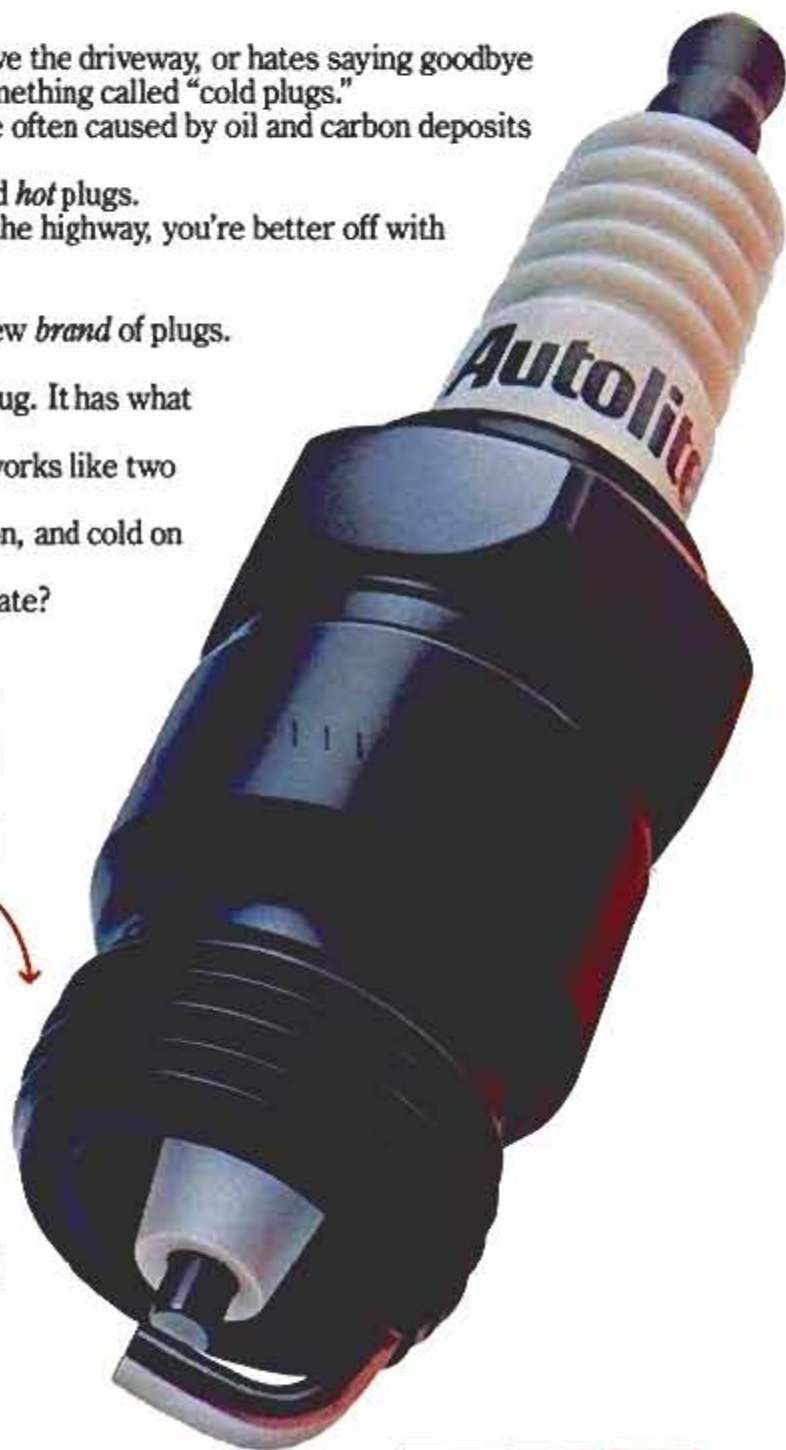
So if your car stalls or misfires, why hesitate?

Put in Autolites.



In an ordinary plug, the tip is short, which makes it lose heat faster at low speeds. And, because it's not as exposed to cool intake gasses, it stays hotter at high speeds.

Autolite Power Tip plugs have longer insulators and electrodes. Heat transfers more slowly at low speeds, so carbon burns off. But at high speeds, low-temperature intake gasses keep the tip cooler, to help prevent pre-ignition and overheating.



\*Available for cars where space in the combustion chamber is sufficient to accommodate the Power Tip.



Fram and Autolite are Bendix Companies  
Fram Corporation, Providence, Rhode Island 02916



# CAR CARE GUIDE

FALL '81

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Car Care Guide designed by Don Mannes. PM art: Fred Wolff, Ed Lipinsky, Jeff Mangiat and Gene Thompson. PM photos: George Ancona.

## When Should YOU Change Engine Oil?

How you drive determines how far and how often you should change your crankcase oil. It is nearly impossible to drive a car properly so that yearly changes of oil would be safe for your engine.

Traffic jams, winter warm-ups, short runs, taking kids to school, and those short trips to the store all tend to shorten the life of your oil.

On top of that, today's engines are smaller, work harder and run hotter. All of these things help foul up engine oil, create varnish, gum and sludge as they use up the additives in the motor oil.

A quart of RLSLONE with each oil change and new filter will help get rid of power robbing deposits, and clean engines run better, longer and more economically than dirty ones.

Look for the big QUART red, yellow and black RLSLONE can. For 40 years, motorists have been telling us that RLSLONE really works!



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### THE SHALER CO.

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WAUPUN, WISCONSIN 53983

In Canada: Warren Packaging Co.,



# THREE MOBILE SERVICE ISLANDS

These three islands can make all your service and maintenance jobs easier and faster.

## COSMETICS ISLAND

This cabinet has power outlets for an orbital polisher, car vacuum and heavy-duty sander. It's also stocked with everything from car wax to mag-wheel cleaner to upholstery shampoo—everything, in fact, to take proper care of your car's appearance.

## DIAGNOSTIC ISLAND

Precision tools and delicate test equipment are stored separately from hand and power tools. This island contains engine analyzer, digital dwell/tech, digital volt/ohmmeter, timing light, battery charger, air compressor, sparkplug sandblaster, dial-indicator gauge set—in short, all equipment you need for a complete engine diagnosis.

**D**id you ever notice that, no matter how well stocked with tools your garage is, you always end up working in the driveway? The reason is obvious: There's a lot more light out there and also a lot more room to move around. Having your tools well-organized and neatly put away in a workbench or cabinet in the garage, and working on your car in the driveway usually requires a lot



# YOU CAN BUILD FOR UNDER \$100

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**CAR CARE GUIDE**

## TOOL ISLAND

For fast access to all tools, this island has an open design. The shelves are adjustable to accommodate whatever arrangement of tools works best for your car. A fold-out shelf holds a repair manual, and a fire extinguisher is attached.



of shuttling back and forth between car and garage.

In the course of an afternoon, this shuttling back and forth usually leads to a large puddle of tools building up at your feet around the car. Invariably, the odd socket ends up rolling into the street or gets kicked by accident into the neighbor's yard. A corollary to this is

Islands designed by  
PM Auto Department  
Construction: Angelo Sigona  
PM Photos: George Ancona





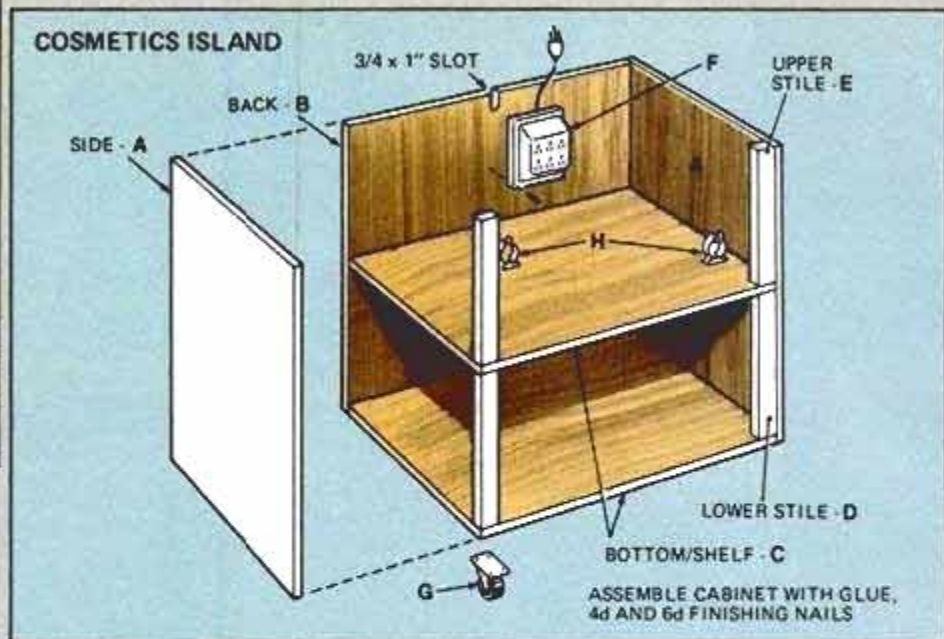
Body care and appearance items are stored on this island. It holds vacuum, orbital polisher, sander and all cleaners.

#### MATERIALS LIST—COSMETICS ISLAND

| Key | No. | Size and description (use)                      |
|-----|-----|---|
| A   | 2   | 1/2 x 18 x 24" plywood (side)                   |
| B   | 1   | 1/2 x 23 x 24" plywood (back)                   |
| C   | 2   | 1/2 x 17 1/2 x 23" plywood (bottom shelf)       |
| D   | 2   | 3/4 x 1 1/2 x 12" plywood (lower stile)         |
| E   | 2   | 3/4 x 1 1/2 x 11" plywood (upper stile)         |
| F   | 1   | 6-receptacle outlet, 1" No. 8 fh screws (4)     |
| G   | 4   | 2"-dia. plate casters, 1/2" panhead screws (16) |

stacking tools and test equipment on the inner fenders, fan shroud, battery and air cleaner. And, of course, these delicate balancing acts always lead to something small getting unbalanced and wedged down between the headers.

Working under those conditions eats up time and makes repair work a lot harder. After looking at this common problem,



ASSEMBLE CABINET WITH GLUE, 4d AND 6d FINISHING NAILS

we decided there had to be a better way. Our answer is a series of mobile service islands.

Our first impulse was to go with over-the-counter metal tool cabinets. But, for many of the jobs you have to do, these metal cabinets have shortcomings. First of all, they have too many small drawers which don't hold essentials like timing lights, meters and other diagnostic tools. They're great for storage of hand tools, but don't have the flexibility to do the various jobs. Second, they're expensive.

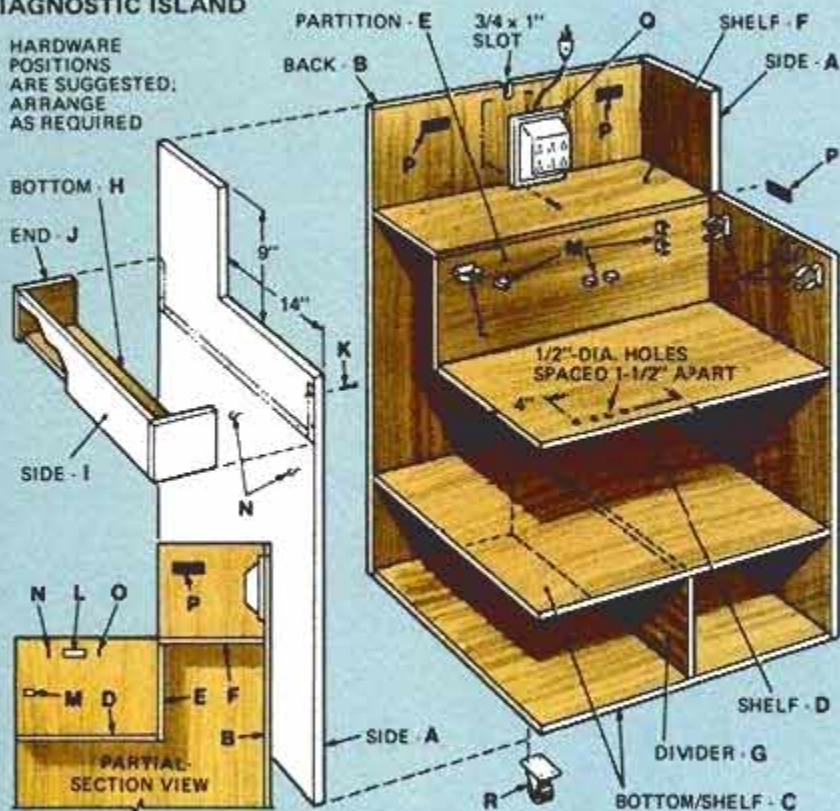
We analyzed the types of jobs normally

#### MATERIALS LIST—DIAGNOSTIC ISLAND

| Key | No. | Size and description (use)                    |
|-----|-----|---|
| A   | 2   | 3/4 x 24 x 40" plywood (side)                 |
| B   | 1   | 1/2 x 22 1/2 x 40" plywood (back)             |
| C   | 2   | 1/2 x 22 1/2 x 23 1/2" plywood (bottom shelf) |
| D   | 1   | 1/2 x 14 x 22 1/2" plywood (shelf)            |
| E   | 1   | 1/2 x 9 x 22 1/2" plywood (partition)         |
| F   | 1   | 1/2 x 9 1/2 x 22 1/2" plywood (shelf)         |
| G   | 1   | 1/2 x 8 x 23 1/2" plywood (divider)           |
| H   | 1   | 1/2 x 3 1/2 x 23" plywood (bin bottom)        |
| I   | 1   | 1/2 x 4 x 23" plywood (bin side)              |
| J   | 2   | 1/2 x 4 x 4" plywood (bin end)                |
| K   | 2   | 2" No. 10 fh screws                           |
| L   | 5   | Large clamps, 3/4" panhead screws             |
| M   | 6   | Small clamps, 3/4" panhead screws             |
| N   | 3   | 1/2" hook-eye screws                          |
| O   | 1   | 1" screw hook                                 |
| P   | 4   | 1 x 3" self-adhesive Velcro                   |
| Q   | 1   | 6-receptacle outlet, 1" No. 8 fh screws (4)   |
| R   | 4   | 2"-dia. plate caster, 1/2" panhead (16)       |

#### DIAGNOSTIC ISLAND

HARDWARE POSITIONS ARE SUGGESTED; ARRANGE AS REQUIRED

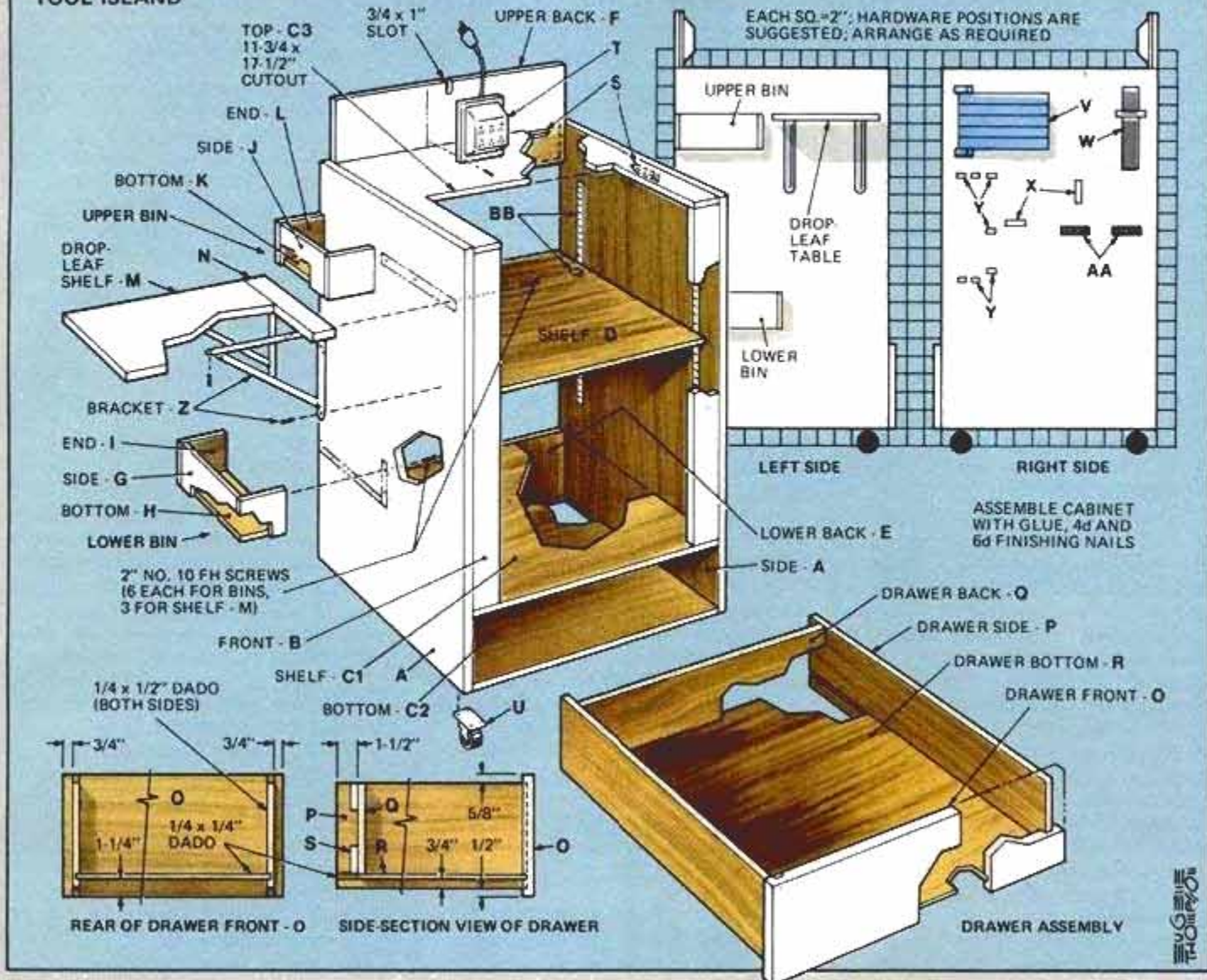


ASSEMBLE CABINETS WITH GLUE; 4d AND 6d FINISHING NAILS





## TOOL ISLAND



### MATERIALS LIST—TOOL ISLAND

| Key | No.   | Size and description (use)                       |
|-----|-------|--|
| A   | 2     | 3/4 x 24 x 40" plywood (side)                    |
| B   | 2     | 3/4 x 2 1/2 x 30 1/2" plywood (stille)           |
| C   | 3     | 1/2 x 22 1/2 x 23 1/2" plywood (shelf)           |
| D   | 1     | 1/2 x 22 x 23 1/2" plywood (adjustable shelf)    |
| E   | 1     | 1/2 x 9 x 22 1/2" plywood (lower back)           |
| F   | 1     | 1/2 x 10 1/2 x 22 1/2" plywood (upper back)      |
| G   | 1     | 1/2 x 4 x 11" plywood (lower bin side)           |
| H   | 1     | 1/2 x 3 1/2 x 11" plywood (lower bin bottom)     |
| I   | 2     | 1/2 x 4 x 4" plywood (lower bin end)             |
| J   | 1     | 1/2 x 4 x 9" plywood (upper bin side)            |
| K   | 1     | 1/2 x 3 1/2 x 9" plywood (upper bin bottom)      |
| L   | 2     | 1/2 x 4 x 4" plywood (upper bin end)             |
| M   | 1     | 3/4 x 12 x 14" plywood (drop-leaf shelf)         |
| N   | 1     | 3/4 x 1 1/2 x 12" plywood (ledge)                |
| O   | 1     | 3/4 x 9 x 23 3/4" plywood (drawer front)         |
| P   | 2     | 1/2 x 7 7/8 x 22" plywood (drawer side)          |
| Q   | 1     | 1/2 x 8 3/8 x 21 1/4" plywood (drawer back)      |
| R   | 1     | 1/4 x 20 1/2 x 21 3/4" plywood (drawer bottom)   |
| S   | 16    | 3/4 x 3/4 x 3" fir (glue blocks)                 |
| T   | 1     | 6-receptacle outlet, 1" No. 8 fh screws (4)      |
| U   | 4     | 2"-dia. plate casters, 1/2" panhead screws (16)  |
| V   | 1     | Swing-out tray unit, 3/4" panhead screws (4)     |
| W   | 1     | Fire extinguisher holder, 1" No. 8 fh screws (2) |
| X   | 2     | Large clamps, 3/4" panhead screws as reqd.       |
| Y   | 7     | Small clamps, 3/4" panhead screws as reqd.       |
| Z   | 1 pr. | drop-leaf supports, 3/4" No. 8 screws (12)       |
| AA  | 2     | 1 x 3" strips of self-adhesive Velcro            |
| BB  | 4     | 24" shelf standards, screws, 4 shelf clips       |

\*As required.

◀ Challenging job of troubleshooting is made easier because all instruments are visible and within reach. The unwieldy instruments, like the engine analyzer, stay on the island while the leads run to the car.



Tool Island is the main one, holding all hand tools and power tools you're likely to need. A drop-leaf shelf (left) holds a service manual. Fire extinguisher, drill, small-parts bin, extensions, filter wrench and screwdrivers are mounted on side (right).



# Three mobile service islands you can build for under \$100

done by Saturday mechanics and came up with three categories. In the first are the diagnostic jobs which require a lot of test equipment and not many tools. Diagnostic tasks include all electrical checks, cooling-system tests, engine timing and so on. You need specialized and often delicate tools that you don't want rattling around in the same drawer with torque wrenches and ball-peen hammers.

The other two job categories entail actual repair work requiring a lot of tools, and body care and maintenance.

To fill these job requirements, we came up with three separate islands: diagnostic, repair and cosmetics.

## Diagnostic Island

The diagnostic cabinet is designed to hold virtually every piece of test equipment you'll need for tracing a problem in any of your car's systems. In ours, we have a Sun engine analyzer complete with timing light and engine compression tester, also a complete set of digital test equipment from Dixon: dwell/tachometer, volt/ohmmeter, ammeter, charging-system tester, electronic-ignition tester, vacuum gauge and fuel-pump pressure tester.

All these items are on the top shelf of the diagnostic island. The timing light is held in place by brackets which act like spring-loaded clips, and the lightweight testers are secured by adhesive-backed Velcro strips.

The cabinet also holds a sparkplug gapper, circuit tester, hydrometers for battery and coolant, sparkplug sandblaster, cooling-system pressure analyzer, dial indicator, battery charger, air pump to blast small parts clean and a bin for spare parts and small items like electrical tape, fine-grit sandpaper, sparkplug terminal pliers, wire cutter/stripper, ignition wrenches, point file and so on.

Notice that there aren't any hand tools in this cabinet; we want to keep them separate.

This island keeps diagnostic items within reach and visible. You won't have to balance an analyzer on an air cleaner to do your test. The analyzer stays on the island and you simply run the leads to the engine. The cabinet is designed to be high enough for you to be able to read the meter over the fender.

We built a shelf on the side of the island to hold aerosol cans of degreaser, lubricants, silicone wire spray and so on.

Electrical outlets are built into each island to run tools and testers.

## Tool Island

As the name implies, our tool island holds all your hand tools.

Unlike those large metal tool cabinets, it has an open design with only one draw-

er. We felt it was much easier to grab the tool you want from a shelf than to rummage through half a dozen little drawers to find what you need. Although we picture only two shelves on our island, you can use as many as you need since they are adjustable. The drawer holds tools not often used.

For convenience, we built a drop-leaf platform to hold a service manual—so it doesn't have to be propped up on a fender or air cleaner where it invariably gets greasy or falls over.

For safety, a fire extinguisher is mounted on the side where we have also located a small-parts bin for screws, nuts, washers, grommets, two sets of screwdrivers, an electric drill and ratchet extensions.

## Cosmetics Island

Our cosmetics island has nothing to do with lipstick or rouge. We're talking obviously about the things that keep your car looking good.

On the top shelf, we secured a car vacuum, orbital polisher and heavy-duty polisher/sander. The car vacuum uses 12 volts from the cigaret-lighter socket for power, while the other two plug into the island's 115-v.a.c. outlet.

The rest of the cabinet is stocked with every imaginable item you'll need to keep your car looking sharp.

## Construction and assembly

All these islands are constructed in essentially the same way. First, cut all the plywood pieces using the materials list as a guide. Make the cuts accurately; the extra time spent to keep them straight and square will pay off later.

**Cosmetics Island:** Begin assembly by laying out the position of the shelf on the inside of each sidepiece. Then fasten the back to the two sides using carpenter's glue and 6d finishing nails. Next, glue and nail the bottom in place.

If your cuts are square on the bottom piece, this should automatically square the whole island. Nail the lower stiles to the sides and up through the bottom, then position and nail the shelf, add the upper stiles and locate the hardware as shown. Install the six-plug receptacle—simply a matter of cutting out the notch in the top of the back and driving four screws. It's best to install the casters so that part of the flange will be underneath the edge of the side. This takes some of the weight off the bottom. Finally, set the nails, fill the holes, sand the whole island and paint.

**Diagnostic Island:** Start this island in the same way. Lay out the sides for placement of the shelf, then mark the bottom and shelf for placement of the divider.

Glue and nail the back to the sides and add the bottom and the lower shelf.

Assemble the three pieces for the upper split-level shelf with nails and glue; then carefully place it between the sides, adjusting the assembly to match your layout marks, and nail it in place. Add the hardware we suggest or choose and place your own.

Build the simple bin by gluing and nailing the front to the bottom, then the sides to both. Screw the bin to the island side, attach the casters, finish-sand the plywood and paint.

**Tool Island:** First lay out the sides for the bottom and the lower shelf, and for the position of the shelf standards. Then attach the standards before constructing the cabinet. Place them about 4 in. in from the front and back edges of each side.

Next glue and nail the lower and upper backs to the sides as shown, and then install the bottom and lower shelf. Glue and nail stiles next, then U-shaped top.

The drawer is made by cutting the  $\frac{1}{4} \times \frac{1}{4}$ -in. dados in the drawer sides and front, and the  $\frac{1}{2}$ -in. dado  $\frac{1}{4}$  in. deep in the back of the drawer front. Assemble the drawer with glue and 4d finishing nails, but don't glue the drawer bottom into the slots; let it float.

Finally, install all hardware and the adjustable shelf, the receptacle and the casters, and you're done. The upper and lower bins are made in the same way as on the diagnostics island.

Products for our service islands were provided by:

**Hand tools:** K-D Manufacturing Co., 3575 Hempland Rd., Lancaster, Pa. 17604

**Diagnostic equipment:** Sun Electric Corp., 1560 Trimble Rd., San Jose, Calif. 95131

**Wax and polishes:** Johnson Wax, S.C. Johnson & Son, Racine, Wis. 53403

**Air pump:** The Coleman Co., 250 North St. Francis, Wichita, Kan. 67201

**Digital diagnostic equipment:** Dixon, Automotive Div., Box 1449, Grand Junction, Colo.

**Lubricants:** Fiske Brothers Refining Co., 129 Lockwood St., Newark, N.J. 07105

**Cordless drill:** Skil Corp., 4801 West Peterson Ave., Chicago, Ill. 60646

**Cosmetic products:** Armorall Products, Box 19039, Irvine, Calif. 92713

**Sparkplugs:** Champion Spark Plug Co., Toledo, Ohio

**Filters:** Fram Corp., Providence, R.I.

**Hand tools:** Ingersoll-Rand, Proto Tool Div., Box 717, 2600 East Nutwood Ave., Fullerton, Calif. 92631

**Cosmetic products:** Meguiar's, Box 17177, Irvine, Calif. 92713

**Cleaners and solvents:** E.I. duPont de Nemours & Co., Wilmington, Del. 19898

**Lubricants, high-mileage oil additive:** Tufoll, Flo-tech Inc., 601 Water St., Framingham, Mass. 01701

**Lubricant:** WD-40 Co., San Diego, Calif. 92110

**Cleaners, chemicals and solvents:** Taylor Made Products, 3200 West Market St., Akron, Ohio 44313

**Adhesives, bonding agents:** Woodhill Permatex, 18731 Cranwood Pkwy., Cleveland 44128



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# SATURDAY MECHANIC LOOKS AT THE '82 FORDS

Even without computer controls, a new V6 is surprisingly efficient.

Just what the world needs—a new Lincoln Continental—commented some sarcastic observers of the automotive scene. Well, it's obvious that Ford *did* put most of its '82 engineering dollars into a car nearly 17 feet long and a fairly large (3.8-liter) V6 engine. However, the Continental is anything but a reborn dinosaur, and the new engine, mated to Ford's automatic overdrive transmission, should produce impressive fuel-economy numbers. This power train will also be available in Cougar XR-7 and T-bird.

The Continental weighs in at about 3,550 pounds, so it's far from a pig. It has the modified strut suspension pioneered by Ford, and with a sway bar and rack-and-pinion steering, it's a surprisingly nimble road car.

The 3.8-liter V6 is exactly the same displacement as the Buick-built GM V6 and, like that engine, it's an even-firing powerplant with a 90° angle between the banks.

Ford just chopped two cylinders off the 5-liter (302-cu.-in.) V8, you say? Anyone who's fast at arithmetic or has an electronic calculator handy can easily determine that  $\frac{2}{5}$  of a 5-liter engine is 3.8 liters. But it didn't happen that way.

The 3.8 V6 is a new-from-the-ground-up engine, and Ford engineers mount some powerful logic to justify the decision.

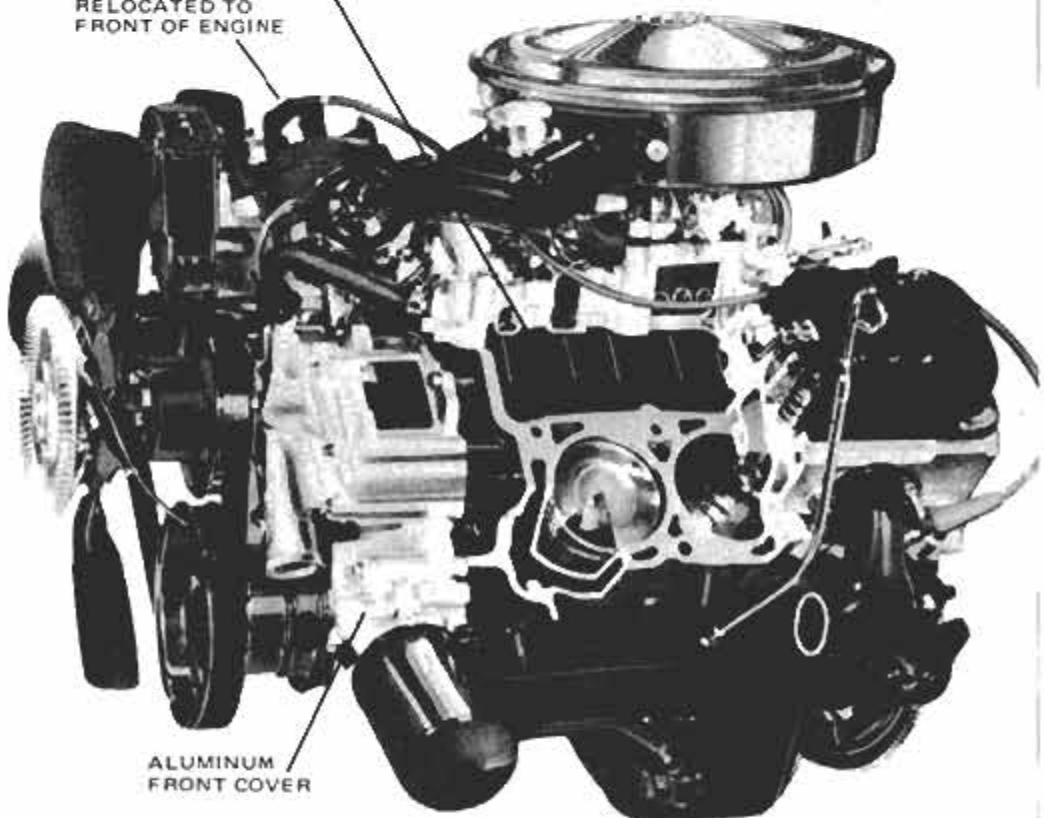
First, the 90° bank angle. If the engine were a 60° V6 (and Ford makes a 60° 2.8-liter V6 in Germany), it would be limited in the stroke end. That's clear enough. The narrow angle between the banks means that if you try to lengthen the stroke in the downward direction, the rods run into each other at the bottom. If you try by increasing the height of the engine, you end up with an engine that's too tall to fit under the hood.

Why not just increase the bore and have an oversquare engine? Isn't that the way you get in big valves for better breathing?

Rocker-arm cover is nylon-filled fiberglass which has no gasket. A lip at the mating surface ensures a proper seal. Aluminum front cover (far right) contains oil filter, distributor and water pump.

HIGH-PERFORMANCE CAMSHAFT  
 DISTRIBUTOR RELOCATED TO FRONT OF ENGINE

Ford's 3.8-liter V6 is an all-new design that tips the scales at a mere 311 pounds.



ALUMINUM FRONT COVER

Well, that was a valid design approach years ago, and the five-liter V8 is an oversquare engine. So if Ford wanted that, it would have chopped a couple of cylinders off the V8. "However," explains 3.8 V6 engineer Roman Kuzma, "the buzzwords today are 'fast burn.'" This means

a cylinder head and its combustion chambers should be designed to promote rapid combustion for lower emissions and better fuel economy, without the need for a lot of spark advance necessary in an oversquare design.

The decision to go with even firing





instead of a 60° bank angle as a route to smoothness leads to a somewhat long engine. To get the even firing, the connecting rod journals must be split—that is, one journal for each rod. To get enough heft to stand the loads, the crank must be relatively long, so the engine becomes longer. Length, however, isn't a problem with a V6, particularly one that's going into the same engine compartment as an optional V8.

The Ford V6 cast-iron block is a precision (thinwall) casting, and the engine weighs just 311 pounds (with accessories and oil) compared to 375 pounds for the Buick V6 and 417 for the Chevy 3.8 V6 (made from the small-block V8). Horsepower is said to be close to 140, better than 36 per liter.

Ford has gone to extra lengths to make the engine smooth enough to please the Continental owner.

### Aluminum front housing

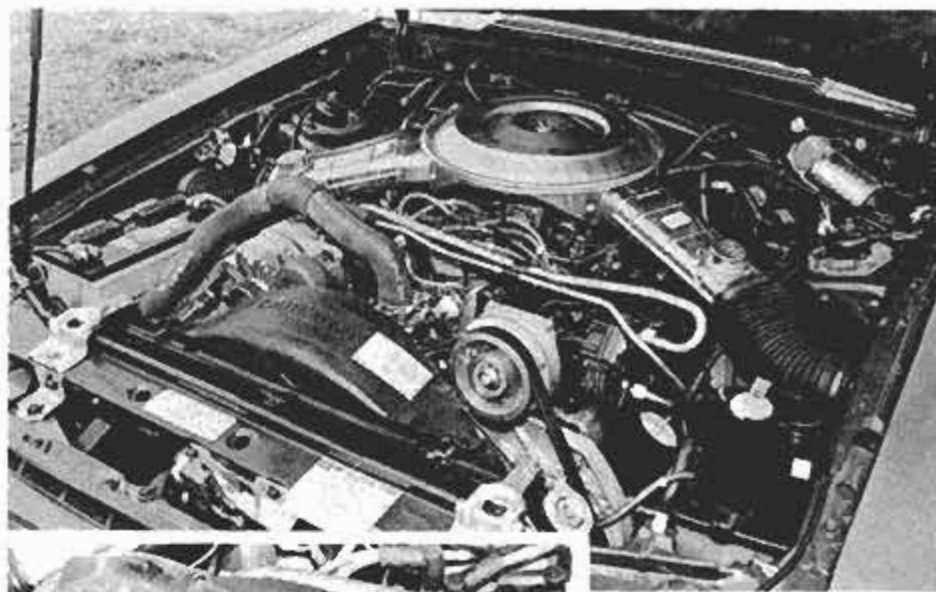
The engine layout is a bit unusual. An aluminum front housing holds the water pump, oil pump and distributor, a setup that improves service access. An aluminum intake manifold looks like a single casting, but actually it's two pieces electron-beam-welded together, with steel tubing inside for the exhaust crossover passage.

With all this aluminum, the cooling system is sensitive to corrosion with the wrong antifreeze, which will result in corrosion particles from the engine depositing in (and clogging) the radiator. Ford faced a similar problem with the Escort/Lynx and announced new performance standards to the antifreeze industry. Northern Petrochemical (PEAK), Dow, Texaco and BASF (a private brander) introduced new formulations to compete with Prestone II, which already met the standards. So when it's time to drain and refill the cooling system, make sure you have the right antifreeze. Check your owner's manual for specs.

Also contributing to weight-saving are the rocker-arm covers, which are nylon-filled fiberglass. Despite the fact that the RTV (room-temperature-vulcanizing) silicone paste is used instead of a gasket, the covers have a lip on the inboard edge of the gasket surface to obtain better sealing.



Spring-loaded friction shoes on C-5 automatic tranny offer smoother entry into overdrive mode, add 2 mpg on the highway.



Twin-snorkel air cleaner is the tipoff that a high-performance, 5.0-liter V8 is in residence. The twin snorkel provides freer breathing, since the new radical cam profile needs extra oxygen. New cam also changed the firing order, which is now printed on a decal on the automatic belt-tensioner (arrow left).

### Engine compartment

The 3.8-liter V6 engine compartment is a reasonable service package. Ford put in access holes underneath, so you can reach the engine mounts without a struggle.

The water pump is somewhat obstructed. You must move the power-steering pump because one stud through the aluminum front housing holds the pump and bracket. You also must remove one airconditioning bracket and disconnect the second from the power-steering pump.

Belt adjustments are reduced to one, thanks to the latest application of the Ford single, grooved belt system. Unlike some other Ford engines, the automatic adjustment provision by a spring housing can't be used (doesn't provide proper tension for the life of the belt). So Ford has installed a jackscrew adjuster. Just loosen a couple of bolts on the idler-pulley

bracket, and turn the screw to move the pulley up or down or change tension.

You must use the fan designed for this engine. A snakelike belt drives all accessories from the grooved side but one, the water pump/fan. It doubles over on its ungrooved side to spin the pump/fan pulley, thus turning it in the opposite direction. If you use a fan meant to spin the other way, it will push hot engine-compartment air through the radiator (instead of pulling cool ambient air through), and the engine will overheat after about five minutes of driving.

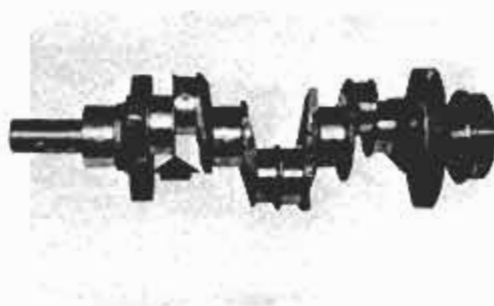
### Computers aren't needed

Like all other '82 Ford engines, the 3.8-liter V6 has a three-way catalyst to reduce oxides of nitrogen (along with hydrocarbons and carbon monoxide), in addition to the conventional catalyst. And like many other Ford products, it doesn't have a

*(Please turn to page 169)*



New V6 has no automatic belt tensioning. Tension is adjusted by loosening two bolts, and setting it with center bolt (arrows).



To gain an even firing sequence, the V6 crankshaft needs to have split connecting-rod journals. There's one journal per rod.



# SATURDAY MECHANIC LOOKS AT THE '82 CHRYSLERS

Fine-tuning of present hardware will ease the do-it-yourselfer's job.

**C**hrysler's lineup of front-wheel-drive cars gets some fine-tuning this year, and some of the tuning elements are really out of the ordinary.

Undoubtedly the most novel is the use of the front bumper to tune idle-speed vibration of the four-cylinder engine out of the passenger compartment. It sounds radical but certainly seems to work. Idle smoothness is particularly critical for the new "Super-Ks" (Chrysler LeBaron and Dodge 400), which are being aimed at buyers who are moving down from six-cylinder and V8 engines.

Engine roughness is bad enough at idle and even more severe when engine load is increased. When the engine is idling with the airconditioning on, the vibration in the passenger compartment can really be oppressive to someone used to a larger, smoother-running engine. Put the four-banger in a transverse-layout, front-drive car and the rough idle causes the entire body to vibrate. The driver feels the roughness in the steering column (as shake) and in the seat and/or floor pan of the car.

The north-south front-drive installation is not as prone to this severity of body

vibration (although it may not be particularly smooth either).

A lot of work has gone into the idle roughness problem, and there have been engine struts, special engine-mounting rubbers and even counterbalancing shafts (as on Chrysler's Japanese-built 2.6-liter engine).

The Chrysler use of the front bumper—on cars with its own (2.2-liter) four-banger—is apparently a first. Each side of the bumper is isolated from its bracket with a rubber bushing. The bushings are actually tuned springs calibrated to the frequency that causes them to act as body vibration absorbers when the engine is idling.

Vibration is transmitted to the bumper, and you actually can feel the bumper vibrate at idle by placing your hand on it. However, it does not shake visibly.

The bumper system is augmented by a second vibration absorber, in the steering wheel hub, covered by the wheel trim pad.

This vibration damper has a small mass of metal that looks like a group of tuning forks glued together and attached to a thick sheet of rubber—another rubber spring. Vibration which is not tuned out by the bumper, goes up the steering shaft, and puts the wheel hub absorber into action.

The idle roughness control system will be standard on all Super Ks plus automatic-transmission-equipped regular Ks (Reliant and Aries). Check the rubber bush-

ings at the bumper for deterioration if the vibration ever picks up significantly in the seat, floor and steering wheel.

## Sway bar

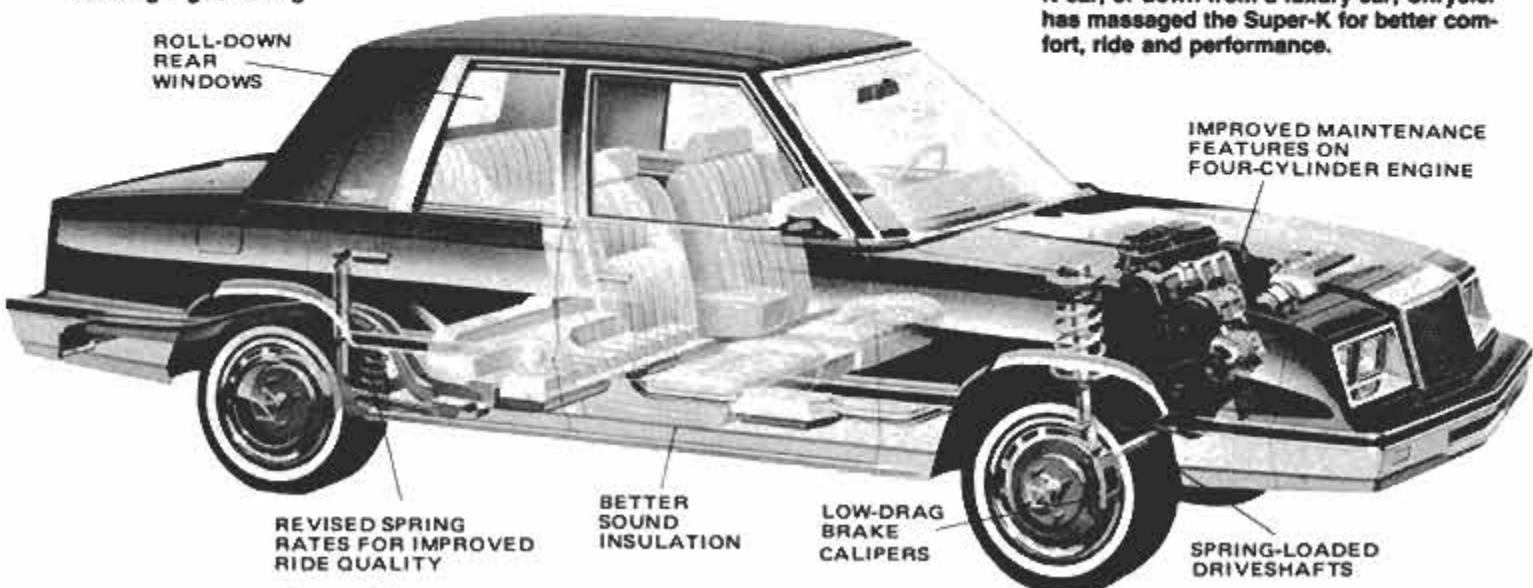
The '82 Ks and Super-Ks also will have a new (at Chrysler) linkless, sway-bar installation. The links between the cross-member and sway bar are eliminated, and the bar is attached directly to the crossmember. The direct connections at the control arm ends remain.

The control arms are redesigned so the sway bar can be extended outboard, which improves its effectiveness. The new design saves two pounds per car and there's easier access for replacement of damaged rubber bushings.

## Power train

There are no major power train changes on Chrysler transverse-engine front-drives for '82. The big changes will come in 1983, by which time the VW engine and manual transaxle will be gone. The Peugeot 1.6-liter four-banger will come on stream by then, and the Chrysler-built manual four-speed transaxle (the A-460) will be the only one available. In fact, if Chrysler runs out of VW manual transaxles during the 1982 model year, it will start shipping VW-engine cars with Chrysler's own box. If you get an Omni-Horizon with the VW engine and the Chrysler manual transaxle, you get a special flywheel, different from the one

## 1982 DODGE 400 SUPER-K Refining a good thing



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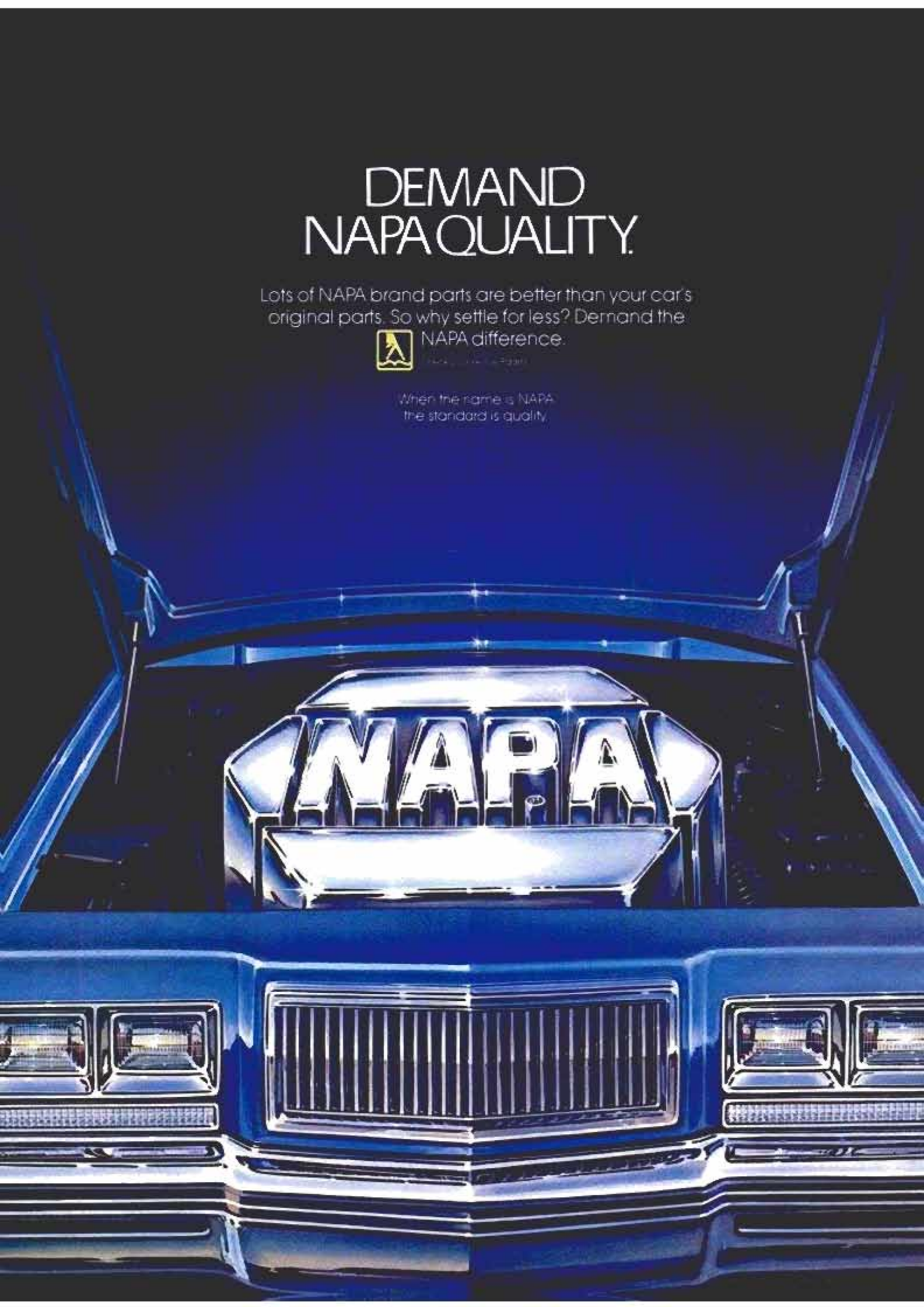
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with the VW (A-412) transaxle. Keep that in mind if you have to order parts.

There will be a new axle-shaft retaining system on all Chrysler transaxles, phased in sometime during the model year. It will use a spring to load the stub shaft that protrudes from the differential and the axle shaft that extends to the wheel, so they remain in proper position during normal operation.

If you have to pull the axle shaft on the previous '81 models, necessary for a number of jobs such as clutch job, engine oil-seal replacement, universal joints and boots replacement, you must pull the transaxle rear cover and remove a C-clip that holds the stub shaft. This involves draining the differential and removing the rear cover. You can easily spend several hours on it.

### Hood and underhood

For '82, the 2.6-liter Four will have a plastic fan with a ring around the blade tips. The blades are curved so they slip more smoothly through the air. This makes the fan run quieter and use 6 percent less energy than the previous electric fan.

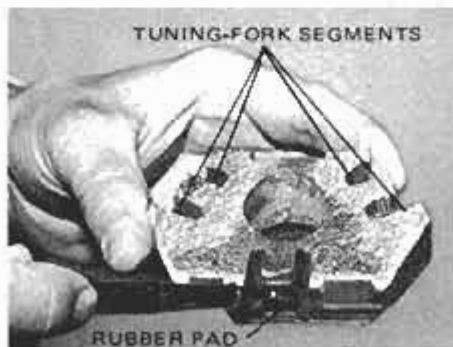
Nonairconditioned models with the 1.7 VW and 2.2 Chrysler engines also get a new fan—an aluminum two-blade fan that weighs less than the previous six-blade fan and also takes less energy to operate. A 3-amp. fan motor does the job for '82, replacing a 5-amp. model.

The serviceability improvements begin with the hood itself. It had been a conventional type with the prop rod. For '82, it's a counterbalanced type, a design that all American cars used to have.

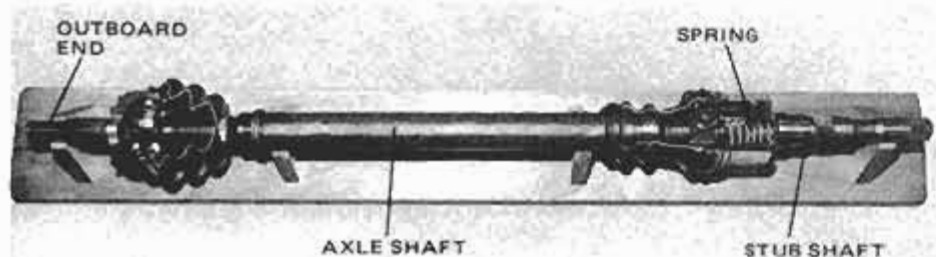
Under the hood is a much neater



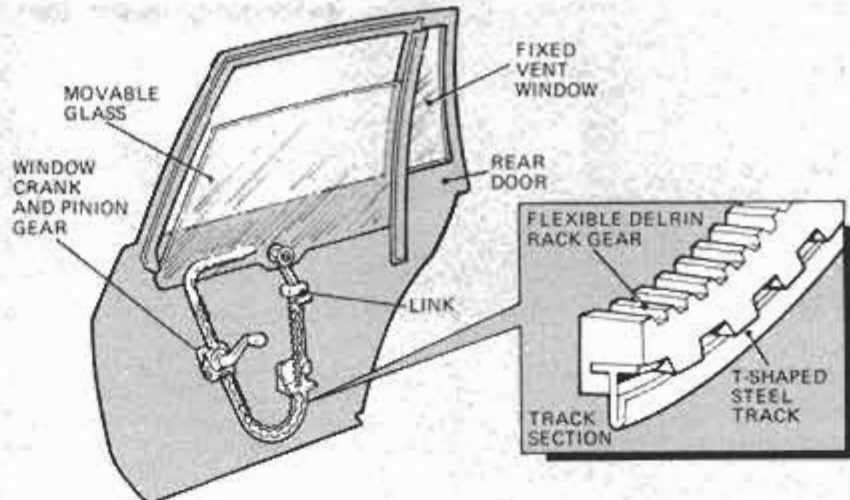
Linkless sway bar installed on the Super-Ks saves several pounds of weight and improves the handling over rough roads.



Vibration-absorbing unit is installed in center of steering wheel, prevents harsh engine harmonics from shaking the wheel.



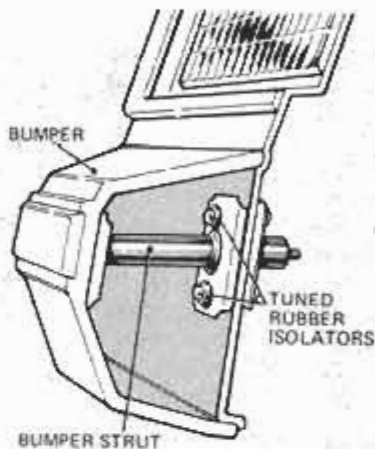
Spring-loaded front driveshafts now make it easy to service or remove these components.



Unique rack-and-pinion gear system designed for the rear-door, window-winder mechanism is made of Delrin plastic which does not need any lubrication, and also saves weight.



New cooling fan reduces the amount of power needed to pull air across the radiator. The blade design improves airflow.



Tuned rubber isolators in bumper strut absorb engine vibrations at idle so that they can't reach passenger compartment.

engine compartment. Wire routings have been changed, with harnesses run primarily around the perimeter of the compartment. The harnesses themselves have been lengthened to expose less wire at the ends. This does reduce the cluttered look and it improves protection of the wiring, but it means you must check more carefully when trying to trace a wiring problem with the color codes.

The engine and automatic transmission dipstick tubes and the dipsticks are about 3 inches longer for easier access.

There's also a small example of "you get more when you pay more." The Dodge 400 and Chrysler LeBaron have a better cold-air duct to the air cleaner. It's a heavier plastic material that looks like rubber, compared with paper-thin material you see on most other cars, including the standard K-cars. The heavier material has an insulating quality that reduces transmission of air-induction noises. It's also more tear-resistant. Saturday mechanics who have found during underhood service that the standard material tears easily appreciate the heavy-duty stuff. It even can be retrofitted to the standard K-cars.



# SATURDAY MECHANIC LOOKS AT THE '82 GM CARS

GM turns its 2.8-liter V6 90° where it assumes an unnatural position in the S-10 pickup.

**I**t was bound to happen: An engine originally designed for a transverse front-drive installation has been reworked to go north-south in a conventional rear-drive vehicle.

The engine is the General Motors 2.8-liter V6 introduced in the 1980 X-cars. For 1982, it's being turned around and installed in the new S-10 subcompact pickup truck, and in a few months will also be put into the Camaro and Firebird.

There's a lot more to the job than a 90° change of direction. Almost everywhere you look on the engine, there are new parts and new parts locations. What was done makes a big difference in service, and is important even if you have an X-car.

## Revised HEI

The High Energy Ignition (HEI) distributor with its ignition coil mounted in the cap is gone. In its place is an HEI distributor with a smaller diameter cap (almost an inch less) and a separate coil. Both the distributor and the new coil are fairly accessible. Access to the coil is doubly important because it must be removed to take off the right-side valve cover.

The new distributor frees up some room at the rear of the engine, so Chevy could move in the exhaust-gas recirculation valve from the pulley end of the intake manifold. There's also room for a round air-filter housing, rather than the oval one on the X-cars.

It was important to move the EGR valve because, with a north-south installation, the entire cooling circuit is changed. The new EGR valve location permits easy testing, but limited access to its hold-down bolt makes removal a bit difficult.

The pulley end of the engine now is directly behind the radiator so, as you would expect, the upper radiator hose goes to the front of the engine. The hose-neck thermostat housing naturally has to be there, and with the EGR valve moved to the rear, there is room for it.

Another no-surprise item: The expensive electric fan goes out and a simpler engine-driven fan that bolts to the water-pump pulley takes its place. The water-

*The 2.8-liter V6, originally a transverse engine, is now used in a longitudinal layout. It required repositioning the oil filter, modifying fuel pump (arrows).*



pump shaft has a bigger bearing to take the extra load of the fan, which is a direct-mount plastic part for a standard, non-A/C installation and a steel-blade clutch type for airconditioned cars. If you ever try to put an X-car water pump in an S-10 or

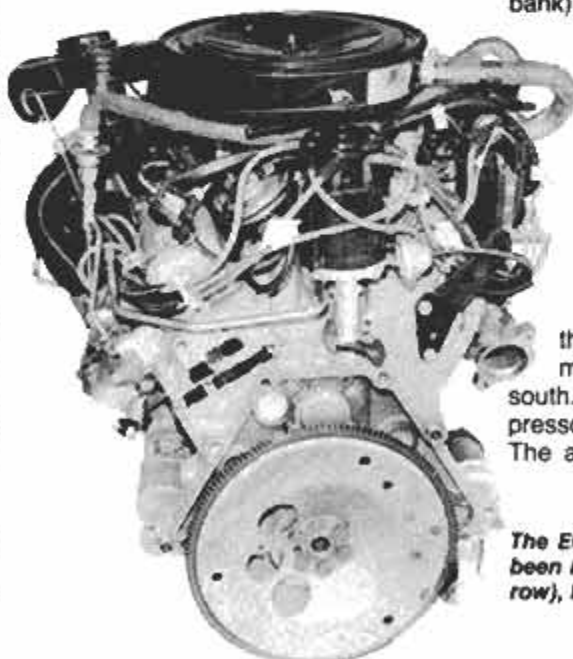
Camaro-Firebird, the extra load on the bearing might result in short pump life.

## Access improvements

Turning the V6 engine 90° frees up lots of room on what was the back bank of the transverse installation (now the right bank). Yes, the sparkplugs are now easier to reach, although they really aren't that bad on the '81 X-cars, either.

The entire accessory drive was redesigned to take advantage of the extra space, so accessory and drive-belt service is more reasonable on the north-south installation.

The power-steering pump is moved from its difficult location on the rear side of the transverse mounting to the left side on the north-south. It's just outboard of the A/C compressor above it, so both are accessible. The alternator is moved from the front



*The EGR valve on the V6 engine has also been repositioned. It's now at the rear (arrow), but is still easy to reach.*





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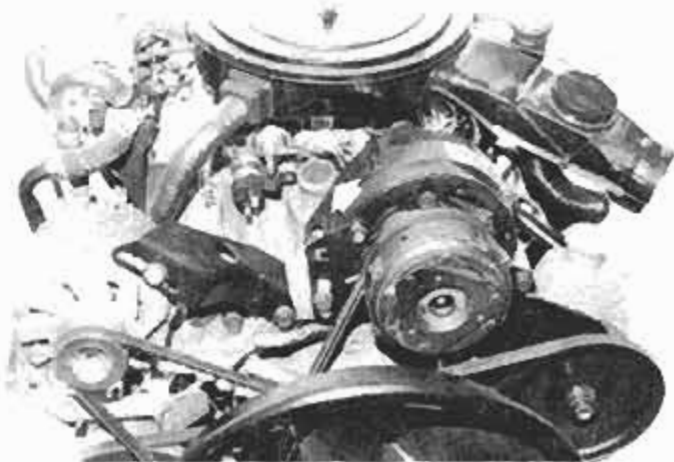
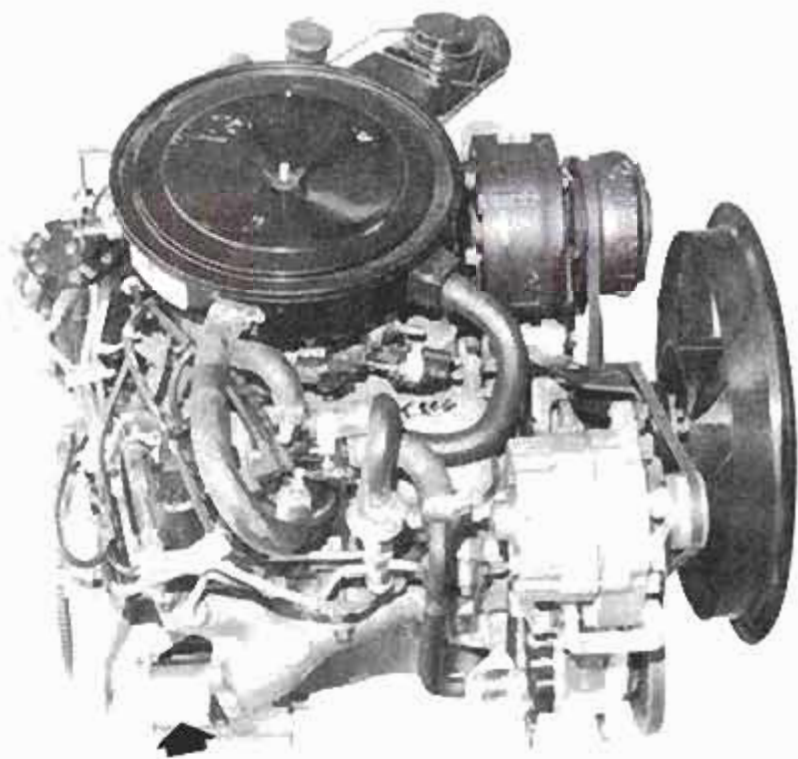
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*Electric cooling fan on the 2.8-liter V6 has now been replaced by an engine-driven unit (above). The starter motor (arrow above) has been relocated to other side of engine. The thermostat housing (arrow, right) is more accessible now than when engine was fitted transversely.*

side on the transverse to the right side on the north-south, where its top location (over the air pump) makes access easy. You can make all belt adjustments except on the air pump from the top of the engine compartment. The air pump is easier on the transverse, but the north-south access from underneath isn't bad, either.

The oil filter is in the same basic location (front side on transverse, left side on north-south), but it had to be put on a new adapter. Reason: It sticks out (forward) on the transverse, and in a north-south would hit the chassis. The new adapter aims it to the rear.

Unfortunately, the filter would foul the starter, so the starter was moved to the right side of the engine.

The fuel system is also different on the two installations. The way the fuel sloshes around in the carburetor bowl on a north-south is different from a transverse. If the

transverse carburetor were used in the north-south, fuel would slosh into the main metering jet and power valve circuits and cause stalling on turns. Baffles, called "stuffers," are used in the carburetor to prevent this. If you try to adapt a north-south carb into an X-car or vice versa, performance problems could result.

The fuel pump is also different. Because of the fuel-line routings, both lines on the transverse are steel. On the north-south engine, one is a rubber hose connected from a steel fuel line to the pump, so the pump has a simple neck with a hose clamp.

Even the items described do not constitute a complete list of parts differences between the transverse and the north-south installations. Further, emission controls for the S-10 truck and the Camaro-Firebird result in differences even in the two north-south installations.

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Idle speed on the 1.9-liter Four can be adjusted without removing the air cleaner.

### The 1.9-liter Four

The stock engine in the S-10 is an in-line four-cylinder made by Isuzu of Japan. At 1.9-liters, it's slightly larger than the 1.8 used in the LUV trucks. As soon as GM has enough J-car engine capacity, it will reportedly give that engine a 90° turn and put it in the S-10. That step is probably a year or two away.

The Isuzu engine has a feature Saturday mechanics will applaud: You can adjust idle speed without removing the air cleaner.

Although the idle-speed adjustment isn't quite as open on the V6 version of the S-10, it won't be around much longer, as an engine computer comes in '83. That computer will also control the automatic transmission lockup torque converter. For '82, the solenoid that triggers lockup is activated by vacuum and transmission governor pressure switches, as was done on precomputer cars. The '82 Camaro-Firebird V6 will have the computer to regulate idle and lockup.

### A Chevette fix

One of the long-term service headaches on Chevette may be in for a factory fix before the 1982 model year is over. It's the location of the A/C compressor and power-steering pump over the distributor, which means you can spend a long time struggling with such a normally simple job as changing a distributor cap or rotor.

As things presently stand, you must take the power-steering pump off its bracket and hang it out of the way, then remove the compressor lower bracket and place the compressor out of the way. Even on the early Chevetttes (on which you could get A/C without power steering), the compressor location is such that you must hang the compressor and remove the lower bracket.

If the planned change goes through, the bracket will be reshaped and the cap will fit through it. So all you'll have to do is cant the power-steering pump (and possibly the compressor) out of the way. **MM**

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CAR CARE GUIDE

# SATURDAY THE '82



The throttle kicker (arrow left) on the carburetor is controlled by the MCU (microprocessor control unit). It boosts the idle speed when a load is put on the engine (if the air conditioner has been switched on or if idle speed drops below 435 rpm). The terminal (arrow below) must be disconnected from the control box and the two prongs wired together to begin a timing procedure. If timing is made without this connection, the timing will be severely overadvanced.



**A**merican Motors has made some seemingly minor changes in its six-cylinder engine computer system for 1982, but they make a big difference in underhood service.

The computer is the MCU (Microprocessor Control Unit), which AMC buys from Ford, but wires to its own specifications. The MCU is used only on the Six because the four-bangers are from General Motors and come complete with the GM Computer Command Control (CCC).

For 1982, MCU operates the vacuum/electric throttle kicker, a device that raises idle speed during cold-engine operation, when the air conditioning is switched on, and if the idle becomes unstable (drops below 435 rpm). In '81, the kicker was controlled by a separate black box.

The MCU also incorporates electronic spark control for '82. It's not the sophisticated digital control used with GM's CCC, the Chrysler computers or Ford's bigger Electronic Engine Control (EEC). Rather, it works with a modified Ford electronic ignition control unit to provide up to 24° of spark timing retard, depending on engine vacuum, idle speed and engine temperature.

The ignition timing procedure, there-

fore, is new and very different from the '81. If you do it wrong, you could end up with real problems. To begin a timing procedure, you must first unplug a two-wire connector from the electronic ignition control unit (not the MCU), which is on the right side of the engine compartment under the starter relay. The wires are yellow and black and it's the only connector with two wires at the control unit. Then connect a jumper wire across the two male terminals of the connector half that is wired to the control unit.

Disconnect the vacuum hose from the distributor and plug the hose end. Yes, the vacuum can still be on the distributor with this system, and it still provides much of the spark advance control. The centrif-



# MECHANIC LOOKS AT AMC CARS

ugal advance in the distributor is also retained and makes its contribution.

Next, warm up the engine and raise idle speed to 1,600 rpm and take your timing readings with a timing light.

If you try to set timing the usual way (with the vacuum hose disconnected and plugged and the engine running at curb idle), the system will have the timing retarded about 17°. You'll aim the timing light and start bumping the distributor until the marks align, and the engine will end up 17° *overadvance*. This much overadvance is sure to cause knock and perhaps melt some pistons.

With all that you have to do on the new models, don't forget to remove the jumper and reattach the halves of the connector. If you don't, timing will be retarded and performance will be poor.

## Warning light

The MCU is a relatively small-capacity computer, so when AMC gave it the two new jobs (idle kicker and spark timing control), it had to take out some work to prevent an overload. AMC decided to take out the dashboard warning light system, a relatively advanced on-board diagnostics arrangement that had the pulsing light display numbered trouble codes as a fault occurred. The diagnostic range was somewhat limited, but it did lead you to the general problem area and reduce the time necessary to pinpoint the fault.

AMC recognized the advantages of on-board diagnostics, and by 1983 it hopes to be able to rework the MCU so there is at least a dashboard warning light to tell you if there is a fault anywhere in the system.

To make checkout easier, AMC is offering a tester that will plug into a socket under the hood. This tester, which reportedly will be priced at about \$200, reduces the checkout to a matter of minutes and seems to be almost foolproof. It gives instructions in simple English on a digital display. It uses an occasional abbreviation, but this is spelled out in the instruction book for beginners. If something is wrong, the tester says so and instructs you to check it.

The tester, which currently checks the sensors, computer and electronic carburetor control, was introduced in the late-1981 model year. The buyer can obtain a new plug-in chip plus a wiring adapter for '81-'82 applications, and there'll be a new chip for '81-'83.

A Saturday mechanic who prefers not to spring for the tester will find manual checkout procedures with ordinary equipment in the shop manual.

## AMC five-speed

A five-speed Warner gearbox will be offered on AMC cars and most Jeeps for '82. The new transmission (in which fifth is an overdrive gear for better fuel economy) has no needle bearings. Instead, there are straight roller bearings for the countershaft and tapered rollers for input and main shafts. As a result, a transmission overhaul is a lot simpler. There's only one bearing that must be removed with a puller, and you don't need dummy shafts to keep all the needles in place when you pull out the shafts for service.

The single serpentine drive belt introduced last year on California Sixes goes nationwide this year. **FPM**

*To make it easier for the Saturday mechanic to check out the status of the computer and sensors, AMC offers this plug-in tester (below). The tester plugs into the left socket of the diagnostic connector (left). Right side is used at the factory for testing electricals.*



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The CAR CARE PROMOTIONS provide a number of ways you can obtain valuable information on how to keep your car in peak running condition.

During the year, you can find helpful maintenance tips and auto product sale announcements in special car care sections of your local newspaper. Many of the 1,400 newspapers carrying these sections use material provided by APAA and POPULAR MECHANICS.

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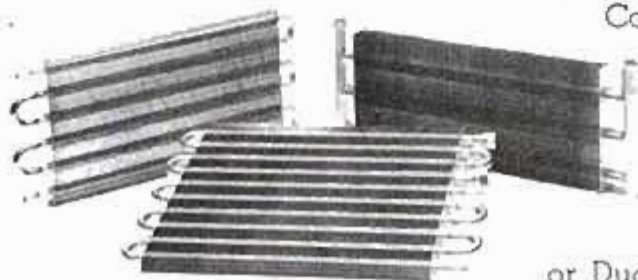
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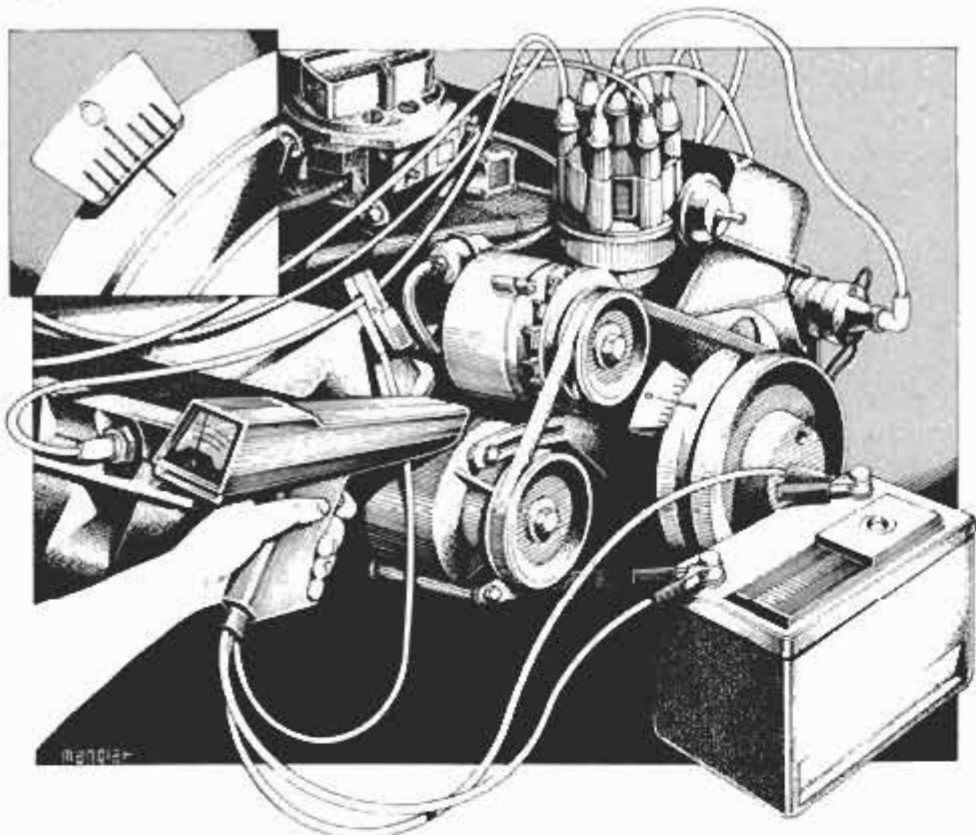


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# THE TIMING LIGHT



Ignition timing is the last adjustment to make when you're doing an engine tune-up. Sparkplugs have been serviced, engine idling speed has been set and distributor point dwell has been adjusted (if your distributor has breaker points). Accurate ignition timing depends on these elements.

To check and adjust ignition timing properly, proceed as follows:

**1. Warm up the engine.** Then, turn it off.

**2. Find the timing marks.** Note that there is an index mark or reference pointer that coincides with the timing marks. The relationship of the index mark or reference pointer with the timing mark when the engine is running tells you the timing of the engine.

**3. Dab the timing mark with white paint** so it stands out from the others. Also paint either the index mark or reference pointer.

In most cases, the manufacturer tells you to disconnect the vacuum hose from the distributor vacuum advance chamber. If you do this, plug the end of the hose with a golf tee or pencil.

**4. Connect the timing light to the battery and No. 1 sparkplug.** If the timing of the spark in the cylinder served by No. 1 sparkplug is correct, the timing of the sparks delivered to all other cylinders will be correct.

The battery hookup presents no problem. The battery leads of timing lights are provided with clips that easily attach to battery terminals.

*The best timing lights have an inductive pickup and a tach function. They can also indicate total spark advance.*

However, the lead that attaches to the sparkplug is another story.

The more expensive timing lights have an inductive (magnetic) pickup clamp. This is a device that attaches right to the No. 1 sparkplug cable. It "feels" current coming through the cable to the sparkplug by magnetic induction. It is easy to use—all you do is attach it to the cable.

With a timing light that doesn't have an inductive clamp, disconnect the cable from the No. 1 sparkplug and insert an adapter between the cable and plug. Then, connect the timing light to the adapter. Never pierce the sparkplug cable with a probe in order to connect the timing light. This will ruin the cable.

**5. Aim the timing light, as you would a pistol—at the timing marks.** If timing is properly adjusted, the timing mark representing the correct adjustment will appear to be motionless in relation to the index mark or reference pointer when the strobe light flashes. If timing is not adjusted to specification, the timing mark will waver. To adjust the timing to specification, follow these steps:

■ Loosen the distributor hold-down bolt. Use a distributor wrench.

■ With the engine running, aim the timing light at the timing mark and rotate the distributor to get timing to specification. If timing has to be set to occur later, rotate the distributor in the

direction the distributor shaft turns. If timing has to be set to occur sooner, rotate the distributor in the opposite direction.

Manufacturer literature may tell you in what direction the distributor shaft turns. If it doesn't, remove the distributor cap and examine the rotor. It may have an arrow imprinted on it that indicates the direction. If not, crank the engine and observe how the distributor turns.

■ When timing has been adjusted, tighten the distributor hold-down bolt. Then, check the timing once more with your timing light to make sure that the adjustment was not altered as you tightened the distributor.

## **Other facts about timing and timing lights**

■ If you know that timing has been set correctly, but the timing mark won't stay stationary, check the following parts: distributor cap, rotor, distributor breaker points, condenser, vacuum advance mechanism and centrifugal advance. One of them is defective.

■ As sparkplug electrodes and distributor breaker points wear, ignition timing is affected. Service these parts and readjust timing frequently, especially if your car does not have an electronic ignition system. With an electronic ignition system, there are no distributor breaker points and the sparkplugs wear less severely.

■ Use a timing light having an inductive clamp to uncover defective sparkplugs. Place the clamp on each sparkplug, in turn, with the engine running. Observe the light. If the light does not flash, the particular plug is fouled.

■ You can test the condition of the automatic advance with a timing light. Connect the light and start the engine. Increase the engine speed gradually. If the timing mark does not move or it vibrates, remove the distributor. Place the distributor on a distributor scope to determine whether the fault lies with the vacuum or centrifugal advance.

■ The most expensive timing lights incorporate a tachometer and a degrees-advance meter that records the total advance (from 0° to 60°, in most cars). These meters permit you to check the total advance at various engine speeds so you can compare the results to manufacturer specifications. If your results don't coincide with the maker's figures, the vacuum advance, centrifugal advance or both are malfunctioning.

Some engines, like the transverse-mounted engines and some foreign engines, do not have the conventional pulley with timing marks and a timing indicator. Instead, they have notches that are cut into the flywheel. In these cases, the notches are lined up with an indicator built into the bellhousing of the engine. The way to see the notches is to remove or slide off a small inspection plate on the bellhousing. Other than this difference, the rest of the timing procedure is performed the same way as on the more conventional engines.



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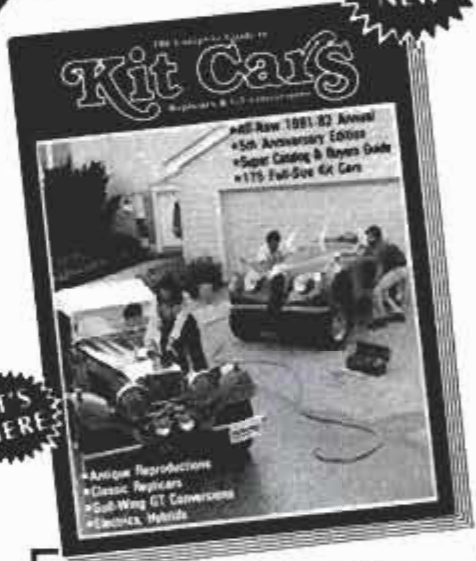
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# THE VACUUM GAUGE

In the hands of someone who knows what to do with it, a vacuum gauge becomes one of the most valuable automotive diagnostic instruments to own. It can help you determine if a gasoline engine has an internal malfunction, and whether there's a breakdown in the fuel, ignition or exhaust system. A vacuum gauge is usually combined with a fuel-pump pressure tester.

To use the vacuum gauge, warm up the engine to normal operating temperature. Then, with the engine turned off, look for a vacuum port in the area of the intake manifold. One way to find it is to trace the vacuum hose from the choke vacuum break on the side of the carburetor to the vacuum port on the engine. After detaching hose, connect the gauge to the port.

If your carburetor has no choke vacuum break, trace the hose from the vacuum motor (the "hump" on the air-cleaner snorkel) of the thermostatic air cleaner to the engine. Disconnect the hose from the vacuum port and connect the vacuum gauge.

Start the engine and run it at slow (curb) idle speed. If this speed is not set to the maker's specification, readjust it.

Referring to the chart at right, proceed with tests, noting both actual readings and how the vacuum gauge needle reacts.

## Fuel-pump pressure tester

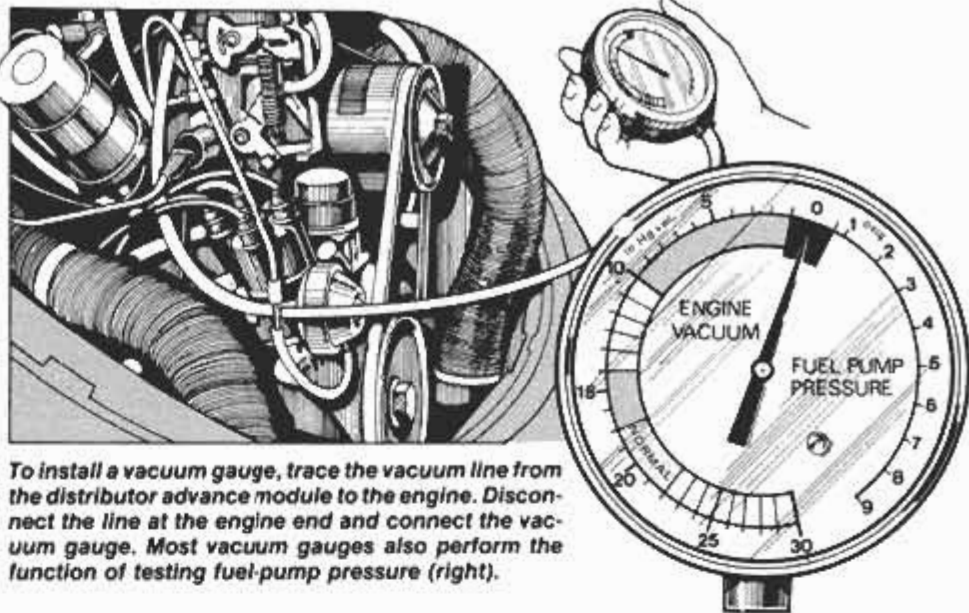
To test fuel-pump pressure of an engine with a carburetor [use the pounds-per-square-inch (p.s.i.) scale of a combination vacuum gauge and fuel-pump pressure tester rather than the inches of mercury (in. Hg.) scale]:

**1. Attach fuel-pump pressure tester adapter** to the end of the gauge hose. This adapter lets you push the hose into the fuel line.

**2. Disconnect fuel line at carburetor.** Catch dripping gasoline in small receptacle or on a rag under the fuel line.

**Cautions:** Don't smoke. Disconnect battery ground cable to prevent sparks that can ignite fuel vapors.

**3. Have someone start the engine,** as you hold the adapter tightly in the end of the



To install a vacuum gauge, trace the vacuum line from the distributor advance module to the engine. Disconnect the line at the engine end and connect the vacuum gauge. Most vacuum gauges also perform the function of testing fuel-pump pressure (right).

fuel line. The engine will run long enough on fuel in the carburetor to let you complete this test.

**4. Let engine idle as you read the meter.** If the reading does not meet the maker's specification, you need to replace the fuel pump.

**5. Hold adapter in the fuel line as the engine is turned off.** The gauge needle should remain steady or fall slowly to zero. If it drops suddenly, the fuel pump may be defective.

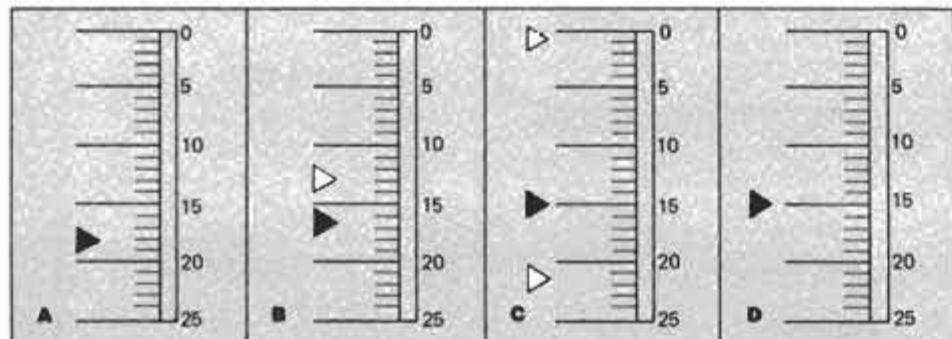
However, first determine if your fuel pump is designed to bleed pressure back to the fuel tank when the engine is cut off. If so, pressure will not maintain itself. The gauge will reflect this, so don't be misled and replace the pump. There's probably nothing wrong with it.

You cannot test a fuel-injection system of a gasoline engine using conventional methods. Consult manufacturer instructions before buying test equipment. In most cases, a special pressure gauge having a three-way control valve is needed.

## VACUUM GAUGE READINGS

| Engine Operation                                   | Reaction of Needle (in. Hg.)  | Meaning of Reaction   |
|--|---|---|
| Slow idle  | Steady at 17-21   | Engine okay   |
| Open and close accelerator rapidly                 | Bounces from 2 to 25  | Engine okay   |
| Slow idle  | Steady at 17 to 21; occasional drops of 1 to 5  | Exhaust or intake valve sticking; sparkplug misfiring   |
| Accelerate gradually                               | Bounces between 17-21; drops several inches at regular intervals  | Burned exhaust or intake valve  |
| Slow idle; then open and close accelerator rapidly | At slow idle, steady between 3 and 5 below normal; as accelerator opens and closes, needle bounces between 0 and 22 | Piston rings or cylinder walls may be worn  |
| Slow idle  | Steady at 13-16   | Ignition timing off   |
| Slow idle  | Steady between 8-14   | Valve timing off due to worn camshaft lobe or timing gear                                       |
| Fast idle  | Steady between 5-12   | Intake manifold gasket, carburetor gasket or PCV hose leaking                                   |
| Fast idle  | Drifts slowly between 14-16   | Sparkplug or breaker point gap out of adjustment; damaged plug, high-tension cable, distributor |
| Fast idle  | Floats slowly between 12-16   | Carburetor out of tune  |
| Slow idle; accelerate gradually                    | Steady when engine starts; slowly drops to 0 at idle; slowly rises at acceleration                                  | Exhaust-system restriction may exist  |
| Slow idle; accelerate gradually                    | Swings widely at all engine speeds  | Head gasket leaking   |
| Slow idle; accelerate gradually                    | Vibrates rapidly between 14-19  | Valve guides may be worn  |

The action of the vacuum-gauge needle is just as important as the readings it gives. Readings below indicate: A, the engine is in good condition; B, valve is hanging open; C, piston rings are worn or leaking; D, ignition timing is off.



▶ NEEDLE HOLDING STEADY

▷ NEEDLE MOVEMENT



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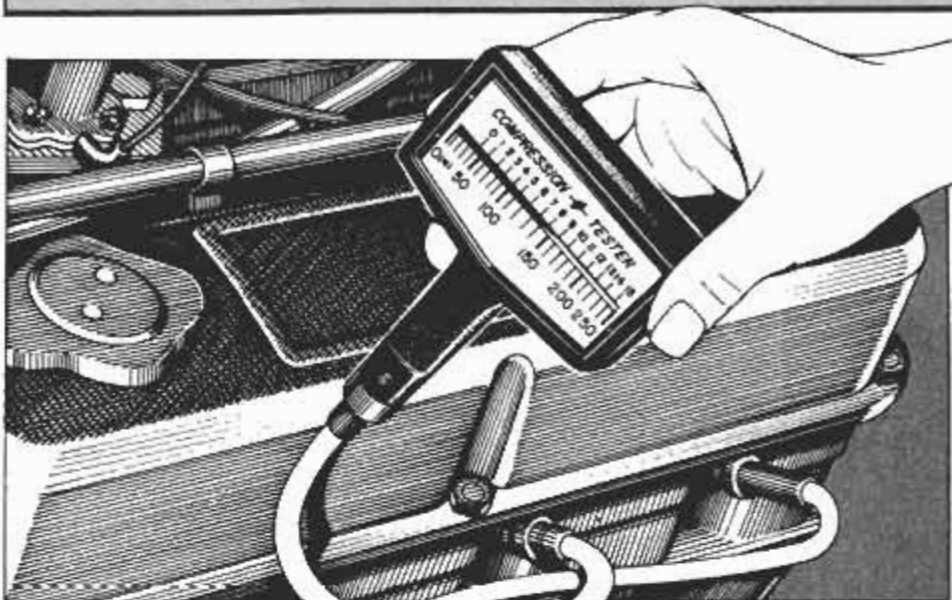
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## SECTION 3

# THE COMPRESSION TESTER



The only compression gauge you should use is screw-in type which lets you thread an adapter directly into the sparkplug port. Handheld units are inaccurate and hard to use.

In spark ignition engines, compression is the pressure developed in cylinders as pistons compress fuel to prepare it for ignition by sparkplugs. In compression-ignition (diesel) engines, it is developed as pistons compress the air, which in turn produces heat that causes the fuel to ignite. Either way compression is a key element of engine performance.

If compression can leak from a spark-ignition or diesel engine, loss of power, excessive fuel consumption and hard starting result. Compression will leak around worn piston rings and valves; also, if the engine has a bad cylinder-head gasket.

The only way to find out if it is escaping from any cylinders is to use a compression gauge. You then compare the readings with manufacturer specifications.

Normal compression for a particular engine is specified in its service literature. If the compression reading falls below the minimum set by the manufacturer, the engine should be overhauled.

### How compression gauges differ

Compression gauges for a spark-ignition engine are usually calibrated up to 300 pounds per square inch (p.s.i.). However, a reading over 200 p.s.i. usually won't be attained. Compression gauges for diesel engines are calibrated as high as 850 p.s.i., but normal readings for passenger-car diesel engines range from 400 to 500 p.s.i.

The two kinds of gauges won't fit both engines. For example, you won't be able to screw the adapter for a gauge used to test spark-ignition engines into the glow-plug holes of a diesel engine.

### Spark-ignition testers

Of two types of testers used on spark-ignition engines, one is screwed into sparkplug ports, the other is held by hand. The former costs several dollars more, is far more accurate, and easier to use. With a handheld gauge,

compression will leak from around the adapter if the instrument isn't held tightly, causing an inaccurate reading. Don't bother buying this type.

To use a screw-in compression gauge, follow these steps:

1. Warm up engine; turn it off.
2. Remove carburetor air cleaner.
3. Remove all sparkplugs.

4. Ground the ignition system to prevent a stray spark from possibly igniting fuel vapors or battery gas.

To ground ignitions of engines other than those with the GM High Energy Ignition (HEI) system, pull the distributor-to-ignition coil high-tension cable from the coil tower. Use a jumper wire to connect the metal terminal in the cable boot to a clean metal part of the engine, such as the alternator bracket or the head of a bolt.

To ground an HEI system, look along the side of the distributor cap and find the terminal marked BAT. Disconnect the wire attached to this terminal.

5. Screw the compression-gauge adapter into the first sparkplug port. Do not use a wrench.

Screw-in compression gauges are often sold in kits with two or more sizes of adapters to fit various sparkplug ports. For example, your kit may have 18- and 14-mm longnose and 14-mm shortnose adapters. Attach the right one to the end of the compression gauge. Then, using a wrench, tighten the adapter onto the gauge.

Caution: If the engine uses 14-mm sparkplugs, be sure the adapter matches the sparkplug, either shortnose or longnose, before screwing it into the engine. If a longnose 14-mm adapter is inserted into a port for a shortnose 14-mm plug, the adapter may be struck by the piston when you crank the engine. This can damage the piston.

6. Crank the engine. Some compression-gauge kits come with a remote starter. If



# FALL 1981 CAR CARE GUIDE

you don't have one, have someone else crank the engine. Record the highest reading shown by the needle. Then stop cranking.

**7. Remove gauge from the cylinder.** See that the needle returns to zero. Most gauges have a pushbutton pressure release.

**8. Test, in turn, all other cylinders in the same way.**

## Analyzing your readings

Consult your service literature for minimum and maximum compression readings set by the manufacturer for the engine (only one specification may be given). Determine if compression is within allowable limits by checking to see if each reading falls within this range. If one falls below the minimum spec, there is a malfunction within the particular cylinder. If only one compression specification is given, a reading below 100 p.s.i. indicates a malfunction.

If a reading is 10 p.s.i. or more above the maximum spec, there may be excessive carbon buildup in the engine, one reason a warm engine may be hard to restart after it has been shut off less than an hour. If you have this problem and possibility of carbon buildup is confirmed by the gauge, ask your auto-parts and accessories dealer for a carbon solvent. Use it according to instructions; then if hard starting has not been resolved, you may want to remove the cylinder head and purge carbon from inside cylinders, around valves and the underside of the head.

Is there a difference of 70 percent or more between the highest and lowest compression readings? If there is, inject SAE 40 engine oil through the sparkplug port into the cylinder giving the low reading. Then retest. If compression does not improve, or does so only slightly, the cylinder valves are probably sticking or burned. If compression shoots up, piston rings in the cylinder are worn.

Is there a difference of 70 percent or more between averaged readings of two adjacent cylinders and those of other cylinders? If so, inject SAE 40 engine oil into both cylinders and take new readings. If both readings increase, you can be reasonably certain that the head gasket is defective.

## Compression in a diesel

Before testing, check maker's literature to determine your preliminary steps. You probably will have to disconnect and tape the electric feed wire to the injection pump, and remove the injectors.

Insert the gauge into injector holes, one after the other, as you crank the starter. Compare readings. Generally, they will mean the following:

■ If compression for any one cylinder is below the minimum allowed or if there is a 70 p.s.i. difference between any two cylinders, engine overhaul is called for.

■ Low readings in adjacent cylinders can mean a bad head gasket. Squirt SAE 40 engine oil into the low-reading cylinder. If readings now increase, suspect worn piston rings, piston or cylinder. If they stay about the same, suspect a bad head gasket. **PM**



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# THE COOLING-SYSTEM ANALYZER

**A** cooling-system analyzer, which is also called a pressure tester, is used for two jobs:

1. Determining if the radiator pressure cap is in good condition.
2. Uncovering parts that are leaking coolant, especially when a leak is difficult to locate.

As long as your engine is cooled by an ethylene-glycol solution, rather than being air-cooled, a cooling-system analyzer can play an important role in troubleshooting and maintenance.

### Testing the radiator pressure cap

To use a cooling-system analyzer for the testing of radiator pressure caps, do the following:

1. **Determine the pressure at which the cap on your car is rated.** This is usually marked on the cap and is the rock-bottom specification at which the radiator pressure-cap relief valve must remain closed.

Pressure in a cooling system, which is controlled by the cap, would increase to the point where coolant would boil were it not for the pressure cap. For every pound per square inch (p.s.i.) at which the cap is rated, the boiling point of the cooling agent is increased 2½°.

2. **Remove the pressure cap from the radiator** and wash it in water. Make sure the engine is cold. Examine the gasket. If it is cracked or torn, don't bother to test the cap. Get a new gasket.

3. **Attach the radiator pressure-cap adapter to the cooling-system analyzer** and attach the pressure cap to the adapter.

4. **Pump up pressure** until the cooling-system-analyzer gauge indicates a reading that is 1 p.s.i. over the pressure specification.

If the cooling-system-analyzer gauge needle fails to reach the correct numeral on the dial, the cap may be faulty. It may also be to blame if the gauge records the correct pressure, but the needle drops when you stop pumping.

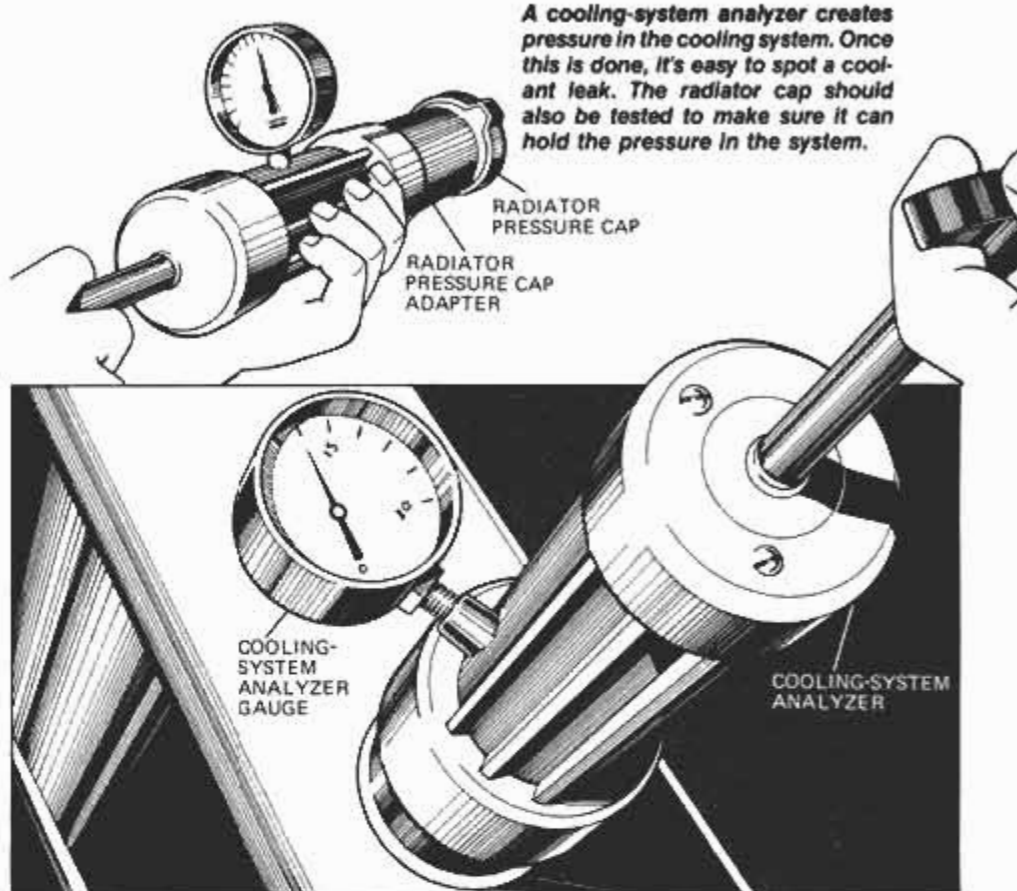
If the gauge shows that the cap is not reaching or holding pressure, remove the cap from the analyzer and wash it again, making sure all deposits are cleaned away. Deposits can prevent the cap from being securely seated.

5. **Retest the cap.** If it still fails to reach or retain pressure, replace it.

### Finding coolant leaks

Many times, gray deposits around a cooling-system hose, on the radiator, around a thermostat housing, or around or on other cooling-system parts will reveal the location of a leak.

However, the location of a leak is not always apparent. Coolant may not leak unless pressure exists in the cooling system, which is only when the engine is hot and running. To avoid having to work on a hot engine near a revolving fan, use the cooling-system analyzer. It will



*A cooling-system analyzer creates pressure in the cooling system. Once this is done, it's easy to spot a coolant leak. The radiator cap should also be tested to make sure it can hold the pressure in the system.*

build up pressure when the engine is turned off and cold.

To uncover a leak, proceed as follows:

1. **With the engine cold, remove the radiator pressure cap.** If the coolant level is low, fill the radiator to the full mark.

2. **Wipe inside of the filler neck.** It must be clean to seat analyzer securely.

3. **Locate the overflow hose coming off the side of the filler neck.** This hose extends down the side of the radiator. Its end will point to the ground or will be attached to a coolant recovery tank. Check to see that this hose is free of obstructions.

4. **Seat the pressure tester securely on the radiator filler neck.** Pump up pressure until the gauge needle reaches the pressure at which the cooling system is rated. Usually (but not always), the pressure rating on the radiator cap and the pressure at which the cooling system is rated are one and the same. Do not exceed the pressure at which the cooling system is rated.

*Note:* A safe rating to use, if you cannot determine the exact rating of the cooling system in your car, is 15 p.s.i.

5. **Stop pumping and watch the gauge needle.** It will do one of several things:

■ It will hold at the specified pressure. This means there are no leaks.

■ It will drop quickly. This indicates a major leak. You shouldn't have trouble finding it. Have someone pump the analyzer so pressure is maintained as you examine the radiator, radiator drain plug, radiator hoses, water-pump housing, heater hoses, heater core, thermostat housing and engine-core plugs.

■ It will drop slowly. This indicates a slow leak, which can be difficult to find. As pressure is being maintained, examine those areas just mentioned.

### Checking inside the engine

If you can't find the leak, it may be inside the engine. Remove the analyzer from the radiator filler neck, reinstall the pressure cap, and start the engine. Let it warm up.

Withdraw the dipstick from the oil dipstick tube and look for signs of coolant in the oil, such as bubbles. Another way of determining if oil contains coolant is to let oil drip on the hot exhaust manifold. If the drop sizzles, coolant is present. A coolant leak inside the engine can be caused by a cracked block or a bad head gasket.

Also check the automatic-transmission dipstick for signs that coolant is mixed in with the transmission fluid. Coolant mixed with transmission fluid would cause the clear red fluid to turn murky, indicating that coolant is leaking into the transmission from a defective transmission oil cooler.



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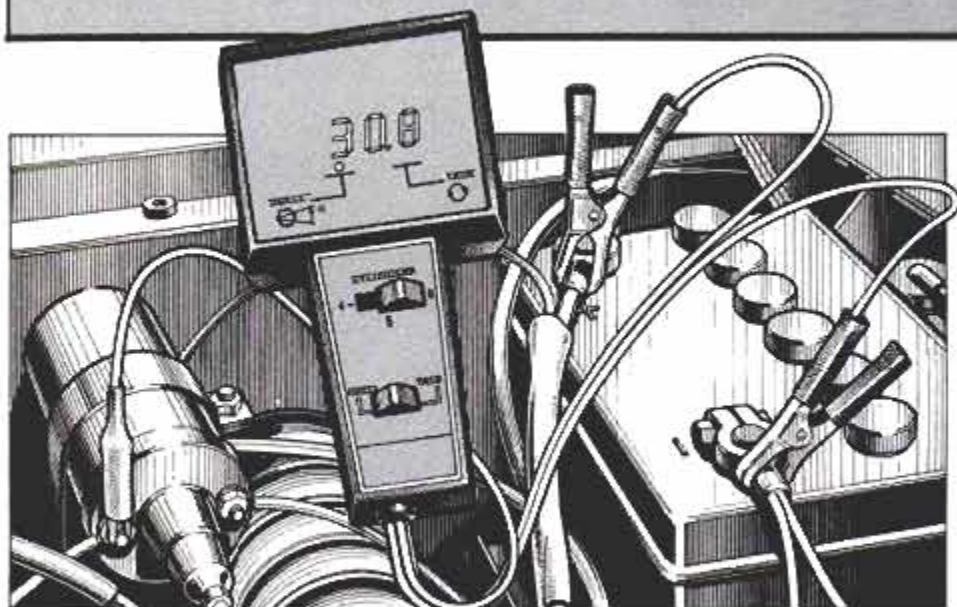
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## SECTION 5

# THE DWELL/TACHOMETER



Digital-type dwell/tachometers are easier to use than the conventional needle-and-dial types. They are accurate to a decimal point and they don't suffer from parallax.

**D**well (cam) angle is the number of degrees through which the distributor cam rotates while distributor breaker points are closed. The time frame during which this takes place is called the dwell period.

The length of the dwell period is determined by the spacing (gap) between breaker points. As the gap narrows, dwell angle increases and the dwell period gets longer. Conversely, as the gap between breaker points widens, dwell angle decreases and the dwell period gets shorter.

When points are closed, energy builds up in the ignition coil. When points open, the ignition coil discharges energy to sparkplugs, which then create the sparks that ignite the fuel mixture. Thus, energy availability to sparkplugs depends on the dwell period.

If the dwell period is too short, ample energy will not have time to build up in the ignition coil. Therefore, insufficient energy will be available to sparkplugs and weak sparks will result. This will cause engine misfire and poor fuel economy.

If the dwell period is too long, the same problems will occur, but for a different reason. If points don't stay open long enough, electricity to sparkplugs is turned off prematurely and a full surge of current won't reach plugs before the points close.

Since electronic ignition systems don't have breaker points, dwell angle cannot be adjusted. It is a fixed setting.

To set dwell angle precisely, you need a dwellmeter. A dwellmeter is often combined with a tachometer into one instrument. Many instruments incorporating a dwellmeter and tachometer (let's refer to them as dwell/tachs) also have a point resistance indicator. When its switch is turned to show point resistance, the needle will point to one of two sections on a colored scale marked OK or BAD. If BAD, replace points.

The dwell, tach and point-resistance indica-

tor require the same connection to the engine. This connection is outlined below.

### How to test dwell angle

Follow these steps:

**1. Determine the recommended dwell angle specification.** General automotive reference books can usually be found in libraries.

Notice that the dwell-angle specification may be given as a range—for example, 29 to 31°. Adjust dwell for the lowest setting. The upper limit is used when making the dwell variation test, described below.

**2. Connect the dwell/tach** by attaching leads to the battery and to the primary terminal (distributor side) of the ignition coil.

**3. Set the selection switch** for the number of engine cylinders. Allow the engine to idle.

If the dwellmeter reading doesn't match the specification, adjust the dwell angle.

### Adjusting dwell angle

If the distributor cap has a slide-open window, lift the window. With the engine running, insert a hex (Allen) wrench into the slot of the point-adjusting screw. Turn the screw one way or the other until the dwellmeter shows that the dwell angle is set to specification.

Be sure to close the window when you're done. Leaving it open will allow dirt to get inside the distributor.

If the distributor cap doesn't have a slide-open window, make the adjustment as follows:

- Turn off the engine.
- Remove the distributor cap.
- Connect a remote-start switch to the starter solenoid and to the battery positive terminal.
- Using a feeler gauge, adjust points to manufacturer specification. This will bring the dwell angle to, or nearly to, its proper position.
- Crank the engine using the remote-start



switch and watch the dwellmeter. If the correct dwell-angle specification has not been attained, set points wider apart or closer together, as necessary. Repeat the procedure until the dwellmeter shows that the proper adjustment has been made.

■ Button up the distributor, start the engine and let it run at idle speed as you check the dwellmeter. A further adjustment may be needed. A difference may exist between the dwell angle the dwellmeter records as the engine is being cranked and the dwell angle the dwellmeter records as the engine is running.

#### About dwell variation

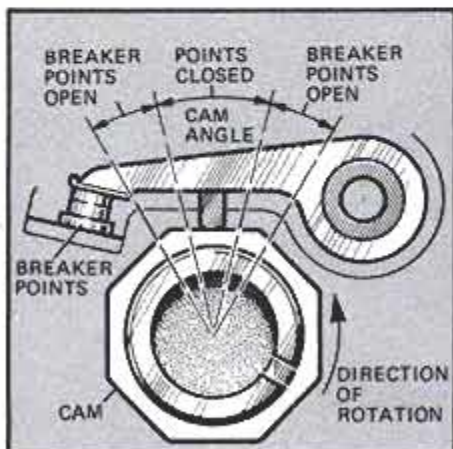
There should not be more than a 4° difference between the dwell angle with the engine running at idle speed and dwell angle with the engine running at high speed.

To check dwell-angle variation, proceed as follows:

1. Warm up the engine to normal operating temperature.
2. Disconnect the hose from the distributor vacuum advance and plug the open end.
3. Connect a dwell/tach.
4. Note the dwellmeter reading at idle.
5. Increase engine speed to 2000 rpm and again note the dwell reading.

If the manufacturer specification provides a dwell-angle range, such as 29 to 33°, the dwellmeter reading at the higher speed should not exceed the upper limit; that is, 33°. If the specification doesn't provide a range, the dwellmeter reading at the higher speed should not be more than 4° above the specified dwell specification.

Excessive dwell variation indicates a malfunction inside the distributor, probably with the centrifugal advance mechanism. The distributor should be removed from the car for repair. **PC**



Dwell angle, or cam angle, is the length of time the breaker points remain closed. It is measured in degrees by a dwellmeter.

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Hot engine runs safely with oil at 300°F manifold at 1200°F

car engine. They ran the engine until it was so hot the exhaust manifolds glowed cherry red. Yet when the engine was examined later, there were no signs of abnormal wear.

Your engine will probably never undergo such extreme heat, but the Shell lab tests prove that Shell Fire & Ice 10W-40 does protect engines when the going gets hot.

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Starting up and driving without the right oil in a cold engine can be damaging, because only certain oils flow well enough at low temperatures to protect critical engine parts. Shell Fire & Ice multigrade oils contain two important viscosity modifiers that allow the oils to remain pumpable at temperatures as low as -5°F.

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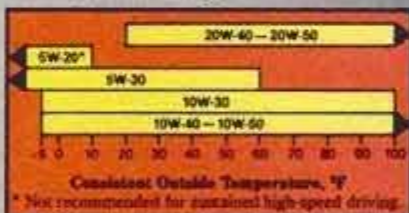
Additive helps protect cam lobes and lifters a coating tough enough to take any pounding the engine can give and lasts until it's time to change your oil again.

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# THE VOLT/OHMMETER

The analyzers needed for testing components that produce, carry and use electricity are the voltmeter, ammeter and ohmmeter. You can buy them separately or incorporated with other instruments, such as a tachometer and dwellmeter. For serious work, you need all three—you can pinpoint the exact component causing a problem. They even allow you to find the parts inside the alternator and starter that are breaking down.

Along with an ammeter, voltmeter and ohmmeter, you should also have a variable-load device (carbon-pile rheostat). It lets you bring current to the manufacturer's specification to check if an assembly is working right.

For instance, suppose you want to find out if a defective alternator is causing the battery to run down. Say that the minimum current rating of the alternator, according to the manufacturer, is 57 amps. Generally, you would connect the carbon-pile rheostat as indicated in the manufacturer's specs.

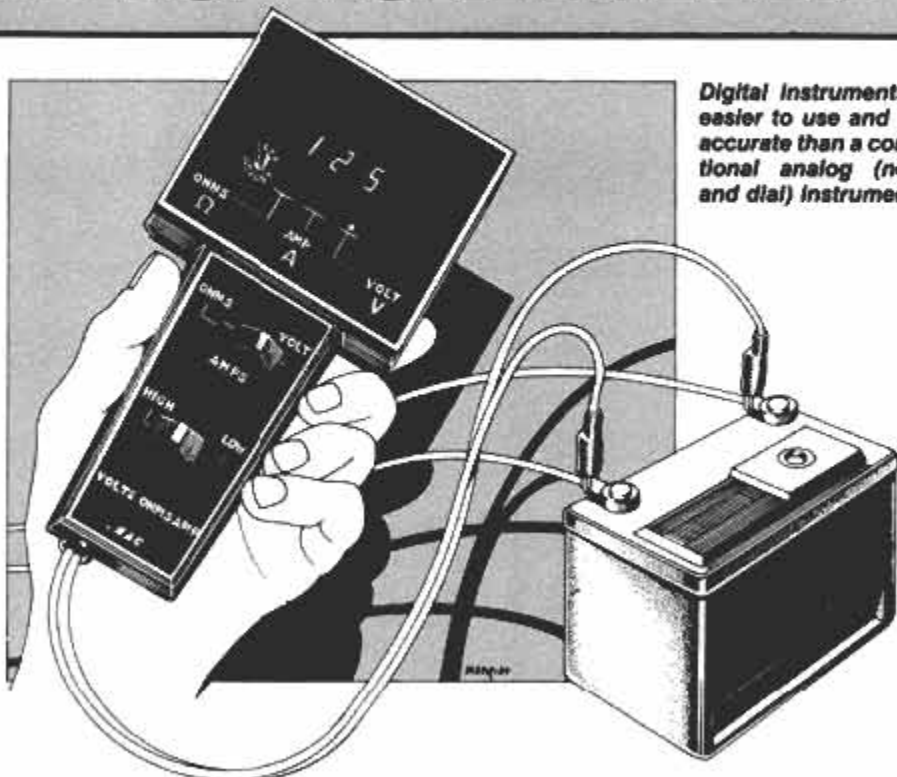
Suppose, for this test, the maker wants the voltage at 15 volts with the engine running at 1,250 rpm. This is the job of the carbon-pile rheostat. It is adjusted so the voltmeter shows 15 volts when the engine is running at 1,250 rpm.

Under these test conditions, the ammeter is supposed to show the alternator is generating at least 57 amps. If the reading is lower, the alternator should be removed from the car, disassembled and tested with an ohmmeter to find the faulty part.

**Caution:** Do not try to test the alternator in your car using this procedure. Each maker prescribes a particular method to prevent damage to the charging system. There are major differences between alternators.

## About ohmmeters

Many components are rated according to their resistance to electricity. The purpose of an ohmmeter is to measure resistance. You can test secondary ignition cables, relays, solenoids, switches, distributor rotors and caps, and the diodes, stator and rotor of an alternator.



Digital instruments are easier to use and more accurate than a conventional analog (needle and dial) instrument.

To show you how easy it is to use an ohmmeter, consider this example—testing secondary ignition cables and the distributor cap:

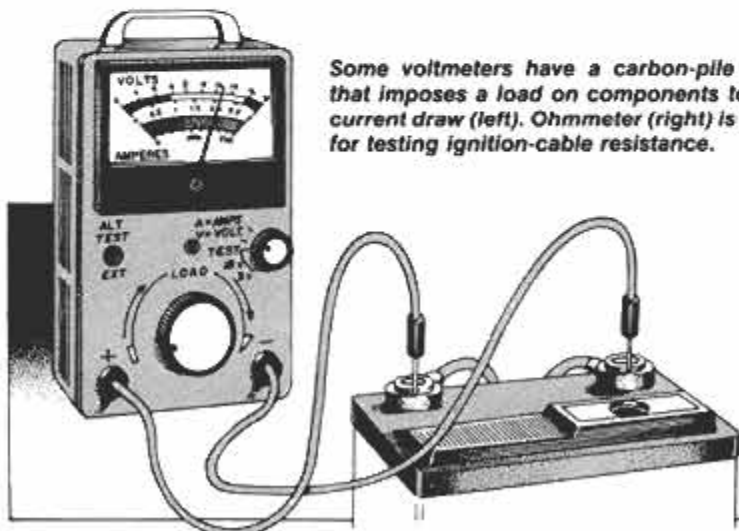
1. Switch the ohmmeter control to the X1000 scale, since you will be measuring thousands of ohms.
2. Remove the cap from the distributor and disconnect a cable from one of the sparkplugs.
3. Touch one probe of the ohmmeter to the terminal inside the distributor cap serving the disconnected cable. Touch the other probe to the terminal inside the boot of the disconnected cable.
4. If the reading is within limits, reconnect the cable and test each of the other cables in the same way.

Determine the manufacturer's cable-resis-

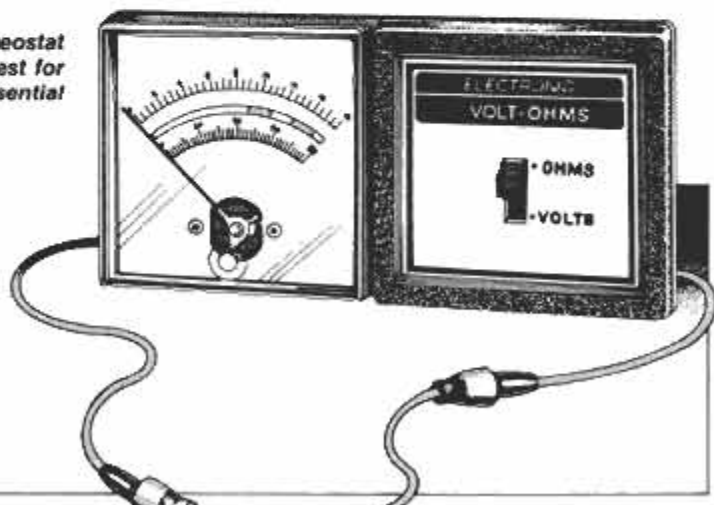
tance specifications for your ignition system by checking the service manual. Depending on the type of cable the ignition uses (suppression or nonsuppression, for example) and cable length, specified resistance may be between 15,000 and 50,000 ohms.

If a cable shows more resistance than specified in the service manual, disconnect the cable from the sparkplug and distributor. Test the cable itself by touching each cable terminal with an ohmmeter probe.

If resistance is still too high, replace the cable. If resistance is now in the normal range, clean the distributor cap with a distributor-cleaning tool. Be sure distributor terminals are not burned or corroded. Reconnect the cable and test cap and cable again. If resistance is still too high, the cap is faulty. You should replace it.



Some voltmeters have a carbon-pile rheostat that imposes a load on components to test for current draw (left). Ohmmeter (right) is essential for testing ignition-cable resistance.





# THE EXHAUST-GAS ANALYZER



*You don't have to be a technical wizard to use an exhaust-gas analyzer. Setting it up requires only a probe up the tailpipe and a connection to your car's battery. The readings are obtained from the display module and compared to the specifications of the car manufacturer.*

An exhaust-gas analyzer gauge measures carbon monoxide (CO) output numerically, as a percentage. In addition, it provides data to define what percentage numbers mean relative to engine performance; that is, the typical exhaust-gas analyzer numerically defines the air/fuel ratio and interprets this to indicate if the fuel mixture is too rich, too lean or just right.

Most exhaust-gas analyzers are also calibrated numerically to show the ratio of air-to-fuel that the engine is actually burning. The optimum air/fuel ratio for each engine is defined by the manufacturer in service literature. It is the ratio that provides the best fuel economy without jeopardizing engine performance. The ratio varies from engine to engine, but it is usually about 14 to 1; that is, 14 pounds of air to one pound of gasoline.

Varying the air/fuel ratio has a direct effect on CO output. There is a direct relationship between the CO percentage specification given by the manufacturer in service literature and the air/fuel ratio. For example, the CO percentage for some 1976 Chrysler Corp. models is 0.5. This translates into an air/fuel ratio of 14.5 to 1. If a malfunction causes a decrease in the air/fuel ratio to, say, 13.5 to 1, the CO output will increase to about 1 percent. A typical exhaust-gas analyzer would show this and indicate the existence of a problem.

## Using the analyzer

To connect an exhaust-gas analyzer, attach the electric pickup clips to the car battery. Lay the transducer at the rear of the car and insert the pickup tube into the tailpipe.

Set up the indicator as spelled out by the instrument manufacturer.

With the engine warmed up, check the percentage of CO at slow idle and fast idle. If the needle shows the CO level is within the limits defined by the manufacturer, you can con-

clude the fuel mixture is in balance. If the needle shows excessive CO output (fuel mixture too rich) the cause might be one of the following:

- Restricted air-cleaner filter.
- Carburetor float level too high.
- Defective carburetor needle valve.
- Malfunctioning (not opening soon enough) or improperly adjusted (set too rich) automatic choke.
- Carburetor set too rich.
- Excessive fuel-pump pressure.
- Incorrectly adjusted ignition timing.

If the exhaust-gas analyzer indicates an excessively lean mixture, check the following possibilities:

- Vacuum leak.
- Carburetor float level too low.
- Leaking carburetor float.
- Inadequate fuel-pump pressure.
- Malfunctioning (opening too soon) or improperly adjusted (set too lean) automatic choke.
- Fuel mixture too lean.
- Restricted fuel filter or fuel line.
- Restricted carburetor passages.

## Propane enrichment method

The catalytic converter has made it difficult to determine whether carburetors are adjusted properly, even with an exhaust-gas analyzer. Converters drop the emission levels of carbon monoxide dramatically.

To uncover an imbalance in the fuel mixture in catalytic-converter-equipped vehicles, therefore, most car manufacturers suggest using the propane-assisted method. Every engine exhibits a characteristic response to an increased richness of the fuel mixture. In other words, with the richness of the fuel mixture at a particular level, engine speed (measured in

revolutions per minute) will attain a maximum level. As richness is increased beyond that level, engine speed will decrease.

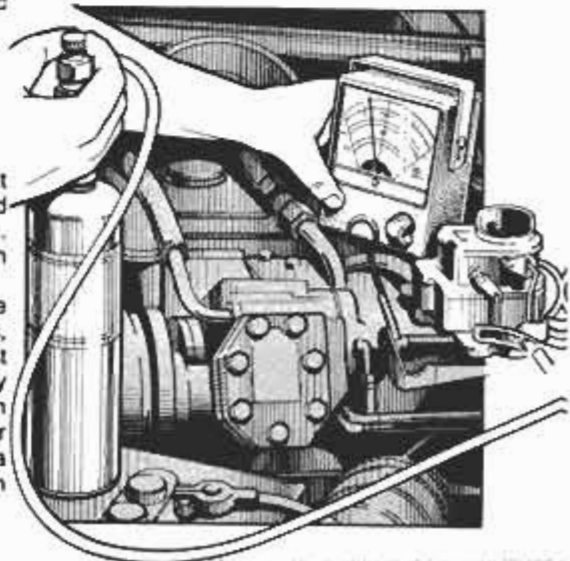
Richness is attained by injecting propane directly into the carburetor. A tachometer is connected and propane is injected into an opening of the carburetor.

*Note:* Follow manufacturer instructions. They vary one from the other.

After attaching the tachometer and propane assembly, adjust the level of propane. Look for one of the following:

- If engine speed hits and stays at the specified level, the fuel mixture is correct.
- If rpm level falls below specification, the fuel mixture is too rich. An adjustment of idle mixture is required.
- If the rpm level is above specification, the adjustment is too lean.

*On some catalytic-converter-equipped cars, it may be necessary to use the propane-enrichment method to get a reading*







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Today, Americans are buying more radials than any other tire. And the Michelin radial continues to set the standard for performance and consistent quality. Tire after tire, mile after mile.

Yet Michelin radials cost about the same as other leading brands. No wonder we're America's fastest growing tire company. We're Michelin. We put America on radials.



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Not so long ago, it was easy to buy an economy car for two or three thousand dollars.

Today, you're lucky to find one for *five* thousand. And replacement engines haven't gotten any cheaper, either.

So it makes sense to change your oil and put in a new Fram oil filter *at least* as often as your owner's manual tells you to.

After all, a new Fram oil filter doesn't cost much. A new engine does. But, the choice is yours. You can pay a little now. Or a lot later.

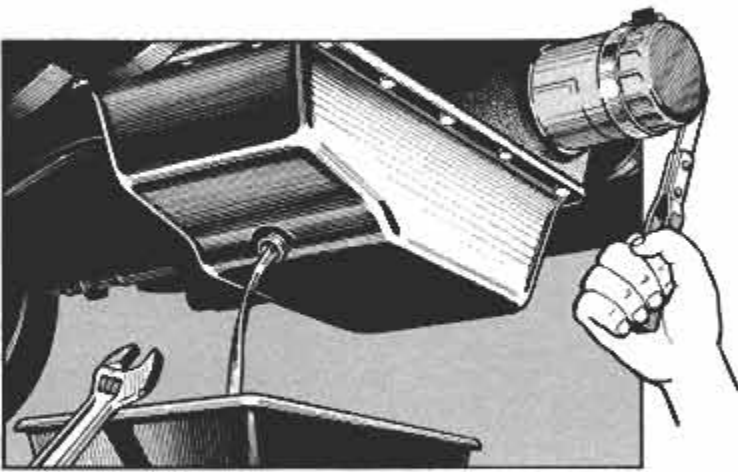


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# OIL-FILTER TOOLS

Changing the oil and the filter is probably the easiest, but most important service job you can do. There are precautions, however. Use the right grade of oil for your engine. Use the right type and size of oil filter and the correct filter wrench. Some of the new car models require special oil-filter wrenches.



**C**hanging engine oil and replacing oil filters are two easy-to-do tasks that are undertaken by many car owners. However, this work can be made even easier if you follow these suggestions:

- Be sure you have an oil-filter wrench that fits the oil filter. The diameter of an oil filter for a passenger-car or pickup-truck engine falls into one of three size ranges: 2 1/4 to 3 1/4 inches, 3 1/4 to 3 3/4 inches, or 3 3/4 to 3 7/8 inches. Oil-filter wrenches are made to accommodate these sizes.
- See that the wrench is shaped to fit the configuration of the oil filter. For example, you can easily slide a strap wrench onto the oil filter of a Chrysler Corp. K-car, but you will have difficulty working with a strap wrench on the oil filter of GM X-body and J-body cars because of limited space between the oil filter and surrounding components.
- Have the right kind and amount of oil on hand. Don't deviate from the API (American Petroleum Institute) oil classification recommended by the manufacturer of your engine in the owner's manual. If the manual says to use API classification CC for a diesel engine, use API-CC—not API-CD.

### How to change oil and filter

To change the oil and filter properly, follow this procedure.

- 1. Warm up the engine to normal operating temperature** or do the job soon after you've run your vehicle on the highway. Turn off the engine.
- 2. Place a pan or pail under the oilpan drain plug.** Know your oilpan capacity so that you can select a container large enough to hold the waste oil without overflowing.  
*Caution:* Engine and exhaust-system components are red-hot and can cause severe burns. Avoid them.
- 3. Loosen the oilpan drain plug using an adjustable or box wrench.** Then unscrew the plug by hand. Draw your hand back quickly to avoid contact with hot oil. Allow the oil to drain.  
*Note:* Some cars have drain plugs with recessed holes. They require a special inset wrench that fits into the hole.
- 4. Put a pail or rags under the oil fil-**

**ter.** Attach the oil-filter wrench and turn the filter counterclockwise to loosen it.

- 5. Wipe the engine flange with a clean rag.**
- 6. Screw the drain plug back into the oilpan and tighten the plug by hand.** Then, using a torque wrench, torque the plug to 20 foot-pounds. Don't overtighten.
- 7. Coat the gasket of a new oil filter with clean engine oil.** Be sure the filter you're installing is the one recommended by the engine manufacturer.
- 8. Screw the filter on the engine hand-tight.** Do not use the oil-filter wrench.
- 9. Fill the crankcase with fresh oil.** If you aren't sure how many quarts of oil are required, check the oil dipstick frequently. Do not overfill the crankcase. Stop filling when the oil level is at the FULL mark.
- 10. Start the engine.** Let it run as you check around the oil filter and oilpan drain plug for leaks.

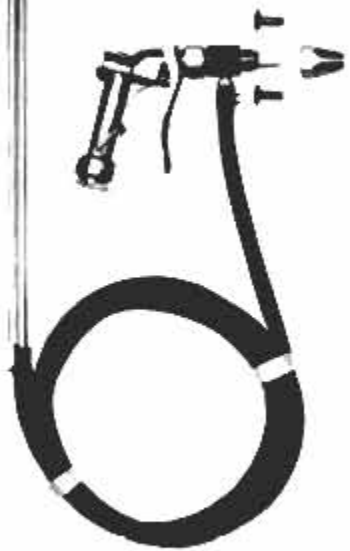
### A matter of philosophy

Should you replace the oil filter everytime you change oil? Automakers recommend you replace oil filters every second oil change. As you might expect, oil-filter manufacturers disagree. They recommend replacing a filter at each oil change. Here are the reasons given by the manager of the testing laboratory and model shop for the Fram Corp.

- Dirty oil will remain trapped in the old filter. If you don't replace the filter when changing oil, this dirty oil will adulterate the fresh oil as soon as the two mix.
- The element of an oil filter is a depository for contaminating agents. Fresh oil has a full "charge" of additives. If you leave an old filter in place, additives will attack the dirt in that oil, leaving less to attack dirt in the engine.
- You can't see inside an oil filter. You don't know if one that's been in use for a time has a relief valve which is stuck in the open position. In this case, oil will not go through the filter; it will bypass it and unfiltered oil will flow through the engine.

Okay, those are the arguments for and against replacing an oil filter every time you change oil. Take your choice. **PMC**

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# Gas Saver Tested & Patented

DENVER—The Copley News Service reported that United States Patents have now been issued to Wm. Trevaskis, California veteran electrical engineer, for his Vapor-Jet® brand water vapor injector.

Trevaskis has developed what amounts to a 20 cents per gallon "rebate" potential on gasoline, by designing a low-cost injector for automobiles, light trucks, vans and recreational vehicles.

The Vapor-Jet® system has test results showing miles per gallon improvement of 17.3 per cent on Trevaskis' 1971 Ford Galaxy and 13.3 per cent on his 1973 Olds Starfire.

Water injectors were developed to a highly refined state during World War II, to give combat planes increased speed and extended range. However, up to now, the low price of gas and the high cost and extremely difficult installation required for earlier injectors combined to make them unattractive.

The Vapor-Jet® has an unconditional 60 day guarantee.

*How does the Vapor-Jet® system work?*

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and a mist to form in the upper part of the reservoir. This mist is then drawn by vacuum through a hose which is connected to any intake manifold suction hose. This connection is made very simply by our exclusive hypodermic-like injector nozzle which contains a regulator to allow just the right amount of mist to pass into the combustion chamber.

The introduction of this mist into the fuel air mixture has a cooling effect that increases the mixture density, extends the burning rate, and improves combustion efficiency. This eliminates ping (predetonation) and dieseling (after running of motor). Since steam is a good cleaner it also helps dissolve carbon deposits on the spark plugs and cylinder walls of older vehicles and helps prevent carbon buildup in new ones.

*How much mileage increase can be expected?*

This varies from car to car. Independent testing on Trevaskis' car obtained improvements from 13.3% to 17.3%.

*Will Vapor-Jet® fit all cars and is it*



*easy to install?*

Yes. Vapor-Jet® is easily installed on all domestic and foreign cars, vans, light trucks, R.V.s, campers, motor homes, and small boats. It will work on fuel injection, lean burn cars and cars with turbo chargers and super chargers and rotary engines. It will also work with unleaded gas, gasohol, or propane burning cars. The same kit fits all cars and contains everything needed. Simple installation instructions with a diagram are included and even a novice should be able to install it in less than 15 minutes. Simply take an ice pick or drill and make a small hole through any intake manifold suction hose (i.e.; PCV hose, brake assist hose, vacuum advance hose, etc.). Screw the injector nozzle into the hole, mount the reservoir by means of the bracket and screw supplied and connect the reservoir to the injector nozzle by means of the hose supplied. If you don't want to install it yourself most service stations will for a few bucks.

*Can Vapor-Jet® damage my engine or cause rust?*

Absolutely not! Vapor-Jet® cools down the fuel air mixture giving a better burn and suppresses ping thus aiding your engine. The mist that enters into

the engine turns immediately into vapor and exits out the exhaust.

*What is the purpose of the methanol V.I.M. (Vapor Injector Mix) and how long does it last?*

The reservoir measures 3½" x 5½" x 7½" and holds just under ½ gallon. A full reservoir should last about 1,000 miles. Methanol (wood alcohol) is mixed with water mainly to prevent freezing and to keep the injector nozzle clean in non-freezing weather. The cost of methanol is minimal (about \$5 a gallon). One gallon will last 8,000 miles. Sources of methanol are chemical supply houses, paint stores and drug stores. Substitutes are gas line antifreezes that contain methanol such as "Heet".

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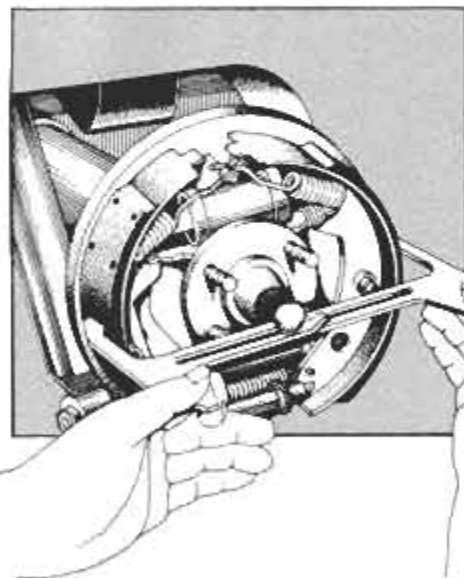
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# BRAKE TOOLS



*Brake-shoe adjusting gauge allows you to check installed tolerance between the brake drum (below) and brake linings (left). It also checks amount of metal removed if drums are cut on a lathe.*



**T**ools discussed in this section are brake-spring pliers, brake spoon, brake-bleeder wrench, one-man brake bleeder, sleeve installer, wheel-cylinder hone, brake-shoe adjusting gauge, drum puller and C-clamps.

Some tools you will need. Others you won't, depending on the car. If you aren't able to determine which tools apply to your particular needs, consult your car's shop manual, or your auto parts and accessories dealer, if need be.

Tools dealt with here are divided into three categories: (1) those for working on drum brakes; (2) those for working on disc brakes; (3) those that apply to both.

## Drum-brake tools

Tools that come under this heading are brake-spring pliers, brake spoon, wheel-cylinder hone, brake-shoe adjusting gauge and drum puller.

■ **Brake-spring pliers** are used to remove brake-shoe return springs, so you can remove and replace worn brake linings. Brake-spring pliers are actually three tools in one. The end of one handle is socket-shaped for loosening or tightening anchor bolts to which return springs are attached. You can then pull return springs free or secure them, using the end of the other handle. It is shaped like a lever to permit you to lift springs off anchor posts. The working end of brake-spring pliers is shaped to grasp brake shoe springs, so you can pull them free.

■ **Brake spoons** are needed only if your car has drum brakes that are not self-adjusting. Spoons are made in several different shapes to fit through the various shaped access holes cut into backing plates and brake drums.

The brake spoon is inserted through the access hole and is placed against the adjusting wheel, called a star wheel. This is turned one notch at a time to bring brake linings against the brake drum. Then, the star wheel is backed off a notch or two so the wheel, when turned, rotates freely.

■ **Wheel-cylinder hones** are used to remove imperfections from the bores of wheel cylinders. Imperfections—scratches, pit marks and rust—damage new wheel-cylinder parts used to overhaul a wheel cylinder. Wheel-cylinder hones come in various sizes to fit different wheel-cylinder bore sizes, so be sure to get the correct size.

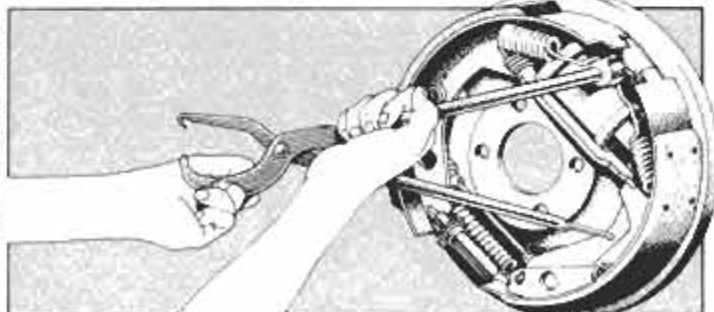
Attach the hone to an electric drill and coat the wheel-cylinder bore with brake fluid. Then, hone the bore, removing as little metal as possible. Wash the bore with brake fluid and place wheel-cylinder pistons in the bore. Check manufacturer specifications for the allowable piston-to-bore wall clearance. Generally, it is no greater than .003 inch.

See if you can get a feeler gauge one size larger than specified between pistons and the bore wall. If you can, discard the bore and use new wheel cylinders.

■ **Brake-shoe adjusting gauge** is used for making the adjustment between the brake drum and brake shoes after replacing the brake shoes. Set the gauge to the inside diameter of the brake drum and tighten the lock screw. Turn the tool over and place it on the brake shoes. Expand the shoes until the gauge just slides over the linings.

■ **Drum puller** is something you may need if a brake drum can't be removed by hand. Place the puller so that its claws hook the drum rim.

*The brake-spring pliers are actually three tools in one. One end of handle is shaped like a socket and allows you to remove anchor bolts. The other end allows you to remove and install the return springs.*



Tighten the lug, exerting pressure inward against the wheel hub. The combination of inward pressure against the hub as the puller's claws exert outward pressure on the drum will cause the drum to pop loose.

## Disc-brake tools

■ **Sleeve installer** is used to guide new sleeves into the ears of a disc-brake caliper when overhauling the caliper. The installer allows you to do this quickly and easily. Just place the sleeves on the caliper ears, put the installer on top of the sleeves and push them into place.

■ **C-clamps** are used to push the piston back into its bore when you have to remove the caliper. The C-clamp keeps the piston from pushing against brake pads which, in turn, press against the rotor. With the piston out of the way, adequate clearance is established, which makes it possible for you to lift the caliper off the rotor.

## Tools for both

Tools you may need when working on drum brakes, disc brakes or both are a brake-bleeder wrench and a one-man brake bleeder. As you can tell by their names, both tools are used following brake repair to purge (bleed) air from the hydraulic system.

The offset brake-bleeder wrench is useful if bleeder screws are located where it's difficult to reach them with an ordinary box wrench. The one-man brake bleeder, a relatively new tool, is designed to permit one person to bleed the brake hydraulic system. Usually, two people are needed—one to pump the brake and the other to work under the car.

To use the one-man brake bleeder, place a box wrench or a brake bleeder wrench around the bleed screw and attach the spring end of the one-man brake bleeder to the bleed screw. The spring locks the tool to the bleed screw. Open the bleed screw.

Go behind the steering wheel and pump the brake pedal slowly six times. A one-way check valve on the end of the one-man brake bleeder will allow air to escape, but will trap brake fluid.

At the bleed screw again, check the see-through hose of the one-man brake bleeder to see if there are air bubbles in the fluid. If so, repeat the procedure. If not, bleeding at this bleed screw has been accomplished. Proceed to the next one.



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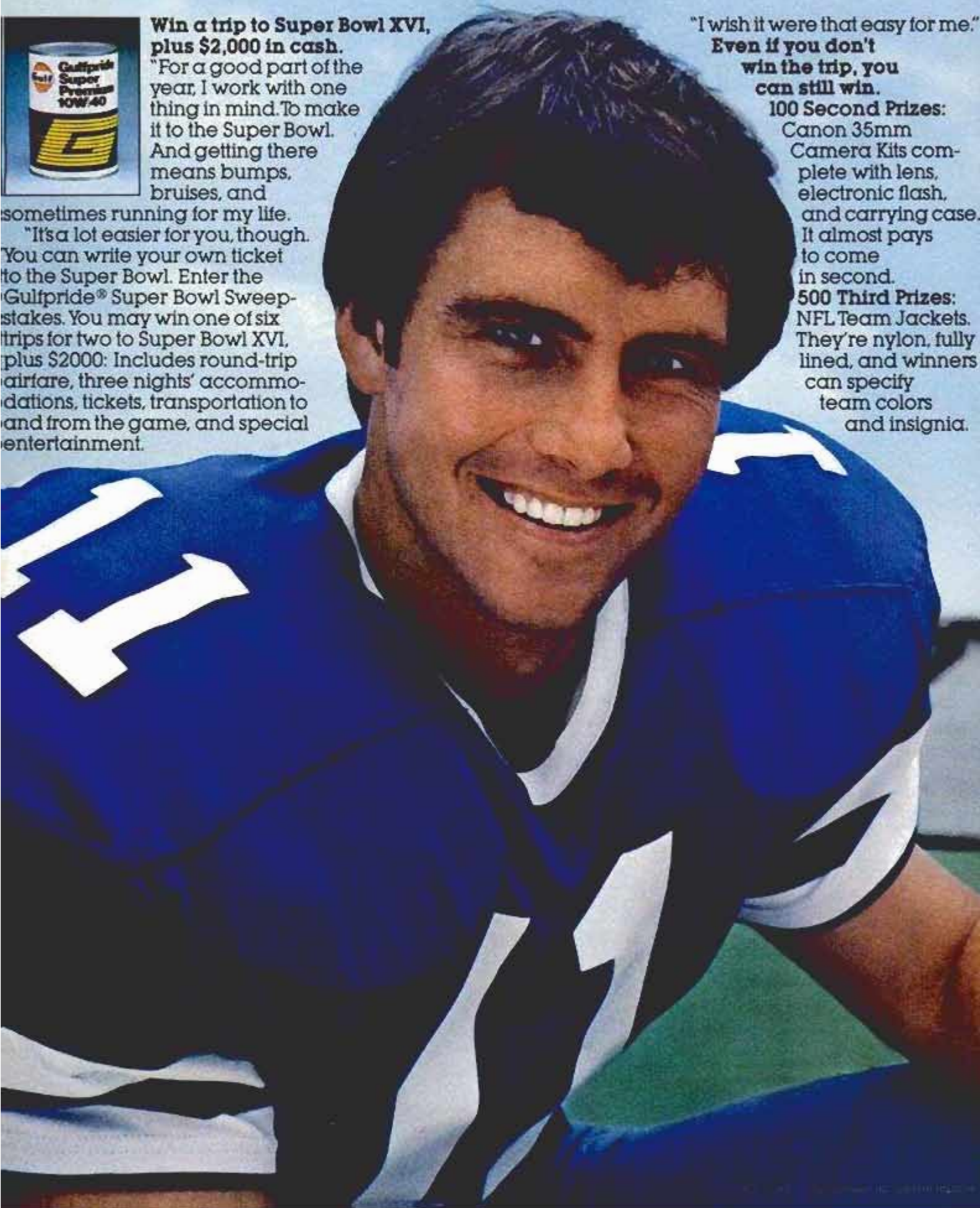
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**Danny White**  
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2. All entries must be received by November 15, 1981. Not responsible for illegible, lost, late, damaged, or delayed entries.

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5. Sweepstakes open to licensed drivers, except employees of Gulf Oil Corporation, its affiliates, subsidiaries, Gulf motor oil re-sellers and agents, advertising and promotion agencies, and the families of each. Void in service stations in Maine, Maryland, Massachusetts, New Hampshire, New Jersey, and wherever prohibited by law or where Gulf Oil Corporation would be liable for any tax.

6. For a list of major prize winners, send a self-addressed, stamped envelope to Post Office Box 4082, Beverly Hills, California 90213.

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FALL 1981  
**CAR CARE GUIDE**  
 SECTION 10  
**THE TORQUE WRENCH**

vented. For example, tightening a cylinder head incorrectly can ruin the head, or components in the head or the engine block of your car.

Other examples? If you overtighten covers and pans, you could twist or distort them. If you undertighten covers and pans, gaskets may not compress sufficiently to stop potentially disastrous fluid leaks.

Torque refers to twist and is summed up by the formula:  $F$  (force)  $\times$   $D$  (distance) =  $T$  (torque). It is measured in foot-pounds or inch-pounds, and the wrench that's used for measuring torque is calibrated in either foot-pounds or inch-pounds.

However, you can usually get by with one wrench, be it foot-pounds or inch-pounds. If you're working with a torque wrench calibrated

**C**ar manufacturers provide torque specifications for a reason. They want certain fasteners tightened to particular values, so serious damage to components will be pre-



**Beam-type torque wrench is the least expensive type you can buy. Reading is taken from the dial and the needle in handle.**

in foot-pounds and the manufacturer specification for the particular item calls for an inch-pound measurement, apply this conversion factor:  $\text{inch-pounds} \div 12 = \text{foot-pounds}$ . Conversely, if you're working with a torque wrench calibrated in inch-pounds and the manufacturer specification for the particular item calls for a foot-pound measurement, apply this conversion factor:  $\text{foot-pounds} \times 12 = \text{inch-pounds}$ .

**Torque-wrench technique**

To use a torque wrench properly, you don't just attach it to a fastener and pull. A certain finesse is needed that is exemplified by the following example for tightening cylinder-head bolts:

- Tighten all bolts to one-third of the torque value, following the tightening sequence spelled out by the manufacturer in the service manual.
- Beginning with the first bolt you tightened, now tighten all bolts in sequence to two-thirds of the torque value.
- Return to the first bolt and tighten all bolts in sequence to the full torque value. Be sure you haven't missed any bolts.
- Warm up the engine and use the torque wrench to check each bolt.

Torque wrenches come in a variety of styles and functions. The cheapest is the beam type, which has a dial and an indicator built into the handle. With this style you have to keep an eye on the indicator and stop when it reaches the desired torque setting. This type sells for about \$12.

The next step up is the clicker type. This has a dial built into the handle which lets you pre-select the desired torque setting. The wrench will give an audible click when the predetermined torque value is reached. These generally cost around \$40.

At the top of the heap is the digital torque wrench. It's similar to the clicker type in that it clicks at the preselected torque value, but it also gives you a digital reading. This type costs around \$60.

No matter what type you purchase, keep in mind that it will have to be calibrated at least once a year. Most manufacturers will charge you a nominal fee for calibrating a torque wrench.

**Some cautions**

To ensure accurate torque readings, see that the fastener threads are clean before fasteners are tightened.

Torque values are figured on the basis of a standard-length torque wrench. If you use an extension that's the same length as the lever length of the wrench, tighten the fastener until double the manufacturer specification shows on the wrench scale.

Don't use a torque wrench to loosen fasteners. This puts too much stress on the wrench, which could be damaged.

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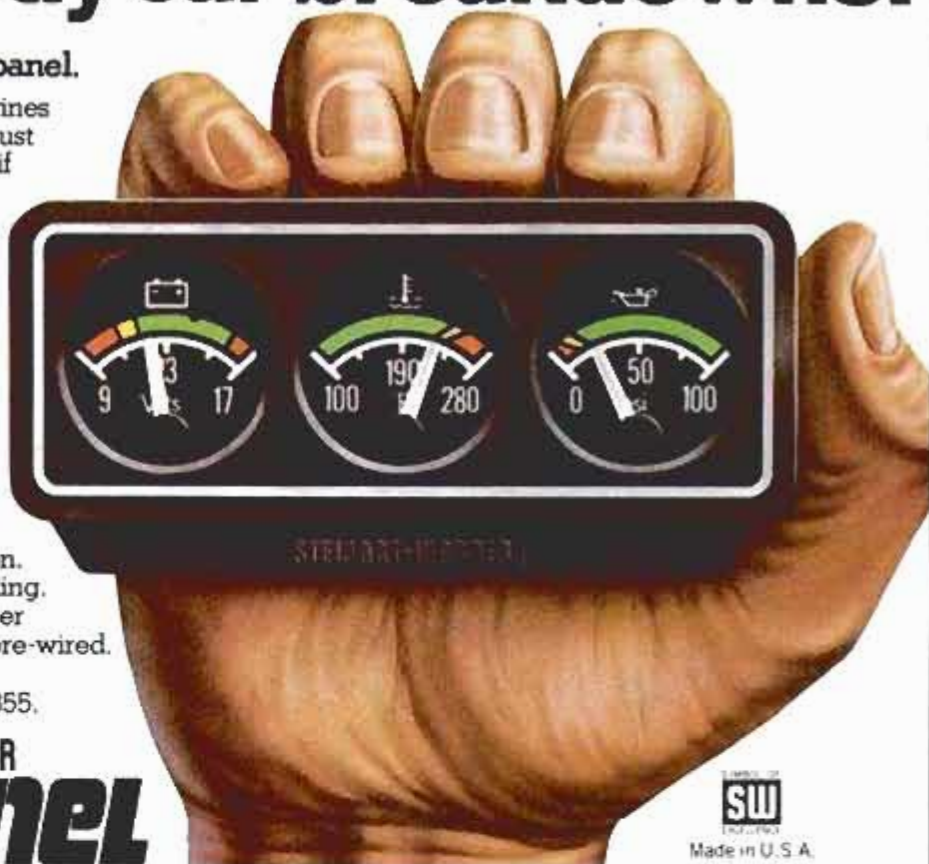
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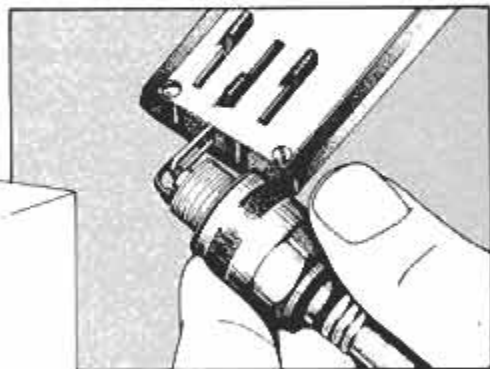
FALL 1981  
**CAR CARE GUIDE**

SECTION 11

## SPARKPLUG TOOLS



Sparkplug sandblaster (left) and gapper are the only tools you need to keep your plugs in good shape. Wire-type feeler gauge is the most accurate for checking sparkplug electrode gap.



If you service sparkplugs every 5,000 miles with the proper equipment, you'll maintain engine performance and fuel economy for the life of the plugs.

### Removing plugs

Remove sparkplugs, when the engine is cold, as follows:

1. Mark each sparkplug cable with an identifying number, so each cable can be reconnected to its proper cylinder.
2. Rotate the sparkplug boot back and forth as you pull the boot off the plug.
3. Loosen each plug one turn. Then, blow away carbon and dirt from around the plug. Use compressed air.
4. Remove each plug and identify it to the cylinder from which it comes.

### Are plugs serviceable?

After all plugs have been removed from the engine, examine them to determine if they can still be used.

Plugs which have been operating in a healthy engine will have few, if any, deposits. The few deposits that may be present will be light tan or gray in color. Electrode wear will appear negligible. In fact, average electrode-gap growth in a properly functioning engine is only .001 in. per 1,000 miles.

The following describes three common conditions you may find when you examine plugs:

- Dry, fluffy carbon deposits on the lower ends of insulators. If all plugs look this way, the engine is probably operating on an over-rich fuel mixture. If only a few plugs are fouled, suspect that ignition cables serving the plugs are damaged or that the cylinders which plugs serve have worn valve guide seals.
- Wet, oily deposits on the lower ends of insu-

lators. In an old engine, suspect worn piston rings or excessive cylinder-wall wear. In a new engine, this condition is normal and will continue until the piston rings seat, which should be within 7,500 miles.

■ White, blistered insulators and rapid electrode wear. Sparkplugs are overheating, possibly because ignition timing is overadvanced and causing detonation, or there is a restriction in the cooling system.

### Servicing plugs

Assuming plugs are in good enough condition to be returned to use, service them as follows:

1. Wipe each plug with a clean cloth to remove oil, dirt and moisture.
2. Wash the plug in a cleaning solvent, such as kerosene if the plug is oily. Dry the plug thoroughly with compressed air.
3. Put each plug in the sandblaster to clean electrodes. Don't blast for any longer than five seconds.
4. Open the side electrode enough to slip a sparkplug file between the electrodes. Use a sparkplug tool, not pliers or any other tool.
5. File electrodes by passing a sparkplug file between them only once or twice.
6. Clean plug threads with a small hand- or machine-powered wire brush, but be careful not to touch the electrodes.
7. Gap plugs to manufacturer specification, which is given on the vehicle emissions control label found in the engine compartment of your car. Bend only the side electrode with the bending part of the gauge to get the proper adjustment. The gap is correct when you feel a slight resistance as you move the wire feeler gauge back and forth between electrodes.
8. Use a thread chaser to clean cylinder-head threads before installing the sparkplugs.
9. Set plugs finger-tight. Then, using a torque wrench, tighten them to manufacturer specification.

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Photos by Ron Hussey

## Mamola scorches Laguna Seca. Champion supplies the fire.

Randy Mamola...  
Champion  
Spark Plug 200  
winner

It wasn't really a sure thing that Randy Mamola would be racing at Laguna Seca this year. The 1981 Champion Spark Plug 200 had attracted most of the big names — guys like King Kenny Roberts and Fast Freddie Spencer — but some expected Mamola might remain in Europe where his performance in the big-bore Grand Prix league has been nothing but sensational.

Fact is, Randy did show up at the Monterey, California, circuit. With a

500cc Suzuki and a desire to show that his European exploits were more than racer's luck.

With Champion supplying the sure-fire plugs, Mamola came up with effortless wins in both AMA sanctioned 100-km heats. Most race observers agreed the Suzuki's dependability (not to mention a little extra daring in Seca's famed corkscrew corner) was a major factor in Mamola's win.

Moral: If you want to run with the champions, run with Champions.



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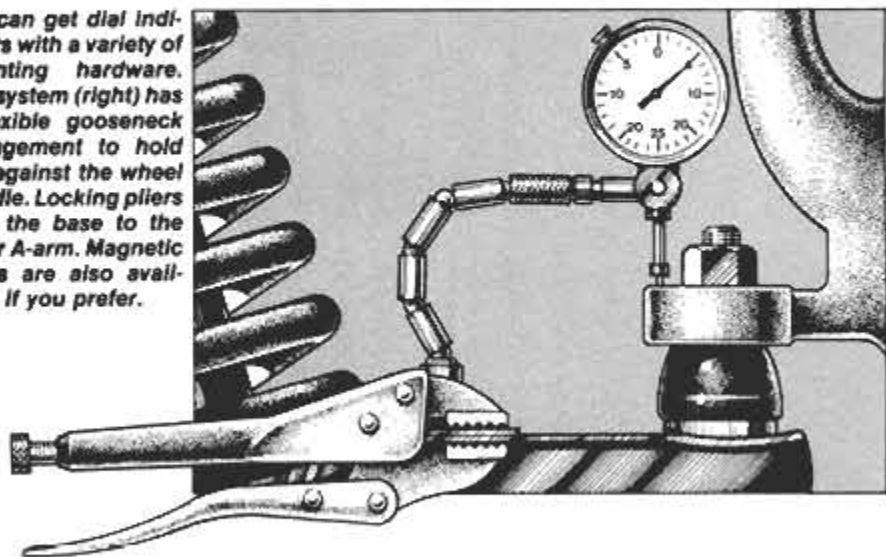


# FALL 1987 CAR CARE GUIDE

SECTION 12

## THE DIAL INDICATOR

You can get dial indicators with a variety of mounting hardware. This system (right) has a flexible gooseneck arrangement to hold dial against the wheel spindle. Locking pliers hold the base to the lower A-arm. Magnetic bases are also available, if you prefer.



Two checks for which you'll need a dial gauge most often are ball-joint looseness and disc-brake runout (unequal wear from one side of the brake rotor to the other). Excessive runout causes a shudder or vibration when the brake is applied.

Other automotive components that should be in motion when being measured and, thus, require use of a dial indicator, include the differential ring and pinion, steering gear and fly-wheel. Most dial indicators measure in .001-inch increments. An excessive reading indicates the component should be repaired or replaced.

### Checking ball joints

If your car's ball joints have built-in wear indicators, you don't need a dial indicator. As a ball joint wears, the built-in indicator recedes into the ball joint cavity.

If your ball joints have no built-in indicators, measure for excessive wear every 25,000 miles, or whenever the car demonstrates a problem such as steering-wheel shimmy, looseness in steering, pulling to one side or wandering from side to side, and a crunch or squeak when the car is driven slowly over bumps.

Of two ball joints on each side of the car, one bears the load, while the other is a follower. Check the loadbearing joint—it fails first.

**1. Support the car so pressure is taken off the load-carrying ball joint.** If the bottom ball joint bears the load, the suspension spring will be on the lower control arm. Place a jack under this lower control arm and lift the car about 6 inches to take pressure off the load-carrying joint.

If the upper ball joint is load-bearing, the spring will be on the upper arm. Put a jack under the frame crossmember and a wooden wedge between the car body and upper A-frame. Lift the car about 6 inches to relieve pressure.

**2. Check that wheel bearings are correctly adjusted.** Loose bearings can give a dial-indicator reading that indicates excessive wear of the ball joints.

**3. Mount indicator so its actuator is against ball-joint stud or spindle.**

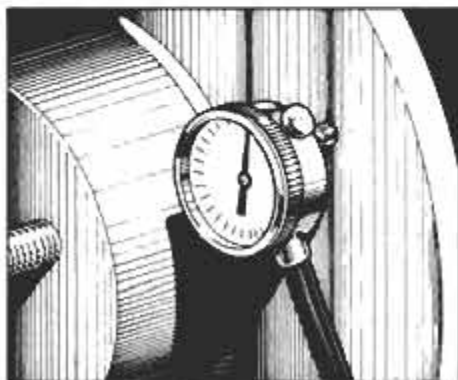
**4. Set dial indicator to zero; move wheel vertically by placing a pry bar under the tire and lifting up.**

**5. Check reading against maker's specification for maximum allowable ball-joint wear.**

### Checking brake rotors (discs)

To determine rotor damage, look for scars or pitting. To check wear, measure runout. Mount a dial indicator so its actuator touches the rotor about one inch from the rotor edge. Take reading after the rotor has turned 360°. The maximum allowable specification is usually no more than .005 inch. If greater, replace the rotor.

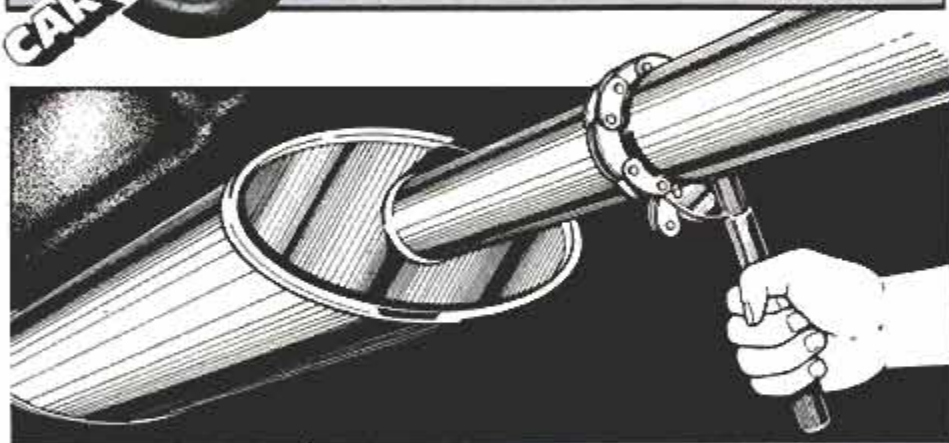
Also check for wear by measuring thickness variation (parallelism) with a linear micrometer. Measure at 12 equidistant points around the rotor, one inch in from the rotor edge. If the thickness varies at any point from maximum allowable specification, have the rotor cut on a brake lathe. If too much metal must be cut away to make the surface equal in thickness, replace the rotor. **FPM**



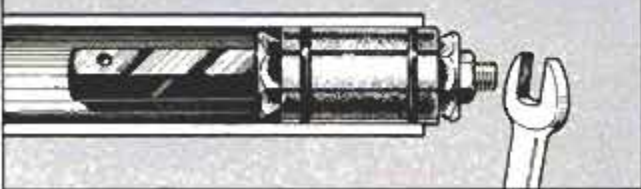
Disc-brake runout is measured by simply turning the rotor 360° and then taking a reading directly from the dial indicator.



# EXHAUST-SYSTEM TOOLS



Two tools essential for exhaust-system jobs are a pipe cutter (above) and the pipe expander (right). Two other items you need are penetrating oil and joint-sealing compound.



Replacing the exhaust system is one of the dirtiest jobs around. That's one reason some people get a lot of money to do it for other people. It's also one of the easiest jobs if you've got the right tools.

In addition to penetrating oil and sockets, you'll need a cutting tool. You could use a hacksaw, but working with one can be torture. A pneumatic muffler gun uses a chisel-type tool to cut through parts almost as easily as a meat cutter slices pastrami, but it's an expensive piece of equipment.

Best choice is an exhaust-system pipe cutter like the one shown here. It's less expensive than a pneumatic tool, and requires less effort than what you would need if you used a hacksaw.

To use an exhaust-system pipe cutter, wrap the chain around the pipe and hook the chain to the tang. Turn the tool handle to tighten the chain. Now, swivel the tool back and forth to make the cut. The cutting edges on the inside of the chain slice the pipe. If the chain loosens as it cuts through, take up slack by turning the handle.

Another handy tool you may want is a pipe expander. Exhaust system pipes are connected by fitting into one another. You may run into a situation where a flange end is a little too narrow. If so, just insert the pipe expander and tighten the expansion bolt to enlarge the end of the pipe.

### Helpful hints

These tips that will help make replacing the exhaust system just another everyday undertaking:

- Work on the exhaust system when the engine is cold.
- Disconnect the battery ground cable to prevent an accident. Working at the exhaust header may bring you close to the battery. If a tool slips and strikes the battery posts, sparks could ignite fuel or battery electrolyte vapors.
- Don't try salvaging old, rusted clamps and

hangers. That's usually a tough job. Save time and sweat; just cut them off.

■ If you have to replace the whole system, start dismantling at the tailpipe and work toward the front of the car.

■ Although other parts of the exhaust system may have failed, the catalytic converter may still be in good shape: It will last at least 50,000 miles as long as leaded gasoline isn't burned in the engine. Be careful not to drop the converter as you cut away pipes on both ends of it. If you drop and crush it, you'll have to replace it. The converter can be reattached to new pipes with clamps.

■ Where you have to remove nuts (at the exhaust manifold, for example), don't use unnecessary force or you may break off a stud, which only adds to your work. If it won't budge, soak it with penetrating oil and let it sit for a while before putting the wrench on it. It'll come loose.

■ Begin installing new parts at the engine and work toward the rear of the car. When installing the muffler, be sure it's not reversed. Inlet and outlet sides are usually identified. If not, you should check with your auto-parts and accessories dealer.

■ Apply sealing compound to ends of pipes before inserting them into mating pipes. Be sure pipes are inserted deeply enough to make a sealed joint.

■ Tighten fasteners to manufacturer torque specifications. If specs aren't given, secure clamps to hold parts tight. Tighten U-bolts so they are partially embedded in pipe or muffler bushings.

■ Provide adequate clearance between the exhaust system and the car's undercarriage or adjacent parts, such as the driveshaft. Noise coming from under the car after you finish the job probably indicates that part of the system is not well secured, or has been tightened too much and is too close to the driveshaft or suspension. Find the problem and fix it before your new system is damaged. **PM**

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- 5/8" - 11/16"
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AT TOOL DEPARTMENTS AND AUTO SUPPLY STORES

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FALL 1987  
**CAR CARE GUIDE**  
 SECTION 14  
**AIRCONDITIONING TOOLS**

Not every car air conditioner lends itself to Saturday mechanic care. Air conditioning is a complex system that often requires specialized repair equipment, including a manifold

pressure set and vacuum pump. For the few times you may need these tools, you're better off taking the car to a specialist.

Still, if you have an air conditioner, you can charge the unit yourself. Before showing you how, let's define some terms and describe the system.

The Schrader valve is a service port. It is covered by a cap, and there is usually one on both the low- and high-pressure sides of the system. The one you want is on the low side of the system; that is, on the side of the system where refrigerant is not under pressure. This is the side between the discharge side of the evaporator and the compressor. The high side of the system starts at the point where refrigerant leaves the compressor, continues

through the condenser and flows to the evaporator.

When you've located the valve cap, remove it. If the valve resembles a tire valve, you've got a Schrader valve and you can charge the unit yourself. However, make sure the valve is the one on the low side. Charging through a high-side service port can be dangerous.

If your air conditioning system doesn't have Schrader valves, it probably uses Rotalok valves. However, charging a system through a Rotalok valve requires those expensive pieces of equipment mentioned above.

Charging an air conditioner through a low-side Schrader valve requires a dispensing valve and collar to fit cans of refrigerant. Kits are available at auto-parts stores.

It's wise to also buy an antiblowback valve. This valve prevents refrigerant from being blown back into the can if you accidentally hook up to the high-side Schrader valve. You may need an air conditioner pressure gauge if your system doesn't have a sight glass.

With the air conditioner running at maximum cooling, if you see bubbles or foam in the sight glass, charge the system.

In the absence of a sight glass, use an air conditioner pressure gauge to take readings, with the engine off, at both the low- and high-side Schrader valves. If readings are equal, but significantly lower than the ambient temperature, charge the system.

If the first set of readings is okay, let the air conditioner run at maximum cooling and take another set of readings at both Schrader valves. If the high-side reading is lower than 140 p.s.i. and the low-side reading is lower than 10 p.s.i., charge the system.

**Caution:** If you hear hissing from either Schrader valve when you take off the cap, replace the cap immediately and have the system checked by a mechanic.

To charge an air conditioner through the low-side Schrader valve, proceed as follows:

1. **Set up the can of refrigerant with the collar, dispensing valve, antiblowback valve and charging hose.**
2. **Turn on the air conditioner.** Set it for maximum cooling.
3. **Remove the cap from the Schrader valve.**
4. **Place the can of refrigerant in a pan of warm water of about 125° F.**
5. **Connect the charging hose to the Schrader valve.** Open the dispensing valve, letting refrigerant enter the system.
6. **Empty the can of refrigerant.** Then check the sight glass or take pressure readings to determine if the system is charged. Add another can of refrigerant, if needed. **PM**



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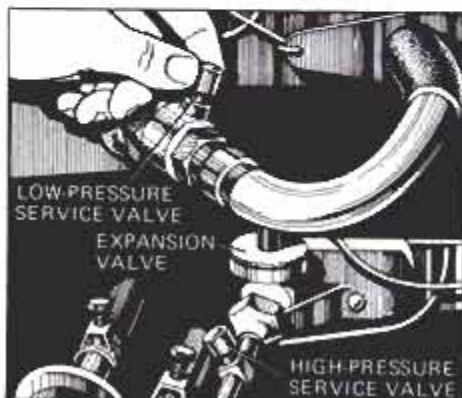
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Low- and high-pressure service valves are either Schrader-type (shown) or Rotalok-type. Rotalok takes special tools.



## THE '82 FORDS

(Continued from page 129)

computer, not even the little MCU (Micro-processor Control Unit) used to control fuel mixture and air pump on many Ford products through 1981.

If you've heard that a computer is necessary to regulate fuel mixture in order for the three-way catalyst to work, there's another side to the story: You can get that cat to reduce emissions so long as you keep the fuel mixture on the rich side, and you don't need a computer for that. Just calibrate the carburetor carefully, and although the end result is a slight loss in fuel economy (about a half-mile per gallon or so), there's a big saving in dollars.

When you're losing money, chopping out a computer, oxygen sensor, carburetor fuel-mixture control and some sensors

on a couple of million cars, you might suddenly be in the black.

Ford hasn't dropped the black boxes completely. MCU still is on full-size cars with a V8 in all 50 states, plus on the 2.3-liter Ford and the new 3.8-liter V6 in California. The Lincoln with throttle-body fuel injection also keeps its big EEC (Electronic Engine Control) computer. How many cars this amounts to, however, is another thing, for Escort/Lynx, non-California Fours, all in-line Sixes and the new 3.8 V6 cars should make up the bulk of production.

The 49-state 3.8-liter V6 does have an electronic control for the air-pump system. However, it's just an electronic timer that triggers a solenoid-controlled valve to switch air-pump air from the exhaust manifold to the conventional catalyst after about two minutes of engine operation.

To check out the system, give the timer an extra minute to be sure, then feel the air hose to the converter, to be sure the air is flowing.

### Performance comeback

High performance makes a modest comeback in '82 Fords in the Mustang/Capri, Escort/Lynx and EXP/LN7 models.

The Mustang/Capri again will have the five-liter V8 as an option. This engine is similar to the one used in these cars in 1979.

A key change is a new camshaft, teamed with a new free-breathing carburetor (356 cu. ft. per minute airflow, vs. 310 on the '79 model) and lower restrictions in both the air cleaner and exhaust system. An A/C compressor cutout switch

(Please turn to page 170)

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opens the circuit at full throttle, for maximum acceleration.

The five-liter V8 goes into the Mustang/Capri engine compartment reasonably well, in part because of the ample width resulting from the Ford modified MacPherson strut design that takes the coil springs off the struts and puts them well inboard.

The marine camshaft, you should know, completely changes the firing order of the engine, from 1-5-4-2-6-3-7-8 to 1-8-4-5-6-2-7-3. There's a decal on the grooved-belt idler-pulley spring housing to remind you. Don't let it come off.

The high-performance engine option on EXP/LN7 is based on the 1.6-liter standard engine. There's a high-lift camshaft, a higher compression ratio (raised from 8.7 to 1 to 9 to 1), free-breathing exhaust, larger two-barrel carburetor and a recalibrated automatic transmission.

### New look

Ford also is beginning a program to give the engine compartments a clean look, both for serviceability and appearance. Starting with the Escort/Lynx in '82, all fluid fill caps will be color-coded yellow so they stand out.

The alternator air-cooling scooper will be eliminated; an upgraded alternator is

being installed with better access. Relays grouped at the firewall will be shielded to keep them clean and dry. Virtually all vacuum hoses will be color-coded and a diagram decal under the hood will show the colors to help you check for an incorrect connection.

Most wiring will be routed around the perimeter of the engine compartment. This will give a less-cluttered look and minimize electrical disconnections you'll have to make for access to many parts.

### Automatic transmission

Ford also put some engineering dollars into the C-5, a new automatic transmission with a brand-new idea—and a good one—for a lockup converter. For use with the in-line Six and the 4.2-liter V8, the C-5 is an example of the company's commitment to going lockup without computers. There seems to be more in its favor than just cost.

The lockup is between a ring splined onto the torque-converter turbine and the converter cover, using spring-loaded friction shoes on a hinge arrangement. As engine power is transferred through the transmission oil in the converter to the turbine and into the transmission, the clutch ring spins faster. The spinning develops centrifugal force, causing the shoes to

swing outward and lock the turbine against the converter cover.

In most cruising modes, the converter will remain in lockup, becoming fully engaged at about 35 mph. If the car is accelerated, the converter overrides the moderate application forces of the shoes against the cover, and the lockup effect is nil. When the vehicle is accelerated from a stop or at very low speed, not enough centrifugal force is developed to cause lockup either.

A major advantage of this design is that it's very smooth. Most people won't feel the engagement. Further, although complete lockup doesn't occur until 35 mph, and primarily in high gear, there is some in first and second gears. Ford engineers estimate the C-5 adds one mpg in the city, two on the highway.

The C-5 is basically an upgrade of the C-4. In addition to the lockup feature, it is designed to run cooler than a C-4 and shift gears with crisp smoothness—"shift esthetics" they call it at Ford. That means you know it shifted because you clearly heard and/or felt something positive, but not harsh.

It's in the same league as the pleasing "thunk" sound of a door that closes completely with one light push. Detroit has a lot of customers to win back, and how well it does this depends on producing cars that make the right impressions. **PH**

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into two units—three if you count the camera. One unit—the actual recorder and its power supply—is the take-along. It's usually carried on a shoulder strap. The other unit, the tuner, is left at home.

One of the most obvious pluses to video is that you can record for a long time on one cassette (up to six hours) and then see your results immediately.

However, most of the video units we saw operate for only an hour on battery power. You can carry more batteries with you, but they are large and add weight. While these units are certainly lightweights compared to their at-home counterparts, they aren't as light as the usual Super-8 camera outfit. The Super-8 buff still has, and for some time will have, lighter equipment to work with. And for the present, he also has the advantage of being able to edit his "takes" easily.

But video is the wave of the future. We have no doubt that at-home editing devices will be developed soon. Already, companies like Zenith and Sony have come out with TVs that hook up to VCRs: Most manufacturers will follow. Equip-

ment will become even more portable—and it is likely that future equipment still will be able to play tapes you record today.

**Optical or electronic finders**

Most of the video cameras we looked at—and through—featured electronic viewfinders. The electronic viewfinder is really a miniature television set behind the camera's eyepiece.

This little TV gives you a good idea of what the scene you're filming will look like when you replay the tape. But because of the expense, these built-in TVs are black-and-white only.

We found that in most taping situations, we didn't miss the color. Indeed, the black-and-white TV image was a constant reminder that we were taping for TV and not for the screen.

If you're shooting a scene and you need to know what the lighting is doing to your color values, try an optical viewfinder, such as on the JVC GX-66 camera.

Make certain that the electronic viewfinder you buy can be used for either left- or right-eye viewing. Not

only must the finder fit on both sides of the camera—there must be a control to flip the image right-side-up from either camera side.

Getting good color value also means that you must be able to set the white-light sensitivity of the camera easily. There are two schools of design on this. The Panasonic camera uses a one-step button. RCA, however, uses a white lens cap along with a control setting. We found both convenient.

**Video tomorrow**

Both Sony and Hitachi have announced one-piece units that feature the recorder piggybacked right onto the camera. This eliminates the strapped-on tuner and makes the whole unit far more portable. Look for these units and others incorporating this design in about a year from now.

As video equipment becomes more compact and it becomes possible to edit at home, only the retail price of a complete outfit will stand in the way of a video takeover. Right now, prices start at about \$1,500.

So, for both artistic and economic reasons, Super-8 may be safe for a while. But video has thrown down the gauntlet. **PC**



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## DRIVING THE 1982 CHRYSLERS

(Continued from page 91)

equipment, including better seats and a power hatchback release, while the tastefully sexy Plymouth Turismo model inherits the mini-muscle-car power train and suspension introduced in mid-1981 on its Dodge cousin, the Charger 2.2.

The excellent, Mitsubishi-built, fwd Champ/Colt subcompact series adds a new five-door hatchback body style; it continues to offer a choice of two peppy but frugal engines, with four-speed, automatic or unique Twin-Stick eight-speed transaxles. And the fwd Saporro/Challenger, redesigned and much improved a year ago, are Chrysler's sport coupes.

We know that Captain Iacocca and his top lieutenants possess some of the finest product minds in the world, but they seem to be making one of the same mistakes that has helped kill Ford's sales in the past couple of years—trying to make efficient, new-generation cars look like oversized, inefficient old ones.

We think the LeBaron and 400 look fine for the moment. But we also think that, left unchanged, they'll look as outdated as white socks and saddle shoes in two years' time.

### Looking underneath

That said, let's look at the good stuff underneath. Like the K-cars they spring from, the new Super-Ks ride on MacPherson-strut front, and trailing-arm, coil-spring rear suspensions, helped in the ride department by a new linkless front sway bar and 14-in., 26-p.s.i. whitewall, steel radial tires. They are propelled by Chrysler's Trans-4 overhead-cam, 2.2-liter engine coupled to your choice of a manual four-speed or automatic three-speed transaxle. A Mitsubishi 2.6-liter Four is optional with the automatic.

Even with the weight of extra components for the elimination, absorption and damping of noise, vibration and harshness (NVH), these cars weigh only 2,500 pounds in base form. With the manual transmission, 2.2-liter combination, they should come in at 25 mpg city, 40 highway.

Inside, they feature a choice of center-armrest front bench seats in vinyl or Kimberly velvet cloth, or fully reclining buckets in vinyl, cloth or Corinthian leather.

Full-length armrests on the door panels have pod-like extensions that house the optional power window and door-lock controls. A multifunction control stalk handles turn signals, windshield wiper/washer, dim/bright headlamp switching and (optional) speed control; and the man-



datory reminder system (fasten seatbelts, turn off headlamps, remove ignition key) uses pleasant chime tones instead of brain-rattling buzzers.

Beyond the padded roofs and luxury trim discussed above, and functional items such as rack-and-pinion steering, electronic ignition and voltage regulator, electric cooling fan and the steel radial whitewall tires, standard equipment on the base LeBaron/400 is fairly sparse. It does include an electronic clock, twin chrome side mirrors, convenience lights, AM radio and deluxe wheel covers.

The upscale Medallion version, though, sports halogen headlamps and cornering lamps, a warning-light package, remote-control outside mirrors, color-keyed "premium" wheel covers, body-side tape stripes and plusher interiors.

On the lengthy option list are the usual center consoles, airconditioning, intermittent wipers, tilt steering column, electric window defogger and various sound systems.

#### New 'styling' under hood

In addition to the much-improved inner door handles and locks, and the linkless front sway bar (for better ride and handling, Chrysler says), there are a number of product improvements that come with the new Super-Ks and extend to the regular Ks as well. One of these is a nicely "styled" engine compartment, all in silver, black and white instead of the usual rainbow color treatment, with rerouted hoses and wires (for convenience and appearance) and counterbalanced hood hinges replacing last year's prop rod.

There are refinements to the 2.2-liter engine: cleaned-up intake manifold and "streamlined" valves for better flow, higher-torque camshaft, closed-loop feedback carburetion with revised electronics to provide built-in altitude compensation, and a new, lightweight, two-blade fan on nonairconditioned cars.

Imagine a softer, quieter K-car with some ultimate cornering power sacrificed to achieve more of a "big-car" ride, and you'll have a handle on what it's like to drive a fwd LeBaron or 400. Acceleration is adequate, braking good, handling agile.

While we prefer the import-like feel of the more stiffly sprung Reliant and Aries, most upmarket mid-size buyers coming out of larger American cars will likely appreciate the softened Super-K versions. With interior dimensions virtually identical to the regular K's, the LeBaron/400s seat four adults quite comfortably, and five or six in a pinch. **PPM**

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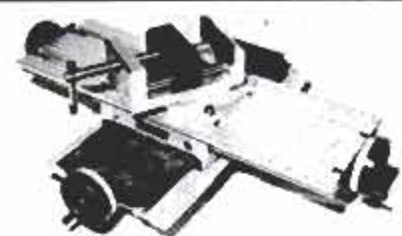
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## DRIVING THE '82 GM CARS

(Continued from page 92)

the same truck under a different name, P'up, GM dropped the truck and developed its own.

Chevy will sell the S-truck as the S-10, while GMC Truck and Coach will sell it as the S-15. The two trucks, however, are almost 100 percent identical, their differences limited to instrument facias, trim and appointments.

The S-trucks will be available in two bed lengths, have two engine options and come with two-wheel or four-wheel drive.

### Driving the S-10

The S-10 and S-15 contain a number of unexpected surprises, the most noticeable being their very untrucklike ride. Here's a series of small pickups that feel a lot more like cars than buckboards. Washboard roads and potholes don't rattle the suspension system. Even without a load, there's not that jiggliness so common in small pickups. Springs and shocks feel nicely modulated for smoothness even without cargo, yet there's plenty of carrying capacity for up to a healthy 1,500 pounds.

The S-truck's performance with the 1.9-liter Four and automatic tends to be a little anemic, but this standard engine turns out to be very adequate when teamed with either the four- or five-speed stick. Fuel mileage figures haven't yet been certified by the EPA but according to GM, they range from 22 mpg in the city to 39 mpg on the highway for the 1.9-liter Four with the five-speed manual gearbox.

Another pleasant S-truck surprise comes in its silence. Up-option models come with extra sound insulation plus under-dash hush panels that make these pickups almost as quiet as cars.

### Opting for options

And nearly every option available for cars can be ordered for the S-trucks, including Delco's new 2000-series sound systems, speed control, power windows, sport/luxury interior and exterior treatments and other add-ons which are not generally associated with trucks.

For drivers who need more carrying capacity, S-trucks offer several heavy-duty packages. There's a "payload" option that raises the standard 1,000-pound carrying capacity to 1,500 pounds. The payload package consists of a stiffer front stabilizer bar, heavy-duty rear springs and power brakes. It's available only with the 2.8-liter V6 and



steel-belted radials. The V6 delivers 110 hp at 4,800 rpm; the Four puts out 30 horses less.

For trailer pulling, there's another special heavy-duty package that allows towing up to 4,000 pounds.

#### The 6.2-liter diesel V8

This new engine was designed specifically for diesel application in pickups, vans, four-wheel drives, and medium-duty trucks. It's an engine that gives up to 25 percent more fuel mileage than a similar-sized gasoline V8 (in this case, the 5.7-liter V8).

I drove several GMC and Chevrolet pickups and utility vehicles with the 6.2-liter (379.4-cu.-in.) diesel V8, and the engine impressed me with its silence and power.

It's generally much quieter than the 350-cu.-in. (5.7-liter) Olds diesel V8 that it replaces. In half-ton pickups, the 130-hp 6.2 gives noticeably better performance plus very nearly the same fuel mileage as the 5.7-liter diesel.

Chevrolet engineers have told me that the 6.2 won't go into passenger cars, although it weighs only about 100 pounds more than the small-block Chevy. It will, though, find its way toward bigger displacements and jobs in larger Chevrolet and GMC trucks.

You can order two different overdrive transmissions for the 6.2: a New Process manual four-speed with a 0.73 to 1 high and GM's Turbo Hydra-Matic 700R4 automatic with a 0.70 to 1 fourth range.

For some applications, like trailering and off-roading, an automatic transmission becomes almost a must. The diesel 6.2 coupled with the overdrive automatic, though, tends to be a little disconcerting, because it freewheels on deceleration. Freewheeling takes away engine braking, which is nice to have when you come down mountains.

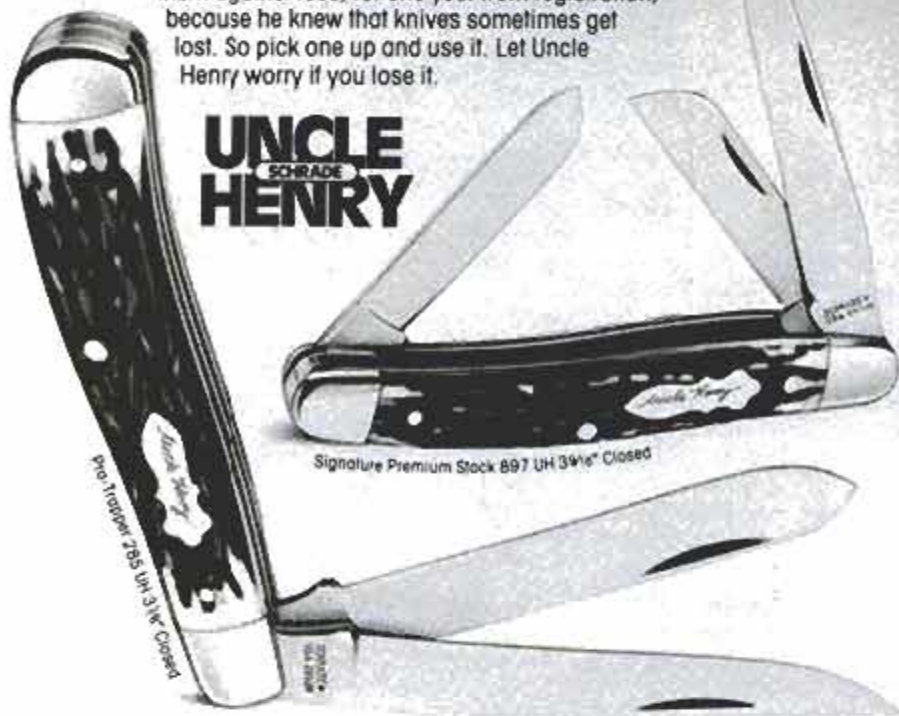
And although the 6.2-liter runs very quietly for a diesel, its silence again depends on which model you buy. Up-option vans and pickups with lots of insulation isolate the 6.2 diesel V8 so it's as noiseless as a gasoline engine. Stripped versions, however, let you know what you're driving.

Otherwise, GM's many lines of light-, medium-, and heavy-duty haulers tend to be carried over from 1981 without major changes. Minor facelifts and mechanical refinements make this new crop from General Motors recognizable as 1982 models.

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## BUILDING A KIT CAR

(Continued from page 100)

don't rely on memory as to how the whole assembly goes back together. Every item that came off the Pinto I cataloged and assigned a number, either in my project notebook or directly on the part.

For instance, when I disconnected a bundle of wires from the harness, I taped each end of the connector plug and wrote the same number on each end. That way I wouldn't make a mistake—I plugs back into 1, 2 back into 2 and so on.

For mechanical assemblies I also used the tape method plus a diagram. When dismantling something, I labeled it with tape, put all the related nuts and bolts in a plastic bag and taped the bag to the part.

### Modifications

Once all necessary components were off the Pinto, I was ready to clean, restore and service them, and to make the all-important modifications to certain critical components so they'd fit in the Blakely.

The Blakely uses half of both the Pinto's rear leaf springs. That means torching off the half you're not going to need, drilling a half-inch hole in the center of the spring and hanging it on the chassis with the hardware provided in the kit.

That was no problem. Directions in the manual were very explicit. Next I cut a quarter of a coil off each of the two front coil springs. I also modified the heater box according to the instructions. Then came the problem.

The instructions say to cut the front yoke off the driveshaft, torch

off a section of the shaft, weld the yoke back on the shortened shaft and have the entire assembly balanced. It has to be balanced; otherwise you'll get vicious vibrations while driving.

I wasn't about to try this job myself. Why take the chance of messing something up and have the shaft twist itself into a wad of putty on the first shakedown run. Driveshaft in hand, I went looking for a pro.

Now, in the greater New York area you can find anything from an upper trunnion pin for a 1939 Armstrong-Siddeley to a shrink for your poodle. New York prides itself on its wealth of goods and services. But as hard as I looked, I couldn't find anyone who would cut, weld and balance a 1977 Pinto driveshaft and *guarantee* that it would hold for more than 10 minutes. I decided not to take chances on a half-done job. I let the shaft sit for a while and carried on with other modifications.

### For reasons beyond our control

While the kit was abuilding, my garage was literally sold out from under me. The new landlord, who had a voice like an air-raid siren, shut off all the lights and heat on weekends—in the dead of winter. Have you ever put a combination wrench down and had half the skin of your palm go with it? On top of that he upped the rent. We moved. More delays.

Work had started in the fall, then tapered off a bit in the heatless winter, and picked up again now that spring had come around. Still no driveshaft, but the engine was in, rear axle securely bolted, most of the cutting and sawing on the body done to spec and we were all looking forward to a mid-spring introduction.

Late one evening a gang (we assume it was a gang from all the damage they wreaked and the booty they made away with) broke into our rented garage. These enterprising urban guerillas didn't just jimmy a window or pick a lock to get to the stealables. They literally took pick and sledgehammer to the cinder-block wall and punched a hole big enough to carry out toolboxes, compressors, floor jacks—everything that wasn't nailed down.

We were out one very complete set of borrowed Sears tools plus 50 percent of the tools I'd been collecting all my automotive life.

Spring was approaching, knocking insistently on our fiberglass doors. The body was nearly ready, but pedals needed to be hung, the upholstery was still in its shipping carton and many odds and ends needed fin-

ishing touches. Still no driveshaft.

The balloons and whistles for our giant kit car rallye (see page 98 for details) had already been ordered, the location rented, but it looked as if our car might miss the party. We were locked into a debutante ball and it appeared that the queen of the ball would have to sit it out—up on jackstands in a greasy garage.

### Denny to the rescue

The Herschbergers came to the rescue. A quick call to Princeton, Wis., produced Denny Herschberger, who arrived a few days later in New York. With rented welding equipment, Denny set to the task of modifying the Pinto driveshaft. He worked with such skill that even old Henry Ford couldn't have told that the shaft was spawned from one of his plants.

Denny is accustomed to making the impossible seem easy. He was an ace mechanic on Horst Kwech's OSCA racing team. OSCAs were Maserati-based race cars, and there's nothing in the world more temperamental, unpredictable (and yet so lovely and fast) than Italian racing hardware.

In short order, the shaft was in, the car was raised off the ground and the shaft was ready for balancing. The procedure is explained in the assembly manual, and it's really easy.

Once that was done, we set to work mating the body to the chassis and adding the pedals, steering column, dash and hooking up the wires to the instruments. This was when the kit's quality began to show.

Mating the body to the chassis was simply a matter of picking it up and plopping it down. It went on smoothly and all the things that were supposed to mate, did—no slop, no strange tolerances, nothing to cut and paste.

The same goes for the upholstery. All the panels and carpeting are cut to size when received from Blakely and they fit as well as anything coming out of Stuttgart or Hiroshima. Needless to say, we made PM's Rallye—thanks to Denny and the lack of glitches in the kit.

The real pleasure in building the Blakely comes after—when the tools are put away and the registration papers come through. On a sunny day, with the top down and the 2.3-liter Four rasping away, you just can't beat our Blakely for unadulterated driving fun. Was it worth the occasional aggravation? Every scraped knuckle of it!

If you want to be the envy of everyone you pass on the road, contact Blakely Auto Works, 124B Fulton St., Princeton, Wis. 54968. **PM**

## PM'S KIT CAR RALLYE

(Continued from page 98)

Norman, 4. Stuart Cantor, 5. Gail Weisman, 6. Harvey Gluckin, 7. Mike Santulli, 8. Steve Feith, 9. Bob Richardson, 10. Marshall Schuon, 11. Jim Beaudette, 12. Dominick DeLuca, 13. Tom Crawford, 14. Joe Oldham, 15. George Whittle, 16. Rich Taylor, in our Bernardi, 17. Chuck Rutherford and 18. Shell Reinish.

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Leifer Auto Sales Inc., 5265 Craner Ave., North Hollywood,

Calif. 91601

Marlowe Motor Car Corp., 96 Cutter Mill Rd., Great Neck, N.Y.

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Conn. 06492

Victor Antique Auto, 2900 Monroe Ave., Rochester, N.Y.

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\*DIESEL MILITARY. Isuzu PUP 4 x 4 2.5 liter turbo D2428 cc engine. EPA 44 estimated MPG highway. Use these figures for comparison. Your mileage may vary due to speed, weather and the condition of the road. ©1987 Isuzu Motors, Ltd. All rights reserved. Isuzu Trucks of America, Inc.



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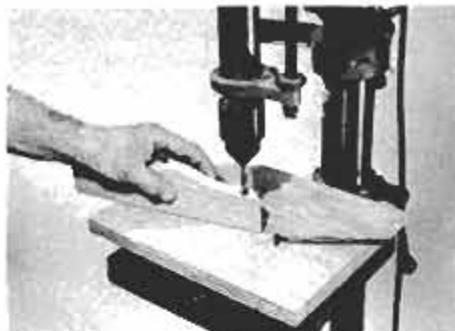




8 After sanding legs to remove saw marks, round outside corners only using round-over bit in router, then sand again.



9 Aprons are cut to shape and locations for screws marked. Counterbored hole is made first with Power Bore Stanley bit.



10 Next, a twist drill is used to bore the 1/8-in. hole to allow clearance for screw.

## MAKING THE 'PILLOW' TOP



11 After cutting top to shape with band- or sabre saw, remove saw marks from edges with a 2- or 3-in.-dia. drum sander. Otherwise, router will follow ridges in next step.



12 Top is cut to shape, then rounded with a 3/4-in. rounding-over bit and router. Avoid damage to wood by making two depth passes (A is after one pass; B after two).



13 Use a Surform tool to finish shaping of the edges. It's easy to control and much faster than rough sanding. Clamping of workpiece can be done in many ways but this setup gives maximum clearance for use of tool. Simply cut the ends of two 1/4-in.-thick boards to match contour, butt against top, hold with two C-clamps.



14 Now mount the drum sander in your portable drill and while the workpiece is still clamped between shop-made blocks, sand off all tool marks that are visible.



15 A small belt sander (the Sandcat here) and a fine-grit sandpaper help to complete this stage of the shaping operation.



16 Switch to larger sander and smooth both flat surfaces of tabletop. Go with grain.



17 Flap-type sander, such as a Sand-O-Flex wheel, makes the final sanding easy.

clamps. Set the work aside to dry overnight.

Using the grid drawing, lay out the shapes for the top, legs and aprons on cardboard or scrap 1/4-in. plywood. When satisfied with the shapes, cut them out with a band-, jig- or sabre saw.

Lay out the parts using the templates. Start by cutting out and shaping the top. Use the method shown in the photos to create those pillowlike edges. Insert a rounding-over bit in your router and make a pass around the perimeter. Then lower the cutter so that the bit bites

below the top surface; in effect, you create a bead cut on top. Set up the clamping arrangement shown in the photos so that you can complete the shaping using the Surform tools, and the various sanding equipment. The Surform tool brings the edges to shape quickly and the belt-, drum- and flap-type sanders make relatively short work of smoothing the wood.

Be sure to do *all* shaping steps on the end-grain edges first, then on the two with-the-grain edges. After the top is shaped and sanded

(Please turn to page 182)



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## TWO PLANT STANDS YOU CAN BUILD (Continued from page 180)

### ASSEMBLING THE TABLE

smooth, set it aside and proceed to aprons and legs.

It is important that the mortises—which engage the aprons—and the hanger-bolt holes be located and executed *before* you cut the legs to shape. To avoid mistakes, draw the four legs on the stock as shown and execute the steps four at a time—i.e., make all four left-hand mortises before changing the jig over for the right-hand mortises.

To cut the mortises, use a dovetail cutter, which produces the bevel edge that "bites" the apron front

(Please turn to page 186)



**18** Make a dummy plywood top to assist you in assembly. Here, a 16-sq.-in. panel has been laid out, and a framing square positions first apron.



**19** First apron is located on the line and a snug-fitting twist-drill bit is used to transfer the screw holes accurately.



**20** Holes are bored in false top; then top and apron are marked for match. Next, the apron will be screw-fastened in place.



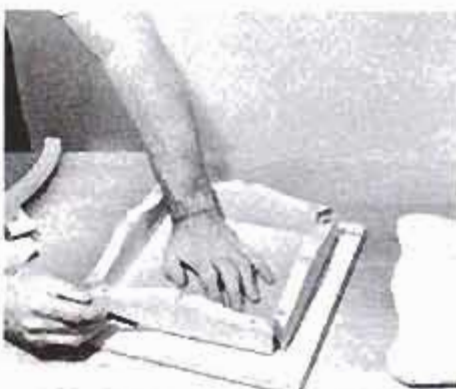
**21** Using a square for accuracy, a second apron and a leg are lined up on the board. When these parts are precisely and properly fitted, move left hand to securely hold the second apron while the leg is set aside.



**22** With apron held in precise position, mark screw holes with a bit, as before.



**23** Again, match marks are made on apron and board; the leg is also marked. The same assembly steps are repeated for the remaining three legs and aprons.



**24** When all four aprons have been attached, it's easy to trace the outline and obtain an accurate cutting reference.



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## TWO PLANT STANDS YOU CAN BUILD *(Continued from page 182)*



**25** Next, hold each leg in place with hanger bolt installed and note measurement from top to bolt centerline. Transfer measurement to corner brace. Label braces on top edge (hidden by glue joint later) to assure proper place in final assembly.



**26** Since 1/2-in. hanger bolts are installed here, a 1/4-in. twist-drill bit was used to gain adequate clearance for the bolts.



**28** The approximately 14-in. square shape is laid out on the underside. For accuracy, first line is made with straightedge.



**30** False top is cut out—on lines that were traced around the aprons—and is used as a template for locating screw holes.

surface when the table is assembled. After cutting all eight mortises, square all corners using a sharp chisel. Cut the legs out, shape the *outside edges only* with a rounding-over bit and router, sand smooth and set them aside. Cut out the aprons and sand them smooth, too.

### Assembling the table

Do as the professional cabinetmaker does and make your first assembly of the pillow table on scrap plywood as shown in the photos. This will help you to determine quickly if there are any irregularities that can be corrected before final assembly.

Because of the shape of the table *(Please turn to page 188)*



**27** With the table aprons and legs fully assembled on the dummy top, you can take measurements for the actual shape. These can be transferred to the hardwood top and you can be certain of a craftsmanlike fit.



**29** Second line is located with a ruler; the third and fourth lines with a square. Double check to make sure you've centered the square shape on the top's underside.



**31** After marking for the screw holes, transfer match marks to top. We needed dark lines so they would be seen in the photo; yours can be made much lighter.



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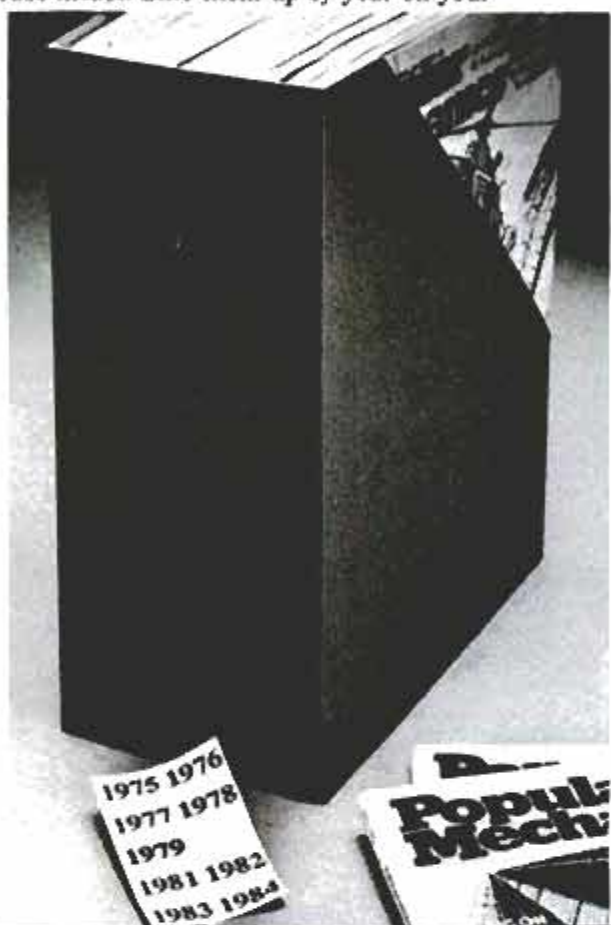
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## TWO PLANT STANDS YOU CAN BUILD

(Continued from page 186)

undercarriage, this first assembly is a bit tricky. It will take some trial-and-error practice, but you'll quickly learn the sequence for lining up the parts and holding them secure while you transfer holes.

Since the aprons are screw-fas-



**32** Bore holes 1/2-in. deep using masking tape as a gauge. With accurate transfer, real top should fit as neatly as false one.



**33** Table is assembled using match marks as reference. Glue, screw aprons to top.



**34** After the piece has been stained and allowed to dry for at least 24 hours, a paste wood filler can be applied (see text).



**35** As soon as the shine has disappeared, you should rub off all the filler and put the unit aside for 24 hours.

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tened to the top, the screw shank and counterbore holes should be made before test assembling. Drill the counterbore hole for the screw-head first, then bore the shank hole. Stick the latter bit in your nail apron for use in transferring hole locations to the temporary plywood top later.

### Lining up the aprons

Line up the first apron with a leg. When the corner is square, carefully set the leg aside without disturbing the apron. Use the twist bit to mark the hole locations. Remove the apron, make match marks on all parts as shown and bore pilot holes for the screws.

Assemble the first apron to the plywood. Continue on around in this fashion until all legs and aprons are located accurately and aprons are screwed in place. At this stage, the legs are not fastened to anything so you can work on only one leg at a time. Measure from hanger-bolt center to table, bore an accurate hole in the appropriate corner brace and secure the leg with a wingnut.

When the undercarriage is fully assembled, trace a line around the outside of all four aprons. Remove all pieces from the plywood.

Using the dimensions determined from the traced lines, carefully lay out the undercarriage location centered on the bottom side of the oak top.

Position the plywood top on the oak one and, again using a twist drill that fits the holes snugly, transfer the hole locations to the oak. Make certain that you also transfer the match marks.

Bore the holes in the oak and assemble the table using glue. Let it dry overnight.

### Finishing the stand

You could leave the oak natural and go right to a varnish, but on the prototype we used a light oak stain (to darken the wood somewhat and come closer to the finish on the original).

The table shown was finished with two "wash" coats of varnish; thus, a paste wood filler to pack the pores could have been eliminated. If you want a conventional varnish finish, the pores should be filled.

To create the hand-waxed look we thinned Pratt and Lambert's satin-finish varnish about 50 percent with turpentine and applied two coats. We allowed the first to dry 24 hours before brushing on the second coat.

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## COAL MAKES A COMEBACK

(Continued from page 111)

As the coal burns, the bed settles; this allows more coal to descend from the hopper into the fire chamber. Most internal hopper stoves have double-walled construction instead of a firebrick lining.

A few space heaters have not only an internal hopper, but also a thermostatically controlled stoker system which feeds the coal to the burning chamber by means of a screw mechanism (drawing on right, page 111). Because of the machinery and storage size of the hopper, this design is usually used for hot-water heaters and central-heating furnaces. One drawback of automatic stokers is that they produce an intermittent disturbing, crunching

(Please turn to page 213)



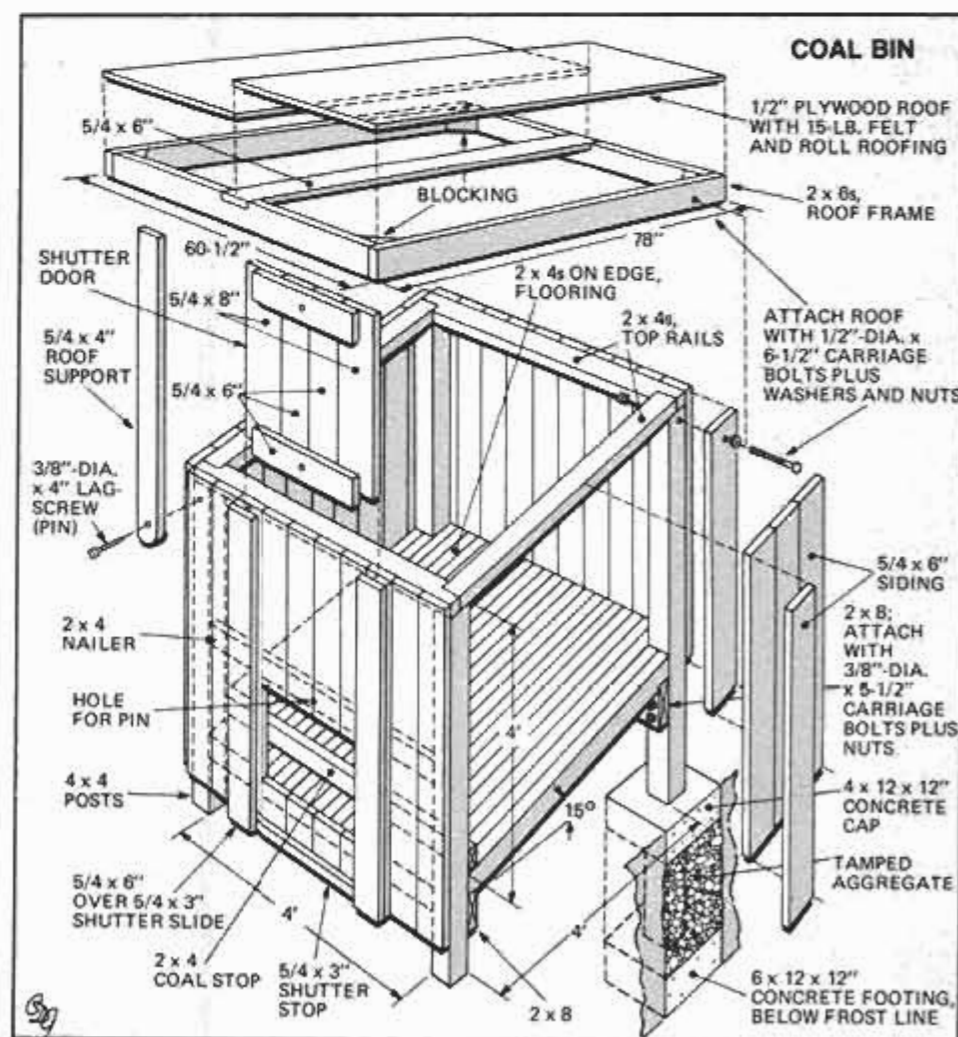
Shenandoah, like many stove makers, also offers a fireplace insert. Some inserts burn cannel coal. Prices: \$400 to \$1,200.

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increased to provide a bin holding as much as seven tons.

When planning the bin, check with your local distributor and ask about the truck he uses. Some modern trucks are equipped with lifts, but others must dump the coal in a pile. Then you have to get it into the bin and this can be a great deal of work. Locate the bin close to the house to prevent long trips in snow.



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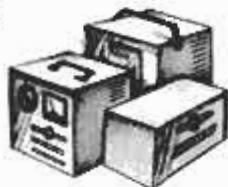
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# TECH LINES

## Renault's robots

### Automotive

Like a giant vulture, the machine descends toward a stack of bonelike crankshafts, clamps down on one, lifts it and carries it to the mouth of an assembly line.

There the machine holds the shaft within view of an optical sensor, turns it for easier swallowing and releases it to the line. Then the device returns to a supply pallet for more 26-pound shafts. The task of searching, finding, picking up, hauling, testing and releasing takes about 23 seconds.

The work requires no brains—no human brains. But it does call for a smart robot: one that recognizes patterns using just a TV camera and ultrasonic squeaks.

Its inventor is the Renault Corp., the nationalized French automaker that is building impressive business success (1980 sales were up 17 percent over those of 1979) on the backs of hundreds of clever robots.

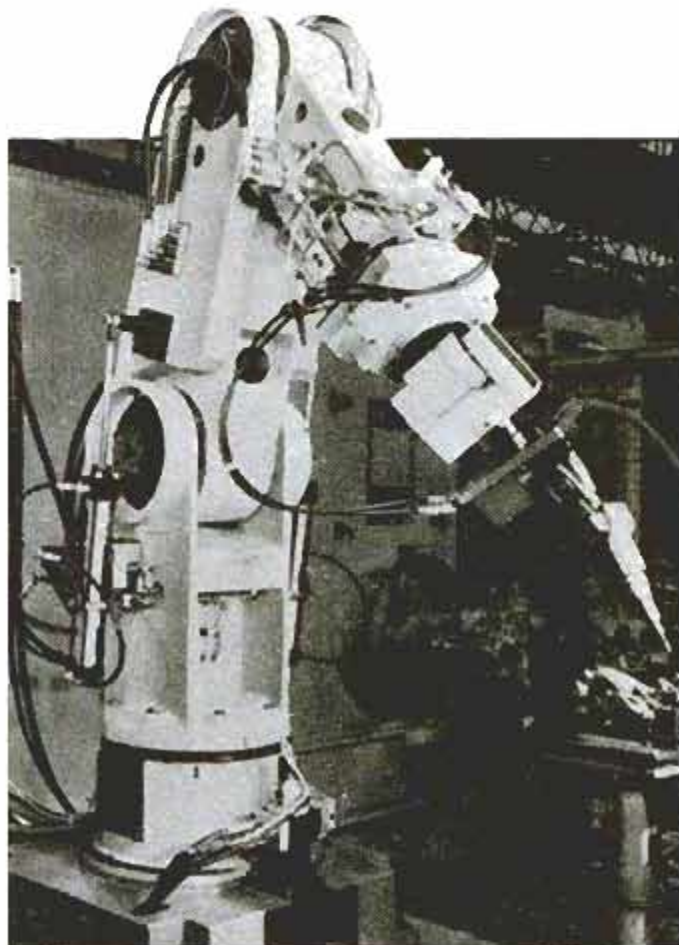
The "vulture" (Renault

calls it a "vertical robot") was due to replace two men recently at the company's Cleon assembly plant. Both men will be retrained for other jobs; Renault does not fire people when robots take over.

The basic vertical robot has been working for the company for several years. What's new about this version is a TV-sonar sensing system.

The camera, which is mounted high over the pallet of crankshafts, feeds shapes it sees into a computer. Digital circuitry instantly compares outlines with storage data, signals the electric motors in the robot to swoop down on one part and grab it. The 60-kilohertz sonar system—designed by Polaroid to change the focus of its automatic cameras—provides information on stack height to complement what the camera sees.

Quick recognition takes place even if a shaft is 15° out of place. But the robot is single-minded: A ther-



Sensitive robot locates a 26-pound crankshaft on a pallet, then lifts it, turns and places the shaft on the assembly line.

mos left carelessly on the pile would bewilder the robot and cause it to shut down.

An even more impressive-looking robot has been in service in France for the past three years. Renault calls it the "elephant's trunk" because—like the working end of an elephant—it can undulate around corners and snake into crevices. A pair of "trunks" can spray paint an entire car in a matter of seconds.

### Robot menagerie

Renault's robots join a growing menagerie of machines that work without pay or vacation in automotive plants around the world.

General Motors alone expects to be using approximately 14,000 robots by the end of the decade. Japan claims that some 29,000 are already in service, although Japan's definition of robot, according to the French, among others, includes many simple machines with only three degrees of freedom. (The "elephant's trunk" has seven.)

Pierre Pardo, manager of the automation division for Renault, says future applications for machines like these depend on further progress in robot sensing systems, particularly sight and touch. Does he foresee the time when robots will build an entire car? "Oui," within the next decade.



"Elephant trunk" robot spray paints an auto in seconds—safely.



## Inventions

### A real mine blower

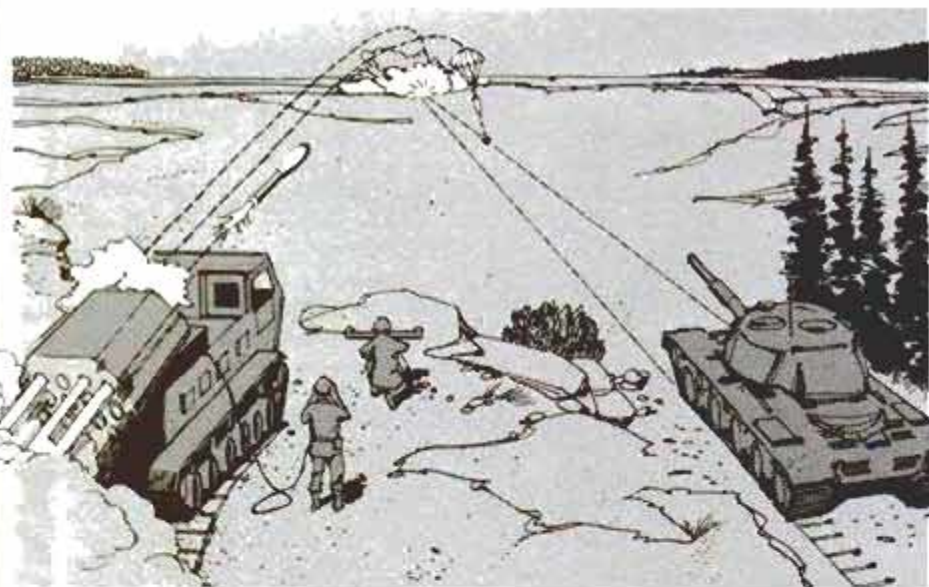
Clearing a safe path through an enemy minefield won't be so dangerous anymore. Downward pressure from an exploding fuel/air cloud—detonated a safe distance from the forward position of advancing troops—sets off all antipersonnel and tough antitank mines within range of the cloud.

Under contract to the Army, Michael H. Aley, James A. Bowen and Cecil A. Glass of the Naval Weapons Center, China Lake, Calif., invented the system. (Patent 4,273,048.)

Trajectory of a fuel/air-mix-carrying rocket begins at a multiple warhead launcher (below, left) After

launch, burn carries the rocket into its arc. Once its burn has been completed, the rocket soars "free." Then, at a preprogrammed instant, a parachute deploys from the tail and slows the rocket into the downward side of the arc, headed toward its target. Simultaneously, a probe extends from the rocket nose. When the probe strikes the ground, cloud detonators are launched upward at approximately 55° to horizontal. Immediately, a second charge bursts to release the cloud, which is then fired by the cloud detonators already in the air.

Sequentially fired rockets fall one behind the other in a line wide enough through the minefield for tanks and troops to maneuver. According to an Army spokesman, the launcher has been tested successfully in the field. Fuel/air mix is essentially propylene oxide.



While launcher, at left, fires mine-clearing rockets to get poised tank moving again, the tank serves as protection for the launcher and crew. Launcher follows tank.

### Oenological laser

If you think that means a laser beam to test the taste of red wine, you're right. A group of scientists at Science Spectrum Inc., Santa Barbara, Calif., tested some lunch wine as a lark. Behold, the beam produced a fixed differential light-scattering pattern (DLS) for the wine. Encouraged, they aimed a beam at other brands—and got different fixed measurements.

The clincher surfaced when they matched their own tasting notes with the laser-produced figures. Red wine, shown by the laser to contain particles sized at about 1/4 micron, consistently tasted better than wines with larger sediment (2 to 3 microns).

Says company president Philip J. Wyatt, "At first, we were amused. Now, we're beginning to see a potential for the methodology. I can see a time when people will rate wines they know nothing about by DLS number."

### Wood-chewing enzyme

Among the first living microorganisms to receive a patent is a cellulase enzyme that chews up cellulose into its parts—mainly glucose, a simple sugar. Discovered by Benedict J. Gallo, a scientist at the Army labs in Natick, Mass., the enzyme (Patent 4,275,163) promises future fuel and possibly food from cellulose-based waste farm and forest products.

Glucose is a base for ethyl alcohol, a fuel under certain conditions, and the ingredient added to gasohol. Purified, glucose is an edible sugar. And glucose can be used as a substrate for other microorganism growths to generate plant protein. Its potential for poorer countries is great.

## Photography

### Full-circle photo

The print at right was made by a new camera that rotates to snap a complete 360° scene. From a standard 36-exposure, 35-mm roll, the camera exposes eight shots. Price is \$1,500. For data: GlobuScope, 1 Union Sq. W., New York, N.Y. 10003.



The widest angle photo of all was taken from a point near the center of New York City's



## Aviation

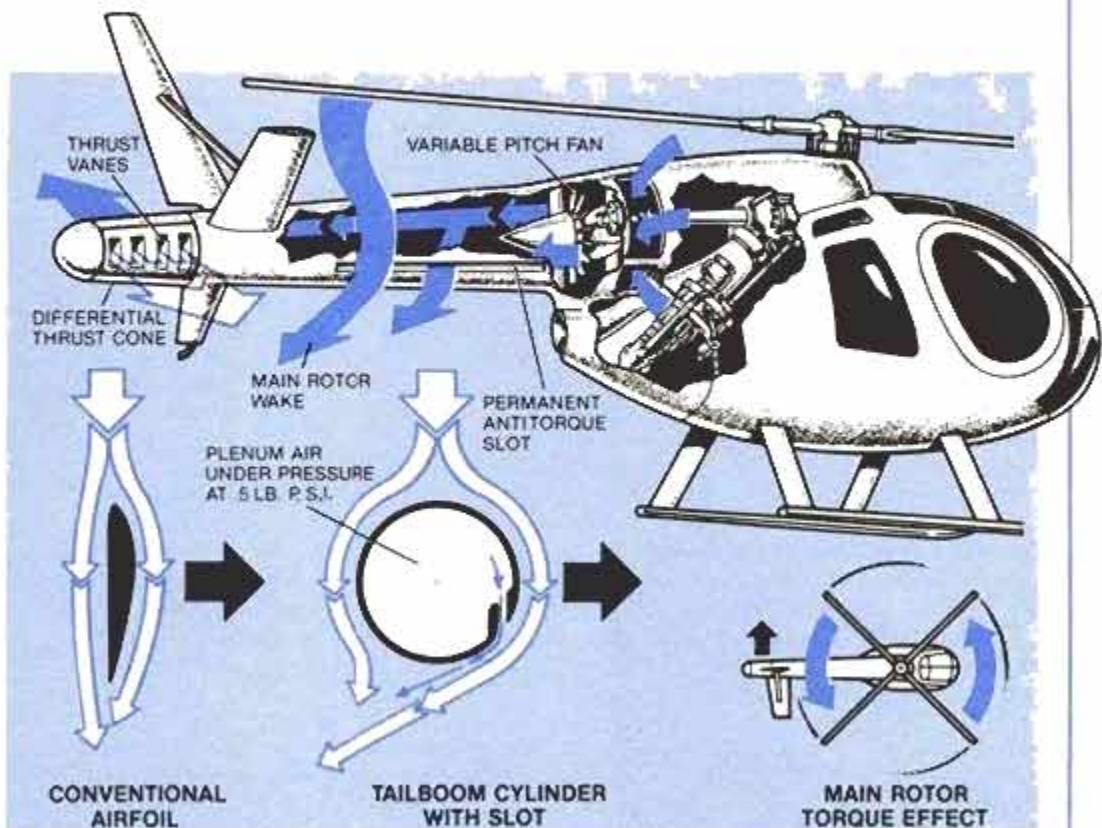
### New-tech tail for chopper

The tail-rotor, that pin-wheel-like fan that hangs on the aft end of a helicopter's tail boom to oppose torque and provide directional control, is just as unsatisfying technically to an engineer as it is damaging to a whirlybird's looks. It's inefficient, noisy and inherently unsafe. Now, an alternative may be taking shape, as Hughes Helicopters completes assembly of its NOTAR (no tail rotor) modified OH-6 'copter under contract to the Defense Advanced Research Projects Agency.

The no-rotor craft could make its first flight within two months.

The Hughes concept uses a variable-pitch fan driven by a shortened tail-rotor shaft to maintain low-pressure (.5 lb./sq. in.) air inside a hollow tail boom. Some of this air is bled off through a permanent slot about 1/8-in. wide on the lower right quadrant of the boom. All this does is provide automatic main-rotor torque compensation in a hovering mode.

The reason: The low-pressure airflow provides



The Hughes no-tail-rotor concept uses a combination of permanent slot and variable-opening

thrust vanes in a pressurized tail boom. Air bled through these openings becomes a control force, eliminating the need for a rotor. Slot creates lift by accelerating unilateral airflow.

enough pressure differential, as the main rotor wake blows down over the tail boom, so that considerable lift develops on the right side.

So far, so good. But in forward, sideways or backward flight, there isn't enough main rotor wash blowing down over the boom to maintain this lift. So the Hughes design bleeds the remaining low-pressure air through

thruster vanes in a cone at the tail-boom end. Using an inner sleeve linked to the pilot's directional (rudder) controls, the effective vane openings on either side of the cone can be increased or closed to provide differential thrust—in other words, steering can be achieved in any flight mode.

Success of the Hughes design depends not only on the system's ability to

maintain control and its reliability, but on the projection of operating costs (no additional power takeoff from the engine) not exceeding those of conventional tail-rotor choppers.

Hughes says it will be as economical to fly. In any case, it'll sure look better.

Editor: Gurney Williams

Contributors: John H. Ingersoll, Stacy V. Jones, Robin C. Nelson, Neil L. Shapiro.



Brooklyn Bridge. Camera has a 25-mm lens with stops from 1/3.5 to 1/22. Rotation is by a spring motor operating on a fluid drive.



## Electronics

### Type it again, Sam

Until now, getting computers to speak hasn't been easy. Even the best systems have had a relatively small vocabulary. But a new device from Votrax Co., called the Type-N-Talk, promises to make more computers speak their minds.

Its speech synthesizer has an unlimited vocabulary. The user simply types in a word—any word—and the Type-N-Talk (connected to any home computer) speaks the word in a surprisingly natural-sounding voice.

We envision that it will be only a matter of months before someone hooks the "talker" to computers that can recognize typed words via a camera lens. The result, of course, will be the world's first read-aloud computer.

Other applications, ranging from talking typewriters to an increasing number of talking appliances, will follow logically. Cover your ears. Here comes the future.

### Calculating confidence

Have you ever bought one of the new scientific calculators, only to put it aside because it was too difficult to use? If so, you'll be happy to hear that Texas Instruments has redesigned its Student Math Kit.

The kit comes with a new TI-35 calculator along with a beautifully written, 224-page guide. The guide proved popular when packaged with the older TI-30 calculator, but the new TI-35 has some additional features: A "constant memory" retains data even after the calculator has been turned off. And the keyboard has been revamped. The TI-35, with its guidebook, makes learning calculators fun.

### Wide-eyed sentry

You're driving down the highway. White lines flow by endlessly; scenery is an unchanging blur; the sun is hot and the tires whir on the road like swarming bees. Your eyes close slowly. Then *CRASH!* You're lucky if you wake up.

A device called Stay-A-Wake, from



The man shown above is "reading" a line of type printed in braille, the finger-readable lines for the blind. AEG-Telefunken unveiled the unit recently. Automatically transcribed braille flows on the panel from text which can be transmitted by teletext or other TV systems.

Reli Corp., Markle, Ind. 46770, claims to babysit a sleepy driver electronically. The unit monitors the number of steering corrections that are being made. If it senses a loss of attention, it sounds a wake-up signal before the driver loses control of the car. We haven't tested one, but the idea seems promising.

## Energy

### Solar-cell tests

A big, sun-tracking Fresnel lens is now testing photovoltaic cell efficiency at Albuquerque, N.M. The system, developed by Sandia National Labs staffer

Burrell E. Hammons, sends data to a computer on cell current, voltage, temperatures and solar insolation from one sun (ambient sunpower) to 1,500 suns. As sunpower increases, cell current rises. But as cell temperature goes up, efficiency drops. Hammons hopes to find a high-power, low-temperature cell.



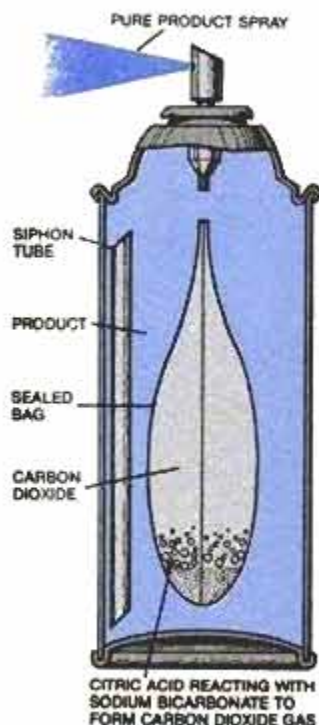
Inventor Hammons checks positioning of solar cell in system.

## Packaging

### Super-safe spray

A new spray-can system avoids problems brought on by hydrocarbon and carbon-dioxide cartridge propellants. The system uses an expanding plastic pouch which sprays nothing but the contents of the can.

The pouch, suspended in whatever fluid the can contains, holds sodium bicarbonate and citric acid, which produce carbon dioxide.  $\text{CO}_2$  expands the pouch and puts pressure on the fluid. Spray begins at the touch of the nozzle. As the fluid is depleted, more acid is released to generate more pressure. Enviro-Spray Systems Inc., devised the idea.



Cross section shows siphon tube (left side) that helps clear 98 percent of contents.



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## DRIVING THE 1982 AMC CARS (Continued from page 94)

through fifth, respectively. The shift mechanism is mounted entirely inside the transmission, thus eliminating any external linkage. Beside being more precise, this design allows the shift mechanism to be continuously lubricated.

I found shifting the new five-speed Warner T5 gearbox smooth and precise. There was never a glitch selecting the gear I wanted. The floor lever permits rapid up- or downshifts, and this transmission can be shifted so quickly that I didn't have to lift my foot off the accelerator pedal.

All linkages are internal. They're lubed by the transmission oil, which helps shifter action when the car is new and stiff and will prevent the mechanism from stiffening up as the car gets older.

The same good shift manners apply to the four-speed as well. The five- and the four-speed, in fact, are cousins under the skin because the five is the Warner T4 with an overdrive fifth ratio added inside a slightly different aluminum case.

Overdrive gives top ratios of 0.86 to 1 with the 2.5-liter Four and 0.76 to 1 with the 4.2-liter Six. Cruising in overdrive at legal highway speed keeps rpm right at 1,800, depending on rear-axle ratio. Not only does this low tick-over improve fuel economy, but it keeps noise level and engine vibration to a pleasant minimum. That's especially noticeable in 1982 AMC Eagle four-wheel drive. Eagles have always been quieter than most 4wds, but with overdrive they're a real joy on the freeway.

### Spirit shows zip

For all-out performance I found the 258-cu.-in. Six in the Spirit—in combination with the five-speed overdrive—a real road burner. This car truly wants to go. It's fun to drive, with a just-right transmission ratio for every situation.

Add the optional rally-tuned suspension package and the Spirit becomes a handler, too. This suspension option includes a rear stabilizer bar in addition to a heftier-than-stock front one, tuned strut-rod bushings, adjustable Gabriel heavy-duty Strider shocks, special rear spring pods, stiffer rear leaves, plus a quick steering ratio. This often-overlooked handling package is well worth the extra cost.

You'll be hard pressed to distinguish 1982 AMC passenger cars from their 1981 counterparts. Externally, nothing that I could see has changed. Grilles, taillamps and trim have been carried over, apparently

without revision. It's the first year in memory that AMC hasn't given its passenger cars at least some minor new-model tattoos.

American Motors' primary lines continue in the three basic flavors established over the past few seasons. There's again the subcompact Spirit, the compact Concord, and the four-wheel-drive renditions of both, called Eagles. The Spirit and its Eagle counterpart come in SX/4 lift-back and Kamback versions; the Concord and its alter-Eagle are available as two- and four-door sedans, as well as a station wagon.

Every Spirit, Concord, and Eagle list the Pontiac-supplied 151-cu.-in. Four as standard equipment, along with the Warner T4 four-speed. A wide-ratio automatic can be ordered for the in-line Six, or you can get a normal automatic with the Four. One big change for the Six, by the way, is the use of a single "serpentine" drivebelt to drive all engine accessories.

The '82 Eagle continues as AMC's top-line model, and, as such, it's loaded with standard equipment. You get, for example, Select Drive 4wd plus power steering and brakes, seat recliners, padded roof (except on the wagon), remote outside mirrors, digital clock, glass-belted radials, extra sound deadening and upgraded trim.

One item that helps all Eagles is Select Drive, which was introduced as an option midway through last year but, as I mentioned, becomes standard for all AMC Eagles in 1982. Select Drive lets you shift back and forth between two- and four-wheel drive by simply flipping a dashboard switch. AMC's four-wheel drive Eagle series continues to use a viscous fluid hookup between the two axles.

### What's new in Jeeps

AMC's Jeep division is adding a new luxury model for 1982—the Jeep CJ-7 Limited, which is really loaded.

The Jeep Scrambler, introduced late last year, continues unchanged. The 2.5 Four and 4.2 Six are available in all CJs, along with the five-speed and the same automatics as in AMC passenger lines.

The compact Renault 18i continues unchanged, but Le Car has undergone a few minor revisions. The three-door Le Car Deluxe adds a Sport package that includes a fancy steering wheel, tach, bio-formed reclining seats, special stripes, gear-shift knob and boot, plus halogen foglights.

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## PUT IN A COAL STOVE

(Continued from page 113)

corner of the square through which you can insert your sabre-saw blade.

Make the cutout and insert the chimney-support box into the hole so the flanges rest flush against the ceiling. Secure the box by nailing through the upper sides directly into the joists. The box measures 14½ in. square so it can fit between the joists in most homes. If it doesn't, headers may be necessary. Either way, the box should be firmly supported by nailing. A telescopic pipe section is then inserted into the chimney-support box.

Now move the floor panel and stove back into position. Join the stovepipes to the stove and pull the telescopic section of pipe down to engage the stovepipe. This completes the installation in the room.

### Installing the chimney

Triple-walled chimney sections, also available in stove-supply stores, are used in the attic and through the roof. To locate the center for the roof cutout, drop a plumb bob, using the same method as on the ceiling. The plumb bob, however, is centered over the stovepipe section in the attic floor. Bore a hole through the center mark on the attic ceiling.

Go to the roof and scribe a circle for the chimney-pipe cutout, using the drilled hole as the center mark. Make the cut with a sabre saw, cutting directly through shingles and roofing board at the same time. Do not remove or damage any of the shingles surrounding the hole.

Insert the chimney section through the flashing unit, then slip the upper edge of the flashing under a row of roof shingles. When the flashing has been positioned, the chimney section or sections can be lowered onto the support box in the attic. Two sections of chimney were required to carry the chimney from the attic floor through the roof for the installation shown here. Markings on the chimney indicate which end is up for proper joining.

Silicone sealant is applied under the top and sides of the flashing. The flashing is then nailed to the roof with galvanized or aluminum roofing nails. Sealant and nails are not used along the bottom edge.

Sealant is also applied at the joint between the top of the flashing and the chimney. The adjustable flashing collar is secured in place by tightening the connecting bolt. A bead of sealant is then applied along the top edge of the collar. The chimney cap completes the job.

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## OUTBOARDS '82

(Continued from page 103)

hulls that can perform with all that horsepower hitched astern. Already, there are big offshore utilities, cruisers, small commercial craft and models with stern-drive or inboard engines that could harness up convenient outboard power.

Meanwhile, most other changes in next year's outboards will be tucked out of sight. Refinements that improve fuel economy, power and performance are hidden underneath



Powered with a 15-hp Chrysler, a deck boat on pontoons like this Kayot can carry a large crew while burning little gas.



Small outboards can do the job for some types of fishing, too. Bass-Hunter trolls easily with a 2-hp Evinrude motor.

the hoods of the '82-model engines. Production engines from Evinrude and Johnson start again at 235 hp and go, in about 20 model steps, down to 2 hp. Special heavy-duty models to appeal to the commercial market in 25, 40 and 55 hp will be called Johnson Work-Horse and Evinrude Worktwin.

Mariner, with an established reputation for workboat performance, will have engines with horsepower ranging from 2 up to 200, with extra-long shaft lengths of 25 inches available for the top of the line.

Mercury models, from 200 hp down to 3.6, will have a number of improvements that increase power and performance. Redesigned combustion chambers, spark adjustment, and an optional 15-amp. alternator in place of a 9, are among refinements for larger Mercs. Fish-line cutters are now built into the

(Please turn to page 206)

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## OUTBOARDS '82

(Continued from page 203)

line so that monofilament will not wrap around prop shafts.

Suzuki outboards will be made in 2, 3.5, 5, 8, 9.9, 16, 25, 40, 50, 65, 85, 115 and 140 prop-horsepower ranges. Their automatic oil-injection mixing of gas and lube is starting to be copied by other makes.

In the Chrysler line from 3.5 to 140 hp, new models of 3.5, 25, 50, 105 and 125 hp are being introduced for a strong showing of 15 categories.



Sailboats with high, above-the-waves motor brackets can use extra-long-shaft models like Evinrude's Yachtwin.



Largest Mariner for next year will be the 200-hp, loop-charged V6 with a narrow (60°) powerhead taking less transom space.

Sources of smaller motors will include American Honda with the only four-cycle outboards, Aqua Bug, Aquascooter (with a submersible model), Eska, HMC's Cruise 'n Carry, Mighty Mite, Porta-Bote, Seagull, Tanaka and Tohatsu. Montgomery Ward will have Sea King models; Sears has Gamefishers.

The small kickers won't pull many water skiers, but make up for it in lightweight portability and stingy gas consumption.

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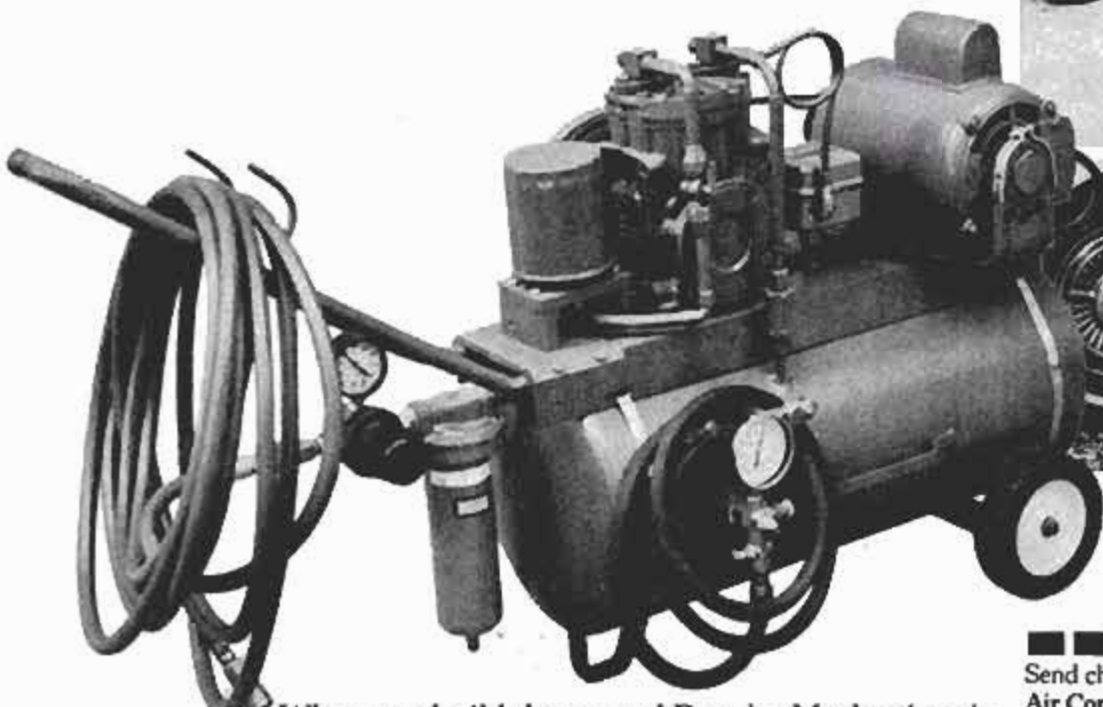
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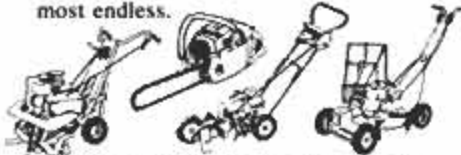
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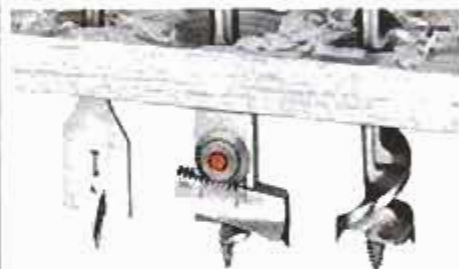
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## COAL MAKES A COMEBACK

(Continued from page 190)

noise when the screw-feed is working.

One of the great myths about wood stoves is now apparent: You cannot burn coal in a wood stove without probable damage from intense heat, unless the firebox and grates are designed to handle both fuels.

Stove makers are under great pressure to provide versatile stoves that can burn a variety of fuels. But the challenge of producing an efficient coal and wood stove is considerable, because of the marked differences in the ways these fuels burn. The fact is, a stove that will burn both will burn neither efficiently.

While efficiency is the key word in coal stoves, be wary of any maker claiming an efficiency greater than 70 percent. All fuels have their limits, regardless of burner design.

### Tips on burning coal

■ The kindling temperature of coal is around 800°F. This means a kindling fire of wood is necessary to get the coals started. Practice is the rule, but it can be a little frustrating at first. If the fire doesn't catch, you'll have to remove the coals and lay another wood fire.

■ If smoking occurs during the fire, there is probably something amiss in the flue. This is the most common problem with coal stoves.

■ Make sure that the size coal specified by your stove is available. Don't burn other sizes or kinds of coal or your grate won't work properly.

■ Last year, during the "coal stove rush," coal distributors were swamped with orders. Because it is a small industry, there is less flexibility in delivery and supply systems of anthracite coal. Order early.

■ Develop patterns of checking your coal stove regularly. Even the automatic stokers require ash removal by hand on a regular basis.

■ Never disturb the bed of burning coals with a poker, as used to be the practice with old potbellies burning bituminous. This disturbance will produce clinkers and defeat the purpose of the well-designed grate.

■ Finally, remember to follow the maker's instructions carefully to get maximum stove performance from this highly efficient fuel. Burning coal, however, does require a certain modification of your lifestyle. Unlike gas or liquid fuel, which you may never even see, coal is handled and the stove must be tended. Rather than thinking this inconvenient, some homeowners seem to feel that they want to be closer to the basic household necessities. They literally want to keep home fires burning. **FW**



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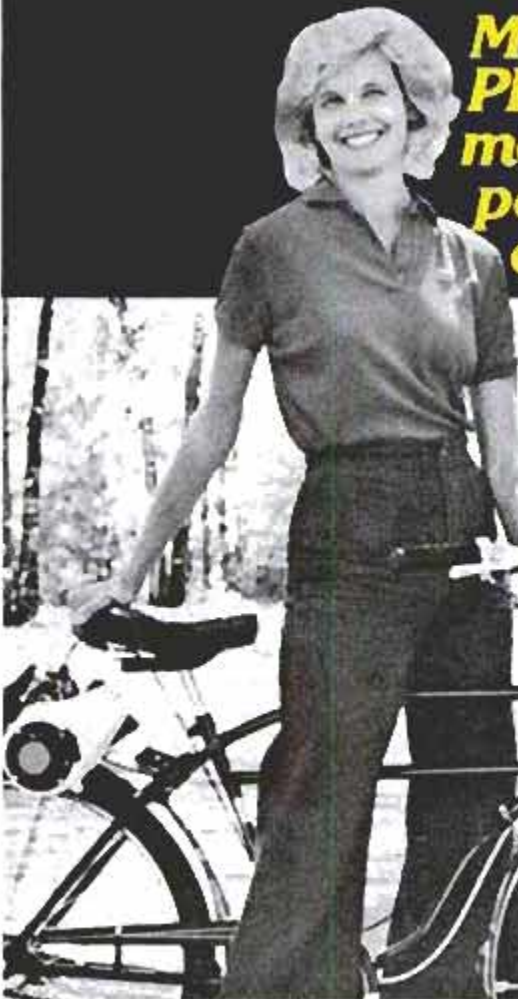
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## GARDENING & LAWN CARE

(Continued from preceding page)

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# STOP BURGLARS BEFORE they enter your home

Protect your Home and Business with this new micro-computer burglar alarm "FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under \$2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.

## THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the most advanced security system available for consumer use. With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

## THOUSANDS OF OPTIONS

Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. Only you know your code. But if your son's friend receives a "demonstration", you can easily change the code again...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

## HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

## A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is highly resistant to false alarms because it is not sensitive to motion or sound. Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack—all without setting off an alarm.

## COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

## COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines pre-entry protection with micro-electronic circuitry to provide the most protection at the lowest cost.

## U.L. LISTED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a burglary protection device, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

## YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

## HERE'S HOW TO ORDER

To order simply send your check for \$199.95 plus \$5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ unit complete with easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

Give yourself some peace of mind—order a Perim-A-Tron™ today at no obligation.

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This photo shows a transmitter & magnet installed. If a break-in attempt occurs, the transmitter and magnet become separated triggering a wireless radio signal which activates the alarm. Installation takes only a few minutes and doesn't even require a screwdriver.



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