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Popular Mechanics

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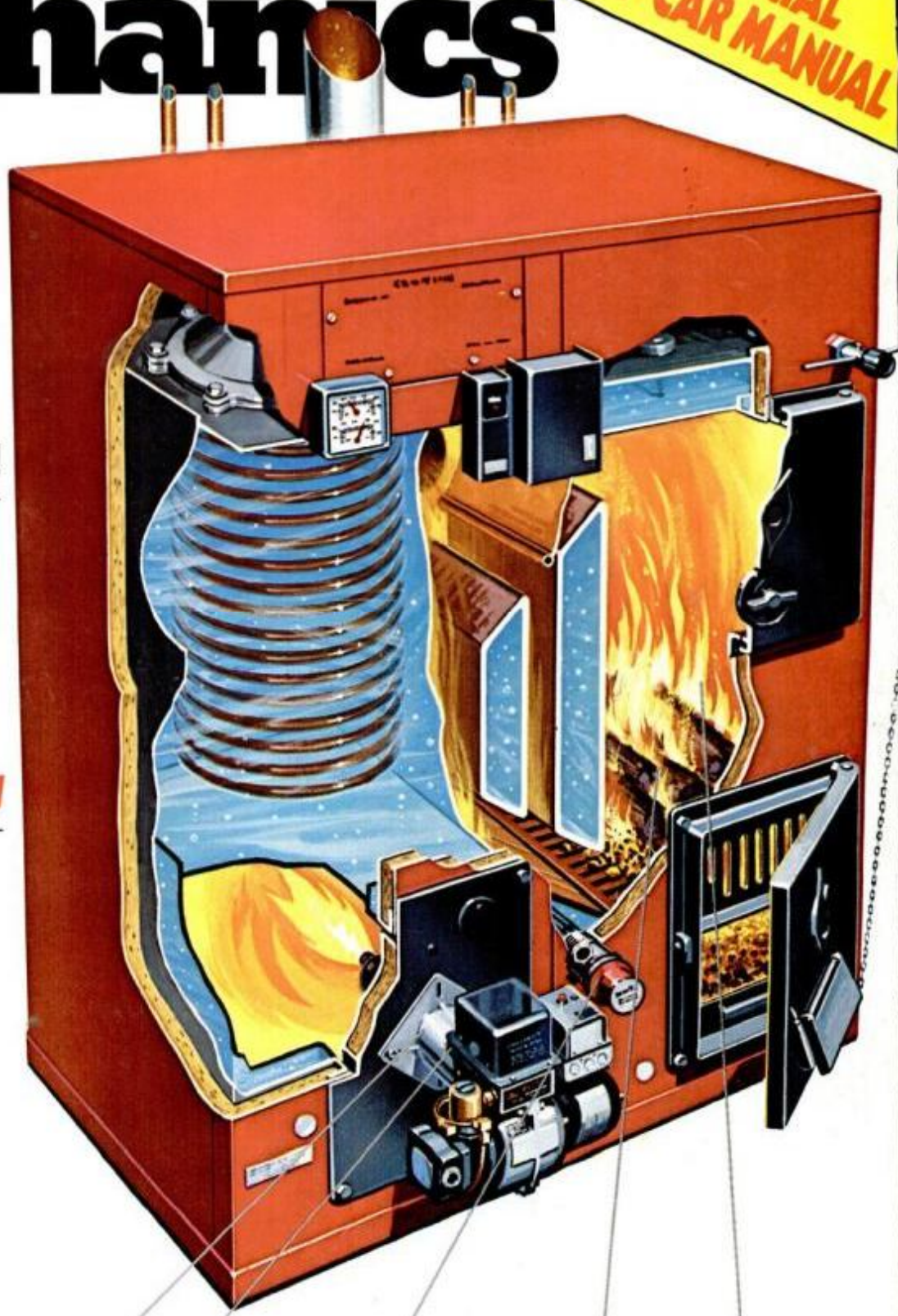
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An unfair comparison of the world's two best known woodcutters.

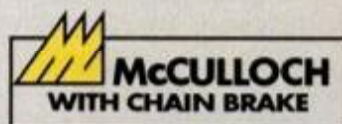


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On the cover

As the question of short fuel supplies hangs over the oncoming winter, this new kind of furnace is something to get excited about. It can interchangeably use gas, oil, coal, electricity and even firewood to heat your home comfortably and provide hot water. On page 118, PM tells you how it works; on page 122, how it should be installed.

—PM painting by Ed Valigursky

Popular Mechanics

OCTOBER 1979

CONTENTS

VOLUME 152 NUMBER 4

INTERNATIONAL EDITIONS: CARIBBEAN, ITALY, MEXICO, SOUTHERN HEMISPHERE

Special features:

PM looks at Detroit's 1980 cars

GM, Ford, Chrysler and AMC have engineered the best mileage yet into their new model lines.

98

Electric cars you can buy

Yes, Virginia, there is an off-the-shelf electric car you can drive today. PM tells you about it and others, how they measure up, and what's coming along in the near future.

96

A master craftsman's 12 dream tools

You may not have heard of these beauties, but let an expert tell you their secrets for shortcutting shop chores.

124

New compact stereos

PM evaluates small units that can bring you unexpectedly big sound performance.

94

Toughest chain-saw cuts

Professionals' tricks for rigging and cutting that'll make your saw superhandy.

126

When your car becomes a deathtrap

How to escape fire, live wires, water submersion.

106

Automobiles and bikes

- 17 [Detroit Listening Post](#)
- 24 [Car stereo—install it like a pro](#)
- 42 [Imports and Motorsports](#)
- 51 [Car Clinic](#)
- 62 [The PM Garage](#)
- 92 [PM Owners Report:](#)
[Chevrolet Citation](#)
- 96 [Your first electric car—build or buy?](#)
- 98 [Driving the 1980 General Motors models](#)
- 100 [Driving the 1980 Ford and Lincoln-Mercury models](#)
- 102 [Driving the 1980 Dodge, Plymouth and Chrysler models](#)
- 104 [Driving the 1980 American Motors models](#)
- 106 [How to survive when your car turns into a trap](#)
- 114 [Never say scrap! Greatest automotive flea market](#)

Photography

- 14 [This fall, shoot foliage from a different angle](#)
- 18 [Photo Hints](#)

Home and yard

- 22 [Homeowners' Clinic](#)
- 59 [Appliance Clinic](#)
- 118 [Now! Multifuel heaters](#)
let you choose your fuel
- 122 [PM installs multifuel boiler](#)
- 126 [How to make the tough cuts with your chain saw](#)
- 129 [10 features to look for when you buy a chain saw](#)
- 130 [PM's Family roomful of ideas](#)

Boating and outdoors

- 30 [Kit-built muzzleloaders](#)
- 45 [All Outdoors](#)
- 112 [How new outboards squeeze out more performance](#)

Every month

- 6 [Letters](#)
- 40, 60, 90 [It's New Now](#)
- 73 [PM Briefs](#)
- 80 [Notes from the Editor](#)

FALL CAR CARE GUIDE

133 [Cover](#)

Saturday Mechanic

- 135 [Servicing 1980 Ford models](#)
- 136 [Spotlight on the 1980 T-Bird](#)
- 140 [Servicing 1980 GM models](#)
- 144 [Servicing 1980 Chrysler models](#)
- 148 [Servicing 1980 AMC models](#)

Service Tips

- 150 [Section 1: Lubrication](#)
- 156 [Section 2: Ignition](#)
- 160 [Section 3: Fuel system](#)
- 164 [Section 4: Emissions control](#)
- 168 [Section 5: Battery](#)
- 169 [Section 6: Brake system](#)
- 172 [Section 7: Transmission](#)
- 172 [Section 8: Tires and wheels](#)

Shop and crafts

- 55 [PM Workbench](#)
- 60 [New Now for home and shop](#)
- 66, 81, 232 [Hints from readers](#)
- 71 [Workshop Minicourse:](#)
[Using the drill press](#)
- 116 [PM takes you tailgating](#)
- 124 [A dozen extraordinary woodworking tools](#)

Electronics, radio and TV

- 24 [Car stereo—install it like a pro](#)
- 49 [PM Electronics Monitor](#)
- 76 [Is quartz worth your time?](#)
- 94 [Compact stereos sound better than ever!](#)
- 130 [PM previews Hewlett-Packard HP-41C calculator](#)

Aviation

- 109 [The Channel challenge:](#)
[An engineering triumph](#)

Science and engineering

- 12 [Science Worldwide](#)
- 85 [Do-it-yourself disaster](#)

Worth writing for

Looking for more ideas and information? See page 167.

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LETTERS TO THE EDITOR

Tape loading problem cured?

The article *Home Computers That Plug In and Go!* (page 66, Aug. '79) gives the Radio Shack TRS-80 a bad score on loading in programs from the tape recorder. After many frustrating hours in that effort, I switched to Maxell UD C-46 tape and now have a zero failure rate. By the way, only Level II machines have this problem; Level I is very dependable, but slower.

LEE R. ABEND
NORTH MIAMI BEACH, FLA.

See PM Electronics Monitor (page 49) for a description of a gadget that cures the TRS-80's loading problems. Also, Radio Shack now has a free modification that will help some.

American Colonial in Prague

I happened to get several older copies of *Popular Mechanics*, and in one of them was the design of a beautiful colonial candlestand lamp (*You Can Build This Candlestand Lamp*, page



Reader Kocourek's colonial lamp.

168, Nov. '79.) After minor adjustments of your plans, I made the lamp and everybody likes it very much. I even made another smaller lamp.

The designs that you publish are outstanding and I am only sorry that I don't have the chance to get more copies of your excellent magazine.

DANIEL KOCOUREK
PRAGUE, CZECHOSLOVAKIA

Ragtop revival

I read *Return of the Roadster* (page 62, July '79) and realized that it is worth my while to restore my convertible to near-original condition. I'm not going to soup it up or put high risers in it, though. I'm going for gas mileage, style and comfort.

I've got a '69 Camaro convertible with a manual top. It needs a lot of body work, and I'll have to redo the interior, rebuild or replace the engine and give it a paint job. It will take me a few years, but good things



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MARK J. BEAUREGARD
EAST SWANZEY, N.H.

Drip, drip of excess acid

I have thoroughly enjoyed your magazine for years and have learned more about cars than I could ever tell you. Now it's time to return the favor.

While having some work done on my car, another mechanic called me over to a '71 Olds Cutlass he was working on. The steering gear box, the tie rods and—would you believe—the entire left side of the frame had been totally corroded away by battery acid leakage. The mechanic was cutting away the frame with a torch, and it was all the more pitiful because the car was in otherwise immaculate condition.

I think that proper battery maintenance is a small investment that will pay enormous long-term dividends.

GEORGE A. MITCHELL
SUNRISE, FLA.

Now hear this

Your article on choosing a television receiver (*Seven Tests To Help*

Choose a Color TV, page 66, July '79) fails to mention the quality of the sound. Why is the audio so neglected by the manufacturers? I have a 5-year-old set with outrageously bad sound. The repairman says that the speaker is too small and of inferior quality. The manufacturer told me there is no way to hook up an external speaker. Do any manufacturers provide better audio for their TV sets?

MARTIN BERMAN
TEANECK, N.J.

Audio quality is a very subjective measurement—but it is true that TV sound has always left something to be desired. Due to some new regulations, broadcasters now have the capability to transmit good audio. Be sure to watch our upcoming issues for more information on just how you will be able to get hi-fi from your TV.

Intelligent guesswork

Howard Foggan renews the Biblical charge against evolutionary theory (*Letters*, page 7, Aug. '79). But the original Darwinian theory simply took account of variation and natural selection. Neither the patri-

archs, who compiled the books of the Bible, nor we were present at the dawn of creation. We have options considering belief in that event which are evident in worldwide religious variation.

Let us relieve Darwin of the charge that he believed we "descended from monkeys." What he suspected was that all creatures shared some common ancestors. At best, it is all no more than intelligent guesswork; why can't we make peace with this guesswork?

CHARLES R. LA DOW
SAN DIEGO, CALIF.

Corrections

We have received several complaints from our readers about the Quik-Ring tool (*PM Looks At*, page 194, April '79). According to the tool's manufacturer, the company has been having production problems. Readers are thus advised to write first, to see if the product is available, before they send in a check.

Also, the price of the book *Practical Electrical Wiring* was listed incorrectly in the July *PM Workbench* (page 38G). The correct price for it is \$18. **PM**

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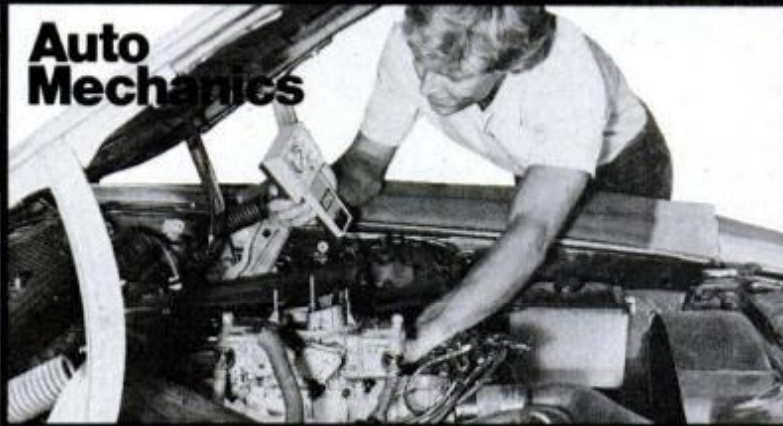
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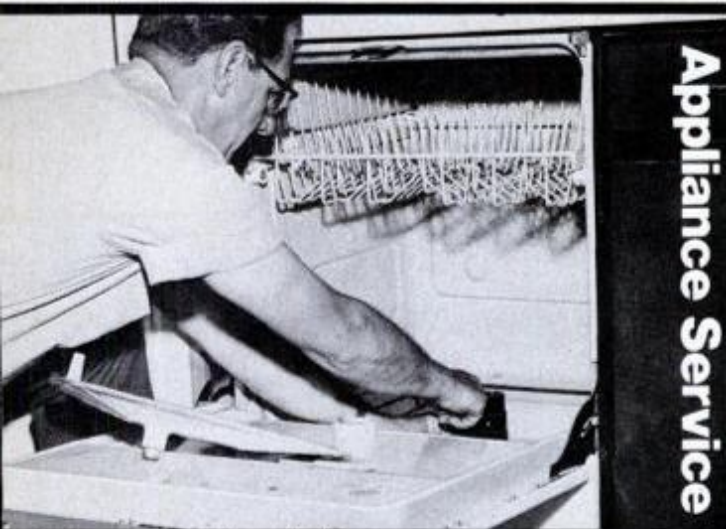
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varactor diode tuning and digital read-out. Computer courses now include the NTS/HEATH computer with 4K memory, Interface, and Video Terminal.

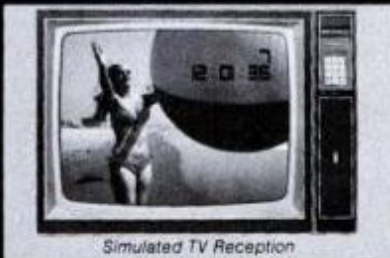
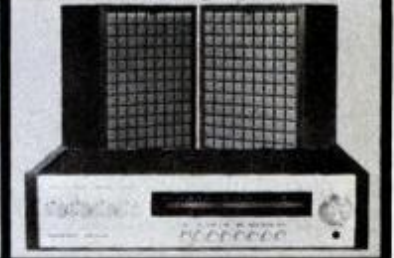
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SCIENCE WORLDWIDE

Anguished cry aids DC 10 probe

A maintenance man's exclamation of horror as he watched a DC 10 crash last May 25 helped investigators reconstruct the final seconds of the American Airlines flight.

"Oh my God!" the man said into a microphone in his truck on Chicago's O'Hare field. He told National Transportation Safety Board investigators later that he had spoken at the instant the nose struck the ground. The crash, the worst air disaster in the United States, killed 273.

His voice was transmitted to a control tower where it was recorded on a tape of all calls, along with an indication every second of the exact time. The anguished cry enabled investigator Paul Turner to establish within a fraction of a second the time when the plane crashed. With this information, he and investigator Dr. Carol Roberts took another look at the digital flight-recorder tape.

Turner and Dr. Roberts had at first believed that the data recorder had mysteriously stopped working before the plane went down. But Turner's new research, helping to establish how long the plane had been airborne, showed that the flight recorder worked well. It was on, collecting data about systems in the plane, for the same length of time the DC 10 was in the air.

Dr. Roberts told PM that her latest study of the tape showed that the plane climbed to something over 300 feet, far lower than first estimates, before plunging down. Shortly before impact, it rolled to 117°. It appeared to recover slightly in the last half-second, Roberts said, but this recovery might reflect the initial contact of the left wing with the ground.

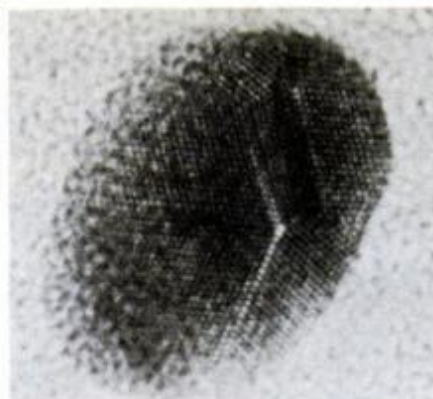
Data from the recorder has been used to help pilots reconstruct the disaster on a simulator.

Mining atoms in the gold

The dots falling into neat rows in the photo above are atoms of gold as magnified by a new electron microscope at Cambridge University.

It took eight years and approximately \$2 million to build the new 'scope, which rivals several similar high-resolution instruments in Japan.

The British model draws its power from a 600-kilovolt generator, powerful enough to provide clear



Gilt edge: Rows of gold atoms appear in micrograph (above) taken with Cambridge 'scope (right).

images on a viewing screen even at magnifications of up to 500,000 times. Cambridge scientists are currently using the device for inspection of materials. But in the future, they may be able to get pictures of the atomic structure of organic or biological molecules.

Blocking surgical 'static'

For years, surgeons have used high-voltage current to cut through human tissue in heart, skeleton and brain operations. This technique, electrocautery, sears blood vessels closed, preventing bleeding during surgery.

Unfortunately, the exotic cauterizing knife also sends a jumble of radio waves through the patient's body. And this static, according to Dr. William New of the Stanford University School of Medicine, creates interference in devices used to monitor heart function and other vital signs.

Now Dr. New and a team of researchers at Stanford have developed computerized equipment to filter out the static. The device picks up the patient's electrocardiogram signal, a measure of heart contractions, while blocking interference caused by the radio waves.

The device could be commercially available within two years.

Cleaning up coal

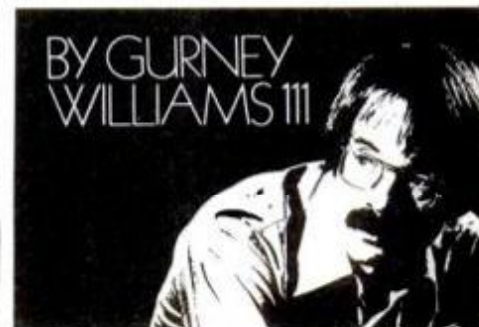
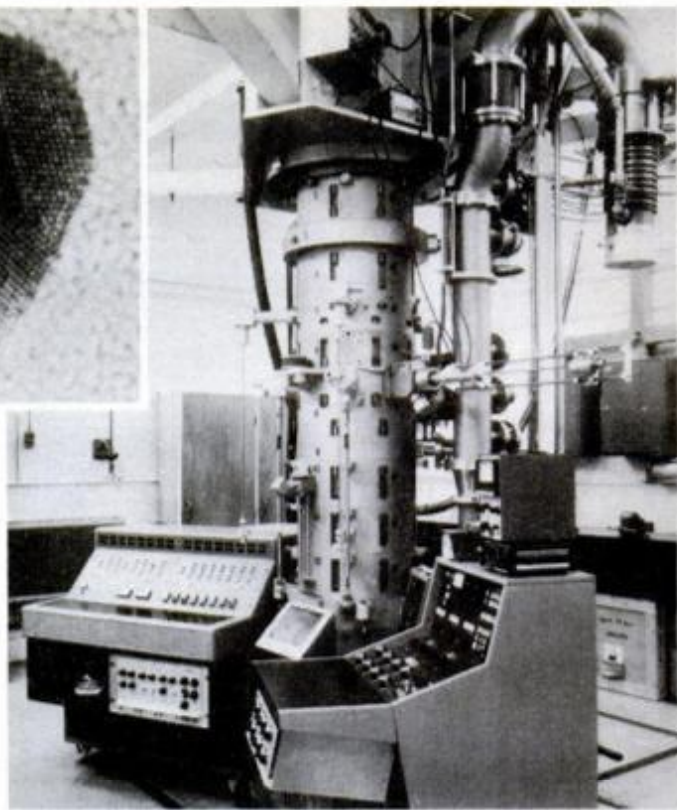
As the United States takes another look at coal to help fight the energy crunch, government researchers have discovered a new problem: The devices used to control pollution at coal-fired power plants may them-

selves pollute the air with electrically charged particles.

The researchers at the Commerce Department's Atmospheric Physics and Chemistry Laboratory in Boulder, Colo., investigated the effect of electrostatic precipitators. These devices set up a high-voltage field inside the stack, instantly charging particles of fly ash. Most of the heavier particles are then drawn to a positively charged plate before they escape into the air.

The problem in some precipitators is that some small particles elude the plate and create a negatively charged cloud above the plant. This cloud could affect rainfall, and influence animal and plant life throughout the region.

A spokesman for the Department of Energy said the department was unaware of the study. But she minimized the environmental danger of the cloud. "Mother Nature likes negative particles," she said. **PM**

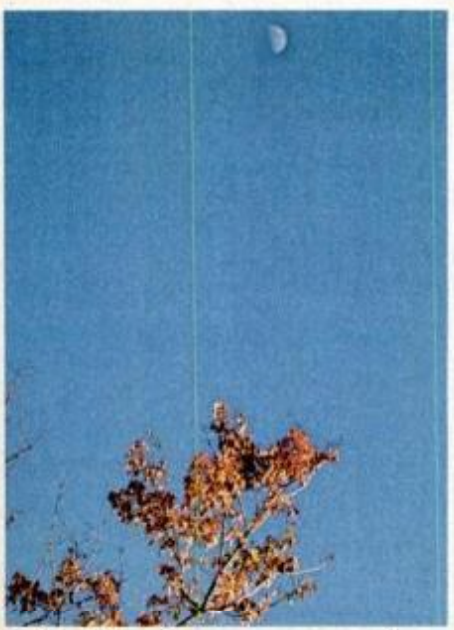




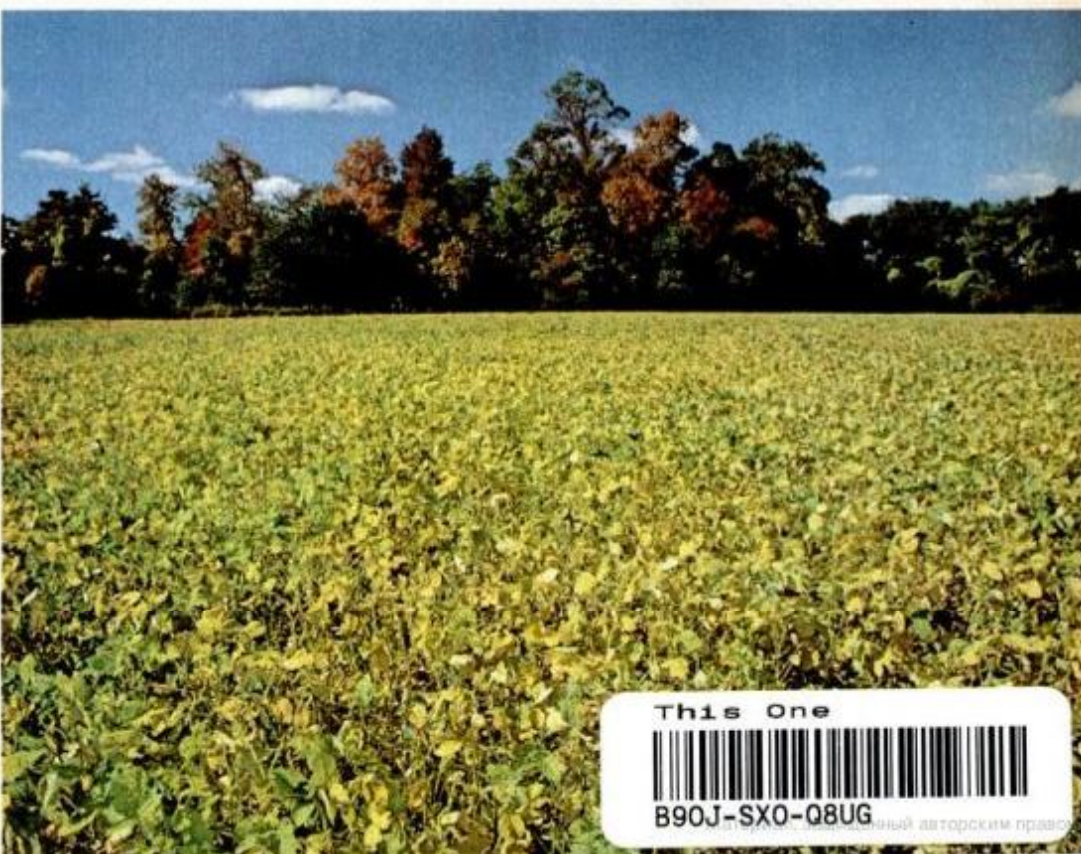
3. Be on the lookout for contrasty scenes like this one. The photographer, knowing his film, exposed a half stop below the "correct" meter reading to make background darker.



4. Photographer circled stump (above) for best lighting. Lens was opened to reduce depth of field. 5. Back-lit sumac (below) used 135-mm lens at dawn. Telephoto permits "close-ups" without special lens.



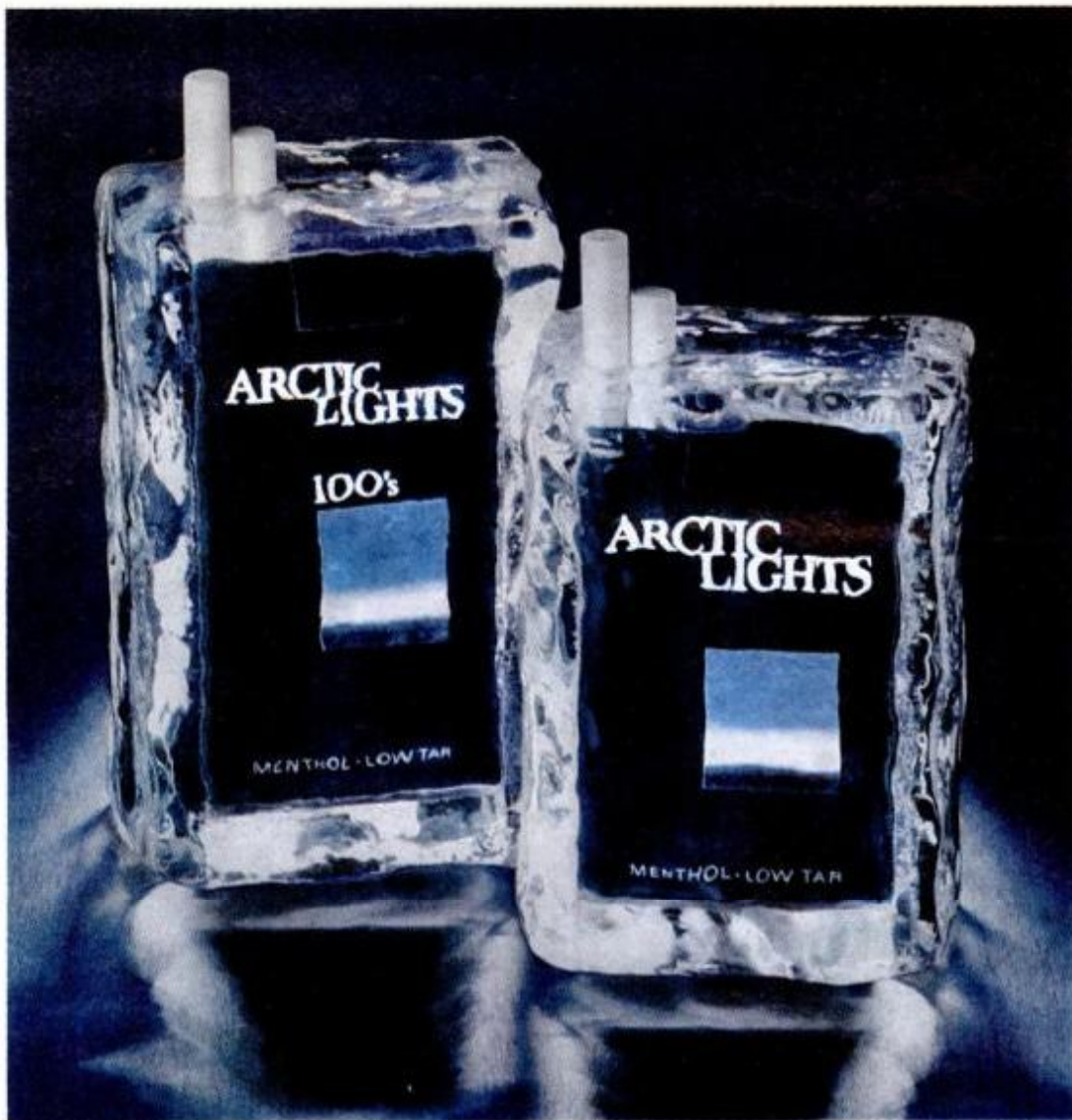
6. Telephoto lens compresses foreground and background, making moon appear much closer than it is (above). 7. Not all foliage need be on trees. Wide-angle shot of soybean field (right) is an eye-appealing change of pace.



This One



B90J-SX0-Q8UG



Discover
Arctic Lights
—more menthol refreshment than
any other low 'tar' cigarette.

Full menthol refreshment. That's what ARCTIC LIGHTS delivers.

A very special kind of menthol refreshment you just won't find in any other low 'tar' menthol cigarette.

You see, while the filter holds back 'tar,'

the unique new ARCTIC LIGHTS menthol blend comes right through. Result? You get the iciest, brightest taste in menthol smoking—puff after puff. Light up your first ARCTIC LIGHTS. **You just won't believe it's a low 'tar' menthol.**

Arctic Lights: Kings & 100's

© 1978 B&W T Co.

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

9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

DETROIT LISTENING POST

Small and sporty

Just because everyone is thinking small again is no reason not to think in terms of small, economical, performance cars. At least that's what some insiders at Chevrolet are thinking.

Chevy scored high marks last April with its X-11 sporty version of the front-drive Citation, although that package is little more than a dress-up option for the more ordinary Citation two-door coupe and three-door hatch models. But it shouldn't be long before there's a pepped-up engine, a turbo perhaps, to go with the performance-oriented graphics.

Chevy has duly noted Ford's success with Cobra and the turbo Mustang models and feels it should be in there slugging it out with Ford as well as arch-rival Pontiac.

Pontiac, for its part, seems to have made a mistake by not having a performance-oriented X-car version, but that mistake should be corrected by next fall with the GTO name on a jazzed-up Phoenix.

This Chevy/Pontiac/Ford minuscule competition will continue into the '81 model year when Ford will debut its front-drive Pinto replacement and GM will have front-drive Monza/Sunbird successors ready.

The very successful Mustang and Capri are in for renewed competition themselves when GM rolls out its Camaro and Firebird for 1982.

New Chrysler experimentals

Two handsome new experimental cars were unveiled within weeks of each other last summer, and Chrysler Corp. was involved in development and design of both.

The first, a research safety vehicle (RSV) jointly developed by Buffalo, N.Y.-based Calspan Corp. and the National Highway Traffic and Safety Administration (NHTSA), is a four-door, five-passenger hatchback based on the front-drive European Chrysler Simca 1308. It's powered by a 1.7-liter Four mounted transversely, weighs 2675 pounds and measures 178 inches long, 67 wide and 53 high on a 105.7-inch wheelbase.

In accordance with NHTSA goals of investigating "practical, producible, energy-efficient and safe family transportation for the mid-

1980s," the Chrysler/Calspan RSV features energy-absorbing interior panels, run-flat tires, a passive "inflatable" restraint system (plus a driver's-side air bag) and a soft front-end design for pedestrian safety and low-speed damage protection. It's reportedly capable of protecting its occupants in 40 to 45-mph front barrier impacts and car-to-car



Safe family car of the '80s is joint design by Chrysler Corp. and Calspan Corp.

crashes of 40 to 45 mph on the side and 50 mph in the rear.

The second prototype is a four-passenger, two-door hatchback, experimental electric car (also front-drive) jointly developed by Chrysler and General Electric Research under a Department of Energy (DOE) contract (see 1980 cars, page 96). Called ETV-1, it was built to design goals of acceptable drivability, comfort and styling in addition to energy efficiency, utility, safety, ease of production and cost. It can cruise at 55 mph, pass at 60 mph, accelerate from zero to 30 mph in nine seconds and climb a five-percent, one-mile grade at 50 mph. Practical range with two passengers is about 100 miles between charges if speeds are kept below 45 mph.

Both of these vehicles, it should be emphasized, are ultra-expensive, one-off prototypes developed with government money, and neither is anywhere close to production for sale to the public.

Trained mechanics needed

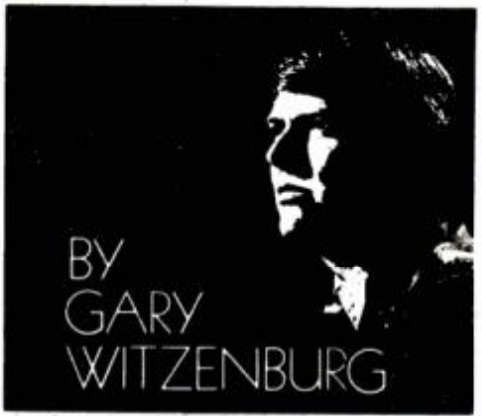
It's no secret that cars get more complicated every year, thanks mostly to emissions and fuel-economy standards. Such engineering esoterica as fuel injection, turbocharging, electronic engine controls and three-way catalytic converters with sophisticated exhaust sensing and feedback are driving back-yard mechanics bananas. Even carburetors as we know them are on the way out as automakers begin replacing them with newly developed single-

point fuel injection, called CFI (central fuel injection) by Ford, TBI (throttle body injection) by GM and EFM (electronic fuel metering) by Chrysler.

On top of that is the push by the Environmental Protection Agency (EPA) to make engines tamperproof. Some carburetors already have sealed idle-mixture screws and choke adjustments, and by next year the government wants those items plus nonadjustable idle speed and spark timing on all cars. Unfortunately, this will mean a lot of parts will be replaced to cure engine ills where before a simple adjustment would have done the trick.

Not helping the situation is a nationwide shortage of trained auto mechanics. The Automotive Information Council (AIC) reports that the United States has some 250 vehicles per mechanic compared to 74 in Japan and 68 in England. Both GM and Ford, keenly aware of the problem, have free summer workshop programs for high-school and community-college automotive teachers, and Plymouth's famous annual Trouble-Shooting Championship is credited with bringing as many as 28,000 people into the field in its 18-year history. The government, however, has scrapped its Auto Mechanic Apprenticeship Training Initiative program.

One reason for the shortage, which AIC says is probably going to get worse, is heavy criticism by so-called consumer advocates and some government officials. "We get blasted so often that the motoring public now looks on us as a bunch of crooks," says one very disgruntled shop owner. "No wonder we're having trouble attracting new talent or even keeping the talent we now have." **PM**





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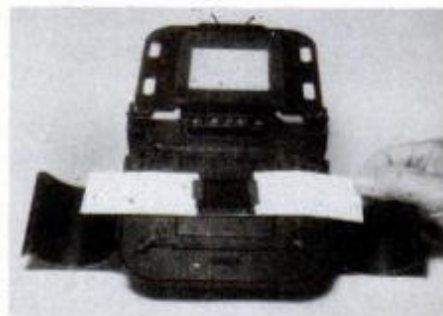
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PHOTO HINTS

Hold your tongue



Short negative strips can be handled in an enlarger easier if you tape on paper tongues about 3 inches long. On the paper note printing data and subject.—*Robert Hertzberg*

Wise wiring



Keep the wire on a photo flood socket short, so it doesn't break from its own weight. A short, threaded nipple between socket and plug supports wire, permits adjustment of a hot bulb.—*Bob Berger*

No-cost film washer



Drill a ring of 12 to 15 1/4-inch holes near the bottom of a one-pound coffee can to make an excellent film washer. Paint the inside to prevent rust. Put the can under a faucet and adjust flow so water fills and drains at the same rate.—*Robert Hertzberg*

LYNCHBURG HARDWARE & GENERAL STORE

Box 342, Lynchburg, Tenn. 37352



FIELD TESTER CAP

This is a comfortable sportsman's billed cap. Black mesh (air cooled) and adjustable to any size head, with an official "Jack Daniel's Field Tester" patch on the front. Guaranteed to shade your eyes and start a lot of conversations. My \$5.25 price includes postage and handling.

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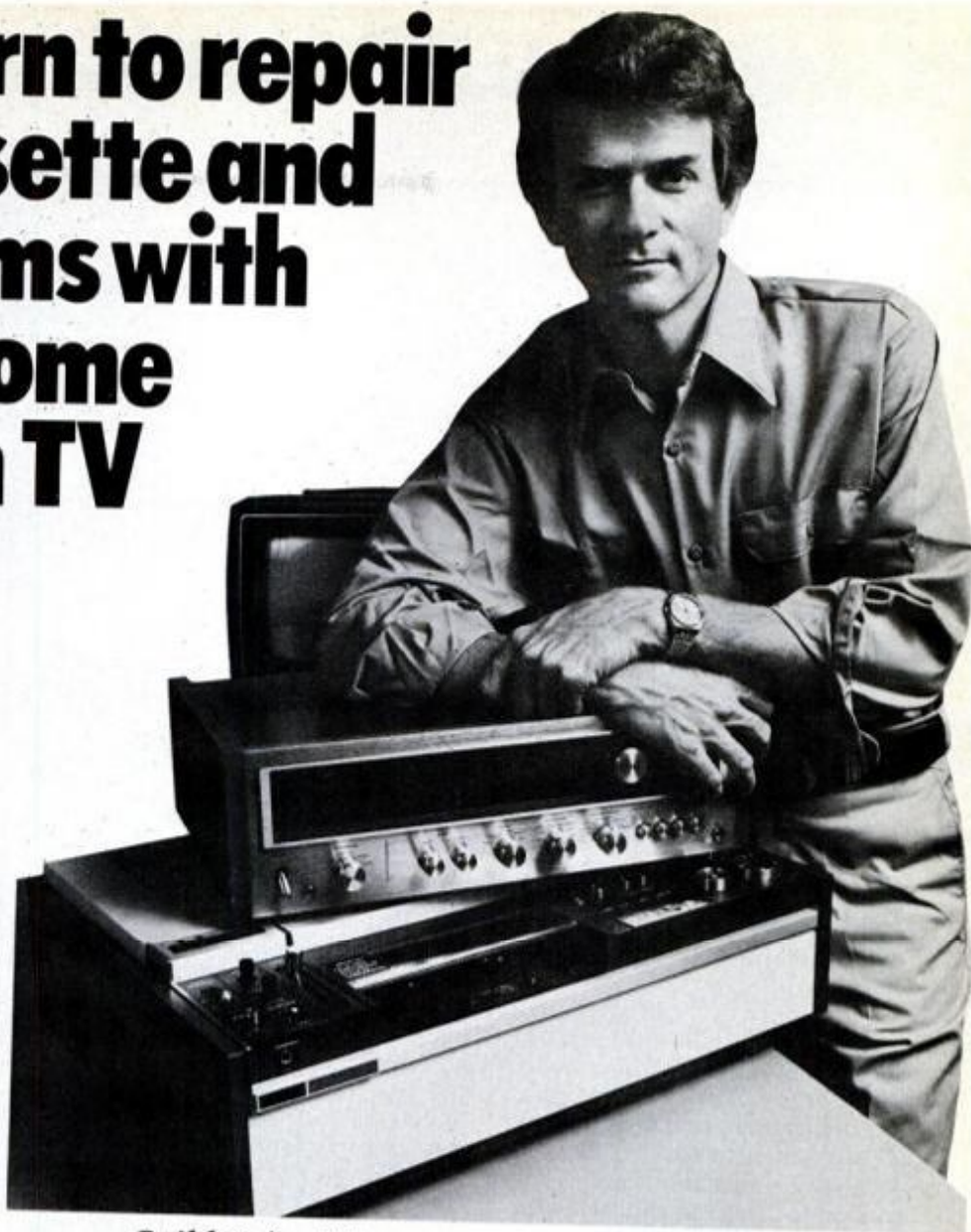


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Send today for the 100-page catalog that shows all the lessons, all the equipment and training material you get. The catalog will show you other NRI opportunity fields like the new course in Microcomputers & Microprocessors, Complete Communications, and more. With the addition of video cassette and disc systems, television has taken on an exciting new dimension. NRI training can put you right in the center of that dimension.

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HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Rotting roof

There are sheets of ice on the inside of my attic roof due to condensation. I have added soffit vents, roof vents, a gravity ventilator and 6 in. of fiberglass insulation to the original 3½ in. between joists. I have even shut off my furnace humidifier. What now?—C.T. Eckel, Pleasantville, N.J.

Warm, moist air has pressure and will seek a dryer, cool surface. Since your home is well insulated, the attic roof members are even colder than usual. Appliances such as dishwashers and dryers will add moisture to that contributed by baths, showers and cooking. Check your bath and kitchen vent systems to make sure they exhaust through the roof.

Make certain that your attic access door is completely sealed. If your basement is unfinished, moisture from it can travel through the cavities between wall studs upward to the attic. Block off these cavities with insulation.

When the above criteria are met, if the problem still exists, check the vapor barrier on the ceiling below your attic. The vapor barrier *must* be installed between the bottom of the ceiling joists and the drywall plaster, vapor barrier facing the heated room. If the original insulation was improperly installed with vapor barrier facing toward the attic, or if it wasn't sealed properly (at light fixtures and joists), moisture will permeate. You can tell if the vapor barrier is facing the wrong way because the ceiling will probably be stained.

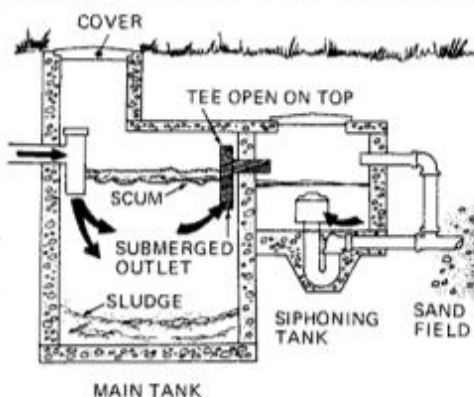
To install a vapor barrier now, you will have to staple 6-mil polyethylene over the existing ceiling and then apply another layer of plasterboard. However, a prime coat of aluminum paint followed by vapor-resistant oil paint (or wall covering) may be your solution. (Water base paints are *not* vapor resistant.) Usually a total of three coats is required. Before applying, check the compatibility of the new paint with that of the existing paint.

Sand-filter problems

Our new home is only two years old and is serviced by a septic tank, sand filter and lateral lines. Our problems are that we can't tolerate the odor from the sand filter, and tissue keeps coming through the pipe. Do you see

a solution?—Russel G. Arnold, Anchorage, Ky.

After studying all the engineering data I could find to no avail, a call to Mr. H.T. Adams, an expert septic-tank builder for 40 years, provided me with the solution in about 30 seconds. If you look at the sketch (below), you will see a tee connecting



Tee leading to siphoning tank prohibits scum from flowing directly into it.

the main tank to the siphoning tank. The tee is open at the top (an ell could create a siphoning effect, still sucking out tissue and sludge).

If this tee is improperly installed or broken, sludge and tissue will flow directly from the main tank to the siphoning tank, then to the sand filter. In a properly functioning septic and siphoning tank, the submerged part of this tee should be about 1 ft. 6 in. long to assure decomposition of floating tissue and solids prior to discharge into the siphoning tank. Tissue will be decomposed long before it passes through the sand filter.

Frozen pipes inside and out

During last winter's unusual cold, the water line froze between the street and my house. Frost reached depths up to 8 ft. Can you tell me about heat rods?—Dr. Walter Chapman, Lyons, Colo.

I have no information on heat rods, but a check with Easy Heat Engineered Heating Products, New Carlisle, Ind. 46552, reveals that they make a heating unit that fits

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.

inside a water line. It's called the M.I. (Mineral Insulated) Inpipe Heater. It is fed through a hole bored in an elbow where the pipe enters the house. A special fitting assures a watertight fit at the elbow. Be sure to specify the approximate length of your water line when you order.

As installations require that the water be turned off at the main and all lines drained, I would call a plumber. The cost will be minor compared to that of last year's grief.

The insulated water pipes in my unheated crawl spaces and garage froze last winter. I'm on a well and septic tank, so I can't allow my faucets to drip through every cold spell. Any suggestions?—William R. Howell, Cragmoor, N.Y.

If your pipes froze even though wrapped with insulation, I strongly recommend that you install heat tapes. They are thermostatically controlled to supply heat when the temperature at the pipe surface drops to 35° F. Easy Heat (address above) also makes these. Follow the manufacturer's instructions for adding insulation over the heat tapes, especially regarding the thermostat.

Cutting concrete

How can I cut an 8-in. hole in a concrete basement wall 8 in. thick?—Chester Matheur, Oregon, Mo.

Your local tool-rental company should have a rotary hammer, or hammer drill as it is sometimes called. It is an electrically powered tool similar to the jackhammers you see on road repairs, but a rotary hammer is scaled down for home use. You will have to bore a series of holes around the perimeter of the opening, then break out the center with a sledge. Whoever works on the concrete should wear safety goggles and work gloves. **PM**



Endorsement Battle

NEW PRODUCT

A famous golf star endorses the Lanier. Our unit is endorsed by our president. You'll save \$100 as a result.



We not only took the unit apart, we examined our competition as well.

Judge for yourself. That new Olympus micro recorder shown above sells for \$150. Its closest competition is a \$250 recorder called the Lanier endorsed by a famous golf star.

FANCY ENDORSEMENT

The famous golf star is a pilot who personally flies his own Citation jet. The Olympus recorder is endorsed by JS&A's president who pilots a more cost-efficient single engine Beachcraft Bonanza. The golf star does not endorse the Lanier unit for free. After all, a good portion of his income is derived from endorsing products.

Our president, on the other hand, does not get paid for endorsing products—just for selling them. And his Bonanza is not as expensive to fly as the golf star's Citation. In fact, our president also drives a Volkswagon Rabbit.

SOLD DIFFERENTLY

The Lanier is sold through a national network of direct salesmen similar to the IBM sales force. Naturally, these salesmen must be paid expenses and commission.

JS&A efficiently sells the Olympus through this advertisement—a very direct and inexpensive way to market a product.

With less overhead, no direct national sales staff, and no expensive endorsements, Olympus can sell its recorder for less money to JS&A. And with our company's efficiency, we can sell you practically the same recorder as the Lanier for much less—a savings of \$100.

Is the Olympus better than the Lanier for less money? We weren't sure, so we took them both apart and what we found amazed us. Other than a slight size difference, the units were practically identical. For example:

CORELESS MOTOR

Both units have the new coreless motor. Conventional motors require a long and heavy solid core that is wirewound. In a coreless motor, the windings are on the outside or stationary part of the motor making it flatter, yet it has greater initial torque and more consistent speed than any other conventional motor.

THE FERRITE HEAD

Both units use ferrite for their recording heads—the same material used in precision studio recorders. This extremely hard, diamond-like material will last a lifetime and prevents oxide build-up.

A NEW KIND OF MIKE

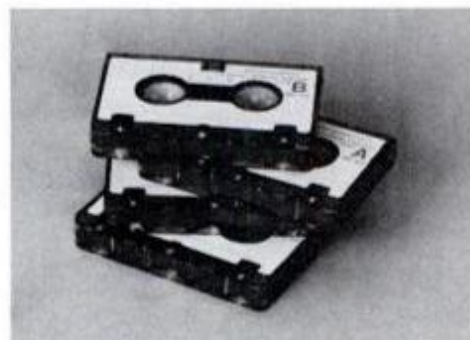
Both units also use an electret condenser microphone with automatic level control. In an electret system, the impedance of the microphone remains constant, thus passing on the natural sound quality of all frequencies without distortion. The result is a clear recording with an extremely low signal-to-noise ratio, so you'll hear less objectionable background hissing or humming.

MANY SIMILAR FEATURES

Both units use the microcassette tapes that play 30 minutes per side. The Olympus measures only 1" x 2½" x 4⅞" and weighs only 9 ounces. The Lanier is the same weight as the Olympus and measures only ⅞" x 2½" x 4"—practically the same size.

HERE'S OUR PLAN

But prove it to yourself. Order an Olympus recorder from JS&A. After you receive it, call in your Lanier sales representative. Have him bring you a sample of his unit. (You might even check to see what kind of car the salesman drives.) Then make a side-by-side comparison. Compare both units feature for feature



Micro cassettes are the newest recording medium. Each cassette will record for 30 minutes per side.

and see how much better the Olympus sounds. Then carry them both in your pocket and on trips. Use them at meetings or while you drive in your car. Really give them both a workout.

Then decide. If you don't feel that the Olympus is as good a unit or better than the Lanier for \$100 less, simply return the Olympus within 30 days for a prompt refund and then purchase the Lanier unit, keeping

one of our tapes as a gift. If you decide to keep the Olympus, consider yourself a smart shopper. Anyone who would take the time to read this advertisement and take the action to order and test the Olympus unit, deserves to save \$100.

SERVICE AT ITS BEST

Both the Lanier and the Olympus units are solidly backed by efficient service organizations. Olympus has an outstanding service-by-mail facility so no matter where you live, just slip your unit in its handy mailer and send it in. Olympus is the same company that manufactures high quality precision cameras and optics, and JS&A is America's largest single source of space-age products—further assurances that your modest investment is well protected.

To order your Olympus unit for our comparison trial, send your check for \$150 plus \$3.50 for postage and handling to: JS&A Group, Inc., One JS&A Plaza, Northbrook, Illinois 60062. (Illinois residents add 5% sales tax.) Credit card buyers may call our toll-free number below. We will promptly ship your unit, one free tape, complete instructions, and one-year warranty. If you wish to order additional cassettes, you may order them for \$3 each or \$15 for a package of five (our minimum quantity).

CONSUMERS CAN BENEFIT

Endorsements are very helpful when you sell products. They attract attention and give consumers confidence that their purchase is also used by someone famous. But indirectly, consumers pay for endorsements. They also pay for a large sales force and less efficient marketing methods.

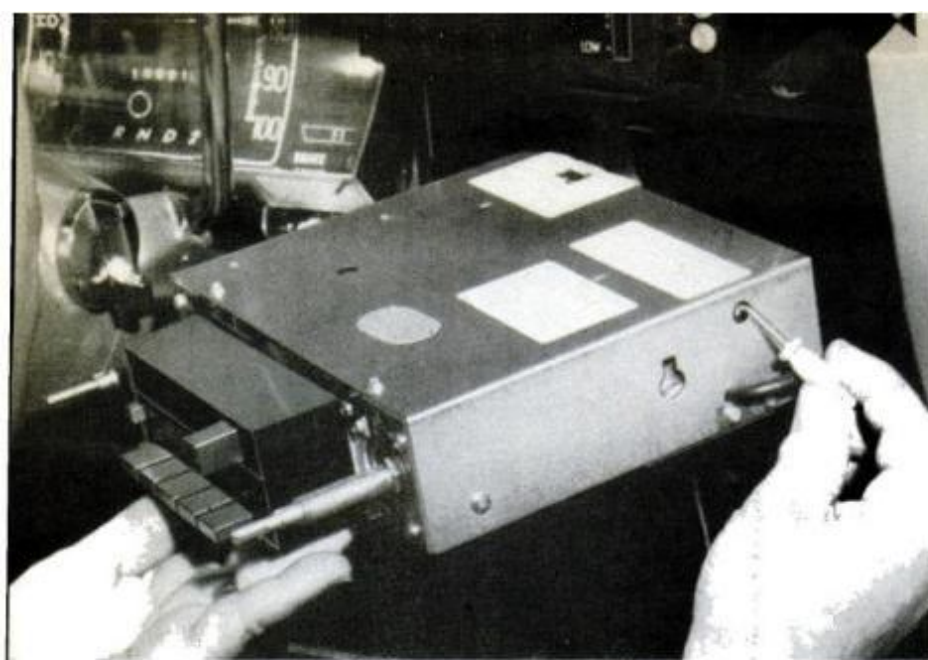
When you purchase an Olympus from JS&A, you pay for just what you get. A great product. Why not order an Olympus recorder at no obligation, today?

JS&A PRODUCTS
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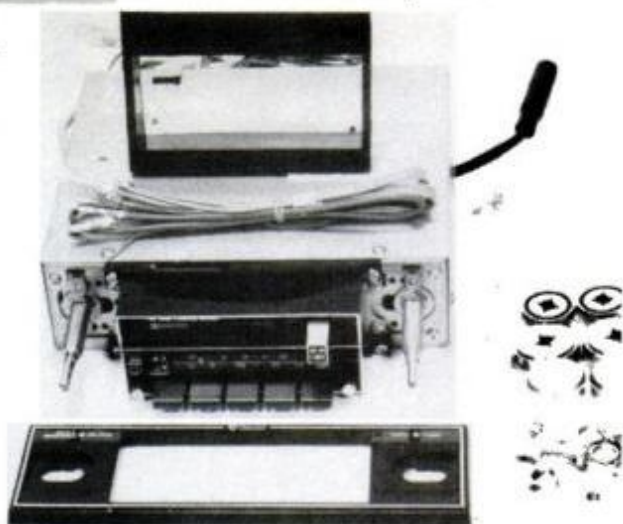
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Make certain that any in-dash radio you install comes with all the mounting hardware and a mounting bracket. We show Clarion's PE-751A unit in these photos.



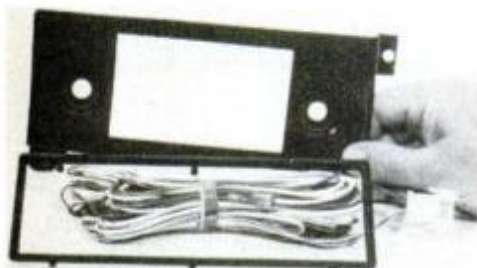
Here's an important adjustment that many people forget—the antenna trim. Just adjust for the loudest volume at the high end of the AM band.



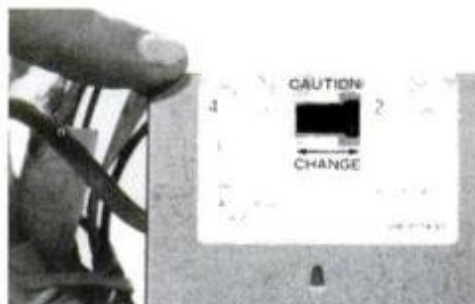
Car stereo— install it like a pro

If installation worries have kept you from getting the new, great-sounding car stereos, let PM show how easy it is. Supersound can be only hours away!

by Herb Friedman



If there is no radio in the car to start with, you'll need a metal mounting bracket or adapter, such as this one. Some autosound makers offer special kits.



Before you finish your installation, check that the speaker selector switch is set to the right number of speakers. You don't want to have to rip out the radio later.



Modern Chrysler and GM mid-size cars can only accommodate small speakers. Get a speaker like these Jensen 3 1/2's with large magnets to deliver bass notes.



You can also try a rigid-surface speaker like this Clarion SK-103. Though it has the tweeter and honker next to the woofer, it fits a 6x9-inch speaker cutout.

There's a new sound on the highway that's being called "autosound." Whatever you call it, it all comes down to the fact that just about anyone can upgrade the typical car radio or radio/tape player to a stereo high-fidelity system on wheels. Well, maybe it won't be quite as good as what you get from your home component system, with its giant speakers, but it will come close. You can have crystal-clear FM reception, even FM Dolby, a Dolbyized cassette player, enough power to rattle the windows in the next car, and speakers that can reproduce a bass which vibrates the dashboard, while bouncing superhighs off the rear deck.

Fact is, all this equipment is available as direct-replacement hardware—meaning it's made to be directly substituted for what you already have installed in your car, van, or RV. Just remove what's there and substitute the autosound equipment. With rare exception, the upgrading to highway hi-fi won't involve much more wiring than snaking two pairs of wires under the carpeting to the trunk for a set of stereo rear-deck speakers. If your car already has rear speakers, the wiring is in place, so even that chore is eliminated.

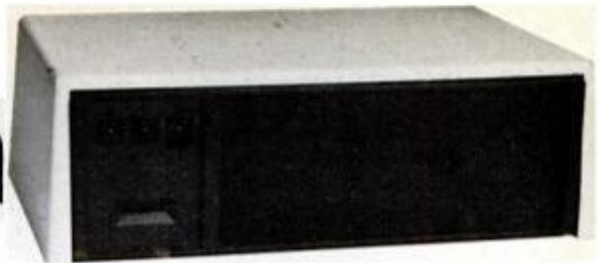
The only real problem you'll have is selecting quality equipment, for just about everything in autosound is touted as "high fidelity," yet very little of it really is of hi-fi quality.

Installing speakers

Loudspeakers make the most significant improvement; simply replace the existing speakers with autosound models, and it's as if a whole

(Please turn to page 26)

Burglar Alarm Breakthrough

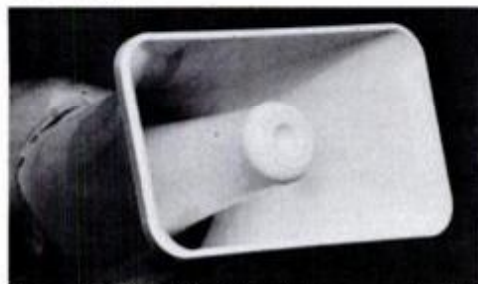


A new computerized burglar alarm requires no installation and protects your home or business like a thousand dollar professional system.

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

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

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



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

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

NO MORE FALSE ALARMS

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

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

ARRIVE HOME SAFE

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

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

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

PROFESSIONAL SYSTEM

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

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

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

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

COMPARED AGAINST OTHERS

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

YOU JUDGE THE QUALITY

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

Each component is first tested at extreme

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

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

PEOPLE LIKE THE SYSTEM

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

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

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

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

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

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Make sure that the radio works before finally securing it into the dash. Then tighten the nuts on the two shafts that secure the radio to the mounting plate.



Once radio is in, check out each function—even those you won't use very often. The completed installation should look just like a factory job—only better!

new world of sound were created in the car. But what is an autosound speaker?

An autosound speaker delivers the best possible sound for its size—not necessarily true high-fidelity sound. For example, mid-size Chrysler and GM cars use 3½-inch stereo speakers up front in the dash. There is no way anyone will get real bass out of a 3½-inch speaker. Fact is, there are few minispeakers that can handle the power needed for loud sound without generating severe distortion. One of the very best, according to many experts, is the Jensen 3½, whose magnet is almost as big as the speaker itself. It fits perfectly into the dash cutouts on mid-size Chrysler and GM cars.

What if your dash isn't cut for 3½s? It has only a mono 4 x 10-inch speaker? No sweat! On the GM you replace the 4x10 speaker with an adapter bracket that supports two angled 3½s. It's not the greatest separation in the world, but it's stereo. On Chryslers you'll find the 4 x 10 approximately in the center, and a 3½-inch "well" under the dash cover on each end. You can use a 4 x 10 adapter bracket, or mount the 3½s in the end wells. Punch the dash cover for a 3½-inch opening and cover with a perforated trim plate available from some (not many) autosound dealers. The wide-spaced 3½s create a greater stereo effect than mid-mounted 3½s.

Even if you can use larger speakers in the dash, the really solid bass and maximum volume come from speakers mounted on the rear deck. These are the "hi-fi" speakers, usually 6x9-inch woofers with a tweeter or with a honker for the mid-range and a tweeter for the upper high frequencies. Models are available with power-handling capacities up to 200 watts per speaker.

If your car already has rear-mounted speakers, simply remove

them and substitute hi-fi autosound speakers. These should have the same mounting-screw locations. Remember, size is not as important as mounting-screw location because you want to be able simply to exchange speakers without the need to drill new holes in hard steel.

You need to match mounting holes because many hi-fi autosound speakers are considerably larger than the speakers they replace, yet everything is designed to fit standard speaker openings, usually 6x9 or 4x10 inches (6x9 is almost a universal rear-deck standard). The whole mounting problem is tied into the fabrication of the rear deck: The speaker will distort when the mounting nuts are torqued, but wide tolerances in budget speakers handle the warp with no effect on their somewhat limited sound quality. High-fidelity speakers, however, are precision devices, and a warped frame will lead to rubbing of the voice coil, which produces an irritating buzzing or distortion.

Some manufacturers, such as Jensen, handle the problem through a rigid rim about ¾ inches thick that's secured to the speaker frame and is literally unbendable. Others, such as Epicure, use a 5-inch woofer with side-mounted honker and tweeter on a rigid steel plate that is also unbendable. The plate is drilled to match 6x9-inch speakers and looks as though it won't accept Epicure speakers. But the speakers fit.

On the other hand, Clarion and others have surface-mounting speakers: 6x9 woofer and side-mounted honker and tweeter in an oversize rigid housing that drops directly into a 6x9 opening from the top of the deck. The surface-mounting speaker is oversize, but it uses standard 6x9 mounting holes. (It is mounted on top of the rear deck in cars which have a full rear-deck speaker cutout, not slots.) Again,

the rigid frame housing protects the speaker(s) from warp when the mounting nuts are tightened.

If your car isn't wired with rear speakers, look at the rear deck from inside the trunk. On a reasonably late model, say 1970 or later, there will probably be two 6x9 or 4x10 cutouts in the metal underdeck. Follow the cutout with a keyhole saw to cut through the cardboard or thin veneer rear-deck cover in order to create openings for rear-deck speakers. If your car has only one rear cutout in the metal underdeck, or none, simply use a speaker supplied in a "wedge" enclosure made to mount on top of the deck. The wedge shape directs the speaker sound forward.

The radio . . . and tape

In autosound equipment you have your choice of AM/FM stereo, AM/FM stereo with stereo cassette (usually with automatic reverse at the end of one side), or AM/FM stereo with an 8-track stereo tape player, though 8-track is fast fading in popularity in favor of the cassette (because you can record cassettes at home and play them in the car). There are high-end models with Dolby FM, Dolby tape decoders, separate bass and treble controls and—well—just about any feature you would find on home high-fidelity equipment.

But take warning. The unit you want may not fit your dash. Volares and Aspens are very tight front to rear. About six inches is all you have, but it's usually enough for a radio/tape player whose leads come out the side or bottom (not the back), such as the Clarion PE-751A. A Buick Century has a shade extra room and can handle a Jensen R420 whose leads come out the rear. The new X-body GM cars can, so far, take nothing but the radio GM plans to supply as standard equipment (you tape fans will be stuck with an easily stolen under-dash mounting for a tape player). Most larger cars, vans and RVs can accept just about any type of in-dash radio.

Almost all new and late-model cars have radios that are installed from the front, generally in a plastic "honeycomb" (a compartment for each item). If you already have a radio, it is secured to a metal mounting plate; use this plate for installation of your new radio. If your car has no radio, obtain a mounting plate or adapter; you cannot install the radio with the so-called "universal mounting hardware" supplied. This hardware is *universal* only if the radio installs from behind the dashboard or if you have the mounting plate.

(Please turn to page 29)

AND PERFORM.

This is a highly engineered chain saw for those people who are serious about woodcutting. The Stihl 028WB. A high performance, mid-size saw with all the design integrity of the big professional Stihl saws — which are the best-selling saws in the world! Like the pro saws, the 028WB is a saw you can count on to start right up, winter or summer, to run smoothly and handle easily. And to do the job you give it to do.



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This exclusive new fast-chargin' cordless drill and screwdriver comes loaded with power and features to blast through big jobs.



Powered for the professional! Made tough, for the pro who uses a drill more than any other tool. Made powerful, to work long, hard hours every day—and recharge in just one hour. Made with features like variable speed and reverse, for driving and removing screws and tough drilling jobs.

Skil's Boar Gun Model 2016 drill/screwdriver has Dual-Torque: two powerful gear ranges that maximize power at the chuck. "High" delivers 0 to 750 rpm for high speed drilling; "Low" provides 0 to 250 rpm at high torque, for tough drilling and driving applications.

Boar Gun drill/screwdriver recharges in just one hour, thanks to Skil's remarkably efficient Power Paks. With a pair, you'll be able to rotate 'em and drill all day—with no delay. Plus, each Power Pak can be recharged up to 1,000 times before you replace their long-life batteries!

See Skil's 3/8th-inch Boar Gun Model 2016 drill/screwdriver with Dual-Torque (mfgs. sugg. retail: \$99.95), and models 2008 and 2012, with single torque ranges (mfgs. sugg. retail: \$89.95), at your participating Skil dealer. All models include one Power Pak and charging unit. Now you can do it with Skil—and save. With the tool it took Skil to build: Boar Gun Cordless drill and screwdriver!

Do it with **SKIL**.

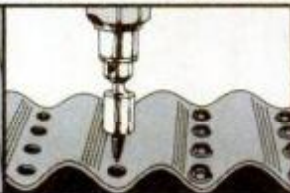
SPECIAL INTRODUCTORY POWER-PAK OFFER:

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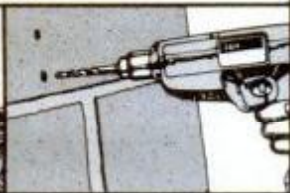
price) for just \$5.00, plus a full year's free service. Offer expires Dec. 31, 1979.



Power to drill hundreds of holes in hardwood. Variable speed and reverse.



Drills in metal. Variable speed for tough screwdriving.



Even drills in tough masonry.

INSTALLING CAR STEREO

(Continued from page 26)

All reliable manufacturers such as Clarion and Jensen have installation kits for specific cars which include the mounting plate, any special wiring cables and speaker grilles. But not every dealer sells the kits, or even admits they exist. If you need a mounting kit or plate, and your dealer says there's no such thing, look for another dealer or phone the distributor for the company whose radio you want to buy. If

he gives you a hard time, better select a different radio. *You cannot install a front-mounting radio without a mounting plate or kit.*

Installation of radios in American cars is reasonably easy, generally less than an hour for someone moderately handy with tools. The photographs show how to upgrade an ordinary car radio to high-fidelity autosound. The equipment shown is typical of what you might select. It consists of the Clarion PE-751A AM/FM stereo/stereo cassette in-dash radio and Clarion SK-103 surface-mount-

ing speakers. (Jensen 3½s were used up front in the dash).

Our Volkswagen Rabbit installation uses the somewhat smaller Clarion PE-662C AM/FM stereo/stereo cassette with a special rear-shelf speaker housing with forward-facing speakers designed for the Rabbit by Clover Industries.

Autosound is like putting home sound on the road and, as we've shown, it doesn't have to be difficult to install. So pick out the radio that best appeals to you, choose your speakers and go to it! **FM**

How to install autosound in a hatchback

Foreign cars, with the exception of Volkswagens, can often reduce the amateur installer to tears of frustration; many are best left to the professional installer, even if the installation fee seems exorbitant. In fact, foreign-car radio installations can be just as frustrating—and time-consuming—for the professional equipment installer as for the Saturday mechanic! Still, some foreign cars are easier than others. One that we chose was the VW Rabbit.

The hatchback question

Many compact American cars, as well as foreign cars such as the Rabbit we used, are hatchbacks. A hatchback can often make installation a nightmare. You usually cannot use flush-mount speakers, as the rear shelf is often merely decorative. Surface-mount speakers are possible, but they can

interfere with the operation of the hatchback, particularly if the rear seats fold.

Most people settle for surface-mount speakers up high, between the car body and roof (where the bass-producing effects of a trunk-like space are lost) or they install the speakers in the doors. Door installations are the hardest and scare off many an installer.

We used a newly designed speaker console from Clover Industries; they have consoles available for most any hatchback with a rear shelf, both foreign and American. Once installed, the console produced good sound and allowed normal operation of the hatchback.

If the radio fits . . .

The Clarion 662C radio that we chose came with all of the needed mounting hardware for the VW Rabbit. However, no matter what car you're installing the

equipment in, be *certain* the manufacturer gives *everything* you need.

In the case of the Rabbit, there is a special clip that fits over the front of the radio and pressure-holds it in place. Try to get the right clip from anyone—including a VW dealer—and you'll get an idea of what drives professional installers bananas.

Clarion supplied the clip and the right mounting plates. Make absolutely sure the manufacturer you deal with offers the same quality of hardware support.

Again, if you have any doubts as to whether your foreign car will enable you to make a normal, in-dash installation, leave it to the professionals, unless you are very sure of yourself.

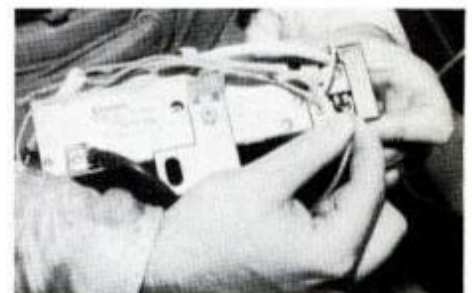
Given the right circumstances, even if you own a foreign hatchback, you can still get in on the fun of installing your own autosound.



For a hatchback with a rear shelf, Clover Industries likely has a speaker console to fit. Installing speakers in such cars was hard—but not anymore.



The speaker console from Clover matches most upholstery and, from outside the car, doesn't announce your expensive autosound system in the dash.



Connecting ground wire is usually done with a small clip. At the other end you can go to your cigaret lighter or to the fuse panel. Get the polarities right!



Note the clips on the side of this Clarion PE-662C unit—you need them for Rabbits and Audis. Clarion radios have mounting kits for most imported cars.



Again, don't forget AM trim adjustment. Doing it now will assure you of good sound later. The trimmer may be hard to find, but instructions should show it.



Once again, the final installation. Note how mounting plate Clarion supplied fits dash perfectly. It's little touches like this that make for good styling.



Revolutionary replica, the Brown Bess musket is \$225 from Navy Arms.

Kit-built muzzle loaders that stretch seasons

Now black-powder buffs can create or assemble their own ready-to-fire replicas for hunting or targetry.

by Angus Laidlaw

For target shooter, shotgunner, hunter, plinker or classic collector, there is now the added challenge and fun of building your own gun to fit exactly and follow your own ideas of how it should be done. Most factory-finished black-powder rifles, pistols and shotguns can also be had, at considerable cash savings, in kit form with all the parts required to



Hawken-style half-stock percussion rifle by Lyman comes as kit, \$160; finished, \$200.

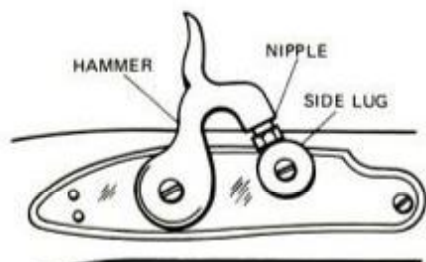


CVA/Flintlock (\$210; \$150 for kit) fires .45 or .50 cal.

Percussion version (\$200; \$140) has cap ignition.



FLINTLOCK



PERCUSSION

Flint sparks and cap-lock flame are the two ignition methods for firing black powder.

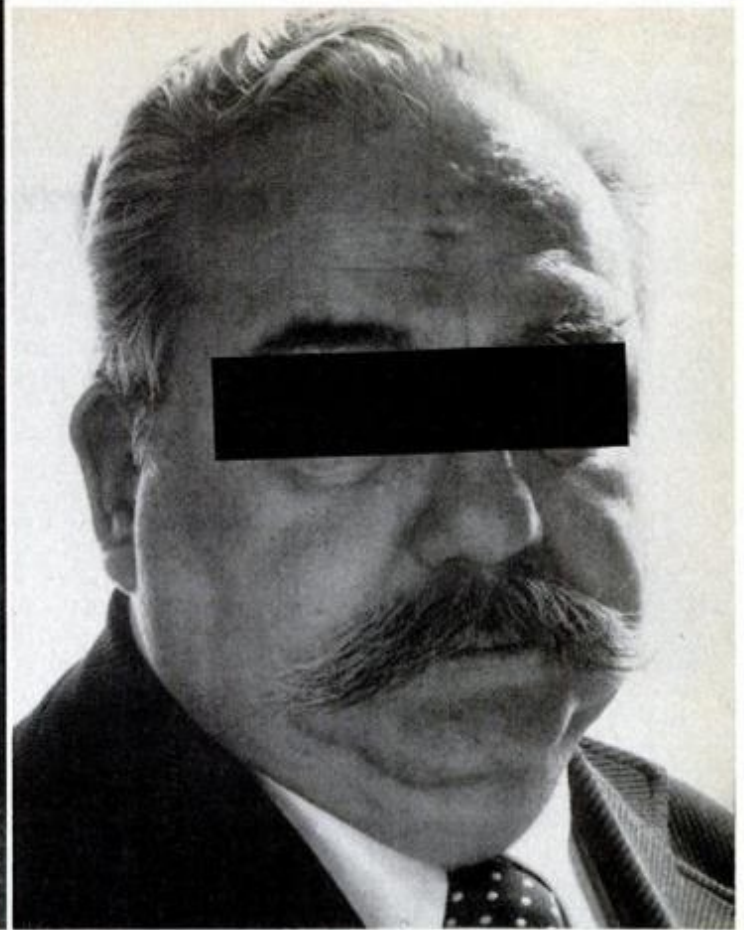
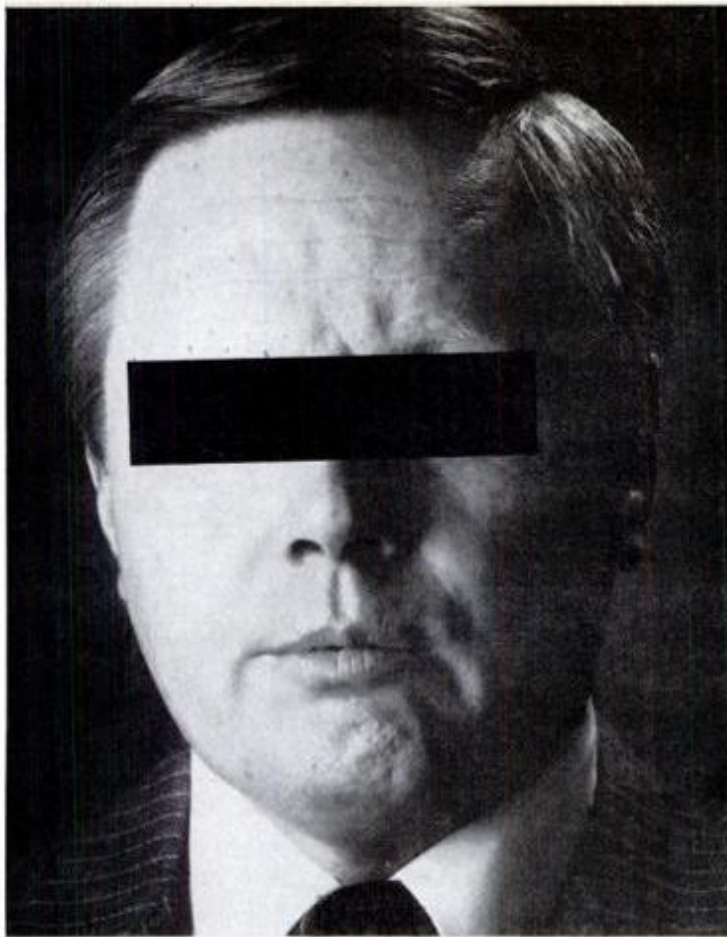
build one as good or better than the factory job. For the experienced and enterprising, high-quality locks, barrels, stock blanks and other components are available so you can start from scratch.

Modern muzzle loaders take two forms. Most make some effort to duplicate the styles and mechanisms of antique arms that were once the most modern in the American woods. They do this with varying degrees of authenticity at prices ranging from under \$100 to several thousand. Other modern models make no attempt to copy old guns; instead they are the best designs their makers can devise using flint or cap-lock ignition. Some are pains-

takingly and authentically hand-forged, but most replicas and modern designs alike are made by modern methods to keep costs within reason.

And many experienced hunters are turning to muzzle loaders to extend their hunting seasons. Special open dates for muzzle-loading guns have become available in over half the states and more are pending. Even if your state does not yet offer a special season, you can use your black-powder gun during the regular season (subject to specific caliber and lock mechanism requirements; check local laws with fish and game departments). Many shooters are

(Please turn to page 32)



One of these men had a business that went into a slump, into the red and up in smoke.

He had a fire of a "suspicious" nature, but arson could not be proved. So, he was able to collect a substantial amount on his insurance. He turned his business loss into a profit for himself but into an additional expense for the insurance company and the policyholders.

Arson has become the "hottest" crime in the nation. Who are these arsonists? They range from small, one-time offenders, like the man on the left, to organized professional "torches." Many have found arson a profitable crime. Shocking! Even more shocking are the losses related to arson—700 lives and an estimated \$1.6 billion in insured fire losses in 1977. When you consider lost jobs, property taxes and higher costs in consumer goods, the total economic loss is a staggering \$10 billion!

We're a major group of property and casualty insurance companies and we're alarmed by the rise in this violent, costly and dangerous crime. Not only does arson jeopardize lives and property, it costs policyholders a lot of money—approximately 40¢ of every claim dollar paid for fire losses. That's four times more than ten years ago.

Recently, the FBI re-classified arson as a major crime, in the same category as murder, rape and grand larceny. This re-classification will result in greater attention by federal, state and local law enforcement agencies. We

in the insurance industry urged the government to take this action. We will continue working with law enforcement agencies to stop the spread of this vicious crime.

Here's what we're doing:

- Trying to take the profit out of arson by more extensive investigation of claims and by cooperating in the prosecution of more persons involved in "suspicious" fires.
- Supporting the Insurance Crime Prevention Institute's investigations of insurance fraud.
- Conducting arson-detection seminars for insurance personnel.
- Developing the Property Insurance Loss Register—a computerized file of previous loss claims which will alert investigators.
- Encouraging state legislators to pass stricter laws that carry heavier punishments for arson.
- Encouraging community and state arson task force programs to deal with arson problems on a local level.

Here's what you can do:

- Report any suspicious persons or activity to the police, fire department or fire marshal.
- Support efforts in your community to fight arson.

This message is presented by the American Insurance Association, 85 John Street, New York, N.Y. 10038.

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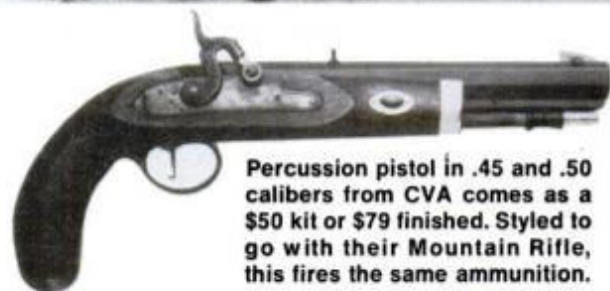
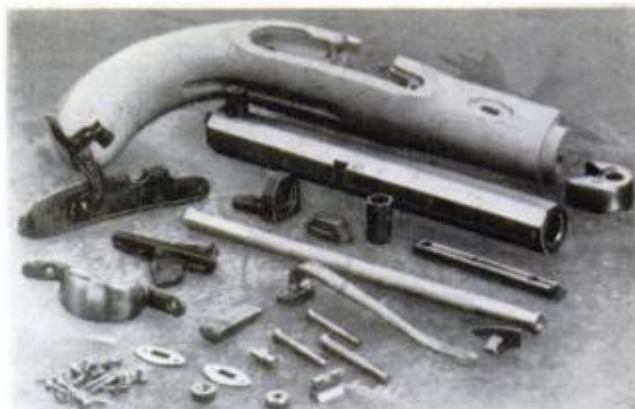
Mail with 25 cents in stamps or coins to:
 Macklanburg-Duncan Co.
 P.O. Box 25188, Dept. M2
 Oklahoma City, Oklahoma 73125

KIT-BUILT MUZZLE LOADERS *(Continued from page 30)*

finding that stalking game the way great-grandpa had to do it—with only one shot from a flint or cap-lock front-stuffer—makes hunting more challenging than using a scope-sighted repeater.

One of the most popular and practical of the replicas is the percussion-lock Hawken Plains Rifle. Developed in the 1820s and still popular after the Civil War, these simple half-stock rifles were prized for their power, accuracy and, above all, the dependability that the mountain man required when he would be away from the settlements for several years at a time.

The first of a flood of replicas was the Thompson/Center Hawken, introduced about 1970 in .45 and .50 cal. This high-quality, mass-production gun combines the best features of modern design and production methods. It comes with anachronistic coil springs in its investment-cast lock, adjustable open sights, and shallow rifling with one turn in 48 inches for use with a modern Maxi (a conical design) or Minie bullet (hollow-base design named in the 1840s after French Army captain Minie) or more traditional, cloth-patched round lead ball. Considering the high quality of manufacture—all in American factories—



Percussion pistol in .45 and .50 calibers from CVA comes as a \$50 kit or \$79 finished. Styled to go with their Mountain Rifle, this fires the same ammunition.

the \$220 price for the percussion model and \$10 more for the flintlock make this a bargain. Kits list for \$155 and \$165 for cap and flint.

In a more traditional vein, the Ithaca-Navy Hawken from Navy Arms goes all out for authenticity. This finely finished rifle could have come out of Sam Hawken's gun shop in St. Louis and no mountain man would have noticed anything special about it. The rifling is one turn in 66 inches for a patched round ball and is cut, rather than cold-formed, with a modern button technique. The browned octagon barrel is one inch across the flats, making this a heavy rifle that feels and handles exactly like the

originals it resembles so closely. At \$395 finished or \$285 for the kit of parts, its prices reflect the quality of the components supplied.

Dating from the earlier colonial and Federal periods of our history, Kentucky or Pennsylvania full-stock flintlock and percussion rifles make an attractive and practical choice. Although they're not as unbreakable as their plains rifle successors, these full-stocks are much showier, with their brass inlays and patch boxes. Usually of smaller caliber than the Hawkens, these traditional American rifles take you back to colonial times. Yet, when properly tuned, they can



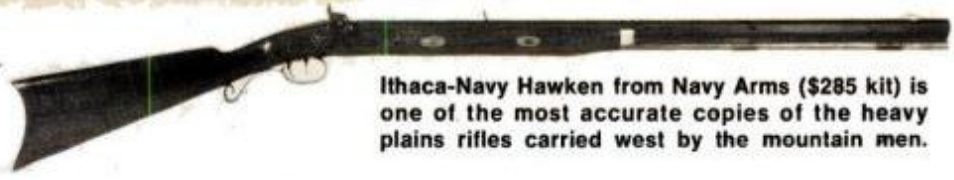
Single-shot Patriot pistol, \$135, comes finished only.



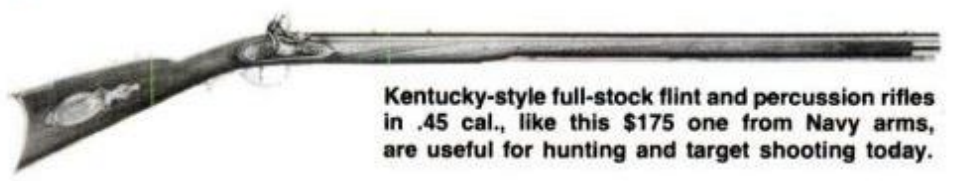
1860 Army Model Colt revolver (\$275) is reissued by Colt.



Old Army by Ruger is modern \$175 stainless cap-and-ball.



Ithaca-Navy Hawken from Navy Arms (\$285 kit) is one of the most accurate copies of the heavy plains rifles carried west by the mountain men.



Kentucky-style full-stock flint and percussion rifles in .45 cal., like this \$175 one from Navy arms, are useful for hunting and target shooting today.



Styled after replica of U.S. .45-70 carbine of 1873, \$350 H&R cap-lock muzzle loader combines antique and modern features into this accurate shooter.



Modern \$195 percussion rifle designed specifically for hunting combines Hawken features with modern butt shape. It's a Thompson/Center Renegade.

put venison on the table just as well today as they did two centuries ago. Navy Arms, Dixie Gun Works, and many other sources make these rifles, in qualities ranging from crude to super in direct relation to price.

Dixie and Tennessee Valley Arms also offer a plain, iron-mounted Kentucky derivative rifle called the Poor Boy or Tennessee Mountain Rifle. Both are attractive and offer the option of using both flint and percussion locks on the same rifle. Kits: \$175; complete: \$195.

Take a step farther back in time (some states like Massachusetts require smooth bores, Pennsylvania flint ignition) and you get into the excellent Revolutionary musket replicas that appeared for the Bicentennial. Like the Navy Arms .75-cal. Brown Bess in the lead photo, these smoothbores can be used today as they were then—with either birdshot or ball, depending on what season is open.

Turning to the modern muzzle loaders designed specifically to take advantage of special seasons, there is the \$350 Harrington and Richardson Model 175. This is a muzzle loading spin-off of their reincarnation of the 1873 .45-70 Springfield cavalry carbine. Offered in .45 and .58 cal., it combines the ruggedness of the horse-soldier carbine with modern accuracy and practicality.

Thompson/Center has also modernized some of their offerings in style as well as mechanical function. The Renegade .54 rifle (a smooth-bore barrel is also available) is a modern muzzle loader rather than a copy of anything. Prices for finished guns are \$180 cap-lock, \$185 flint.

Handguns, allowed in some states, follow the design of the rifles with the addition of percussion revolvers. Almost all of the common and scarce Civil War and pre-Civil War revolvers have re-entered the market in the past 20 years. Kit prices start at about \$50 and some roughly finished versions come at lower sale prices.

Colt offers fully assembled non-replicas (they call them reissues) of several Dragon and other percussion models, with prices starting at \$250 and going up to \$385. Since these pistols bear the Colt name, they'll probably hold their values well.

Ruger combined the design of a modern cap-and-ball revolver with features from old-timers to make the Old Army model. In blue it goes for \$137.50, \$180 in stainless steel. Unfortunately, there's no kit version.

A good first step in getting into muzzle loaders is to join the National Muzzle Loading Rifle Assn., Box 67, Friendship, Ind. 47021. Their magazine, *Muzzle Blasts*, has a wealth of information and ads on all aspects of black-powder shooting.

Other suppliers are: CVA, Saybrook Rd., Haddam Conn. 06438; Colt Firearms, 150 Huyshope Ave., Hartford, Conn. 06102; Dixie Gun Works, Union City, Tenn. 38261; Harrington & Richardson, Gardner, Mass. 01440; Lyman, Rte. 147, Middlefield, Conn. 06455; Navy Arms Co., 689 Bergen Blvd., Ridgefield, N.J. 07657; Sturm Ruger & Co., Southport, Conn. 06490; Thompson-Center Arms, Box 2405, Rochester, N.H. 03867; Tennessee Valley Arms, Union City, Tenn. 38261. **FM**



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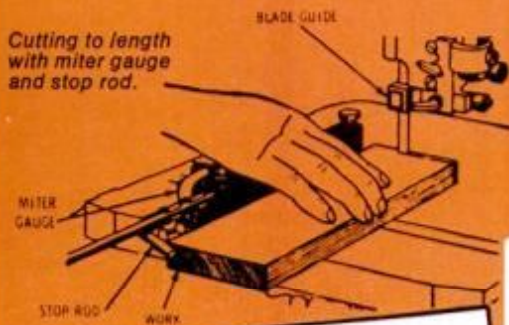
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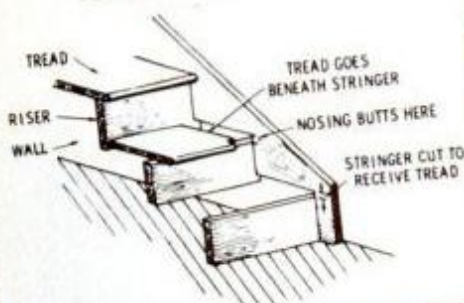
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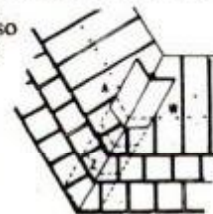
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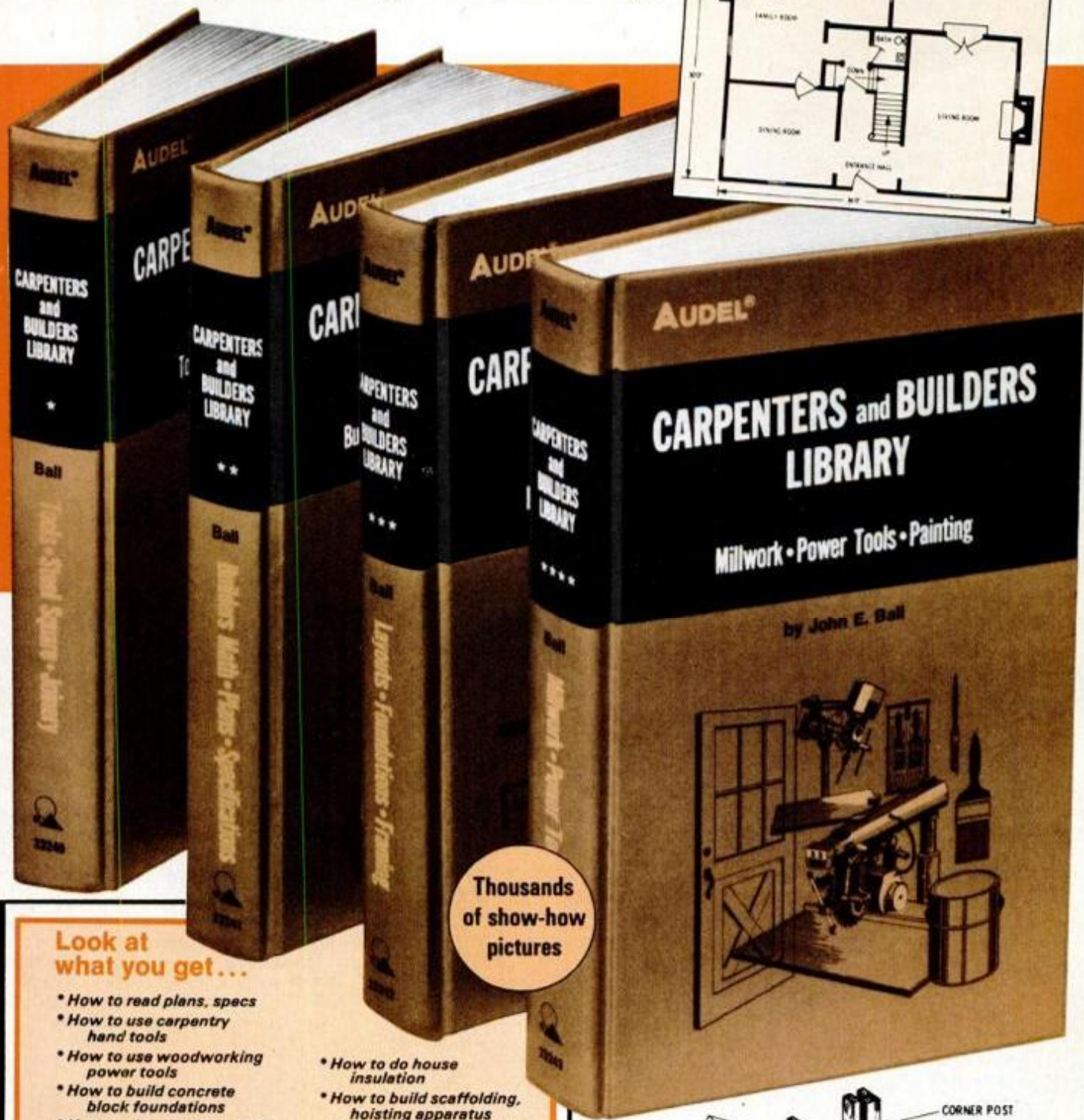
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Single mortise and tenon joint.

Installing metal shingles under wood shingles.

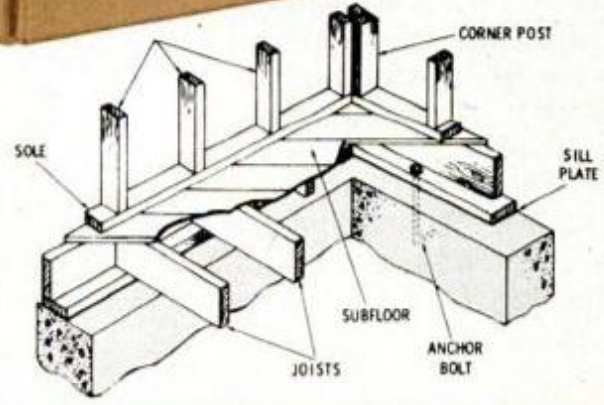
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Courtesy Light is a 12-v.d.c. accessory light for cars, RVs, trucks and boats. It mounts under a trunk or hood with two screws. Model 302, with slide switch, costs about \$6. Dyna-Plastics Inc., 3205 Forge Rd., Shreveport, La. 71109.



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Bike Shelf is a wall-mounted repair and parking stand for bicycles. Its hardboard shelf holds tools and accessories, while its plastic-coated steel brackets hold the bike by the frame, leaving the wheels free to rotate. About \$15 from The Ally Co., Box 248, Mequon, Wis. 53092.

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The Pack and Pedal is a lightweight bicycle bag that detaches from its own bicycle rack and doubles as a briefcase, a shoulder tote or an overnight bag. Made of water-repellent nylon, it comes in several colors for about \$40. McNeill-Favia, 2284 Old Middlefield Way, Mountain View, Calif. 94043.



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From breadbox to bus



It's a mini, a micro, no, it's VW's new nine-seat big bus.

There's no mistaking VW's old Type 2—the problem has always been what to call it. Minibus, microbus, van, transporter, breadbox? It's called by all those names and more. The box has been in production since 1950, with 5 million manufactured.

Here's the latest version. We're going to call it, simply, bus. It is—to use an expression that's passé when talking about cars—bigger and better. It's better balanced, more aerodynamic, roomier and safer than its predecessors. It has a longer wheelbase, wider track, revised suspension, an all-new steel unit body (instead of the Beetle platform chassis) and space enough in the rear for a diesel (even though it's being introduced with the familiar, air-cooled flat Four). We'll have more on this big bus in a roundup of VWs for 1980.

Fresh from Fuji

Subaru of America (which gets its cars from Fuji Heavy Industries in Japan) will have a handsome model lineup for 1980. Now that these redesigned Subarus are on the way, and since Subaru has earned a tremendous respect for well-built and reli-

Good looks come to Subaru with introduction of 1980 models, including this hardtop.



able cars (see *PM Owners Report*, page 96, Sept. '79), it's okay to call them "ugly little suckers." That's what one owner affectionately calls the cars that built Subaru's reputation here (see *Subaru—Is it here to stay?*, page 24, May '71).

The question posed in our 1971 story has been answered, and Subaru will continue to keep a good grip on U.S. roads with their latest fwd and 4wd cars. Seen here are the two- and four-door notchbacks that are slightly larger than the previous sedans. Wheelbase is 96.8 inches, overall length is 168 and width, 63.5. The



Subaru four-door gets clean styling, too.

flat Four continues up front. Good mechanicals include four-wheel disc brakes, transistorized ignition and rack-and-pinion steering. Dash and console have instruments galore.

Thoroughly modern Mini

After 20 years and 3½ million cars, the old Austin Mini is being updated. The Mini was the original transverse-engine with front-wheel-drive car, remember, and credit for



BL Ltd. and Honda's new Mini for British.

the configuration that even GM is now adopting goes to the Mini's designer, Alec Issigonis. The new Mini, seen above, is referred to as the LC-8 project and is scheduled as a 1981 model. BL Ltd., is cooperating with Honda for its small-car expertise. A tweaked model, like the Cooper S soup-up of the Mini, would be fun, but we don't expect any new Minis here.

Phantom with opera window

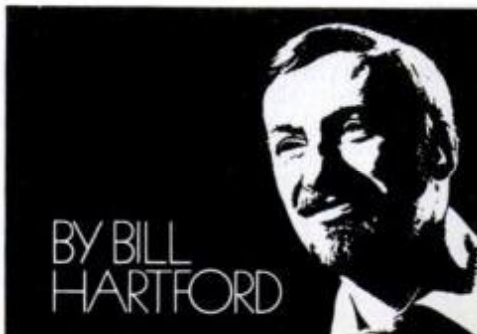


Fiat X1/9 with new roof for opera lovers.

Italian cars are naturals for opera windows—after all, La Scala in Milan is the world's most famous opera house. This Fiat X1/9 with opera window is not in production, though—it's an idea car that was spotted in Italy. It's not a 2+2, but does have welcome space behind the front seats.

Meanwhile, the X1/9 on sale here is a lot more car than when first introduced, and it was impressive then (see page 26B, Sept. '73). Recent changes include five-speed transmission and larger engine. Performance is now more worthy of a sports car.

PM



89 mg. "tar", 1.3 mg. nicotine av. per cigarette, FTC Report MAY '78.

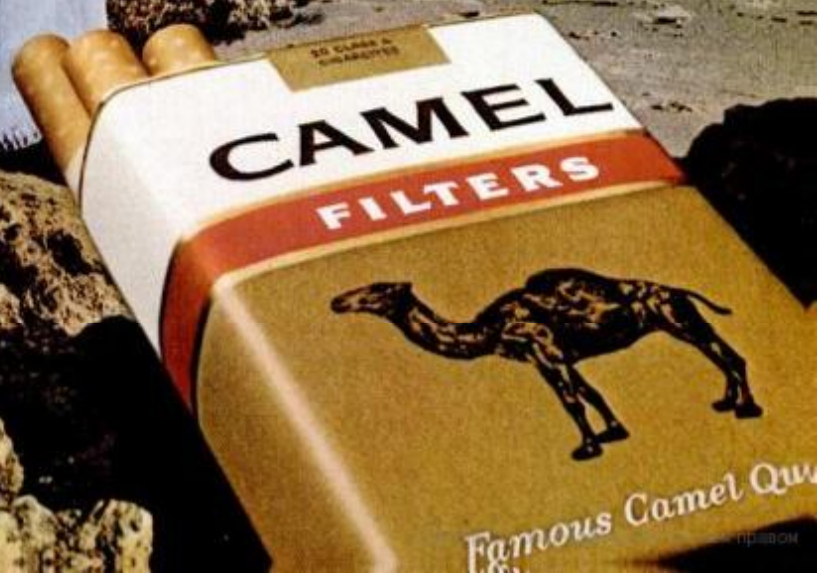
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ALL OUTDOORS

Fuels to mix and match

The fields and forests, hills and lakes are likely to be far away from a filling station. Sportsmen have always had to figure ways to carry or provide for extra fuel or stretch out what they've got. Now, with gasoline supplies tight, some substitutes are being suggested. Transportation, heat for cooking and comfort, and light at night are the major consumers of fossil fuels for the outdoorsman.

Gasolines with extenders mixed in—kerosene, diesel oil, alcohol and liquefied petroleum gas (LPG)—are among the products worth considering. For campers, firewood is also a possibility, but too often in the past, live trees have been hacked and scarred. It's best to assume there is no longer enough dry deadwood around for all the outdoorsmen who would like to build campfires. Fuel that is packed in is the better choice.

What about gasohol?

Stretching gasoline with additives isn't new. Alcohol is a popular choice. Brazil has been using a 20-percent alcohol to 80-percent gasoline mix for several years; taxis we rode in that burned it, as well as outboard motors we drove on the upper Amazon last fall, seemed to function well. Cutting the gas with a higher percentage of alcohol usually requires engine retuning we were told, and additional problems can crop up.

Would gasohol be a worthwhile alternative fuel for the outboard motors of North America? We asked the top engineers of the industry, and here are their exclusive recommendations for PM outdoorsmen.

Gasohol may work well enough in a car where the mix receives constant agitation, advises Paul Quick of Chrysler, but may not be suitable for other uses. Chrysler has not tested gasohol extensively in outboards because, at present, it costs more than gasoline and thus offers no price advantage and is unlikely to be used.

Mercury votes a qualified "no." To use gasohol in Mercs, its extensive testing shows, would require a conversion kit—thus added expense—to assure good performance. Alcohol in your body or your gas tank absorbs water, of course. If you've been drinking too much of it, you'll be dehydrated and plenty thirsty

the next morning. If you put a little can of "winter gasoline tune-up" in your car, it's probably alcohol and combines with any condensed water in your tank to burn it away.

But in the tank of a boat, which lives in a wet environment to start with, 10-percent alcohol in the gas can soak up a considerable amount of water. If the craft sits idle between weekends, this water absorbed into the mix from the humid air might stratify and give the engine a big enough gulp of noncombustive H₂O to kill it completely.

ENERGY OPTIONS

While experts advise that any kind of fuel is worth trying for short-term heat or power in an emergency, use of some fuels may lead to problems.

■ Gasohol, in a 90-percent gasoline to 10-percent alcohol mix, should be used promptly and the fuel container shaken before use.

■ Outboard motor owners should be certain whatever fuel they use meets the octane level required for their engine.

■ Gasoline campstove and lantern users can substitute gasohol in most stoves for a short while, but leaded gas can ruin a catalytic heater in minutes.

■ For battery-powered outboards and camp lighting, a deep-cycle battery gives longer life.

Merc also feels the gasohol might affect the carburetor float, rubber fuel lines and other parts of a Merc engine. So as of now, the company advises against its use in Mercurys.

Outboard Marine's research and development specialists will go along with gasohol if certain conditions are met. Before use, for instance, a tank with gasohol must be shaken to be sure the mix has not stratified into layers of gasoline, alcohol and water. Octane rating should be 89 for smaller engines, and must be 89 octane or over for the big V6 mills. Don Kueny reports that tests here and abroad show no metallurgical problems or deterioration of rubber fittings in Evinrude and Johnson motors using the 10-percent mix. Be sure you know you're getting a good mix, however, he cautions. In undeveloped areas, the gas or mix can be less than pure.

Tecumseh, maker of small engines for lawn and garden equipment, also emphasizes the quality of the mix. The company found that a short run on a 10-percent mix of anhydrous isopropyl alcohol with gas could stop

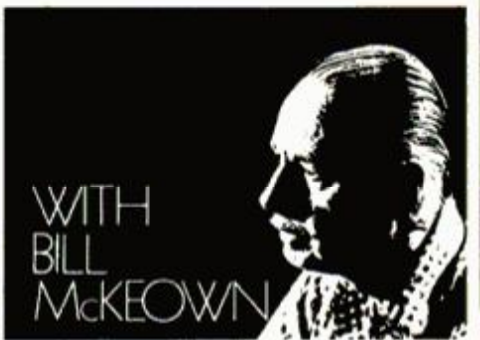
corrosion caused by small fuel residues after factory testing. Grain or methyl alcohols that are not anhydrous may react with water to form corrosive acids that can attack some rubber and plastics. Outdoor power equipment, it is noted, often is tuned to run rich and may be subject to off-season storage. Both these factors might allow corrosion.

Or kerosene?

Yes, you could run your outboard on kerosene, Outboard Marine's Don Kueny states, if gasoline really gets scarce. A lot of overseas Johnsons and Evinrudes have run on it and are sold specially tuned for it. But you might not get your motor started. Gasoline is necessary to prime and kick the motor over, and you cannot idle or troll with kerosene. Natives of remote villages who use only kerosene find it convenient to run their work boats and fishing craft on the same fuel. But, Don admits, once the owner of a kerosene kicker sees the operation of the same size motor with gasoline, he can't wait to convert his motor to gas.

LP update

The Winnebago motor homes that can run on gasoline or the LP gas they already have along for cooking and such seem to have started a trend. Holiday Rambler has announced the same option for some of its RVs, and Dodgen Industries' Born Free motor homes on Ford and Chevrolet chassis offer the same option for about \$1000 extra. Chrysler has extended its warranty coverage to five V8 powerplants installed in Class A or Class C motor homes for use with gasoline or propane. The demand for this option is so great, however, that we know of no kits yet available to individual customers for home installation, which may be just as well. There appear to be some tricky adjustments that need first to be worked out at the factory. **PM**



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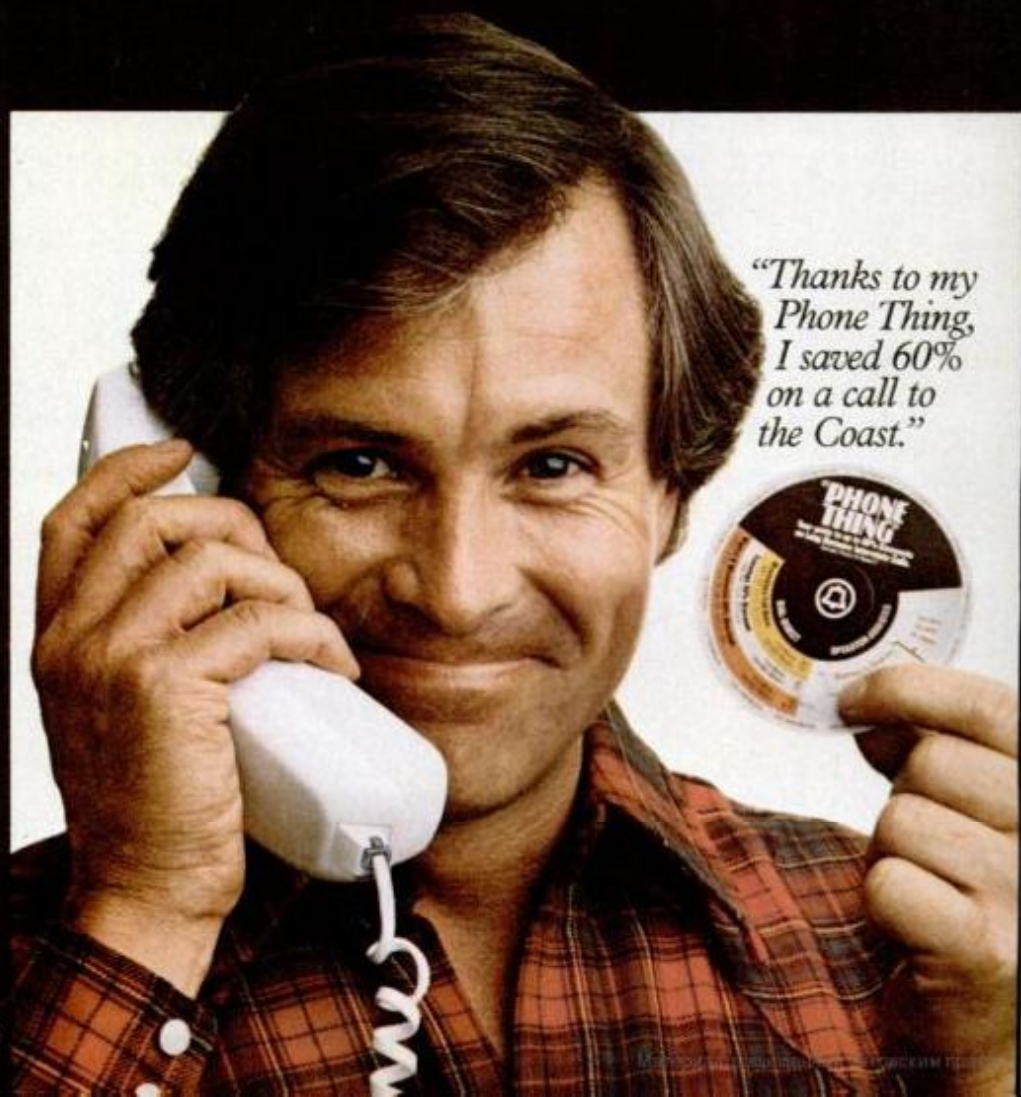
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"Thanks to my Phone Thing, I saved 60% on a call to the Coast."

PM ELECTRONICS MONITOR

Computer goes for the gold

When our Olympic athletes stride proudly to the awards platform, many of them may be silently thanking a cybernetic partner—an Eclipse S/250 computer and peripherals. Donated by Data General (screen from Megatex Corp), the computer will help our Olympic hopefuls to help themselves.

When an athlete competes or trains, not even a careful coach's eye can catch every nuance of movement in order to suggest helpful changes. The computer can.

A high-speed film is used (up to 10,000 frames per second) to capture the athlete's efforts. Then comes the computer. It breaks the film down frame by frame and examines the forces generated by the joints in the competitor's shoulder, upper arm, forearm, wrist, hands and knees. The computer then displays stick-figure images of the athlete on the display screen.

Touch a pen to any of the pictured joints and the computer will calculate the velocity, acceleration, direction and angle of the forces generated by that body segment. Now comes the computer simulation: You can change the displayed stick-figure to find out if a different action would have given a more desirable result.

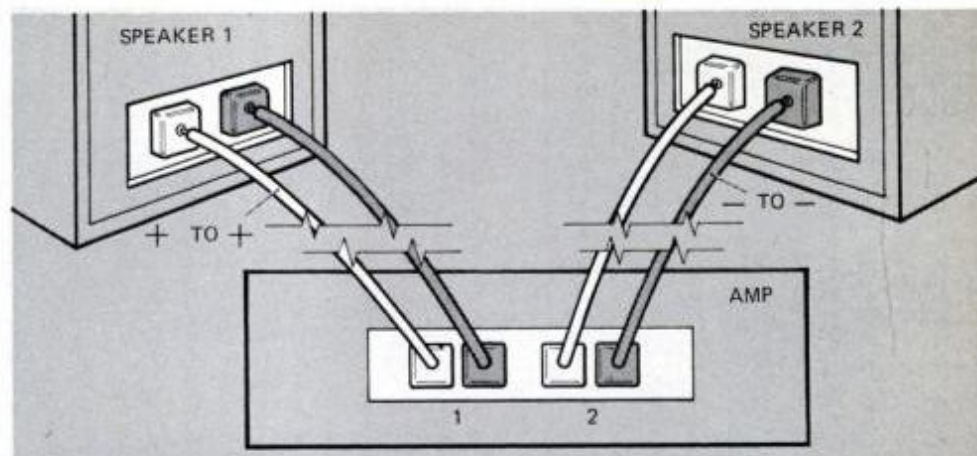
According to Dr. Gideon Ariel, a member of the Sports Medicine Committee and one of the computer's programmers, "That way we know beforehand whether a change would help or not. This makes it much easier for a coach to suggest something new to the athlete since he already knows it will work."

The visible calculator

I was recently allowed to preview a software program that—in my opinion—will revolutionize personal computing. With VisiCalc and a home computer, everyone—not just professionals—will be able to custom-design his own specialized computer programs.

VisiCalc puts on the screen any section of a grid of about 300 by 300 blocks. Any block, and its relationship to any other block, can be instantly entered by plain English and mathematical formulas. If you want block B1 to be labeled "Profit," you can define it in terms of cost and selling price, or whatever you would like.

If you change a variable, say percent of interest in a savings account,



Make your stereo sound right!

Getting the speakers out-of-phase is one of the most common errors made when hooking up a stereo system. Luckily, it is also the easiest to remedy.

Two speakers that are in-phase will move their speaker cones identically, given the same input signal. Out-of-phase means that when one speaker's cone is moving out, the other's is moving in—and vice versa. This ruins, or at least lessens, good stereo.

Put on a monaural record or switch your amplifier to mono position. The sound should seem to come from between the speakers—if you are centered between them and the balance is equal. If not, check your phasing.

Many speaker terminals are marked either plus (+) or minus (-) or are color-coded. Be certain that wires from the speaker terminals go to the same relatively positioned or marked output terminals on your amplifier (as pictured). This will insure in-phase operation. (If you use RCA-style plugs, make sure the shields and inside wires maintain the same relative relationship.)

Use special speaker wire having some identification code, such as one lead of copper and the other of a silver color. This will make out-of-phase hookups easy to avoid. Don't let a simple wiring error ruin your costly stereo investment.

every figure dependent on that variable instantly changes. Think of all the "what-ifs" you can check out quickly: What a rent increase will do to your family budget; what varying Dow Jones averages could do to your stock portfolio; how changes in wholesale prices will affect your business statement. Possibilities are endless.

We'll examine VisiCalc in more detail in a later article. Suffice it to say that it will soon be available for just

The screenshot shows a spreadsheet with the following data:

PAYEE	CHECKS	DEPOSITS	BALANCE
ELECTRIC	14.95		545.28
PHONE	10.00		
DENTIST	10.00		
LABARY			395.00
RENT	350.00		
GAS CARD	12.93		
TOTALS	558.83	395.00	

Programming for personal or business financial management is easy with VisiCalc.

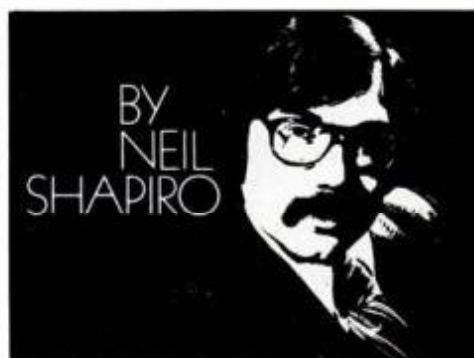
about every home computer and you can write to Personal Software, Box 136-M, Cambridge, Mass. 02138, for more information.

End tape hassles

Most home computers will allow you to save a program on audio tape and then reprogram the computer by simply playing the tape into an input (page 66, Aug. 79). But many computers are quite sensitive to stray noises or interruptions on the tape and it may take several tries before the program is accepted.

The Data Enhancer from Microsette (777 Palomar Ave., Sunnyvale, Calif. 94086) plugs between the recorder and a Radio Shack TRS-80 computer. By sensing the first pulse and "knowing" when the next pulse should come it allows the computer to ignore spurious noise or hum.

It's worthwhile at \$45 and we hope similar units become available for the other home computers. **PM**





OUR \$69 SOLAR ALARM. A CHALLENGE TO EVERY CHRONOGRAPH IN THE WORLD.

People are bumping into more watch ads these days than at any other point in history.

And if you think companies like Seiko with their \$295 solar alarm chronographs are fighting hard for a place on your wrist, you should see the battle in the Under-\$100-Watch Category.

It's Dog-Eat-Dog.

So where did we get the gumption to offer *another* popular-priced mini-genius through the mail? You'd have it too, if you had this watch.

Our \$69 Xernus (its price in stainless) provides every watch and stop-watch function you could ask for (see description below).

Even more important, it offers a level of workmanship and design that you just won't find elsewhere—at even \$20 or \$30 more.

We know, we've looked.

Its display is liquid crystal; the digits are crisp and clear. You get the uncommon convenience of a 24-hour alarm, precise time information for two different time zones. Plus, the latest solar cell technology—to keep your Xernus working for up to 5 years on its original set of batteries. And with an uncanny ± 15 seconds per month quartz accuracy. By the way, Xernus is pronounced *Zernus*.

Its case, bracelet and back are machined from solid stainless steel. Instead of the thinly plated chrome construction you find on virtually all other

chronographs at or near its price.

It's also an incredible 8mm thin. Much thinner than the Texas Instruments alarm chronograph; much, much thinner than the widely advertised Jupiter. Xernus is even trimmer than the comparably clever \$295 Seiko. By more than 2 mm.

Want more? You get a face crystal that's made from tough, hard mineral glass. Most other chronographs in this price field give you nothing better than plastic. And nothing picks up scratches faster than plastic.

Save \$60 while Xernus is hungry.

This isn't a small watch company, or even a very new one. In fact, this pioneer in microcomputer timepieces has

already sold a phenomenal number of chronographs around the world; in countries like Germany, Switzerland and France.

This superb timepiece has been practically everywhere but the U.S. And for that reason, Xernus has agreed to let us offer their chronograph at a dramatic discount. In stainless, it lists for \$129, but you get it at a \$60 savings.

You save even more when you order the Xernus solar alarm in gold (a generous 5 microns over stainless). To be exact, \$70 less than your friends overseas have to pay.

Each Xernus comes gift-boxed with full instructions, service-by-mail convenience, if needed, and a full one-year guarantee against defects by its manufacturer.

And The Sharper Image gives you two weeks to decide if it's really the watch for you. If not, simply send it back as new for a full and prompt refund. But order now to take advantage of this special introductory price.

ORDER TOLL-FREE.

Credit card holders may use our toll-free ordering number. Or send check for \$69 for stainless, \$79 for gold (In California, add \$4.14 and \$4.74 sales tax respectively). Plus \$2.50 delivery.

800 227-3436

In California 800 622-0733

THE SHARPER IMAGE™

260 California St., Dept. XE-114
San Francisco, CA 94111
(415) 788-4747

Normal time display:



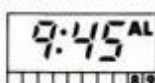
See hours/minutes/seconds, AM/PM, day, Date on command.

Stopwatch display:



12-hour timing to 1/10 second. Even lap and 1-2 finishes.

Alarm setting display:



Set for AM or PM. Audible beep lasts a full minute.

Calendar setting display:



Set time/date for 2 time zones. End-of-month adjustment is automatic.

Extra light at night.



Push a button for bright face illumination.

CAR CLINIC

SOLUTIONS
FOR MECHANICAL
HEADACHES
BY
MORT SCHULTZ



Changing a life style

What can I do about an incessant pinging on acceleration from the engine of my 1979 Chrysler LeBaron? It's a 318-cu.-in. with two-barrel carburetor and automatic transmission. My mechanic says, "Live with it."—Mrs. Gladys Porter, Duluth, Minn.

A recent advisory from Chrysler Corp. says to change the ignition timing setting to reduce spark knock (detonation). Your mechanic is tuning this engine according to the specification he has in the service manual and on the vehicle emissions label. This data calls for timing to 16° before top dead center (BTDC). Ask him to change this to 12° BTDC. After making the adjustment, he should check and reset to specification, if necessary, the enriched idle speed, hot-fast idle speed and slow idle speed.

Cold turkey

My 1978 Pontiac Sunbird with 305 V8 engine is a wonderful car—in hot weather. Come the cold, it snorts, bucks and stalls until I manage to get the engine warmed up. Help, please, before the car stalls when some truck is rear-ending me. The weather is turning cold again.—Ralph Borg, Altoona, Pa.

Look at the automatic choke control, Ralph. I'll wager the index mark is sitting smack on the center-line. This is the setting chokes for this model engine were adjusted to at the factory. The setting doesn't provide a sufficiently rich fuel mixture for cold starting, especially in cold weather. Move it one notch to the rich side.

This adjustment can also be made to 1978 Phoenix, Firebird and LeMans models with 305 V8 engines and automatic transmissions that have experienced the same cold-weather starting problem.

Medical consultation

I read with interest the letter you published from Dr. Linda L. Smith of Atlanta ("Shook to the Roots," Car

Clinic, page 68, April '79). I have had the identical problem with my 1978 BMW 320i and the same difficulty with BMW service: denial that a problem exists and numerous trips for needless wheel balancings.

After no less than five visits to the BMW service center, the district service manager acknowledged that the Continental 771 tires, which came as standard equipment, were "scaloped." I presumed that this meant these tires, which had only 10,000 miles on them, were wearing poorly and may have been causing the steering-wheel vibration.

He recommended that I purchase new Continental 771 tires for the front wheels. A ridiculous solution! I replaced all four Continentals with Michelin XVS steel-belted radials. The car rides like a different automobile.—Richard A. Gambescia, M.D., Philadelphia.

At least you found a solution, albeit an expensive one.

Up and at it

I've got an odd-ball problem with a 1977 Mercury Monarch I recently purchased. The car has a four-speed overdrive transmission that, at

times, is hard to shift into REVERSE. At other times, shifting into REVERSE is easy. I never have a problem shifting into any forward gear. What's wrong?—David Bates, Lima, Ohio

Mechanically? Probably nothing. There's a knack to shifting this transmission into REVERSE—a knack you undoubtedly hit upon without realizing it. This is when shifting into REVERSE is easy. If there were a mechanical problem, it would be difficult to shift into REVERSE all the time.

To shift, depress the clutch pedal and lift up the shift lever before pulling the lever toward REVERSE (to the left). As you maintain this upward pressure, move the lever left and forward.

Plugging holes

My car, a 1976 Cadillac Seville with electronic fuel injection, has started hesitating and emitting an exhaust roar. Two local mechanics swear engine and exhaust systems are perfect. Everyone is stumped. Can you throw some light on this for us?—Edward Gibbons, Hannibal, Mo.

There's been a tendency for the brazed connection on the underside of the EGR (exhaust-gas recirculation) back-pressure transducer-valve vacuum diaphragm to break in '75-'79 Cadillacs with electronic fuel injection. When this happens, the engine hesitates, stumbles, produces exhaust and/or buzzing noises and develops spark knock.

Check to see if this connection is broken by holding a mirror under the EGR back-pressure transducer-valve vacuum diaphragm. The break may not be visible, but the presence of carbon indicates that it definitely does exist.

(Please turn to page 52)

Hot-weather tip for cold-weather starts

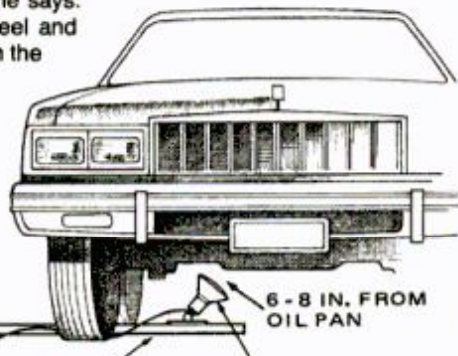
Reader Vic Scott, who now lives year-round in warm Port St. Lucie, Fla., but remembers "my cold-winter starting problems up north," suggests this tip for you Yankees: Vic tried heater hose elements, dipstick heaters and the like in attempting to make it easier to start cars parked outside in cold weather. "Nothing was more effective and as easy to use as an ordinary 150-watt heat lamp in a swivel socket," he says.

He put a board under the car behind a front wheel and placed the heat lamp and socket 6 to 8 inches from the oil pan. "Engine and oil were kept nice and warm, and starting

was as easy as if the temperature was a Florida-like 80° rather than 10° below zero," Vic remembers.



BOARD BEHIND WHEEL ON GROUND



150-WATT HEAT LAMP ON SWIVEL SOCKET



CAR CLINIC

(Continued from page 51)

Repairing a broken connection is not hard. You need a special retaining clip (part No. 1617054) to secure the EGR exhaust tube in place. This eliminates the need to replace the whole assembly.

To install the retaining clip, slide it under the valve so the clip legs straddle the exhaust tube. Engage the retaining clip tab over the lip of the back-pressure transducer-valve vacuum diaphragm. Be sure the retaining clip centers the vacuum tube in line with the hole in the diaphragm. Then finish up by snapping the legs of the clip over the lip of the diaphragm.

Evil eye

I've been having a problem starting my 1978 Chevrolet Caprice. The fellow at the service station where I buy gas showed me that the indicator dot of the car's Freedom battery was all dark. Because of this, he said the battery is going bad. He suggested a new battery, but I'm hesitant. Is there no way to determine the condition of this battery other than by the indicator?

The attendant says there isn't, be-

cause the battery is sealed and a specific gravity test can't be made.—Jim Stollman, Escondido, Calif.

True, the Freedom battery is sealed and specific gravity cannot be tested, because you can't get at the electrolyte with a hydrometer. However, it is not true a dark dot means the battery is bad, and it is not true the battery can't be tested. The dark dot signifies the battery should not be tested until it is charged. Look for the dot to turn

green as charging takes place. At this point, the battery can be tested.

The only valid test for a Freedom battery is a load test. A specified amperage load is placed on the battery, and the battery is tested under specified time and temperature conditions. The specifications and conditions are provided in the service manual for the particular battery.

If the battery fails the test, a replacement is needed. If the battery

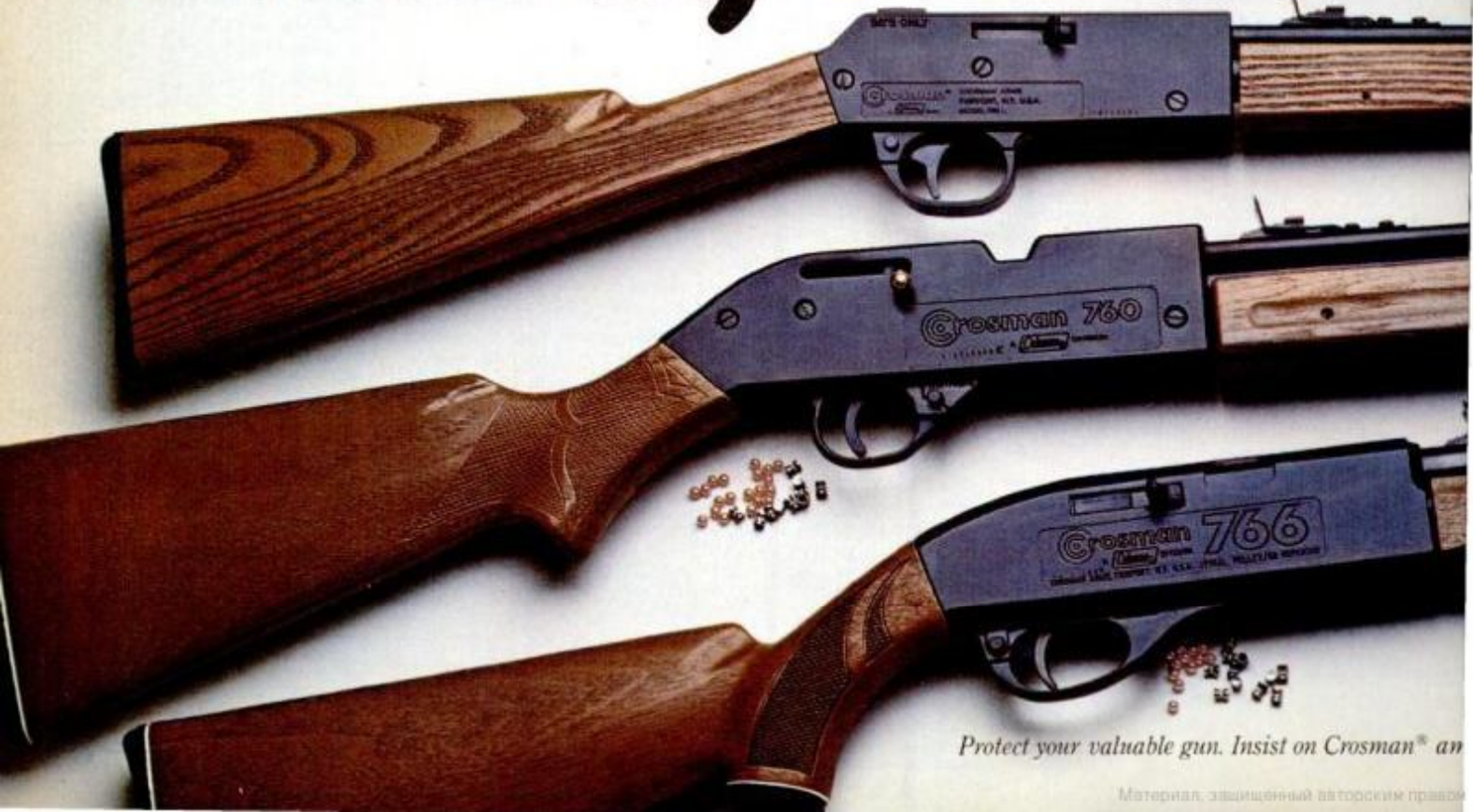


Pulling loose from rubber cement

Speaking of cold weather reminds one of snow. And snow reminds one of a warning by the Tire Industry Safety Council. If your car gets stuck in snow, mud or ice, don't spin your wheels trying to get out. "Tremendous centrifugal force develops quickly and the (free-spinning) tire can actually explode in a matter of seconds," the council says. Moreover, spinning a tire causes excessive tread wear and doesn't help traction. Dig out snow, ice, mud or loose material from front and back of tires. Spread sand, cinders or salt in front of rear wheels (front wheels if car has front-wheel drive). Don't use boards, loose chains or other large objects, which can fly out and injure someone or damage the car. Gently rock car back and forth, shifting repeatedly from DRIVE to REVERSE (automatic transmission) or REVERSE to SECOND (manual transmission) while applying moderate power.



PNEU, FROM



Protect your valuable gun. Insist on Crosman® an

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passes the test, it should be put back on the charger. Keep in mind that the appearance of a green dot does not mean the battery is fully charged. The green dot appears when the Freedom battery attains a 50-percent state of charge. To fully charge a Freedom battery, keep it on a charger until the rate of charge drops to about 5 amps.

Give a guy a brake

Do I have to put up with a high-pitch squeal from the brakes of my 1978 Dodge Challenger? My service manager says I do.—William Lewis, Garden City, N.Y.

I say you don't. Tell your service manager to open his tech service bulletin file and dig out bulletin 05-09-78. It tells him to:

■ Make sure no abnormal condition exists with front disc brakes, such as worn linings, scored discs or worn pins.

■ Remove the two pads, place them together and measure the total thickness. If total thickness is less than 1.2 inches, he's to install one kind of shim (part No. MB150749) on the outer pads and another kind (part No. MB150748) in the piston pocket. If total thickness is 1.2 inches or more, the mechanic should

file the pads to obtain a thickness of less than 1.2 inches and add shims.

■ Check brake dragging torque by bottoming a lug nut on the rotor wheel bolt, starting the engine, and applying and releasing brakes. The torque needed to turn the rotor should be less than 9 in.-lbs.

Forewarned is forearmed

Please suggest that before people put tape on a component in the engine compartment they check their service manuals. I used plastic electrical tape on a vacuum hose. The tape deteriorated because of high temperature.

Afterward, when I was reading through the Plymouth service manual, I came across a warning that this would happen. The manual suggested using a nylon tape made by 3M Co. instead.—T. Feneck, Brentwood, N.J.

Thanks for the useful words of wisdom.

GOT A PROBLEM WITH YOUR CAR?

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

Service and safety tips

■ To improve performance at higher altitudes, American Motors Corp. has okayed a change in ignition timing for its 1979 models that have a 258-cu.-in. engine, two-barrel carburetor and automatic transmission. You can increase timing in 2° increments, up to 12° before top dead center (BTDC) from the basic setting of 8° BTDC. But remember to set the timing back to 8° when you come down off the mountain.

■ Don't keep containers of fuel in the trunk of your car. Joan Claybrook of the National Highway Safety Administration states that traveling with gasoline in the trunk of a car is "like riding around with dynamite that can explode at any time. Even a minor rear-end collision or a spark from a short in a taillight or brake light could set off an inferno resulting in injury or death."

Here are tips for the gasoline shortage:

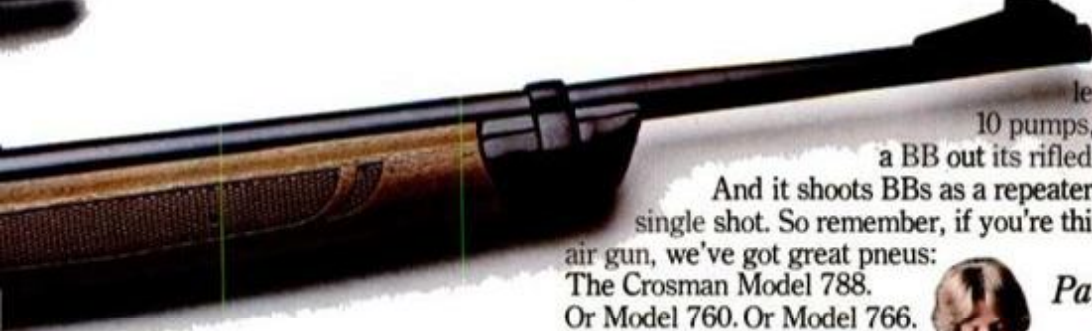
■ Keep all gasoline containers tightly capped if they contain any quantity of fuel. Keep away from heat and flame.

■ Use containers designed for gasoline storage only. Never keep in the house.

■ When a container is emptied, thoroughly ventilate and leave cap off to allow fumes from last remaining drops to evaporate.

■ There's been a change in the maximum front-wheel camber specification for '74-'79 Volkswagen Dashers. You can go as much as 1°, not ½° as previously suggested. Keep it in mind if edge tread wear shows up.

CROSMAN.



No air gun offers more power than a pneumatic pump-up. And nobody offers more pneumatic pump-up guns than Crosman.

There's the Crosman Model 788 BB Scout,™ for example. It's the only pump-up BB gun designed especially for younger shooters. It's only 31 inches long and weighs less than three pounds. So it's easy for smaller kids to handle.

Then there's the Crosman Model 760. With "big-gun" features like adjustable sights, solid-steel barrel and cross-bolt safety, it's easy to see why it's the top-selling gun in America.

The Crosman Model 766 lets you pour on the power. At 10 pumps, the Model 766 will punch a BB out its rifled steel barrel at 710 fps.

And it shoots BBs as a repeater, or .177 caliber pellets as a single shot. So remember, if you're thinking about buying a pump-up air gun, we've got great pneus:

The Crosman Model 788.
Or Model 760. Or Model 766.

*Part of being a kid
is owning a Crosman.*

*Air guns must be
used under adult supervision.*



Crosman
AirGuns



Premium. Imported.



BLACK VELVET® BLENDED CANADIAN WHISKY, 80 PROOF, IMPORTED BY © 1979 HEUBLEIN, INC., HARTFORD, CONN.

Velvet Touchin'.

PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Tape in choice of lengths

The latest steel tape from Evans Rule Co., 768 Frelinghuysen Ave., Newark, N.J. 07114, is available in 12-, 16-, 20- and 25-ft. lengths, priced just under \$6, \$7, \$8 and \$9, respectively.

Features include a thumb-operated slide lock, automatic power return and tempered-steel blade. Sold at hardware stores, the Tru-Loc tape comes in a tough thermoplastic case.—H.W.



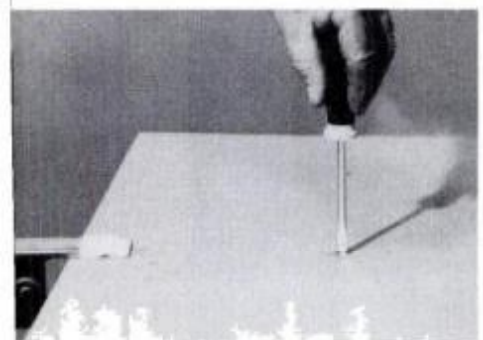
Tru-Loc 3/4-in.-wide steel tape comes in feet and inches, English metric and full metric.

Super-tough panel

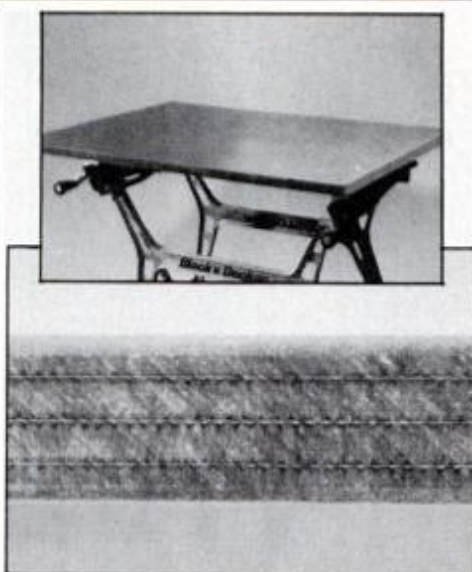
A recent visitor to my office entered lugging an obviously heavy package under his arm. He unwrapped an unglamorous-looking product called Vulcanfibre, a panel of super-dense material that is ideally suited



Use glue and clamps to hold 1x2 in place on bottom of the Vulcanfibre panel.



Flip board over and install four 1 1/2-in. lo. 10 fh screws in countersunk holes.



Board is used with 1x2 gripped by Workmate's table (top). Above, macro photo of a 3/4-in. panel reveals that material has plies (layers) similar to plywood.

for covering workbenches and other work centers that take lots of pounding. I hauled several small panels to my shop and have used them for the last couple of months. The wood pulp is compressed to provide a face strength more than 30 times stronger than face grain of oak, according to the maker.

I made up a panel for use with my Workmate (shown) and it is now a permanent part of my workshop. In order to obtain current prices and buying information, write Campton Products Co. Inc., Dept. PM, 1079 Bog Rd., Plymouth, N.H. 03264.—H.W.

Strong magnetic toolholder

I recently installed one of these magnetic toolholders in my shop and can report that it lives up to its maker's claims of strength. It boasts 10 ceramic magnets mounted in a 24-

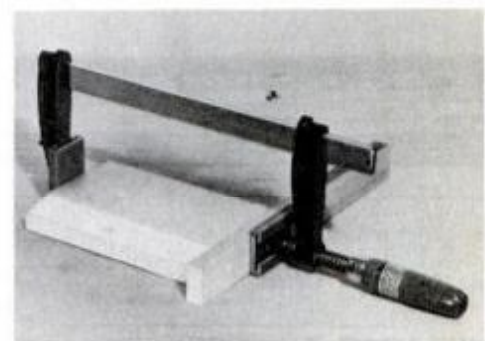


Toolholder is claimed to hold up to 480 lbs., will grip round-shank tools.

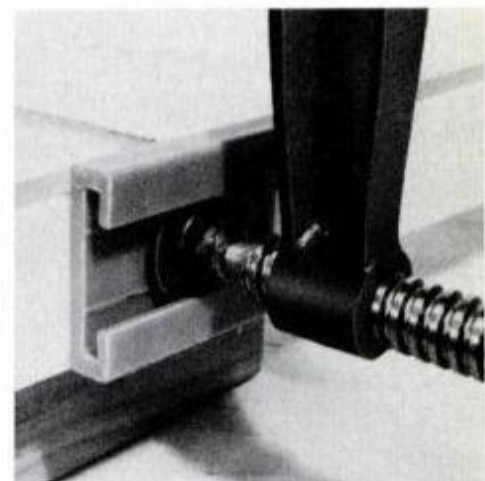
in.-long welded-steel frame that is fitted with hanging tabs and mounting screws. Priced at \$14.95 plus \$1.75 shipping charges, it is available from Gibson's Toolery, Dept. PM9, 34234 Beachpark, Eastlake, Ohio 44094. You can also send for a free catalog of unusual and hard-to-find tools.—H.W.

Fine woodworking clamp

Quick-action, heavy-duty clamp from Bimex MBT has a sliding bar with a slightly oval shape for improved clamping because there are no sharp corners to cause slippage. The steel bar, with its 140,000-p.s.i. tensile strength, is zinc coated to



Heavy-duty clamp is well made and particularly easy to use, says PM's tester.



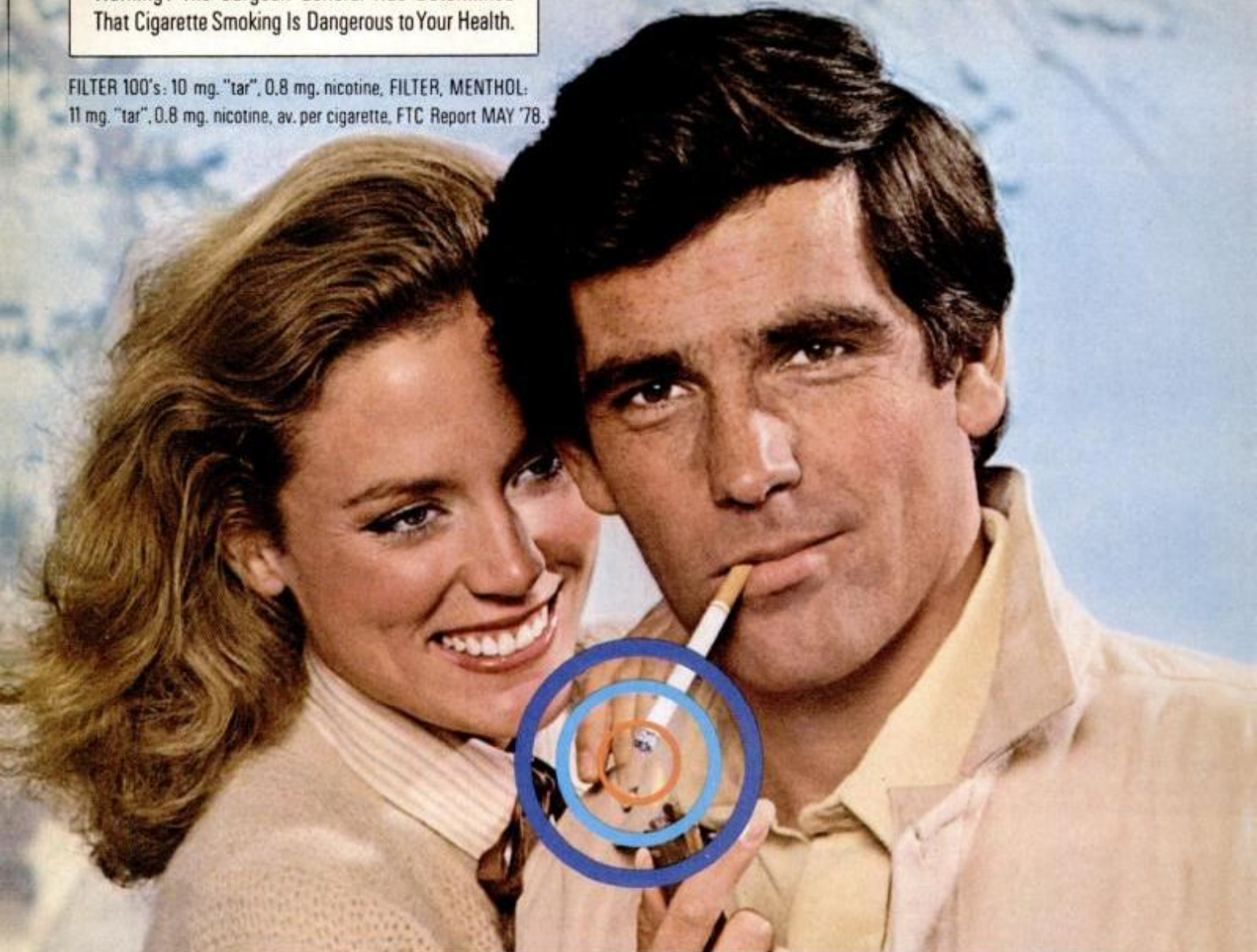
Sturdy plastic pads slide over pressure-plate swivel to protect delicate surfaces.

fight rust. Available with openings of 12, 18, 24, 30 and 48 in., prices range from \$14 to \$52. Write Bimex, 487 Armour Circle N.E., Dept. PM 1079, Atlanta, Ga. 30324, for information. Include self-addressed, stamped envelope.—H.W.

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

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

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



The Vantage Point

Where great taste and low tar meet.



Great taste once belonged only to high tar cigarettes. Not any more. The secret? The specially designed Vantage filter works together with our rich 'Flavor Impact'™ tobacco blend to deliver satisfying flavor in every puff. That's Vantage. Low tar with a uniquely satisfying taste. And that's the point.

Regular, Menthol and Vantage 100's

APPLIANCE CLINIC

QUESTIONS ANSWERED

Basket case

My 15-month-old General Electric washing machine (Model WWA 8320) leaves small, dark, circular stains on most polyester clothing, but none on 100-percent cottons. One GE repairman told me the transmission was cracked and installed a new one. Another GE repairman told me the drain hose was too long and was leaving a soap film that backed up and stained the wash. He shortened the hose.

Both repairmen were wrong. I've tried every kind of detergent and washing aid, it seems. Please help.—Mary Greene, Holbrook, N.Y.

Try a new basket. GE has reduced the number of holes in the basket. The original basket causes what's called washback. This leads to a polka-dotting on polyesters. Foreign matter has a tendency to cling to polyester, but roll off cotton. That's the reason you get staining on one, but not the other.

By the way, you should consider getting the original-length drain hose put back on the machine. A shorter hose may cause annoying over-sudsing.

Shake-down cruise

I installed a Sears Best Kenmore trash disposer (Model 1756650) the same way that the old disposer had been installed. When the unit is turned on, it works fine for about five seconds. Then the unit starts to vibrate, building to a point where the sink shakes. What do you think the trouble is?—John Brady, Utica, Mich.

A disposer is a simple machine. Not too much can cause vibration, if you installed the unit properly. Malfunctions that cause vibration include a loose shredder table or an out-of-line motor shaft.

I gather this is a new unit, still under warranty. If so, call Sears. Hopefully, you didn't damage the works while installing the disposer yourself. If you did, the warranty would be invalidated.

No is the word on no-frost

As an energy-conserving measure, is it possible and practical to disconnect the self-defrosting system of a no-frost Whirlpool EXD19PT side-by-side refrigerator-freezer unit?—James C. Bunn, Leipsic, Ohio.

Possible, yes. Practical, no! You can disconnect the heating system

that provides the self-defrost feature, but refrigeration won't be adequate. The refrigerator-freezer coils are in the freezer compartment. Without benefit of the heating system, coils will freeze and block the flow of air into the refrigerator. Get the picture?

De-icing age

In Snow Bird (Appliance Clinic, page 100, May '79), you told Thomas Clarke that a dehumidifier placed in an area of the home where the temperature approaches 65° F. and the relative humidity drops below 60 percent will experience frosted coils. You suggested he turn the dehumidifier off or reset the humidistat to a higher setting when these conditions prevail.

There is another alternative. Whirlpool makes a de-icing kit (part No. 484191), which is installed on the suction line between the evaporator and compressor and is wired in series with the compressor. If suction-line temperature drops below 32° F., as it does when the evaporator frosts up, the thermostat opens and shuts off the compressor. The fan will continue to run, but the compressor won't restart until all frost has melted.

This kit can be installed on any brand of dehumidifier. I thought your readers would like to know.—Jeffrey Lefever, Alco Appliances Inc., Beltsville, Md.

You're right, Jeff. We do want to know. However, our suggestions that the humidifier be turned off or the humidistat be reset hold true. The kit you're talking about is a safety device which prevents damage to the unit. It does not permit dehumidification under the temperature conditions our reader said existed in his home.

If any reader wishes to install this safety kit in a dehumidifier, it can be bought from a Whirlpool dealer for around \$10. The installation is simple. A do-it-yourselfer can install the de-icing unit by following the explicit instructions that come with the kit.

Broken seal

I have a Maytag washing machine of about 1968 vintage that has worked perfectly. But now it has developed an oil leak at the bottom. I would like you to tell me what the cause could be and how to repair it. I don't want to

junk the machine.—Don Boltze, St. Petersburg, Fla.

Don't. The cause is probably a 30-cent seal that must be replaced in the transmission. Getting to the seal is the expensive part of the project, though. Unless you know how to remove a transmission and disassemble parts, including gears, you will have to pay a Maytag repairman for his labor. That will run in the neighborhood of \$50.

However, be consoled. Having the job done is a lot less expensive than putting out the money for a new washing machine.

SERVICE TIP

When you have to connect a number of wires to a new part, it's difficult to remember which wire connects to which terminal unless you organize the wires beforehand. To do this, cut several pieces of masking tape and write num-



Numbers identify wires for reinstallation.

bers on them from one to as many wires as you have. As you disconnect each wire from the old part, working clockwise or counterclockwise, stick a numbered piece of tape to each wire for easy identification.

When you install the new part, reattach the wires in the order that you previously removed them.

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

NEW NOW for home and shop

A You can produce a two-toned, wood-grain effect on any paintable surface with a single coat of One Stroke, claims its maker. It needs no mixing or thinning; just smooth on dripless, gel finish in direction you want grain to appear. A protective coat of clear polyurethane varnish is recommended on heavily-used surfaces. One Stroke comes in six wood tones, three colonial colors and antique white. Pint kit, sold in paint stores, includes brush, sandpaper, instructions. \$7. New York Bronze Powder Co. Inc., 201 Bay Ave., Elizabeth, N.J. 07201.

B Pollen, smoke, dust and other pollutants are removed from household air by Clear Day reusable Electronic Air Cleaner. It replaces a disposable filter in a central heating or cooling system and is powered by a solid-state unit that plugs into a 110-volt outlet. You can clean the collector in a dishwasher or by soaking it. Clear Day (\$200) is UL-listed and comes with a one-year warranty. For brochure, send stamped, self-addressed envelope to: Roger Dickinson Hauman Marketing Services, Box E, Guilford, Conn. 06437.

C Admiral's Design II refrigerators boast thick foam wall insulation and one-piece ABS plastic food liner to save energy. Storage features include lift-out egg tray and adjustable door bins (inset photos). Nine models from 14 to 22 cu. ft. are available in a choice of five colors. They're priced from \$520 to \$720. Admiral Corp., 1701 Woodfield Rd., Schaumburg, Ill. 60196.

D A tough top layer on Gafstar Series 6700 sheet vinyl flooring is claimed to provide extra stain resistance and durability. It has a foam inner layer to retain warmth and reduce noise. Damp-mop or vacuum to keep the no-wax floor shiny. Patterns include simulated wood, brick, marble, tile and Mexican agate. It's sold in 6- and 12-foot widths for \$12 per sq. yd. Write GAF Corp., 140 West 51st St., New York, N.Y. 10020, for nearest dealer.





Got a ceiling problem?

Cover it up! Dress it up! Light it up! Quiet it down! With a new Armstrong suspended ceiling.

Whatever your ceiling problem—covering up an old or damaged ceiling, adding a new room, or finishing off a basement—an Armstrong suspended ceiling is a problem-solver with style. Beautiful. Washable. Fire-retardant for extra protection. Acoustical to help quiet down any room. Preengineered for energy-efficient fluorescent lights.

Best of all, with an Armstrong suspended ceiling, like Royal Oak shown above, solving your ceiling problem is a do-it-yourself project. There are no staples or glue to mess with, no plastering or sanding. The big 2' x 4' ceiling panels simply drop into the color-matched Super White Grid. The ceiling is easy to install and easy to keep looking fresh and new. If a panel gets damaged, just lift it out, and lay in a replacement.



If lighting is a problem, you can install Armstrong fluorescent fixtures with the ceiling . . . for lighting where you want it, not just where the builder put it.

You can install a beautiful new Armstrong suspended ceiling almost anywhere in your home. Briefly, here's how:

Hang the Armstrong Super White metal runners about three inches below your existing ceiling or open joists (about six inches with light fixtures).

Snap the Armstrong Super White cross tees into the main runners, and lay in the ceiling panels. It takes some time, but it's easy. You can do it!

See your Armstrong ceiling retailer for a broad selection of suspended ceilings. Find him under "Ceilings" in the Yellow Pages. Or send us this coupon, and we'll send you his name and a free full-color brochure.

Armstrong, Dept. 9ARPM
Peoria, IL 61614

Please send me your new color
brochure on suspended ceilings.

Name _____

Street _____

City _____

State _____ Zip _____

Armstrong

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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

New oil-drain pan



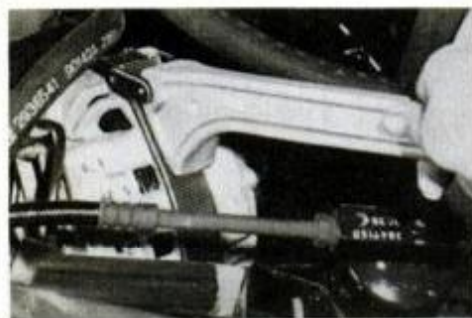
Three-cornered oil-drain pan is tidy.

A name in household products and kitchen dish drains has moved into the garage with a new oil-drain pan. Rubbermaid has an easy-pour design for do-it-yourselfers who may still be catching their dirty oil in old paint cans. The three-cornered pan works like a charm and is less than \$2 at hardware and housewares stores. Rubbermaid Specialty Products, Redding Rd., LaGrange, Ga. 30240.—*B.H.*

All-purpose strap wrench

There are new oil-filter sizes almost every year. Chances are your golden-oldie filter wrench is still in great shape, but won't do the job on the new sizes.

You can beat the system with a strap wrench, the kind plumbers use. A new line of strap wrenches, with high-friction fabric strips and sized right for many automotive applications, has been introduced by Grip-It Corp. I found the most useful application was adjusting drive-belt tension at the alternator, where on my car (and many others), you can't



Strap wrench adjusts alternator's belt.

get in with a big enough pry bar. Just wrap the strap around the alternator and yank on the handle. I also used it to free up a stuck distributor.

For most light-duty use around the car and home, the S-12H model (22-inch strap and 12-inch shank) should do fine. It lists for \$13. The wrench also is available with 6- and 18-inch shanks, and there's a jumbo model with a 24-inch shank and 30-inch strap. For information, write Grip-It Corp., 3612 Old Philadelphia Tpke., Intercourse, Pa. 17534.—*Paul Weissler*

Vacuum-line identifiers



Plug for vacuum line is color-coded.

To remove almost any part in a modern engine compartment, you've got to disconnect a number of vacuum hoses.

So you can later reconnect them correctly, you usually wind up taping each one and labeling it. There is a better way, however. It's a set of six pairs of color-coded vacuum-hose



Six pairs are in set of hose identifiers.

identifiers on a ring. Each pair of identifiers has a female cap that fits over hose connections and a male plug that fits in hose ends. You should be able to get a set for less than the \$8.17 suggested list price. Available from the Thexton Manufacturing Co., 7685 Parklawn Ave., Minneapolis, Minn. 55435.—*Paul Weissler*

Electronic-ignition tester

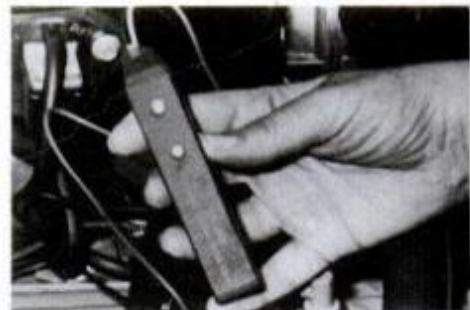
When breaker points were the norm, you could troubleshoot an ignition-system failure on the road with nothing more than a jumper wire or a test lamp.

However, you'll need something better than that with electronic ignition, such as a new \$20 (suggested retail price) LED tester for no-start conditions.

You should begin with the usual check for spark and, if necessary, a careful look at the plug wires, rotor and distributor cap. If they're okay, you then make use of the tester, which has two LEDs and two wire leads.

Connect one to the positive terminal of the ignition coil, the other to ground and just crank the engine. If the No. 1 light is on and No. 2 is on constantly or flashing, the electronic control unit and pickup coil are still in the proper working order. This indicates that the problem is apparently in the ignition coil.

If No. 2 light is off, you then make a second test at the pickup's two- or three-wire connector. Crank the en-



Tester checks electronic-ignition system.

gine. If No. 1 is on steady, No. 2 on constantly or flashing, the pickup is good and the problem is most likely with the electronic control unit. If both lights are off, the pickup is bad.

The new LED tester also makes it possible for you to conduct easy checks for both voltage and reluctor condition.

The tester won't be of any real help to you with the typical intermittent ignition problem, but the price is certainly reasonable enough so that you can keep one in the glovebox in case of emergencies.

The electronic-ignition tester is marketed by the K-D Manufacturing Co., Lancaster, Pa. 17604.—*Paul Weissler*

WHY MORE AND MORE PEOPLE ARE ASKING FOR A CHAIN SAW THEY CAN'T EVEN PRONOUNCE.

Poolen. Pullen. Polann.

With a name like Poulan, getting people to say the name right may be asking a lot.

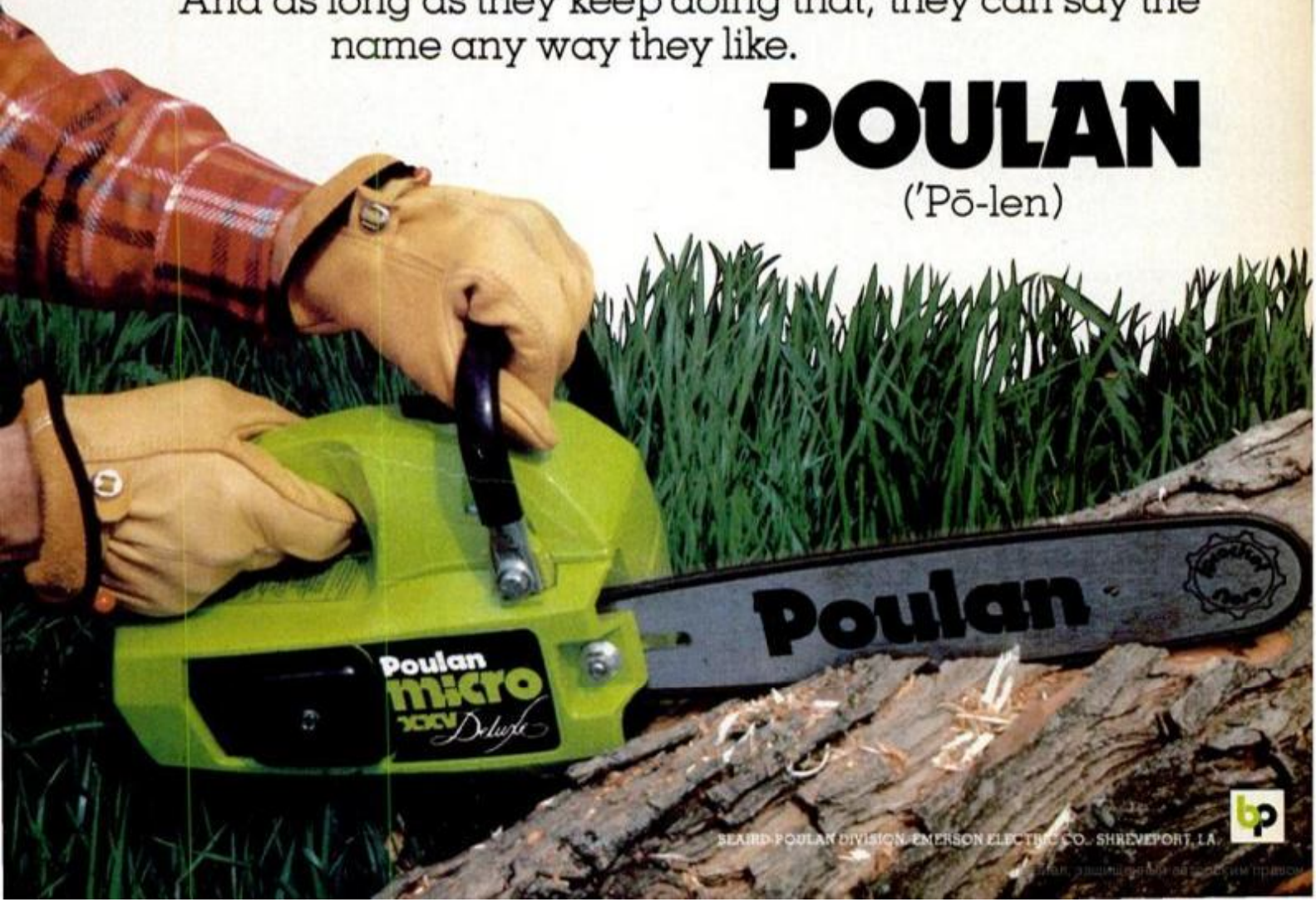
On the other hand, people ask an awful lot of our saws. Quick starting. Extra cutting power. Quiet operation. Beautiful styling. Durability. Affordability.

And we deliver all that plus a lot of other standard features, no matter which Poulan saw they buy. From the Poulan Micro XXV right on up to our pro models.

At Poulan, we figure the more we put into our saws, the less people have to put into cutting.

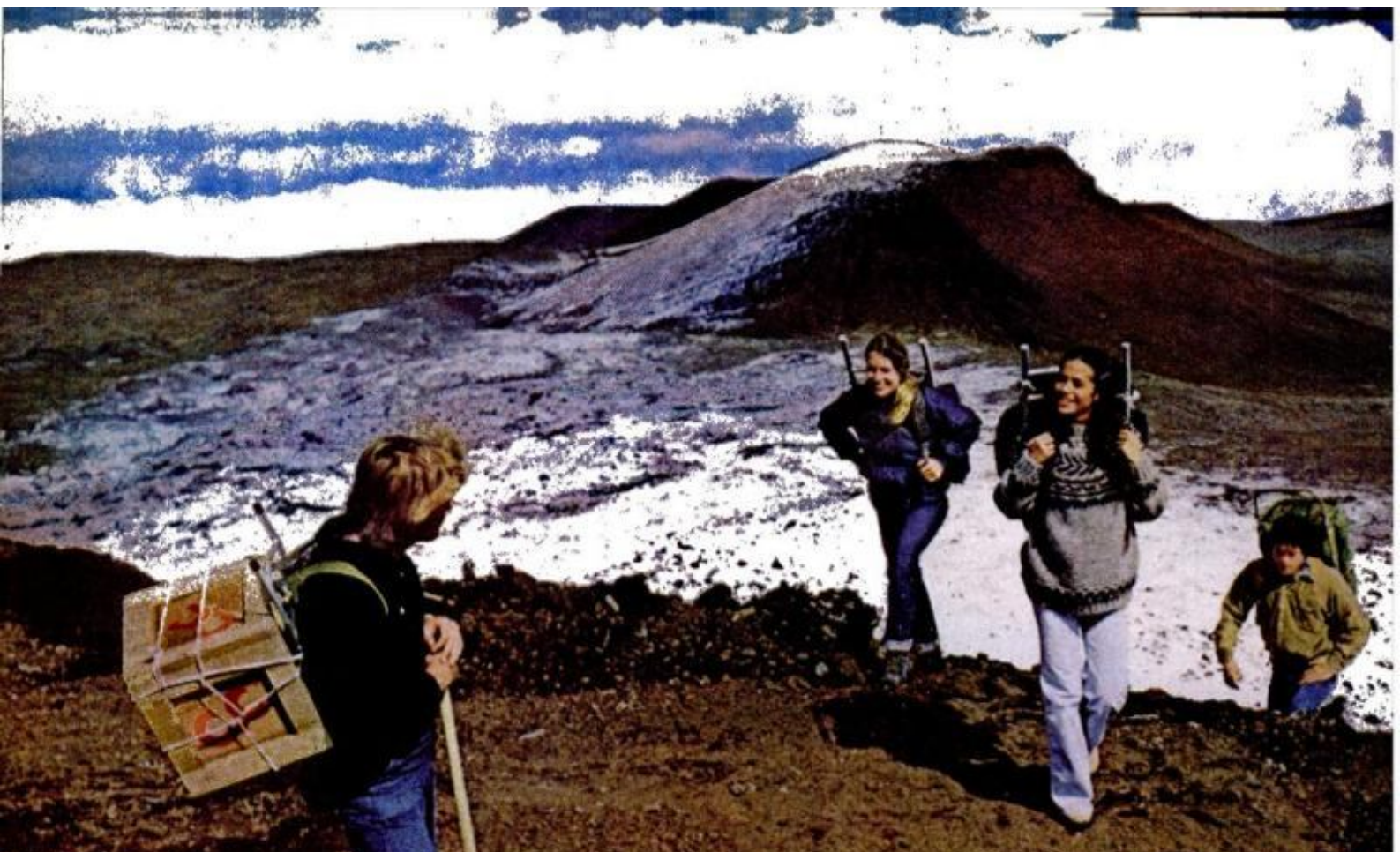
Maybe that's why more and more people keep asking for our saws.

And as long as they keep doing that, they can say the name any way they like.



POULAN

('Pō-len)



We climbed above the clouds on Hawaii's "Volcano Island" to hide a case of Canadian Club.

And you can win a Hawaiian vacation to search for it.



"Watch out for Pele," the islanders warned us of their bad-tempered goddess. We'd come to the Volcano Island of Hawaii, where Pele's tantrums can send torrents of lava skyward, to hide a case of C.C.®

Lava hot enough to boil water.

"Want to see what Pele can do when she's angry?" friends asked. We did, so with our C.C. on a pack frame, we went searching for a hiding place on one of Hawaii's newest lava flows. The river of lava had been cooling for two full years, yet the heat

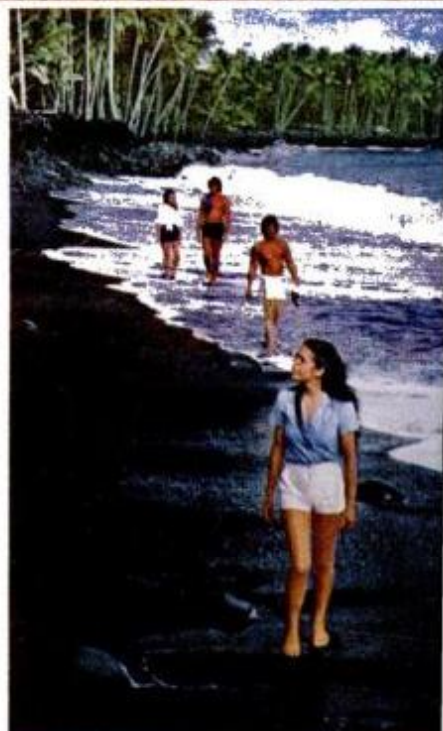
of Pele's anger rose up hot enough to boil water in places.

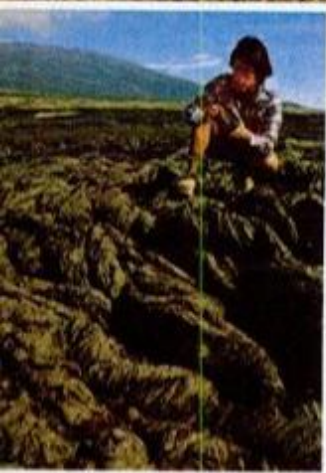
The beach looked like shining coal.

Later, we cooled off while searching another of Pele's works. In a dark temper, the fire goddess had sent black lava coursing into the sea. But the surf had pounded it into a fine, coal-black sand to create one of the world's most beautiful beaches.

Climbing up to one of Hawaii's strangest sights.

Finally we packed our C.C. up 13,796-foot-high Mauna Kea volcano. A surprise awaited us at the peak. Snow! A sight we never expected in Hawaii! Along our trail up Mauna Kea, we buried a surprise for you, the case of Canadian Club. One clue: you don't need to reach the top of the world's highest island volcano (you won't even need to enter the state park) to find the world's finest tasting whisky. Be careful though, Pele thinks that C.C. is hers.





Search for the Hawaiian C.C. on us.
Would you like to search for the C.C. on a special Hawaiian adventure vacation? Then stop down to your participating package store and pick up your entry for Canadian Club's "C.C. Hawaii" Sweepstakes,* or dial 800-223-1216, toll free, for details. (In Hawaii and Alaska, call 800-223-1850 and in New York, call 212-888-0766.) There's no purchase necessary. Nevertheless, you might want to pick up your offering to Pele while you're there: just say, "C.C., please."

*Void in Ohio, Texas, Penn. or wherever prohibited by law.



Canadian Club
"The Best In The House"TM in 87 lands.

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Electra-Fan solves the **GREAT POWER ROBBERY.**

PROBLEM: Belt-driven fans never stop. In fact, they work hardest when you don't need them at all: robbing your power, guzzling your gas and wearing out your water pump bearings.

SOLUTION: Electra-Fan. This Efficiency Expert in engine cooling knows when to quit. Once you've set the temperature on its adjustable thermostatic control, the fan runs only when you need it—not all the time.

Which means you can put tomorrow's cooling technology under your hood today and get...

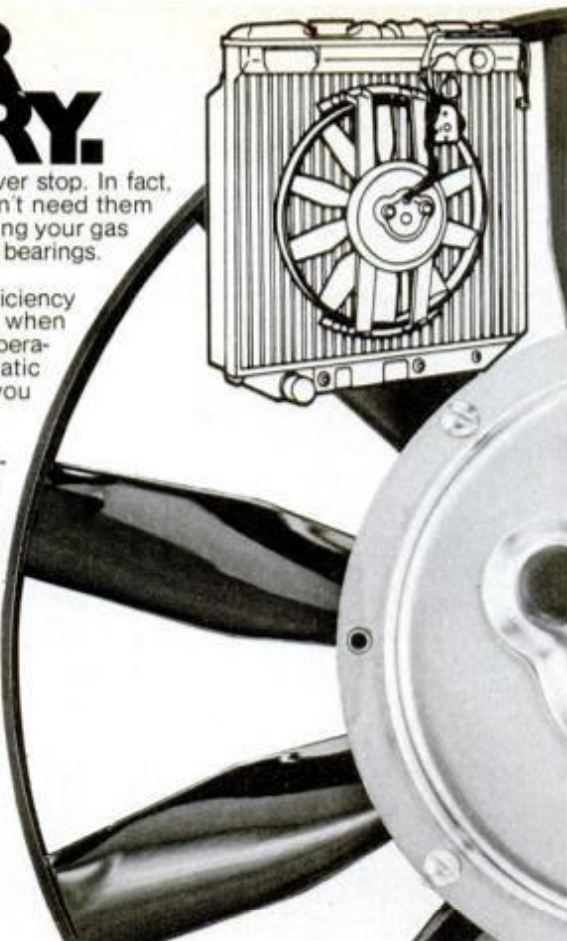
- improved performance
- better gas mileage (up to 15% better)
- quicker warm-ups
- reduced engine noise

ELECTRA-FAN.
Fuel savings you can bank on.

So get down to your local automotive accessory dealer today or write to:

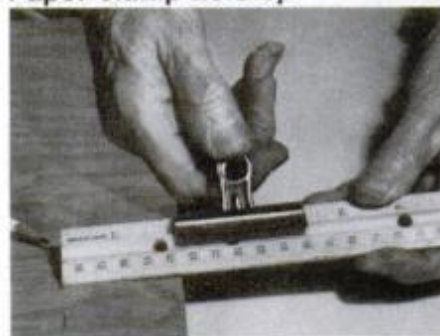
Flex-a-lite Corporation
5915 Lake Grove Ave. S.W.
Tacoma, Wa. 98499

*Fuel savings depend on individual driving habits.



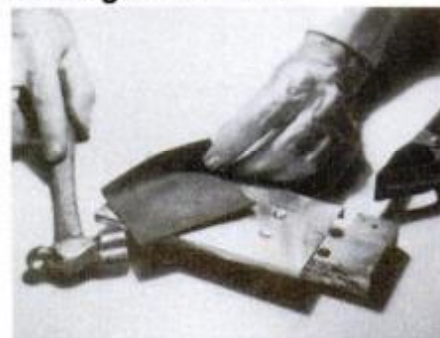
HINTS FROM READERS

Paper-clamp as stop



When marking a given distance from the edge of an object, use a spring clamp as a stop guide on a ruler or straightedge. Clamp is readily readjustable when dimension changes.—*Kurt Bayles*

Marking sheet metal



When sheet metal must be bored, punched or cut to match holes or edges of another metal piece, use a simple embossing process to mark it accurately. Clamp the sheet metal over the mating piece. Lay scrap rubber (as from an inner tube) over the metal and strike it several times with a hammer.—*W.J. Dalton*

Hammer-handle cushion



Pad a hammer handle end with a disc of rubber or leather to make a handy mallet for tapping boards in place without marring the finish.—*E.F. Frank*

Used cars get more use




Ageing makes your car look more abused than used. ARMOR ALL Protectant penetrates surfaces to ward off elements that cause ageing. It protects, beautifies and preserves your tires, vinyl top, dash, upholstery and hoses under the hood.

Just spray, let penetrate, and wipe to keep your car looking showroom city. Get ARMOR ALL Protectant at your favorite automotive or drug store.

PROTECT THINGS WORTH KEEPING

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Choose your destination:
TECHNICAL SCHOOL. After high school, you can train in one of over 140 advanced job skills. Learn on modern equipment. Work beside professionals.

COMMUNITY COLLEGE OF THE AIR FORCE. A chance to work toward an Associate Degree—and a good salary.

AIR FORCE ROTC. Scholarships pay full tuition. \$100 a month tax free. Books and lab fees.

AIR FORCE ACADEMY. An education of unparalleled excellence. If you think you've got what it takes, give it a try.

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GO AHEAD. Talk to your Air Force recruiter. Mail in the attached card. Or call toll free 800-523-5000 (PA: 800-362-5696). Get going today.

We can get you to where you want to go.

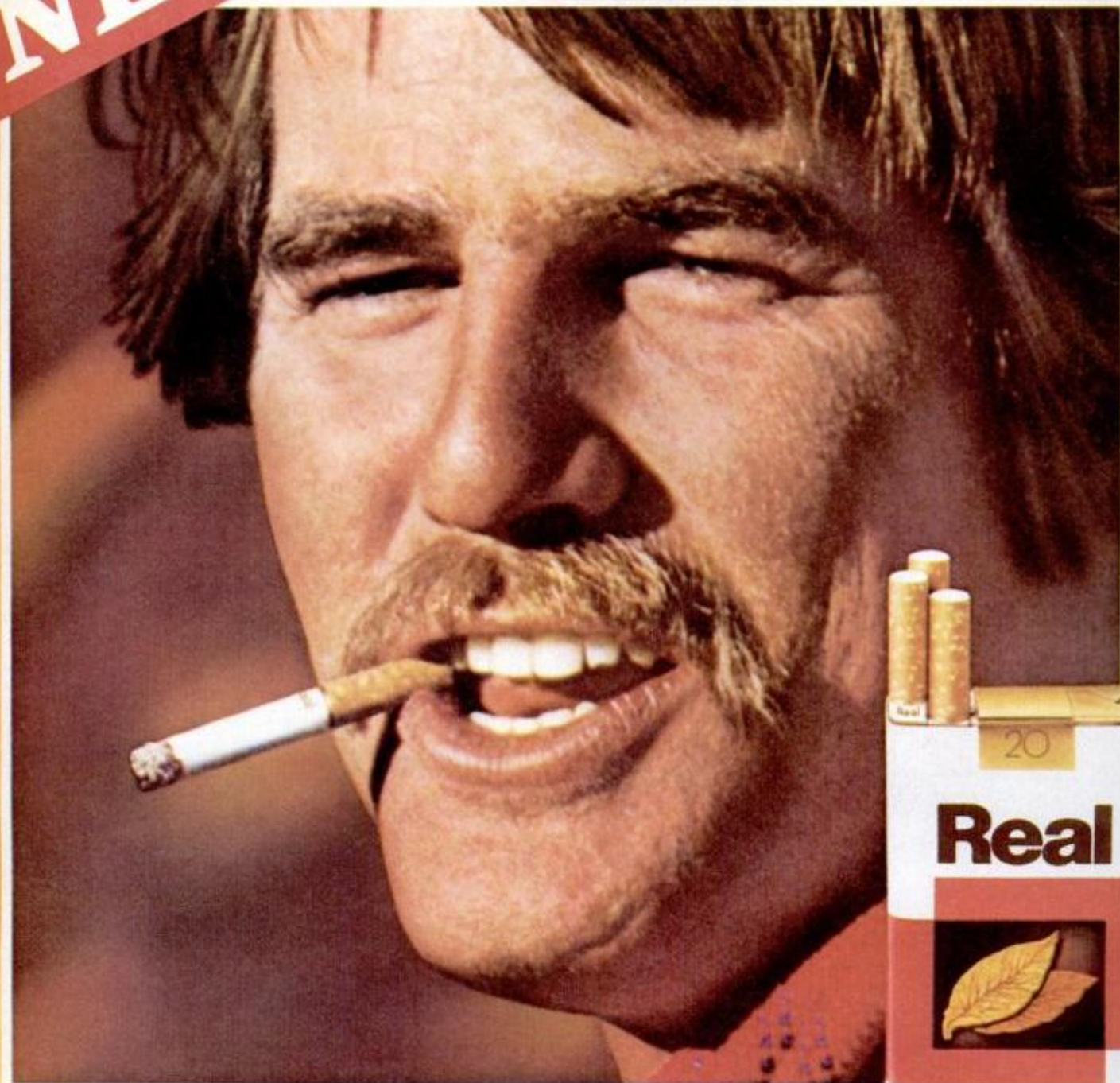


A GREAT WAY OF LIFE.
AIR FORCE 

NEW!

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

10 mg. "tar", 0.9 mg. nicotine av. per cigarette by FTC method.



© 1979 R. J. Reynolds Tobacco Co.

***"Taste Real's new golden taste!
Richer...mellower than before"***

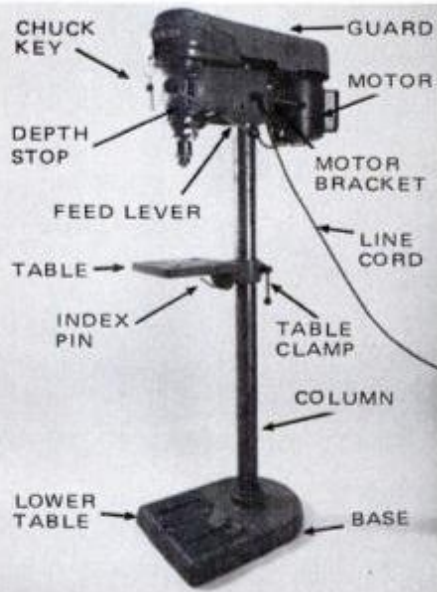
Real's new golden leaf tobacco blend does it.
Tastes richer...mellower...more satisfying.
A taste that's pure gold.

The smoking man's low tar

Матеріал, надрукований за розпорядженням

WORKSHOP MINICOURSE

USING THE DRILL PRESS



Typical floor-model drill press: Cone pulleys (beneath guard) provide you with a selection of speeds. The table can be raised, lowered and locked wherever desired on the column. The table also tilts and locks for accurate angle drilling.

The serious woodworker eventually buys a drill press. It is a versatile tool that lets you perform precise drilling operations that are impossible with a hand-held portable drill.

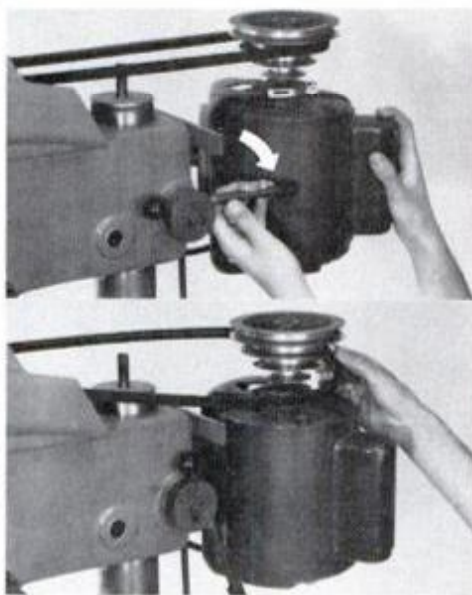
Some find that a bench-mounted press is adequate where the need for great capacity doesn't exist. Most craftsmen, however, choose a floor model because it offers greater capacity. A popular home-workshop-size drill press is the 14-in. model. (Size refers to maximum width of material it can handle. Thus a 14-in. drill press has 7 in. between spindle and front of column and will drill to the center of a 14-in.-wide board. For most of us a 14-in. press is sufficient, but if you have the money to spare, a 16-incher is even better.

If you have never used a drill press, or have had only limited experience with one, read the manufacturer's manual. There are an almost endless number of operations this tool will perform and we can only touch on the basic and typical ones in this space over the course of the months ahead.

Especially take time to read the section about the accessories that can be used on the drill press. Many of them—sanding drums on a concave surface, for example—will help you to upgrade your craftsmanship dramatically. **FM**

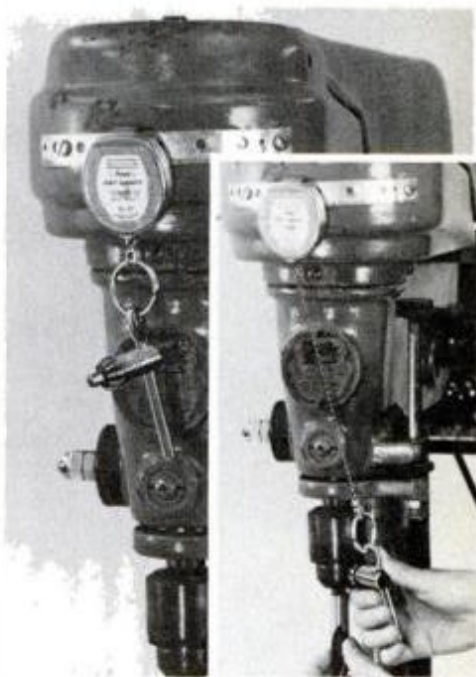


When backing material isn't used beneath workpiece, bit should always be lined up directly over hole in the table's center.



To change speed, tension is removed from motor (arrow, top) so it swings free, loosening belt. Belt position is then changed on pulleys to complete speed change.

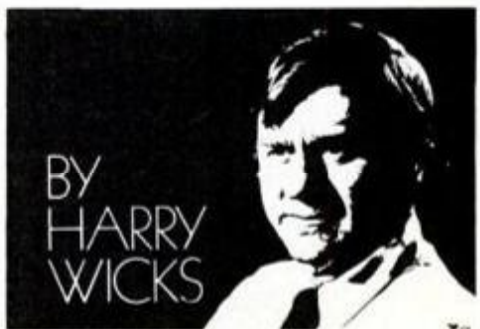
When precise depth is desired, bit is lined up alongside wood and the drill is held steady while depth stops (two nuts here) are set on the drill-press head.



To prevent a wandering chuck key, author uses a key caddy, strip of metal stock, and sheet-metal screws into housing as shown. When needed, chuck key is pulled to chuck (inset). Before turning on drill press, key is retracted safely out of the way.



For drill-press accessory convenience, author built this seven-drawer roll-about cabinet, keeps it parked beneath the press table. There's even space for some bench-saw accessories on cabinet's left side.



Right from the start, its Canadian spirit rises above the rest. What makes it such a popular choice? Super lightness. Superb taste. If that's what you'd like, take off for Lord Calvert Canadian.



**LORD
CALVERT
CANADIAN**

*Canadian Whisky Blend
of choice matured
Eighty Percent Whiskies*

The spirit of Canada:
We bottled it.



PM's Whatsit

Both current servicemen and those nostalgic for the days when that uniform fit nicely may immediately spot something "wrong" with this picture. What is it, first of all, and how would you explain it? Turn the page and we'll dress you down.

PM follow-up: the DC-10

As we go to press, DC-10s are flying routinely again, but questions concerning last May's Chicago crash may take years to resolve (see [Science Worldwide](#), page 12). The legal wrangle over a root cause—maintenance procedures vs. structural deficiencies—has tended to obscure one question we hope gets a thorough airing before the whole thing is wrapped up:

How inherently safe or unsafe is a design in which a breakaway engine rises above the aircraft's wing? This is not, as many people assume, the case with all wide-body jets. Some industry sources suggest that an engine breaking away at takeoff would retain enough fuel to "fly" for as long as 20 seconds. Assuming it would tumble, what would be its probable trajectory and—getting to the point—how close might it come to the tail assembly of the mother aircraft?

It would be good to have the investigators, while they're at it, make public a conclusive evaluation of the above syndrome.



Herbie, I think the Earth moved

We thought we'd heard it all when it comes to car stereo. But you can't hear it all, according to Pioneer Electronics of Long Beach, Calif., unless you feel it in your bones. Their new Bodysonic cushion contains transducers designed to let you "feel" musical vibrations even as you whiz along the freeway toward the first disco taking odd-numbered cars. The sound the body feels, through what the inventors call "bone conduction," is too important to be left out, they claim (you can also plop the cushion in a chair for a jolt of bone conduction around the house or office).

At about \$150 for the cushion and its amplifier (which connects to any car stereo), it may not get you all shook up. But let's wait and read the testimonials.

Gee, officer . . .

What we have here is a bit of barnyard humor perpetrated by the company which manufactures a police radar detector known as the Whistler Radar Eye. It is their idea of what will happen now that the State of New Hampshire has enacted a measure making radar detectors legal.

Sticklers for authenticity should note that the gee horse (right) is wearing a real radar detector while the haw horse (left, of course) is fashionably equipped with a matching dummy.





Whatsit revealed

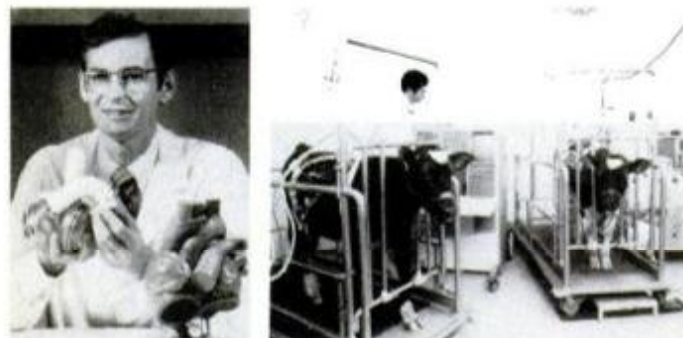
Yes, those are Air Force stripes the sextant-wielding swabbie is sporting and that is an Air Force insignia blazed on his vessel's superstructure. It's no secret mission, though, just a patrol craft (one of seven under Air Force Command) supporting the Air Force target ship *Ozark* (photo above), anchored in the Gulf of Mexico near Fort Walton Beach, Fla. The Air Force's "navy" clears the area of seaborne traffic when firing missions are being run on the ship, and transports photographic equipment and evaluation teams out before and after the shoot.

The ultimate pump

Recent breakthroughs in miniaturization, reliability and biological compatibility have led an interdisciplinary team of researchers at Penn State University's Hershey Medical Center to predict that an artificial heart for humans will be in use within a decade. The forlorn-looking calves in the photograph have lived without hearts at the Hershey Center's lab for more than two months. The record calf was kept alive by an artificial heart for 140 days up until last June.

Human patients have already used an artificial pump, based on Hershey Center technology and known as a left-ventricle assist (LVA), following major surgery. Assuming the function of the heart's main pumping chamber, it allows the patient's heart to recuperate at rest for weeks at a time.

While fraught with the life-or-death drama that must accompany serious cardiac studies, artificial heart research has plenty of plain, workaday stubborn problems. For instance, it took all of 10 years to develop a pump chamber sac made of segmented polyurethane that would be compatible with the human body in a shape that would prevent clotting of the blood. The latest mechanical wizardry: an electric motor drive weighing 2¼ pounds that will fit inside a patient.



Research team director Dr. William Pierce with Hershey's successful artificial heart and heartless calves at Hershey Medical Center.

Calculator program put to the test



While working on last month's issue with its story on programmable calculators (page 98), one of PM's editors became interested in trying out Texas Instruments' marine navigation program module on his sailing vacation. The module was inserted in a TI-59 programmable calculator which then went off to the Chesapeake Bay with the editor. The simpler programs could be easily entered, with a little practice, to serve as a backup to the minimal eyeball navigation required on the well-marked Bay during daylight hours.

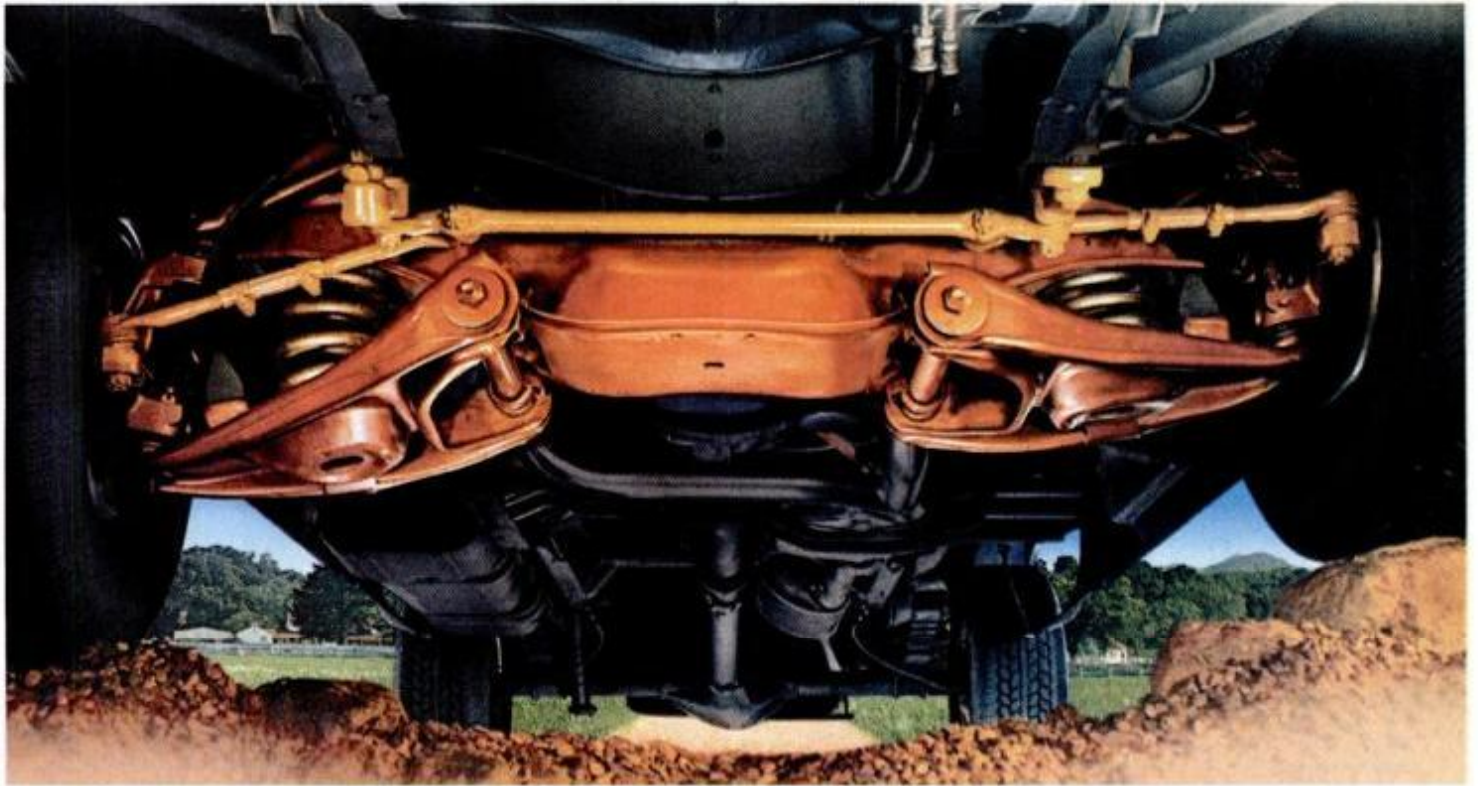
Things changed drastically one night when the party's 30-foot sloop went aground on a typical shoaled-over-since-last-winter channel about a mile from shore in the lower Chesapeake. The grounding occurred in late evening, on a falling tide. The next high tide was confirmed by the Coast Guard to be at about 6:00 a.m. Waiting it out, the editor backed off the shoal and headed out into the Bay at about 4:00 a.m. in a predawn gloom that effectively hid a nasty surprise—a thick, persistent fog bank. The course was southeast to reach a prominent mark—Hooper Strait Light—with shoals to one side and the Chesapeake Bay ship channel to the other.

The latter is no place for a small vessel in poor visibility, as the number of both documented and suspected rundowns by large ships attest. So the editor was a bit reluctant to believe it when the TI calculator's "current sailing" program, hastily punched in as fog enveloped the boat, gave an offshore (toward the channel) steering correction to compensate for a slight tidal current. The calculator also said it would take a little longer to reach the light than the amateur navigators aboard figured it should. The distance was less than three miles—a long way at the pace of only a moderate walk when you can't see anything.

After a short debate, the party agreed to honor the calculator's steering correction and not to give up on finding the light (and simply anchoring) until its elapsed time estimate had passed. In about 28 minutes, one more than the program had figured, the light loomed up almost dead ahead—the fog was so thick that in the dawn light its shape was seen before the beam.

The incident engendered a new respect on the part of one PM editor for what mini-electronics hath wrought.

BUILT TO TAKE IT SO YOU DON'T HAVE TO.



CHEVY'S MASSIVE GIRDER BEAM SUSPENSION SYSTEM.

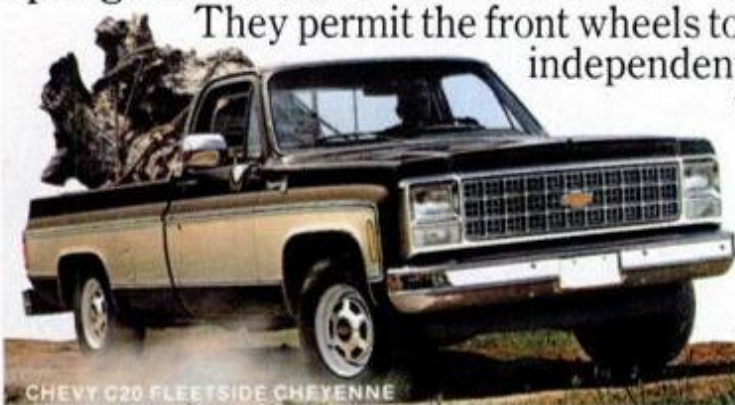
It's standard on all 2-wheel-drive Chevy pickups. A massive, rigid steel beam forms the foundation of this rugged independent front suspension. Two contoured steel control arms with coil springs are attached to each end of the rigid steel beam.

They permit the front wheels to take bumps and ruts independently and help smooth the ride. So make it

easy on yourself.

Let Chevy's tough

Massive Girder Beam suspension take the bumps so you don't have to. See your Chevy dealer about buying a tough Chevy pickup now. Many dealers can arrange leasing, too.



CHEVY C20 FLEETSIDE CHEYENNE
with available rectangular headlights and chromed grille.

84.1%	87.0%	87.5%	93.6%	93.9%	96.1%	96.7%	99.2%	99.9%	99.9%
69	70	71	72	73	74	75	76	77	78

A TOUGH RECORD TO BEAT.
94.8% of Chevy Light-, Medium-, Heavy-Duty trucks and commercial vans in the ten most recent years recorded were still on the job. (Based on R. L. Polk & Co. model year registrations through July 1, 1978. 1979 statistics not available at time of printing.)



BUILT TO STAY TOUGH



The quartz wristwatch at left is priced at less than \$10, the other one at about \$40 and the Tiffany clock at a Tiffany price.

IS QUARTZ REALLY WORTH YOUR TIME?

What's the magic of this mysterious crystal? And why do quartz watches cost anywhere from ten to thousands of dollars?

by Neil Shapiro
ELECTRONICS EDITOR

If man judged the value of materials by their usefulness rather than their rarity or beauty, a quartz crystal would be more precious than gold. Though one of the Earth's most common minerals, quartz has the unique ability to help us keep accurate and reliable time.

Advertisements for wristwatches claim "quartz accuracy," yet the prices for such watches may vary from less than \$10 up to thousands. What is going on? Unless you understand a little of the miracle of quartz, you can become lost in a storm of claim and counterclaim.

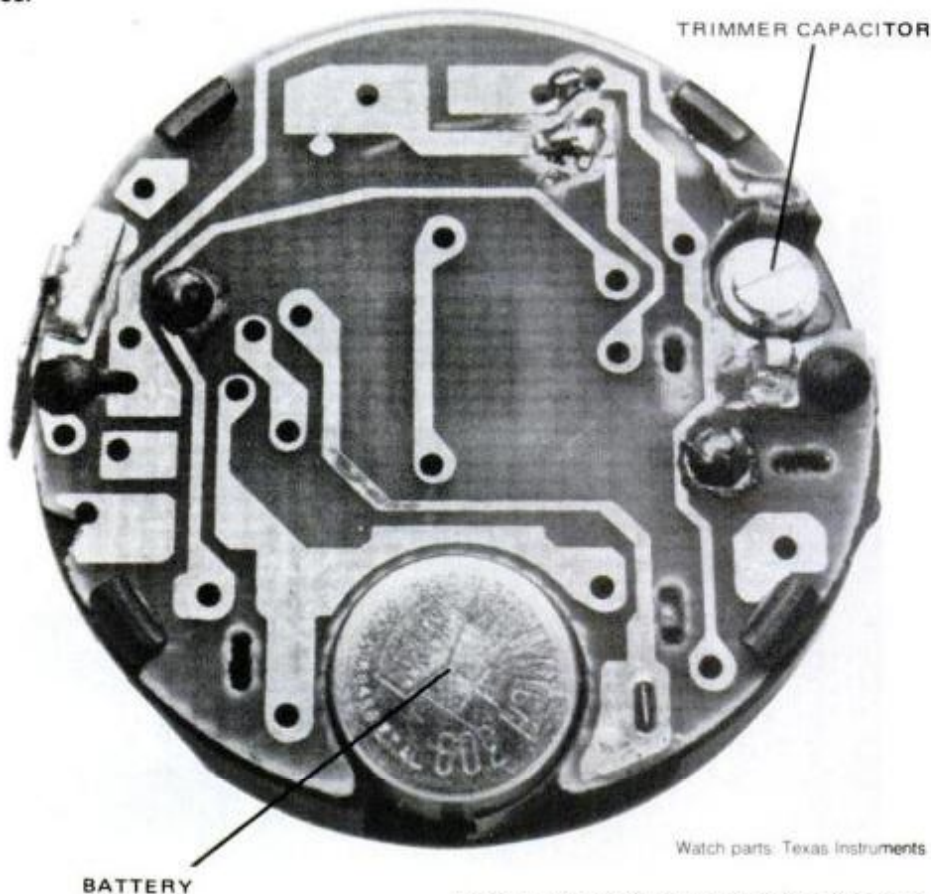
Good vibrations

Quartz exhibits an effect known as "piezoelectricity." If a quartz crystal is subjected to an electric charge, it will vibrate. The frequency of these oscillations depends on how the crystal is shaped.

Controlled vibration is the key to timekeeping. Remember how the pendulum in a grandfather clock slowly oscillates from side to side. In an old-style wristwatch a main-spring slowly unwinds to oscillate a balance wheel. The more controlled

(Please turn to page 78)

BACK



BATTERY

Watch parts: Texas Instruments

Trimmer capacitors are adjusted at the factory. You can realign them if you dare. But beware—they're extremely delicate.

Материал, защищенный авторским правом



When your taste grows up, Winston out-tastes them all.

Only Winston's Sun-Rich™ Blend
of the choicest, richest tobaccos
tastes this full and satisfying.
Winston after Winston.

BOX: 19 mg. "tar", 1.3 mg. nicotine, KING: 20 mg. "tar",
1.3 mg. nicotine, av. per cigarette, FTC Report MAY '78.

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



IS QUARTZ WORTH YOUR TIME?

(Continued from page 76)

and reliable the moving part, the more accurate the watch will be.

The quartz crystal in most quartz watches vibrates roughly 32,000 times per second (32 kHz) when the battery applies voltage to it. A good quartz watch depends on a tiny integrated circuit (IC), as well as an accurately cut and mounted quartz crystal.

First, 15 stages of the IC each divide the 32,000 vibrations by two—one stage after the next. Finally, the result is the familiar one pulse per second.

The divided-down current from the IC goes to the time display. The digits of the LED (light-emitting diode) or LCD (liquid crystal display) require no moving parts—only guidance from the IC—to display time and other functions. For those who prefer to see familiar watch hands, there are analog watches that do have moving parts. As the LED and LCD displays have no moving parts, they are usually more reliable. The IC may also offer other watch functions, including day and date and even stopwatch capability.

Quartz—how good?

All but the worst quartz watches will outperform even the best me-

chanical ones. How good a quartz watch is depends on several factors.

A quartz crystal, like wine, must spend some time in its circuit before it settles down to reliability, an aging process accounted for during factory adjustment. The crystal must be cut properly and contain no flaws affecting its operation.

When you buy a quartz watch, you pay for the electronics, the quality control and, of course, the jewelry (which can really inflate the price). A solid-gold case is going to cost much more than gold paint, and a plastic case will be cheapest. If in two watches the jewelry is equal in value, if they have the same number of functions, and if both come from reputable sources, then the likelihood is that their prices should be about the same.

A \$10 quartz watch can be just as accurate as one that is priced at \$1000. The differences will be found in such things as intrinsic worth (plastic vs. gold) and reliability of switches and integrity of the case.

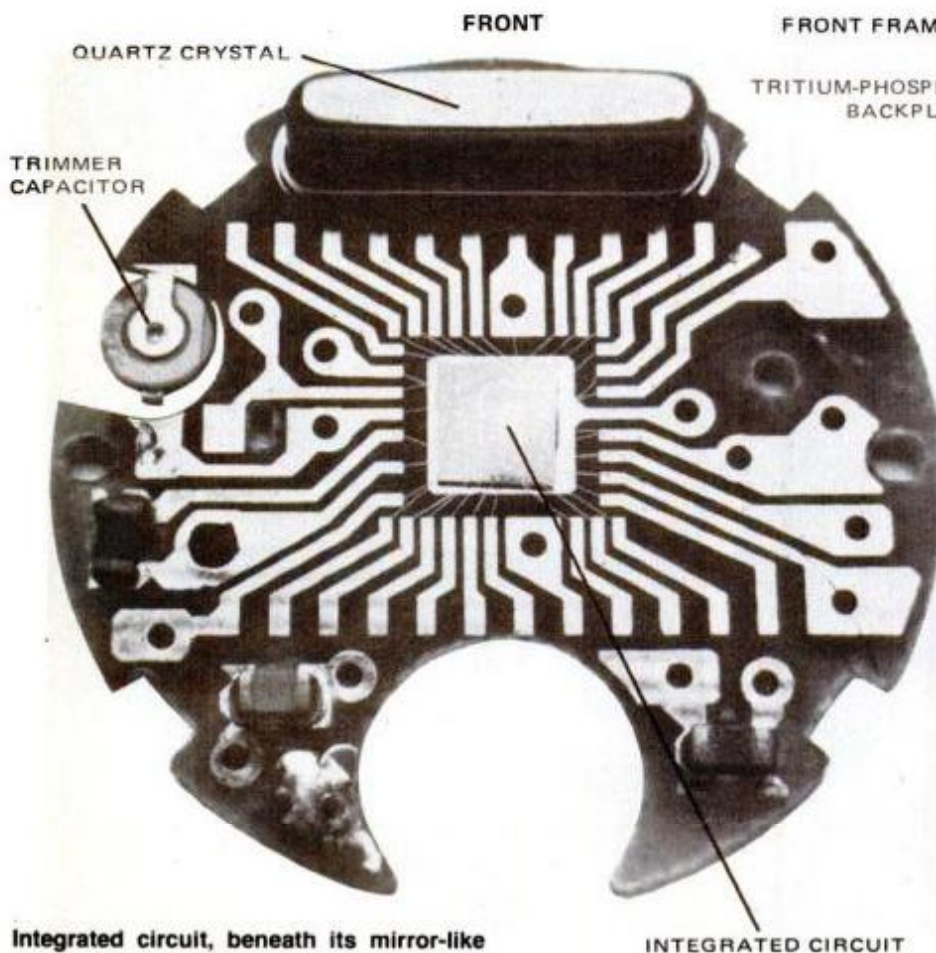
Can you tell whether an inexpensive watch you plan to buy is a dog or a winner? Unfortunately, there's no way to tell without actually using the watch for a while. The best yardstick before buying is the manufacturer's reputation.

Keeping an accurate count

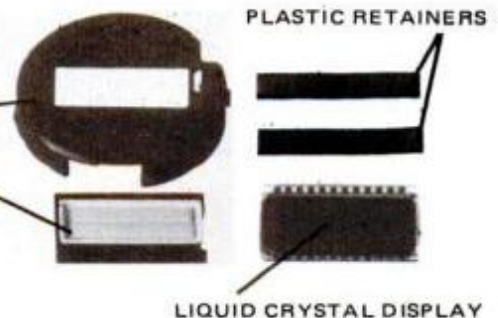
The very best quartz watches will be accurate to within one to two seconds a month. Any good quartz watch should give you accuracy within 10 seconds. A real dog is only going to be accurate within 30 seconds. If you have a watch that didn't keep good time at the start, it probably never will. If an accurate watch "goes out" on you—and you have not dropped it (a crystal can break, given a good enough jolt)—it may only need a simple adjustment. If the watch cost enough to merit it, take it to a professional repairman. If it's a \$10 job, it may make good sense for you to try to adjust it yourself.

Open the back and you should see a small trimmer capacitor. This is adjusted with a tiny screwdriver and compensates for variation in the quartz crystal. Carefully turn it a quarter turn, then note if the watch gains or loses. Keep carefully adjusting. Do not try this if ruining the watch will annoy you—that trimmer is delicate.

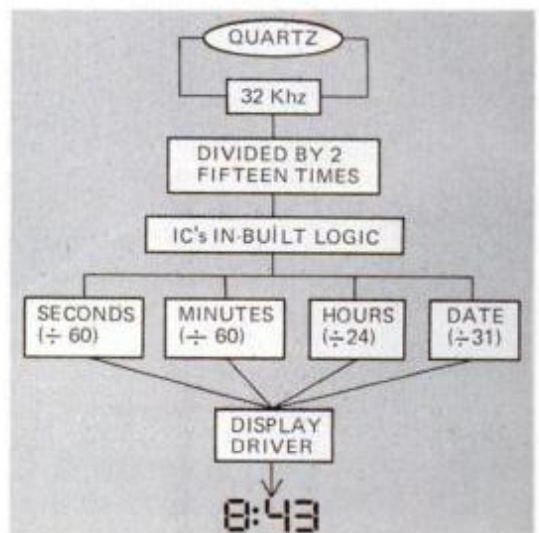
If you don't mind a plastic case, for less than \$10 it's entirely possible that you can have a watch with accuracy that was unobtainable 10 years ago. **PM**



Integrated circuit, beneath its mirror-like sheen, is a tiny computer that deciphers quartz crystal's timing vibrations.



This watch's front frame encloses a liquid crystal display and a tritium-phosphor, glow-in-the-dark backplate. The assembly sits atop the electronic printed-circuit boards.



Quartz crystal oscillates about 32,000 times per second (32 kHz). This is divided down by stages to attain one pulse per second.

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INDUSTRIAL
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VINYL REPAIR

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You can be in business IN A FEW DAYS!

Sensational! That's the **MONEYMAKING POWER** of VIP Professional Vinyl Repair . . . the business of your own that can be part or full time for **QUICK AND GROWING PROFITS!** You need no study — no training — just a few hours' practice and you're ready to do repairs for pay. — **BIG PAY!** You can be in business practically overnight.

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\$513⁰⁰
in first 10 days!

"The first 10 days I made \$513. Now getting business from 15 car dealers, 6 furniture stores, 4 restaurants and bars, and clothing stores . . . H. Whaley, Wash."

"Wherever I see vinyl, I can do business"



"I've made as much as \$60 in 3 hours."
C. Herrera, Jr., Ariz.

9 HOLIDAY INNS FOR HUSBAND/WIFE TEAM

"These Inns have put us on a monthly allotment. We are busy every day. Wonderful to be one's own boss. We are putting on one repairman to handle business other than Holiday Inns. With our setup, we have weekly checks coming from just the Inns."
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"20 car dealers give me all their repair work. I call on two or three every day, take care of what's needed. No matter what the repair is, it's easy to do with VIP."
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"I repaired 55 chairs at the NCO Club at \$8 each — \$440 for 9 hours' work. Materials and transportation cost only \$35!"
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They all started by mailing a coupon like this. YOU CAN TOO!

ALL FACTS FREE BY MAIL — NO SALESMAN WILL CALL. MAIL COUPON NOW

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Both women and men enjoy this easy, profitable way to make good money fast and steady. The VIP exclusive process is so easy, the directions so simple, that anyone who can read plain English can do it. And what a money-maker! A sure way to have an independent income, or build to a business as big as you want to make it. There's no end to the demand!

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PLEASE RUSH BY MAIL FREE FACTS about VIP Vinyl Repair and how I can start making money within a few days! No salesman is to call. I am under no obligation.

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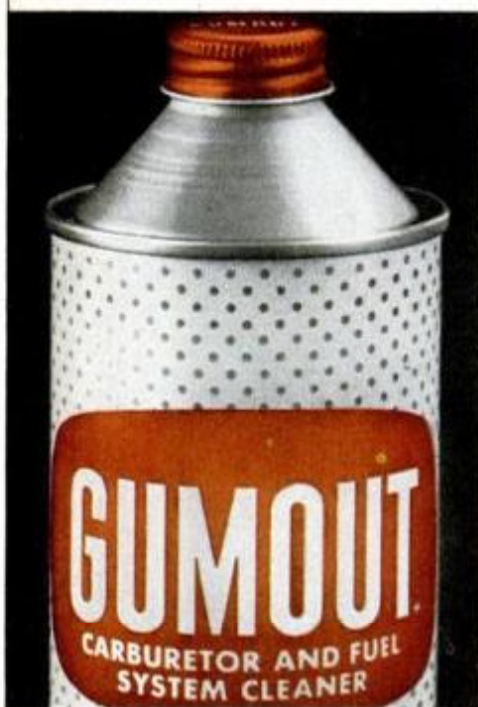


The between tune-ups, tune-up.™

It's too soon for another tune-up, but your car is starting to buck and stall again and the idling is rough. Gumout is the answer.

Use Gumout in your gas tank four times a year and Jet Spray on the carburetor linkage.

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NOTES FROM THE EDITOR

John A. Littleton

In an annual rite, like a gathering of Druids on the occasion of the winter solstice, automotive reporters converge on Detroit to see what the model year that's aborning brings us in the way of new cars.

However, the Detroit ritual is in no way as tidy in its timing as the more cosmic positioning of sun and earth. There isn't any one moment when, say, 800 shiny new cars are lined up on a Sunday morning for all to wonder at.

Rather, Chrysler (as it did this year) may choose to hold its previews for magazine writers during the week of June 4. Then along comes Ford for the week of June 25; American Motors schedules the same week. Finally, giant GM follows up with its gathering on July 9.

During those weeks, writers and photographers must schedule their own, exclusive driving time. Peekers-under-the-hoods must peek when cars aren't moving. (And if you're also interested in trucks and RVs, come back next week.)

Luckily, Popular Mechanics has an Auto Editor who's as adept as a travel agent in scheduling PM's crew to kick tires and otherwise assess Detroit's offerings.

He's Bill Hartford, who somehow gets to Detroit himself while seeing that Mike Lamm gets in from California, Gary Witzenburg stays around hometown Detroit, and "underhood specialist" Paul Weissler makes the pilgrimage from New York with photographer Bob Berger.

All that effort comes together in PM's comprehensive coverage of the 1980 cars, beginning on page 98.



Auto Editor Bill Hartford

It was a full year ago that we took our tailgate picnic "kitchen" to be photographed in a genuine football setting at West Point.

Art Director Ira Herrick, in a maroon Bentley, led an entourage of six cars and a small army of models and photographers to the site. The entire affair was very heady for Ira until a couple of Air Force Academy football players—practicing for the next day's game—insisted that he must *at the very least* be directing a major new movie. Really, all that fuss over a picnic?

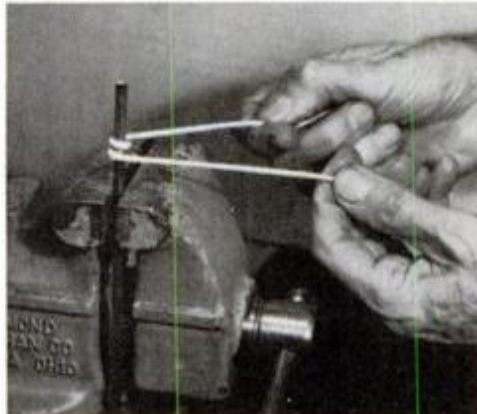
Well, it's not a movie, guys, but tailgating can be lots more fun than eating popcorn in the dark. Look at the happy picnickers on page 116.

The only person in our office who's anxious for winter to arrive is Joe Provey of the Home and Shop staff. Last spring, Joe installed a shiny, red home-heating plant that operates on wood, coal, electricity and the owner's choice of oil or natural gas (page 122). The boiler worked well on an 85° day, but Joe won't be happy until he's tried it in a snowstorm. Joe chose oil as his "regular" fuel, but in a way he'll be getting some heat by way of natural gas: Most of his five cords of wood came from trees being cleared from the right-of-way of an underground natural gas line. Joe says lots of firewood is available, even in an urban area. He's preparing a midwinter article on the tricks he's learned for finding alternate fuels.

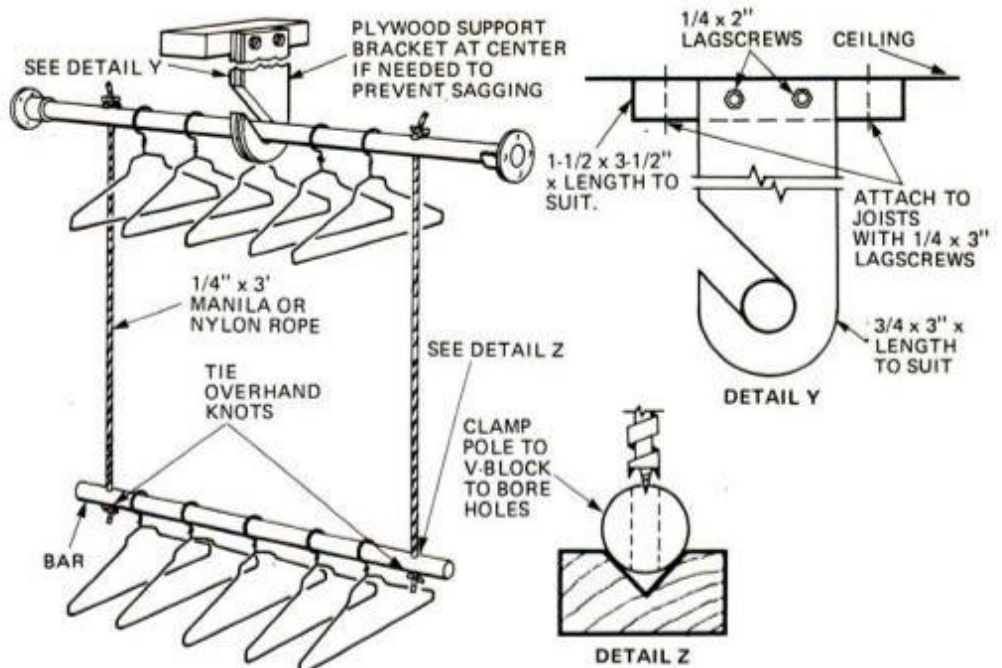
PM

HINTS FROM READERS

Polishing metals



When out of metal polish, you can polish brass, aluminum and other metals with ordinary household supplies. Mild cleansers polish brass; persistent rubbing with toothpaste or powder shines brass and aluminum. Test substitute polishes on scrap or hidden area of metal. In photo, brass rod is polished with moistened cord and cleanser.—*Walter E. Burton*



Sturdy closet extension for more hanging space

You can make this closet-extension bar from an old broomstick or pole. It provides extra hanging space for shirts, skirts or kids' clothes. Cut the bar to length and bore holes for hanging it with rope. Clamp the bar in a V-block before boring (see Detail Z). Cut two 3-ft. lengths of rope and

attach new bar to the original by knotting ends of rope after passing it through the holes. If needed, make a plywood center support and fasten it securely using a pair of lag screws as shown in detail Y. The center of the extension bar can be supported by a third rope.—*K.M. Wilson*

Get The Dry Look... and don't be a stiff.



The Dry Look' leaves hair feeling as soft and natural as it looks.

The Dry Look gives you more than a great look. It leaves your hair feeling soft and natural, too — not too stiff. The Dry Look in pump spray or aerosol — with a formula that's right for your hair. Get The Dry Look... and don't be a stiff!



©The Gillette Company, 1979

Available in pump or aerosol.



**Introducing the first
new truck of the 80's...**

TOUGH NEW 1980 FORD.

Built Ford Tough. Built for the 80's with new aerodynamic design and new engineering advances.

Tough 1980 Fords give you more payload capacity than last year's models with comparable GVWR's. Tough Twin-I-Beam front suspension. An all-new cab with new comfort features. New anti-theft measures. And more.

The 1980 Ford is tested tough—test pickups ran a total of more than a million miles at Ford's Arizona Proving Ground. The first new truck of the 80's. Tough. Aerodynamic. Advanced. At your Ford Dealer now.



New aerodynamic design. Smooth new contours on F-100's and F-150's reduce air drag at highway speeds compared to '79 models. Result: your engine doesn't work as hard. Auxiliary fuel tank option adds 72L (19 gallons) extra capacity on Stylesides.



**Ford pickups. America's
best sellers of the 70's.**

Based on R. L. Polk & Co. registrations

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Coming October 12



All-new cab interior. More leg room than last year. New instrument panel. New anti-theft features like locking steering column, inside hood release. New options include AM/FM stereo with 8-track or cassette player, underhood tool box, tilt steering wheel, Sports Instrumentation Package.

Ford 2WD Pickups	4.9L (300) Six	5.0L (302) V-8	5.8L (351) V-8	6.6L (400) V-8
F-100	•	•		
F-150	•	•	•	
F-250	•	•	•	
F-350	•		•	•

Full availability of power trains. All Ford models for 1980 offer a choice of engines and transmissions to match your needs.

New pickups, new choices.

Rugged Six-Wheeler tops '80 line of high-payload pickups. Roomy SuperCab, new inside and out. Also: new-design Flaresides, 4x4's with Twin-Traction Beam independent front suspension.

Ask about Ford's anti-corrosion warranty. And about Ford's Extended Service Plan.

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**Come to where the flavor is.
Come to Marlboro Country.**



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

Kings: 17 mg* tar, 1.0 mg nicotine—
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**Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.**

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DO-IT-YOURSELF DISASTER

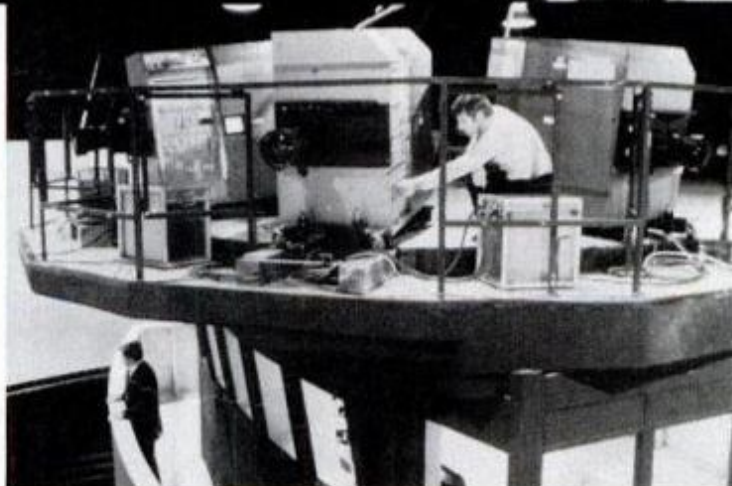


The emergencies are simulated, but the shouting is real.

by Gurney Williams III

Like most modern simulators in action, the Navy's new Damage Control Trainer was awash with realism. The eight men in a sealed chamber battled three leaks in a labyrinth of pipes, one blasting water like a firehose. The water was real. Alarms and disturbing announcements—"Collision imminent!"—echoed in the small chamber, a mock-up of an engine room on a ballistic missile submarine.

One other touch of realism raised the ante for the shaking, shouting crew: The water level was rising fast.



Walter Mitty rides again: The author (above) commands a container ship in New York Harbor—on a simulator miles away. Landmarks and other ships are generated by a digital computer feeding projectors atop a mock bridge (left). Facility challenges helmsmen to avoid collisions, learn local hazardous conditions, keep track of current, dock safely.

Above this scene of simulated disaster at the Naval Submarine School in Connecticut another crew watched quietly behind a 70-square-foot window of high-impact plastic. In a dimly lit room, they hyped up the psychological pressure by turning on pumps, opening valves and

routinely denying requests from the crew in the chamber for additional gear.

The water had risen, churning and splashing, to within a few inches under the deck plate when the mock crisis in the tank got a little too real.

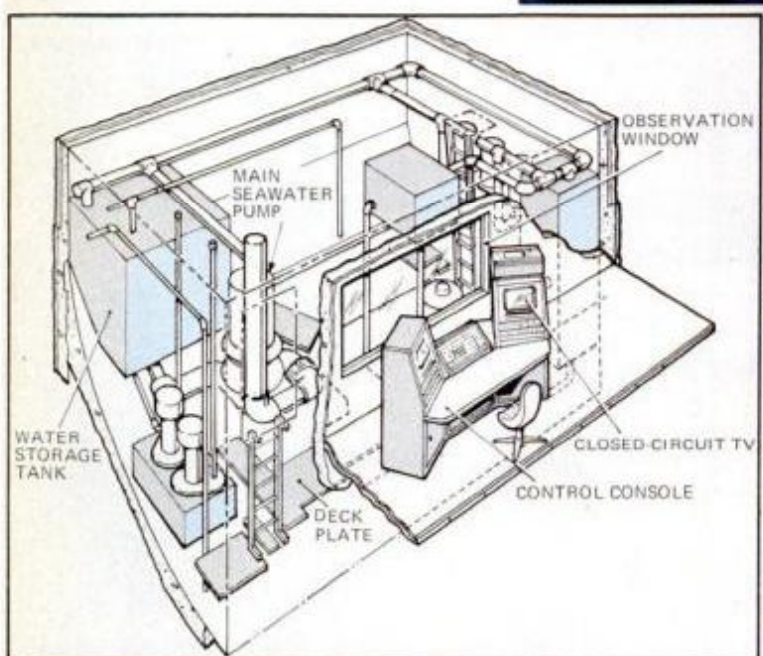
One of the men in the chamber reported the problem in clipped phrases over an intercom. "Engine room lower level. We have a man who passed out on the deck. Secure the flooding."

Directly below the control-room window, one of the crewmen in the chamber was sprawled face down on the deck plate, lying still.

Machinist's Mate First Class Richard Treptow, who had been running the simulation, began snapping orders to his crew. "Secure the flooding. Emergency drain." In seconds, the water level began to recede. The men below in the chamber hovered over the fallen man. "Sound simulation off," Treptow said. Someone rolled the man over and raised his head off the deck plate.

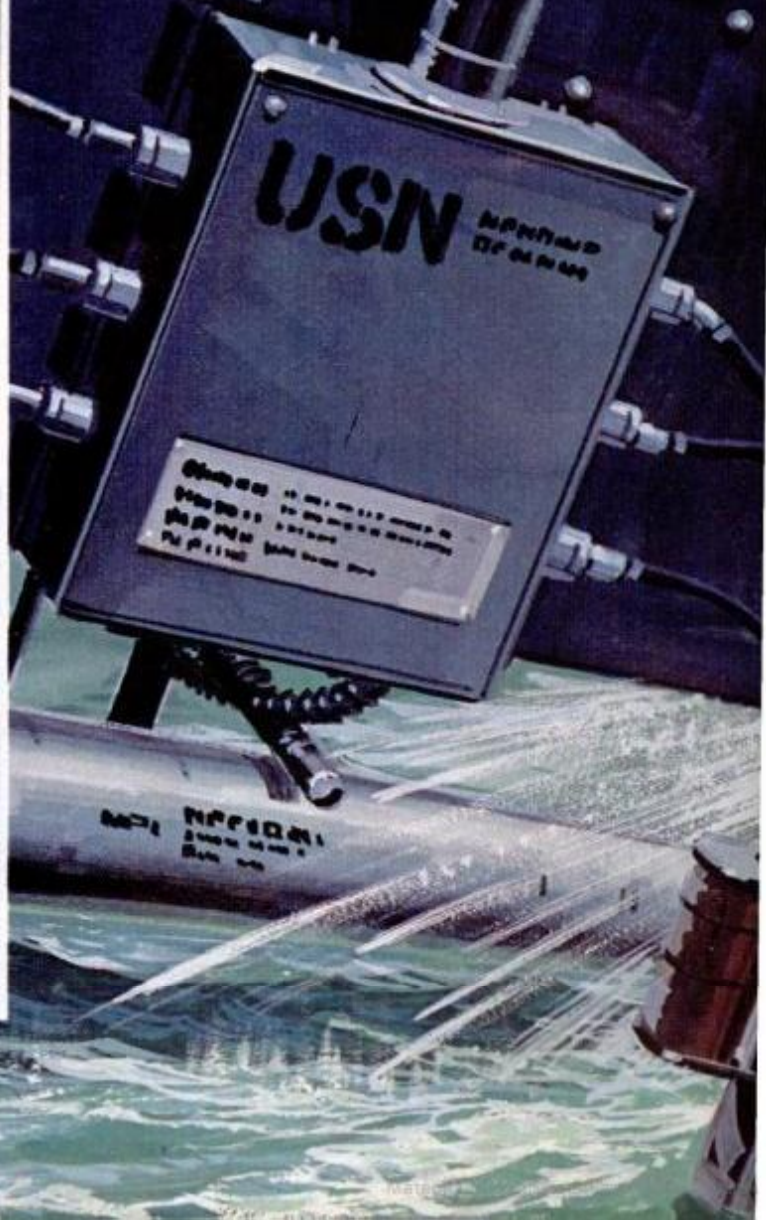
"Call the hospital and give me an ambulance," Treptow commanded.

"Aye," said an assistant working

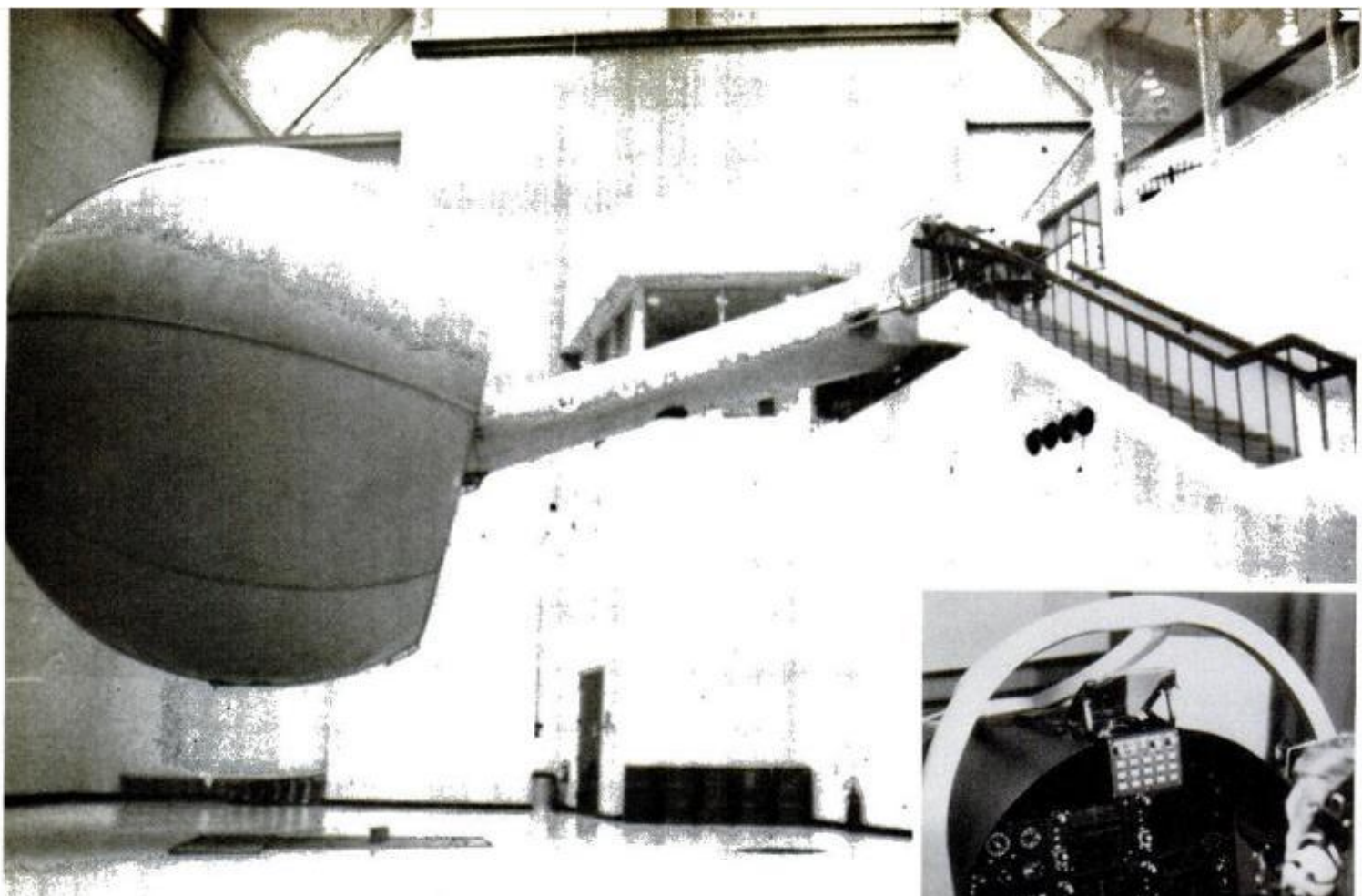


Water rises rapidly in closed chamber (right) of Navy's Damage Control Trainer. Instructors in control room (above) can add new crises with the flick of a switch.

PM art: Ed Valigursky







Wright Patterson aircraft simulator (above) gives pilot a sense of G forces by moving single-seat cockpit, inside bubble, at the end of a 30-foot beam. Moving images, including targets, are projected onto the inside of the sphere. The simulator is used to test control systems for upcoming generations of fighter planes.



Cockpit of the future? Simulator tests will reveal practicality of experimental instrument system relying on digital computers. Cathode-ray tubes guide pilots to targets and back, with electronic maps.



Tiny TV camera on a boom "flies" over model board at Wright Patterson, sending realistic images, including lights, farms, bridges, rivers and cities, to display system in cockpit simulators. Covering TV lens with a filter simulates fog.

the control console. He reached for the phone.

Then, watching the scene below, Treptow countermanded his order. "Don't," he said.

The man in the chamber had both eyes open. He was smiling. *Laughing.* Treptow ran down to the cham-

ber and briefly conferred with him. When he returned to the control room, Treptow hit himself in the chest and groaned.

"My fault," he explained. "I wanted the man to die in the second set of flooding." Signals got crossed, and Treptow's illusion—a simulated

death to see what the crew would do—was staged in the third drill instead of the second.

The situation wasn't unique. Modern simulators are sometimes so realistic they fool the people running them. Several of the staff at the large-ship simulator in Kings Point, N.Y., had to leave the life-sized bridge one day when the harbor scene they were projecting began to revolve uncontrollably. The crew got seasick. A well weathered New York Harbor pilot checking out the same simulator got trapped one day on a collision course with another ship. He did all he could, then turned his back on the realistic scene of impending disaster. "I couldn't watch it any more," he said.

Airplane pilots with dogfight experience shout and sweat in machines simulating high-speed aircraft.

"I've seen guys walk out of aircon-

ditioned Military Airlift Command simulators with flight suits dripping wet," said Don Gum, a simulator expert at Wright Patterson Air Force Base in Ohio. "And I've heard instructors say to trainees in simulators 'Just remember to do it like you did in the simulator last week,' as if they were in a real plane. It's not a joke. The pilots and instructors are really into it."

One major reason for all the shouting is safety. Many simulator programs today duplicate past crises down to the last frozen valve or jammed control. Students on simulators at the submarine school, for instance, routinely encounter—and counteract—conditions that caused the nuclear sub *Thresher* to sink in the North Atlantic in 1963, killing all 129 aboard.

Since the Three Mile Island nuclear powerplant accident in March, hundreds of workers from nuclear powerplants have taken a quick course on a Babcock & Wilcox powerplant control room simulator. The course, sometimes offered around the clock to accommodate high demand, includes four hours in the windowless simulator, under observation by instructors through one-way glass. Students listen to alarms, watch rising core temperature and dropping pressure, and learn how to correct problems that crippled the plant in Pennsylvania.

Simulators also save money, often your tax money. One B-52 weapon system trainer alone saves 307 million gallons of fuel annually—at least \$113 million a year, according to Air Force estimates. Many simulations today parallel real systems so closely that designers can try out new ideas—different cockpit layouts, for instance—without burning fuel or risking lives.

It wasn't long ago that simulators were hardly more sophisticated than a carnival ride. The old Link aircraft trainer of World War II vintage, made with a vestigial tail on the stern, gave student pilots the impression the cockpit was perched on a flagpole, about to fall off. Diesel submarine simulators used in the early 1960s were jostled around, to simulate diving, by a huffing hydraulic system which sounded like a steam train. Realism suffered.

Vivid realistic scenes

In many of today's machines, the secret behind the more believable movements, sights and sounds is modern electronics. At Kings Point, for instance, the heart of the ship simulator is a digital computer with a disc memory. During a mission, the computer feeds full-color images 30 times a second to five TV projectors spotted above the mock bridge. The vivid scenes flash onto a 60-foot-diameter cylindrical screen outside

the windows of the bridge, providing the operator with a 240° view of the horizon.

Because they are computer-generated—something like the pictures in video games—the scenes have an abstract quality. Waterfront buildings have no windows. Docks are devoid of people, like a desolate shoreline in *On the Beach* after a nuclear war has wiped out the population. There are no cars on the bridges. But the computer memory holds enough data to flash all the important harbor landmarks on the screens, and to keep them moving to reflect what the captain does—or fails to do. The computer scene can include up to six other ships underway—*dodge 'em!*—and many more at anchor.

As I discovered during an hour's watch at the helm, the computer can indulge your Walter Mitty fantasies of power, then jolt you awake again at the moment of collision.

Photographer Frank Lusk and I were the only crew bringing a 33,000-ton container ship into New York Harbor. Forward of our bridge, the computer generated an unchanging picture of some of our cargo: 32 white, purple, red, black, green and gray containers. Dead ahead soared the Verrazano-Narrows Bridge and beyond it, the challenge of harbor traffic and the promise of emergencies from a crew running the simulation in a nearby control room.

I tried to remember what I had learned of handling large ships from late-night movies like *The Caine Mutiny*.

"Take the con," I said.

The crew was surly. "I'm shooting with available light," Lusk threatened. "Don't move."

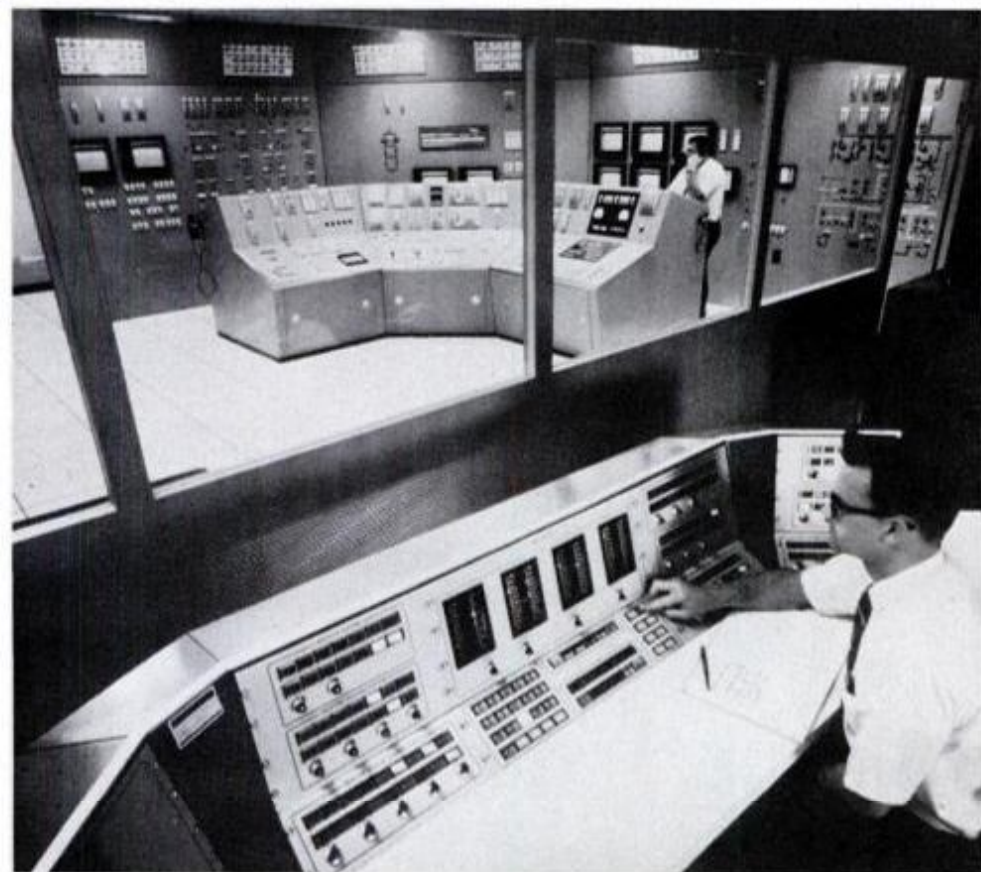
As we slipped into the harbor, under the bridge, I also remembered to say "Red right returning," but by then it was too late: The ship had already jagged majestically out of the channel and was approaching the eastern shore. "YOU BETTER COME PRETTY GOOD LEFT," said an authoritative voice from the radio speaker.

Falling off the earth

I learned later that if I had continued on my errant course, the computer program would have run out, and the screens would have emptied of all images—the modern simulator's equivalent of falling off the edge of the Earth. I turned hard to port, and in minutes was headed straight for another container ship.

This time my mistake was forgetting the effect of current. Water

(Please turn to page 212)



Instructors at Babcock & Wilcox can monitor the performance of students through window of the Link-designed nuclear powerplant control-room simulator. The system can recreate conditions at Three Mile Island, and respond to corrective actions.

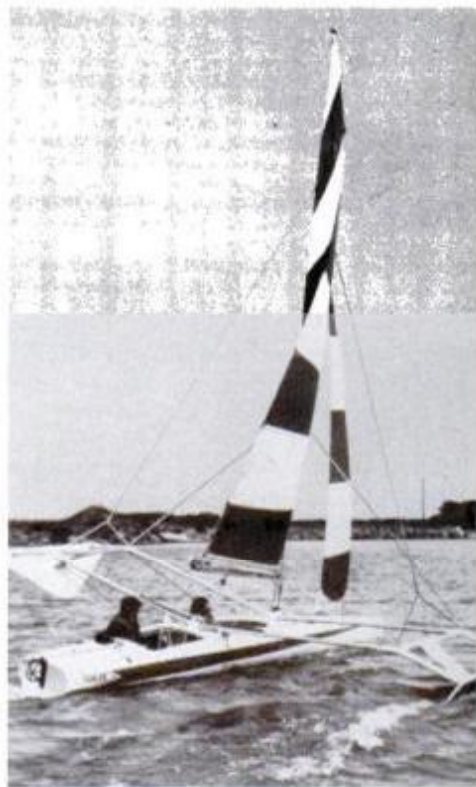
World's largest wind turbine

Atop Howard Knob near Boone, N.C., perches a 2-megawatt wind turbine, the largest in the world. Built by General Electric for the Department of Energy and NASA, it recently began feeding electricity into the local power grid. The 350-ton (including the 140-foot tower) giant is designed to operate at wind speeds be-

tween 11 and 35 mph. Its twin 100-foot blades spin at a constant 35 rpm through a variable-pitch control system and drive an a.c. generator at 1800 rpm. The \$6-million unit is said to be able to provide enough juice to supply approximately 300 to 500 average-size homes at a wind speed of 25 mph.



Speedy sailboat gets sea legs on hydrofoils



This British monohull sailing yacht is stabilized by two surface-piercing hydrofoils. The balancing force exerted by the foils is said to allow a constant heel of up to 10° without the need for crew ballasting or trapezing. The 21-plus-foot Foiler 21 can be sailed single-handedly and can achieve a top speed of 17½ knots, according to the manufacturer's claims.

Energy savings at the push of a button

The humble thermostat has gone digital. Texas Instruments recently unveiled an electronic unit with pushbutton programming capability and digital display of time and temperature. A homeowner can program up to four different times and temperatures to save energy when a dwelling is unoccupied or when its occupants are asleep.



Two for the road

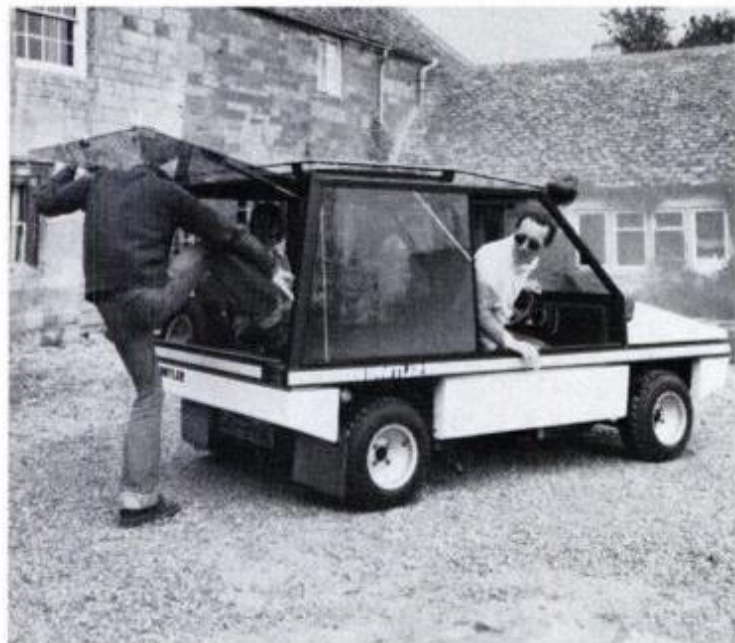
The dual-purpose British Hustler (left, below) can function as a load-carrying workhorse or a highly maneuverable town car. Designed to fit the Austin Mini chassis, it comes ready to install or as a kit. It features an integral roll-over cage and a bronze glass top section. Also from En-

gland, the Salamander (right) was designed with the needs of the handicapped in mind.

To enter the car, the driver opens the wide-swinging door, mounts the wheelchair lift, transfers to the seat, slides the seat across the car and locks it behind the

steering wheel. The wheelchair is carried next to the driver's seat. The car uses the engine and chassis of the Reliant Kitten and a slightly modified fiberglass body shell.

However, it is not expected to be available in this country.



Part of a square meal?



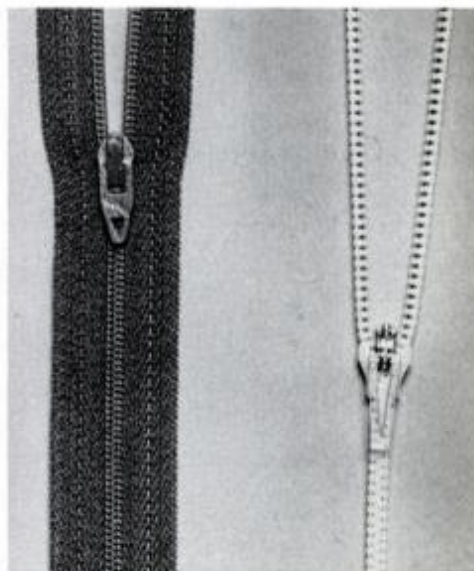
A Tokyo worker ponders the advantages of a square watermelon. According to the horticulturist who developed it, the cubic fruit is easier and cheaper to transport because its shape makes for much less

wasted space. It's handier to store in the refrigerator, as well. One disadvantage, at least in high-cost-of-living Tokyo: The melons are priced at a hard-to-believe \$20 apiece.

Zippity-do-dah

The Mirage is a zipper reduced to the bare essentials. Unlike the conventional kind that require zipper tape in order to be sewn into a garment (below, left), the new design consists only of a nylon chain and a slider.

Thus it can be rendered virtually invisible, and there is no need to stock hundreds of different colors of tape. In clothing manufacture, a computer-controlled sewing machine cuts the chain to length and sews it in. Scovill, Mirage's maker, may eventually market the zipper to do-it-yourselfers.



You'd expect a big, conservative corporation like General Motors to move in ponderous ways. But GM isn't ponderous at all—in fact, quite the opposite.

GM tends to be extremely agile. It responds to world changes with amazing speed—often several years ahead of its competitors.

Nor is GM tied to any particularly conservative policies. GM often comes up with radically engineered automobiles and even more radical policy decisions. Examples from the recent past include cars like the rear-engined Corvair, the transaxle Tempest, aluminum V8 for the Buick Special, and the front-wheel-drive 1966 Toronado. No other major U.S. car company would have dared so many different engineering innovations, some of



Owners praise seat space and riding comfort, say Citation gives big-car feel.

PM OWNERS REPORT: CHEVROLET CITATION

which have admittedly been more successful than others.

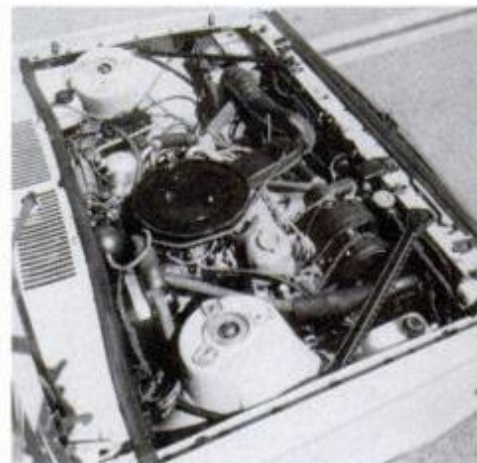
Nor could any other automaker have inaugurated the sweeping downsizing program begun with GM's 1977 models. Only General Motors, in my opinion, could have convinced the American public and the rest of the industry that downsizing *must be*.

GM's latest engineering *tour de force*, its most recent downsizing effort, and a major factor in the corporation's health, is the so-called X-car—the new fwd compact marketed by Chevrolet as the Citation, by Pontiac as the Phoenix, by Oldsmobile as the Omega, and by Buick as the Skylark. The Citation replaces Chevy's second-generation Nova/Chevy II, which served the corporation faithfully

from 1968 through April, 1979, with only minor changes.

Ten years ago, public response to the Citation would probably have been comparable to the Corvair's reception. Today, there's a line at every Chevy dealer's door. GM can't produce Citations fast enough, despite the general downturn in domestic auto sales.

What is it that makes the Citation so



Good fuel mileage, plus plenty of punch, emanate from transverse Four and V6.

hot? For the answer, we turned to the car's earliest buyers, many of whom baby-sat the car during its initial teething problems. We began by asking Citation owners just what it was that attract-

BY MICHAEL LAMM WEST COAST EDITOR

Fantastic fuel economy, front-wheel drive, roominess please owners more than service

Owners applaud hatchback's convenience and versatility.

Spare wheel to match this one costs \$37 extra.



PM photos by the author

ed them to the car in the first place.

An Alabama store manager summed it up for many when he wrote: "We wanted a smaller car with plenty of space inside, good gas mileage, but still plenty of power, enough comfort for four adults, and the resale value of a 1980 model."

A Minnesota airline pilot adds, "I bought the Citation for the advantage of front-wheel drive in winter driving. Mileage was a consideration, too, but here in Minnesota it's secondary to good winter handling."

A Wisconsin sales manager: "I chose the Citation because it's the first 30-mpg American car that has room for four, plus a versatile carrying compartment."

While economy ranked as *the* overwhelming reason for purchase, many buyers were also swayed by the Citation's space utilization. A Michigan key-punch operator notes: "I've always wanted a station wagon, but have never cared for the wagon look. My Citation is as spacious as a wagon and looks neater. I recently bought 30 bags of groceries and, by George, they all fit!"

A North Carolina librarian: "The Citation has an abundance of room. I have the five-door hatchback sedan, which has plenty of trunk space, even with the rear seat upright."

A Texas real estate agent comments, "The interior is most deceiving—it's really roomy for a small car," and a Louisiana

cleric adds, "We don't think of it as a 'small' car."

Owners praised seating comfort and ride. "I drive in a car pool," says a Texas instrument technician, "and the men in the back seat say the Citation has plenty of legroom."

Several drivers, though, complained about the high-back front seats. "The Citation's headrests interfere with visibility," asserts a South Carolina housewife. A Michigan teacher concurs: "High-back seats are horrible for checking the blind spot."

Any new design has its share of bugs.

(Please turn to page 226)



Lots of space with rear seats folded; removable cover hides cargo with seats up.

America's first 1980 models

GM's fwd X-cars roared off to a fast sales start last April 19.

Four General Motors divisions share the X-car, with two engines and two transmissions available in four body styles.

Chevrolet's Citation is the only nameplate that offers three of the four body types: two-door notchback sedan, plus three- and five-door hatchbacks. The other body is a four-door notchback sedan, available only in the Olds Omega and Buick Skylark.

Pontiac builds the standard Four. It has a crossflow head and displaces 151 cu. in. (2.5 liters). Chevy supplies the optional 173-cu.-in. (2.8 liter) V6. These engines rate 90 and 115 hp respectively and mount transversely, in unit with gearbox and differential.

A manual four-speed overdrive transmission comes standard (0.81:1 high), with a three-speed automatic optional.

The Citation's rack-and-pinion steering boasts a 17.5:1 ratio with power, or 26.0:1 without it. MacPherson-strut front suspension complements a transverse beam axle on coil springs at the rear. Both ends have stabilizer bars.

The 1980 Citation replaces the 1968-'79 Chevy II/Nova, which weighed some 750 pounds more and was 20 inches longer overall. Yet roominess inside the new car is greater than before, especially the luggage capacity. The hatchbacks offer up to 40.9 cu. ft. of cargo area with rear seats folded.

The Citation's sport coupe—the X-11—comes with special suspension plus extra trim and graphics.

A NATIONWIDE SURVEY BASED ON 699,552 OWNER-DRIVEN MILES

Exposed wipers unstick more easily in icy weather.

Transverse engine and front-wheel drive save space.

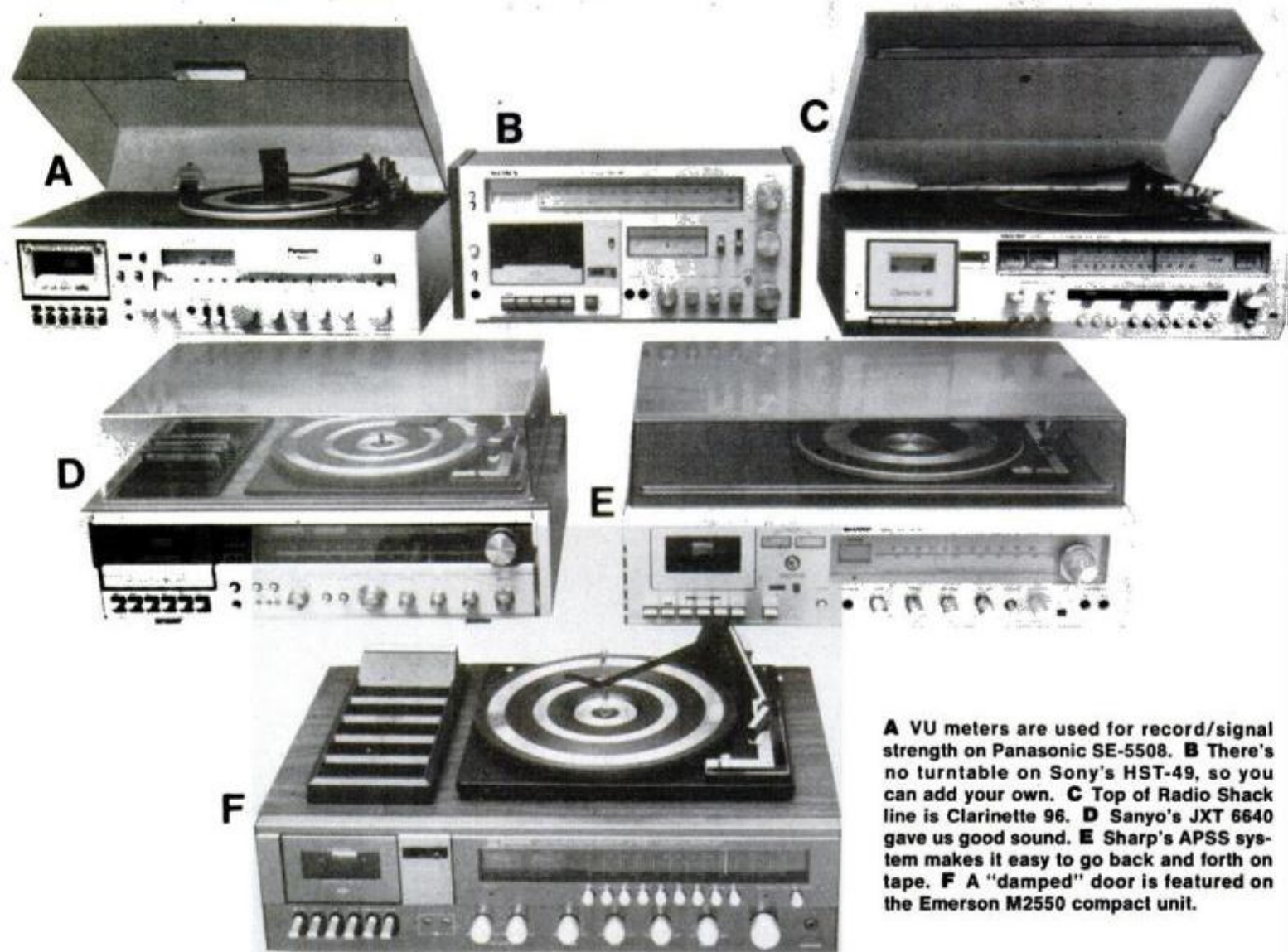


Controversial upright AM radio may now be deleted. It's hard to reach and lacks fidelity, owners grumble.



Four-cylinder engine's oil filter is hard to replace.

Compact stereos sound better than ever!



A VU meters are used for record/signal strength on Panasonic SE-5508. **B** There's no turntable on Sony's HST-49, so you can add your own. **C** Top of Radio Shack line is Clarinette 96. **D** Sanyo's JXT 6640 gave us good sound. **E** Sharp's APSS system makes it easy to go back and forth on tape. **F** A "damped" door is featured on the Emerson M2550 compact unit.

For years, compacts—those all-in-one combinations of receiver, amplifier, record changer and tape deck—have been looked down on by the audio industry. We tried a few of the new ones—and old impressions changed!

by Christopher Greenleaf

Just what is a compact? Think of it as a one-piece electronics module with two separate speakers. The nerve center is the amplifier. Into it feed the turntable, AM and FM tuners, and cassette deck. These are the main combinations, and one or more items may be eliminated to

save money. The cassette unit plays back prerecorded tapes and makes its own recordings, either from the radio or through microphone inputs on the front. Some sets arrive packed with speakers, while others come without. Often, various sizes and price categories of speakers are available. Either way, the options are attractive.

The pros and cons

Some people feel that compacts suffer from three "disadvantages": relatively low power, a lack of sophisticated gadgetry, and, with many systems, the need to purchase specific sets of speakers.

Power is great for driving large, spectacular speakers to a volume that rattles your windows and shakes up your neighbors. But it isn't necessary for much of the lis-

tening done in most homes. Power is more than just volume potential—it is also insurance that you have the "headroom" in your amplifier to produce real-sounding transients (the distinctive starting sounds of many musical effects) and wide-open bass. At the same time, though, remember that compacts come with ample power to raise the roof or simply provide clean, honest sound suitable for most of us. A very important reason for the attractive price of the compact stereo system is the money saved by *not* building-in heavy, expensive power amplifiers. Try to lift a 200-watt-per-channel power amp after first glancing at the price tag, and I guarantee you'll get the message!

A compact's simplicity of operation is one of its better traits. Frills and extras *can* add to what you can



A hinged dust cover protects both the changer and on-top cassette rack on Radio Shack's Clarinette 96. An AM bias switch helps cut much of "whistle" noise on AM broadcast band.



The VU meters on this Sharp compact can be easily monitored for recording, and are separate from the receiver's signal-strength meter. Automatic program search returns you to a selection.



A damping mechanism on cassette door of this Emerson M2550 unit prevents annoying "thumps." There are two VU meters, as well as two mini-size phone jacks for connecting microphones.



The loudspeakers that came with this Panasonic SE-5508 sounded the best of any we tested. This compact features a switch for adjustment of the tape bias from normal range to CrO₂.

do with the audio equipment available, but often they do little more than add to the first and second digits in the list price. A so-called "no frills" compact can have a surprising number of controls as it is. They all have Bass, Treble, Balance, and Volume controls. Function switches offer you many possible adjustments for choosing which of two pairs of speakers you want to play and selecting *AM*, *FM*, *Phonograph*, *Tape* or plugging-in an auxiliary input (a plugged in second tape machine, for example). Or you can turn the speakers off entirely and use headphones.

Other buttons like *Loudness* (a mild boost to mid-bass and/or mid-range) or *Tape Select* often appear

on the face of the receiver, as well. Selecting *Normal*, *FeCr* or *CrO₂* tape on the recorder allows subtle optimization of whatever tape you choose to use. Many compacts also have a Dolby circuit for their cassette recorders to allow quiet, exceptionally clean recording and playback. VU meters let you accurately gauge the level of recordings, using *Record Level* knobs to adjust input. Also, the AM and FM radio almost never come without a decent meter for checking the signal strength of a station, which is quite helpful in accurate tuning.

The third "disadvantage" may be that you like a particular compact, but don't want the speakers that come with it. You may be stuck with

the speakers if you really want the compact. There is a good deal of variety in most companies' lines, though, and if the choice of speakers offered with a compact is not attractive to you, you can usually shop around. Go for the sound *you* want.

Just how do you look for a compact (or any other stereo hardware, for that matter)? *Always* take along a cassette or record you know well. You can get a pretty good idea about whether or not a system sounds the way you want it to by hearing a familiar announcer or recording.

How they played

Here is a sample lineup of six compact stereo systems we test-played.

(Please turn to page 220)

Your first electric car— build or buy?

You can make your own, buy one now or wait for one that's still on the drawing board.

by Bill Hartford
and Mort Schultz

To fuel any new 1980 Detroit car, you may have to wait in line. A gas line. Or a diesel line. The major American automobile manufacturers do not offer a single vehicle that is not powered by gasoline or diesel fuel.

There's only one practical alternative if you want to drive and not be dependent on petroleum: You can build or buy your first electric car. Refueling, then, can be done at your convenience, at the electrical outlet in your own garage. The local power company will fill your "tank" while you sleep—and for a few pennies, at that.

Inevitable electrics

With battery power, you are not dependent on any type of liquid fuel for your car. Electricity is generated at central sources and "pumped" to your home via electric-company power lines. You just plug in. It's a nice way to go.

So why aren't there electric-car showrooms from coast to coast? Because gasoline has been plentiful and cheap, and electric cars are still limited in range. Even though you

can't go to a showroom and kick the tires, you can still own an electric for all your local transportation needs. You can buy one right now or, if you're not in the market for a new car, you can wait for one of the new models to be introduced later in the '80s.

To buy an electric now, you have to contact a manufacturer or his distributor in your region. There are a couple of dozen manufacturers who have electrics in production, or are making individual cars to customer order. One car that's already in production is General Engine's Commuta-Car.

(Please turn to page 202)



One you can buy now

Commuta-Car (right) from General Engines Co. is in production (eight per day) and costs \$4500. If additional facilities are completed, the slightly larger Commuta-Van (above) will be available before the year is out for about \$5000. Range of these vehicles is 35 to 40 miles at a top speed of 40 mph. Electric cars of the conversion type start at \$7500 (U.S. Electricar's Renault LeCar). More expensive are cars like an electric Pacer wagon, which is \$14,000 from Electric Vehicle Associates. More information is available from manufacturers listed on page 97.



Still on the drawing boards.



Experimental car by Copper Development Associates is 3000 pounds with 1200-pound battery pack, goes 120 miles at 40 mph.



Experimental ETV-1 by Chrysler and General Electric is four-seater with 75- to 100-mile range. It may be available in mid '80s.

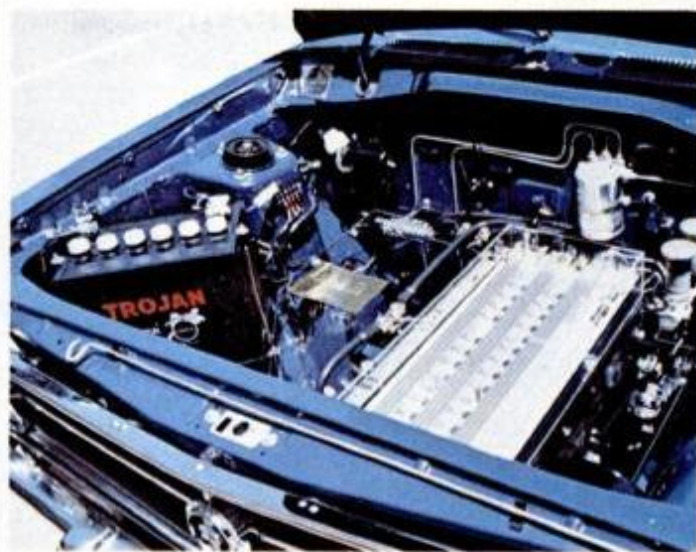
How I built my own electric car

by Bill Williams



Electric-vehicle makers

- B&Z Electric Car, 3346 Olive Ave., Signal Hill, Calif. 90806
- Battery Power Unit Corp., Rt. 3, Box 700, Golden, Colo. 80401
- Die Mesh Corp., 629 Fifth Ave., Petham, N.Y. 10803
- Electric Fuel Propulsion Corp., Robbins Executive Park East, 2191 Elliott Ave., Troy, Mich. 48084
- Electric Auto Corp., 2237 Elliot Ave., Troy, Mich. 48084
- Electric Passenger Cars Inc., 5127 Galt Way, San Diego, Calif. 92117
- Electric Vehicle Associates Inc., 9100 Bank St., Valley View, Ohio 44125
- General Engines Co. Inc., 591 Mantua Blvd., Sewell, N. J. 08080
- Globe-Union Inc., 5757 North Greenbay Ave., Milwaukee, Wis. 53201
- H-M Vehicles Inc., 6276 Greenleaf Terrace, Apple Valley, Minn. 55124
- Hummer Inc., Box 2099, Wichita, Kans. 67201
- Huber Engineering Co., Box 17, Galva, Ill. 61434
- Hybricon, Inc., 11489 Chandler Blvd., North Hollywood, Calif. 91601
- Jet Industries Inc., 4201 South Congress, Austin, Tex. 78745
- JMJ Electronics Corp., 4415 Highline Blvd., Oklahoma City, Okla. 73125
- Kaylor Energy Products, 1918 Menalto Ave., Menlo Park, Calif. 94025
- Lyman Metal Products, 15 Meadow, South Norwalk, Conn. 06856
- Marathon Electric Vehicles Ltd., 8305 Le Creusot St., Montreal, H1P 2A2, Quebec, Canada
- Palmer Industries, Box 707, Union Station, Endicott, N. Y. 13760
- Palmer Sales & Service Inc., 3042 West Colter St., Phoenix, Ariz. 85017
- Quincy-Lynn Enterprises Inc., Box 26081, Phoenix, Ariz. 85020
- Real Electric Vehicles, 727 N.E. Fifth Ave., Gainesville, Fla. 32601
- South Coast Technology Inc., 5553 Hollister Ave., Goleta, Calif. 93017
- 3-E Vehicles, Box 19409, San Diego, Calif. 92118
- U.S. Electricar Corp., White Pond Rd., Athol, Mass. 01331



At the wheel of his converted electric-powered Datsun is author Bill Williams (top right). Gauges were added (right). Engine compartment (above) holds electric motor and controller.



A couple of years ago I decided to be ready for any shortage of gasoline and considered converting my 1972 Datsun sedan to electric. It didn't take long to learn that the technology was available. I joined the local Electric Auto Assn. (EAA), whose 50 members had already converted over 20 autos to electric.

I was still a bit apprehensive about tearing apart a perfectly good gasoline car that was getting over 33 mpg in town. But fate played a part when the Datsun blew its head gasket. I decided in favor of conversion to electric rather than put more than \$700 into it (the rings were also going) only to still be dependent on gasoline.

I went ahead full speed. First to go were more than 375 pounds of gasoline-related components (gasoline tank and lines, tail-

pipes, muffler, radiator, smog control, heater core, alternator, voltage regulator, starter, air cleaner and engine block). Nongasoline-related systems, like steering, brakes, hydraulic clutch, rear end, shocks, and interior components (like the speedometer) were left intact. The back seat was also retained for passengers (though with less legroom space to accommodate four of the total of 12 propulsion batteries).

The trunk compartment was then prepared for eight 6-volt (244AH) Trojan golf-cart batteries, weighing a total of 592 pounds. One extra leaf spring was added to the rear member to support the extra weight. Two safety devices were also installed in the trunk, a 400-ampere fuse and a large switch that could be manually turned off from the driver's seat. These two safety devices were then wired in series with cables routed beneath the car to the engine compartment. The trunk was finished off by installing the batteries (with steel clamp-down rack) and an electric plug in place of the gas-tank filler. Refueling would henceforth be with electricity.

While I was working on the trunk compartment, a fellow EAA member, Bob Steinfeld, was working on a special "adapter plate" for coupling the existing four-speed transmission to the d.c. electric motor (a 30-hp 2CM77 aircraft starter-generator). The adapter plate had been originally cast to fit a

(Please turn to page 208)



Eight of 12 batteries are in the trunk.



Charging connection is at old tank fill.



This car's never waited on a gas line!

by Gary Witzenburg
DETROIT AUTO EDITOR

Driving the 1980

At first glance, GM's fall introduction seems uneventful, especially after the April X-car premiere (see *Driving GM's 1980 Front-wheel-drive Compacts*, May '79). But there's a lot

more than X-cars from the General in 1980. Although much of what's new is hidden under the skin, there are several new models and some much-revised older ones.

Topping the list is a brand new Cadillac Seville on the excellent front-drive Eldorado chassis. It may look odd with its classic Rolls-Royce rear styling, but those who buy it will find instant status in the \$20,000 luxury class.

Next is a complete revision of the big-car lineup from Chevy's Impala to Cadillac's top-line Brougham. Featuring more squared-off roof lines, lower hoods and higher rear decks for better aerodynamics, subtle front and rear design changes and a host of engineer-

PM photos: Bob Berger

Buick Century sedans go to a formal notchback roofline. The 3.8-liter V6 is standard; on coupe, the turbocharged version is available.



Oldsmobile Ninety-Eight models get slightly drooped noses to reduce drag, and standard skirts for rear-wheel wells.



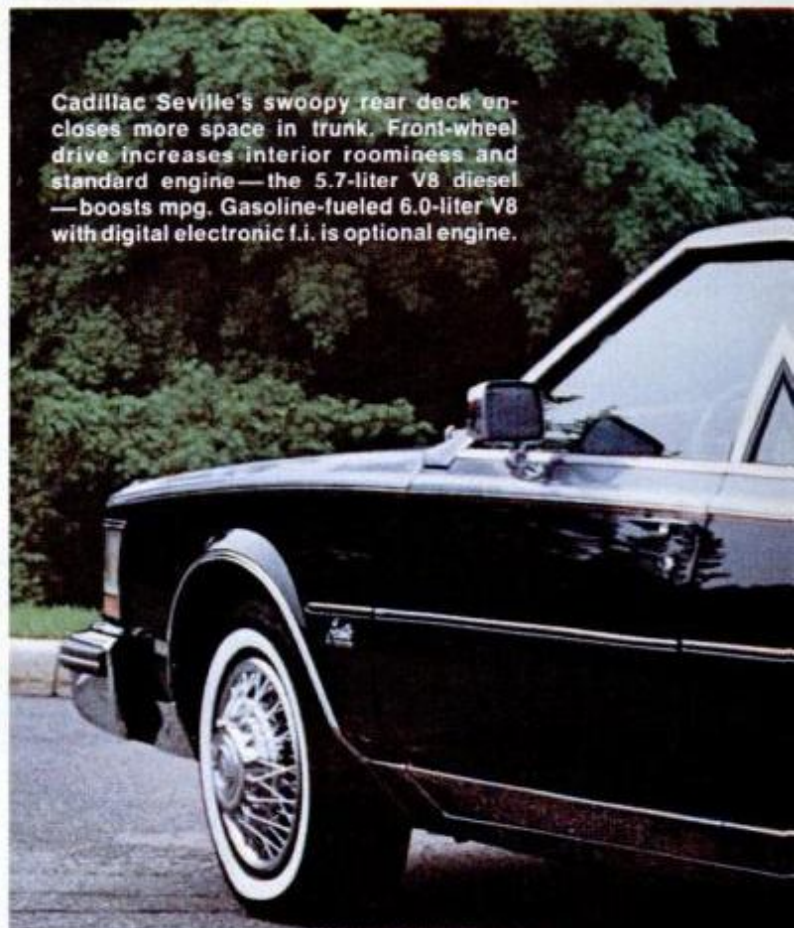
Chevrolet Chevette gets new rear hatch with flush-mounted glass, new rear-quarter treatment and wraparound taillights.



Corvette is 250 pounds lighter, gets new fiberglass bumper that changes the front, integral spoiler that changes rear.



Cadillac Seville's swoopy rear deck encloses more space in trunk. Front-wheel drive increases interior roominess and standard engine—the 5.7-liter V8 diesel—boosts mpg. Gasoline-fueled 6.0-liter V8 with digital electronic f.i. is optional engine.



Second-generation Seville has more windshield rake.



General Motors models

ing improvements, these family-size cars are 100 to 200 pounds lighter and deliver a mile-per-gallon or so better fuel economy than their predecessors—despite 1980's much tougher emissions standards.

Buick and Olds have new four-door, notchback, mid-size sedans to replace the unpopular aeroback Century and Cutlass four-doors, while Chevy and Pontiac offer turbocharged versions of their Monte Carlo, Firebird and Trans Am, respectively. Chevrolet's Corvette sports car features unique new front and rear bumper designs that contribute to a 250-pound weight reduction, and a cleaner, more efficient appearance. Subcompact Chevette

(Please turn to page 236)

Pontiac Catalina coupe gets formal roof line, more aerodynamic front end and 100-pound shave. Safari wagon can be ordered with 5.7-liter diesel V8.



Driving the 1980 Ford and

by Gary Witzenburg
DETROIT AUTO EDITOR



There's *another* new T-Bird. It's unlikely that any other single car could have undergone so many major changes in configuration in 25 years of life, yet still maintain such mystique and image.

For the 1980 version, Ford engineers and designers have succeeded in creating a car in which owners of the old one would feel right at home. The ride, interior quietness, room and comfort are at least as good and

better in some ways. This goes for the T-Bird and the essentially identical Mercury Cougar XR-7, since the cars share the same body and mechanicals.

T-BIRD AND COUGAR XR-7

We found handling to be much improved, due to the more reasonable size, lighter weight and superior strut-type front, and four-bar link, coil spring, rear suspension sys-

Lean and luxurious, the Mercury Cougar XR-7, like Ford's Thunderbird, is built on shorter 108.4-inch wheelbase and has been cut down to 200.4 inches overall.



Lincoln Continental Mark VI is now available as a four-door sedan (left). Five-liter V8 is standard on Mark VI and Continental models, 900 pounds lighter than last year.

Ford Pinto with Rallye Pack (right) is the sporty setup. In standard trim, Pinto is Ford's value-packed, basic transportation machine.

Ford Mustang in its Cobra clothing (far right) is the closest to owning an Indy pace car. Other models let you pick economy or luxury.

Other models let you pick economy or luxury.

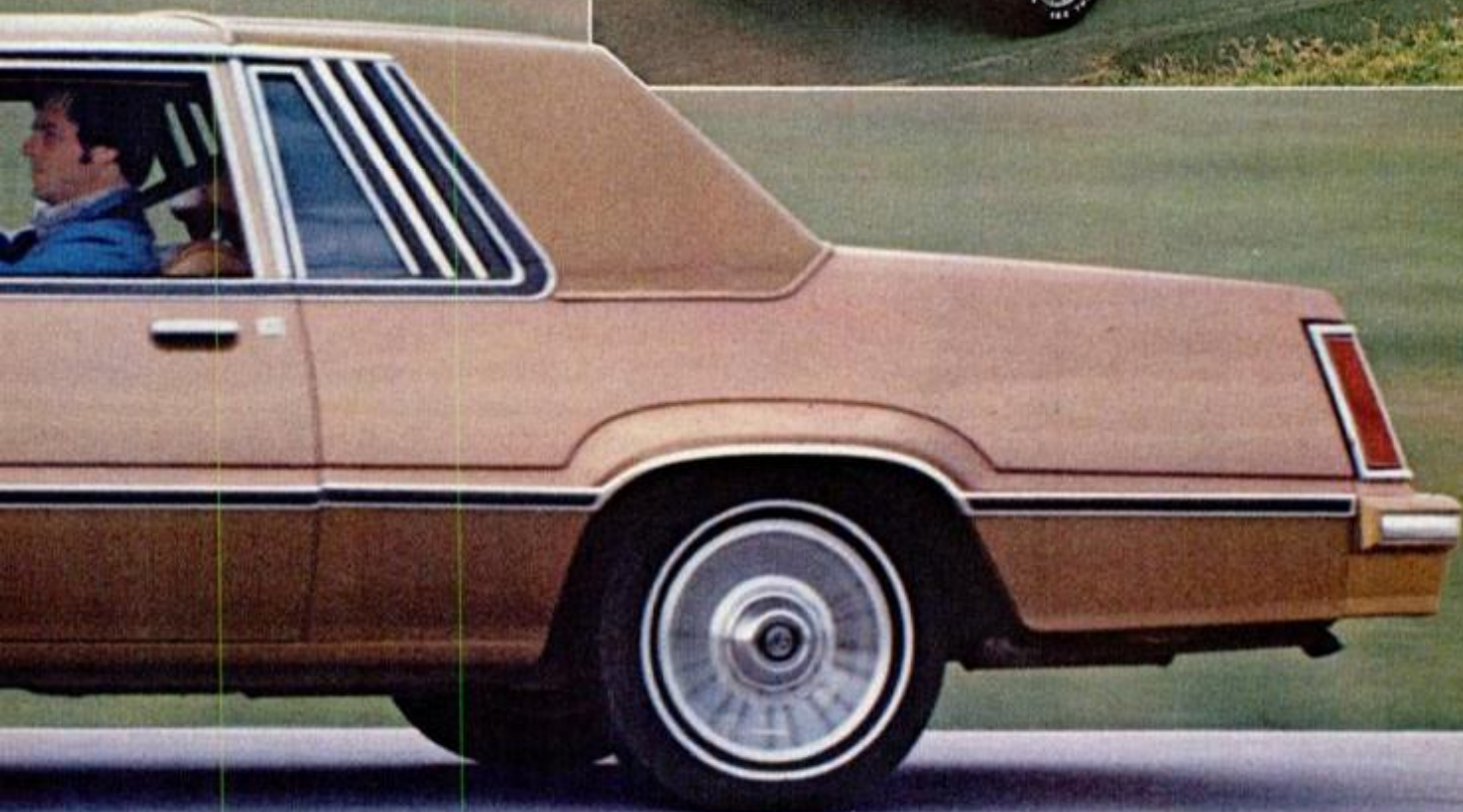
Lincoln-Mercury models

tems. Styling is purposely chunky and massive-looking, to give the visual impression of greater size. We like the cars' generally clean shapes, but can't appreciate their overlarge taillamps, thick-padded half-vinyl roofs and the tendency toward excessive chrome overdecoration of the higher-priced versions.

A new 4.2-liter (255-cu.-in.) V8 engine and three-speed automatic

(Please turn to page 242)

Turbocharged 2.3-liter Four is among the powerplants that are available in the Mercury Zephyr Z-7 sport coupe.





Dodge Mirada, seen on banked track (top), from the rear (right) and opened for inspection (above), replaces last year's Magnum. Sister ship, the Chrysler Cordoba, shares smaller, lighter body.



by Michael Lamm
WEST COAST EDITOR

Driving the 1980 Dodge,

Chrysler Corp. enters the new decade with several new cars, new faces, new nameplates—and nuances.

The Chrysler Cordoba and Dodge Magnum have been entirely changed, including the Magnum's name, which now becomes Mirada. Both the Cordoba and Mirada are smaller outside, larger inside

and 350 to 400 pounds lighter than before.

Plymouth revives its full-sized Gran Fury line for 1980. The Fury had gone into hibernation during 1979. For 1980, the Gran Fury returns to share the 118.5-inch wheelbase of the 1980 Dodge St. Regis and Chrysler Newport/New Yorker.

Other 1980 changes for Chrysler Corp.

cars come in the way of refinements and facelifts for the Aspen, Volare, LeBaron, Diplomat, St. Regis, Newport and New Yorker, plus a DeTomaso package for the Omni 024 and a Turismo option for the Horizon TC3.

Here's a car-by-car, point-by-point rundown on all 1980 Chrysler Corp. offer-



Dodge D-50, like Plymouth Arrow pickup, gets more goodies for 1980. Sport versions of the Mitsubishi-built pickups have five-speed stick.



Colt RS hatchback is front-wheel-drive Mitsubishi-made mini that was introduced with Plymouth Champ last year.



Chrysler LeBaron four-door is on a 112.7-inch wheelbase, but new coupe model is 108.7 inches between the wheels.



Plymouth Horizon TC3 is same U.S.-built, front-wheel-drive hatchback coupe that joined Horizon sedan models for '79.



New Sport package on Omni 024 is the DeTomaso, named for designer. Sport version of Plymouth TC3 is the Turismo.



Plymouth and Chrysler models

ings. And since Dodge cars all have twins in Chrysler-Plymouth lines, we'll examine groups of siblings rather than individuals.

CORDOBA/MIRADA

Chrysler's new J-body stands approximately 6 inches shorter than last year, its wheelbase down 2.3 inches to 112.7.

Average weight is now 3350 pounds. Standard engine: the 225-cu.-in. Slant Six. The 318 and 360 V8s are optional in the Dodge Mirada, while the Cordoba lists only the 318.

All 1980 J-cars come with Chrysler's new wide-ratio TorqueFlite. This automatic transmission uses lower (numer-

ically higher) first- and second-gear ranges with higher shift points. Third range has an automatic lockup feature that engages at 32 mph. This lockup prevents fuel-wasting slippage at cruising speeds. The wide-ratio TorqueFlite gives good off-the-line acceleration even

(Please turn to page 246)

Driving the 1980 American Motors models

Take your pick: AMC is the only manufacturer to offer cars with front-wheel drive, rear-wheel drive and all-wheel drive!

by Gary Witzenburg
DETROIT AUTO EDITOR



Station wagon (above) is easily recognized as rear-wheel drive Concord by its normal amount of ground clearance. New Eagle, seen on PM's cover last month, is a look-alike, but easily recognized as the 4wd car by its additional ground clearance. Familiar Spirit sedan (right), little changed for '80, pulls off rainy test track for photo with author at the wheel. New Four, standard on Concord and Spirit, is 2.5-liter.



We predicted a pretty good year for American Motors a year ago, and so far it's been respectable, if not spectacular. The new, little Spirit started off a bit slowly, but fuel crisis woes boosted its fortunes over the summer, even while knocking a hole in Jeep's. Things could be better, but at least America's smallest automaker has been making a profit in the face of mushrooming government requirements, economic uncertainty and concern over fuel prices and supplies.

Now we'll go farther out onto the proverbial limb and forecast an even better model year for the folks from Kenosha, Wis. They've got a nice four-way attack for the '80 models:

■ First off, they've got a unique and (we believe) highly desirable product in the full-time four-wheel-drive Eagle. At the wheel we were convinced that you can have your 4wd and comfort, too. Our test drive (detailed in last month's report) concluded that, while the Eagle is not built to be crashed and thrashed through the outback, it will take on terrible trails, no matter how deep in mud and snow. And it will get through without need for the extra size, weight, ride harshness and fuel consumption of a truck-type 4wd.

■ Second, they've now got the pep-

py, Pontiac-built 2.5-liter, four-cylinder engine in both Spirit and Concord. It's much better suited to those cars' size and weight specs than the previous smaller, shakier and noisier VW-based Four.

■ Third, they've adapted this same new Four to Jeep CJ models (combined with a new standard four-speed transmission), creating a 20-plus-mpg Jeep that is every bit as useful—and as much fun to drive—as the six-cylinder version.

■ Finally, their Buyer Protection Plan is still the only "full" warranty in the business, and last May they added America's first three-year corrosion warranty.

If all that doesn't give people some good incentives to start thinking AMC, there's more. The new 2.5-liter engine, though larger, is slightly lighter than last year's 2-liter model, and its cross-flow head and other features provide better performance, along with improved EPA city fuel economy. Four-cylinder California cars and all six cylinders have computer-controlled carburetors for better economy and drivability, even with 1980's much tougher emissions standards, and a fuel-saving "lock-up" torque converter comes with every AMC automatic transmission, except Eagle's.

Four-speed (instead of three-speed) manual transmission is now standard on all AMC passenger cars (again excluding Eagle, which is certified as a multipurpose vehicle). One unfortunate effect of the ever-tightening CAFE (Corporate Average Fuel Economy) standards, however, is that the zippy 304 V8 is no longer available in AMC cars.

The reason AMC has so much confidence in its cars' rust resistance is the extent to which the body engineers have protected rust-sensitive areas. Inner surfaces of the hood, deck lids, lift gates, door panels and associated structures are galvanized steel for 1980. Front fender inner liners are plastic and petroleum wax coatings have been liberally applied in other key locations. A new exhaust system for all AMC cars uses long-lasting, rust-resistant aluminized steel pipe, in addition to the stainless-steel catalytic converter housing.

New options we like include power windows, six-way power seats, a leather-wrapped sport steering wheel, cruise control with the four-cylinder and automatic transmission, and a new premium sound system for stereo-equipped Concorde, Spirits and AMXs. The system has

(Please turn to page 248)

CARS 1980

American Motors showrooms are now stocked with LeCars, the front-wheel-drive minis from Renault of France.

Spirit liftback (below) gets interior changes for comfort and convenience. Reclining buckets are now standard on DL and Limited models.



How to survive... When your car turns

Your life could depend on what you do the first minute after a freak accident.

by Ed Fales

We live in a nation of safety experts. We're told all about blowout control, power skids, collision avoidance, defensive driving. But we've had little advice on three of the grimmest automotive emergencies—emergencies in which driving skill won't help you.

What do you do when you're caught in a burning car, trapped by a falling power line, or imprisoned in a car that's just plunged into deep water?

Safety experts told PM what they would do. Their basic message: You can survive these emergencies in many cases. They also warned, though, that in these challenging situations, some of the survival techniques *themselves* carry risks. So you must be doubly aware of what to do and what can happen in such emergencies. Understanding

the dangers in advance can help you devise your own escape plan.

A hot wire on your car

The time to keep up your guard is during those blinding windstorms—summer or winter—that knock a "hot wire" off roadside poles.

Let's say you dodge a broken branch. Suddenly a big, ugly wire is scraping over your hood or roof, or lying under your car. It may be sparking and writhing, or it may be as quiet as a sleeping rattlesnake. *But never assume it's dead.*

The advice you usually hear is: Stay inside the car. It's *good* advice, as a rule. Tires are good insulation (unless your car is rim-deep in water).

What can be instantly fatal, of course, is to open the door and put your foot to the ground. A typical

roadside power line may carry 12,000 volts. Since it's usually bare of insulation, when it touches your car the vehicle itself may become charged with 12,000 volts, which is like dynamite waiting to go off. If you touch ground, you complete the circuit; the car current flashes from the wire through the car, then through your body. Rubber soles or gloves won't protect you.

But suppose you see the wire already on the ground—and not sparking. Isn't it dead? Hasn't the short circuit, when the wire touched ground, tripped circuit breakers in the line somewhere? Not necessarily. The trouble is, even though *some* current may be escaping to the ground, it may not be enough to trip the breakers.

Or suppose you look up at the pole and see the "hot" wire still in place

If you *must* exit, jump as far as possible from car, away from power line. Keep feet together as you jump.

Assume all surfaces are electrically charged.

POWER LINE SNAKES ACROSS YOUR CAR:
If possible, stay inside. Await help.

Tires help insulate car.

*Use lights to warn other motorists.



into a trap

"Double team" blaze from opposite sides of car, using ABC extinguishers.



FIRE RAGES UNDER YOUR HOOD: Shut off engine. Get out fast.

(usually it's the lone wire mounted on a wooden pin on the very top of the pole). The wire about three feet below it is the "neutral" wire. And you see clearly that the neutral wire is the one that's dangling. Is it safe to get out?

You may be in a safer situation. That's because the neutral wire is supposed to be safely grounded every few hundred feet. But don't take a chance. The wire you see may be tangled with the hot wire elsewhere. Or, wires along this particular road may be strung differently. Stay in the car.

Your next problem may be to stop other cars before they contact the wire, or mess it up, or before some would-be rescuer rushes to help you. Flash your lights rapidly. Shout. Use your horn. Wave people back. Use your CB radio to call the police and power company. Or have some-

one else use theirs. Keep others away, and wait for official word that power is off before you walk away.

But suppose you must leave your car—because it's on fire. Experts told us that it can be done, although it's risky. You'll have to jump—and in such a way that no part of you touches the car when your feet touch ground.

First, be sure you know where the wire is. At night use a flashlight from inside the car. Jump where the wire *isn't*. And as far away as possible. Be aware when you leap that the ground near the fallen wire may also carry a charge. This, engineers say, should not extend very many feet from the wire—if the ground is dry. A wet road may carry more of a ground charge; the potential shock depends on how much current is in the wire.

Power company engineers advise trying to jump so you land with both feet close together: The potential between them in the ground could be considerable if you land with feet far apart.

But any kind of movement near a live wire can be risky. The dangers are illustrated in one case, cited by the National Safety Council and reported by *Norfolk Daily News* writer Gene Gaddie:

A power line fell on a car, driven by Girl A. Boy A, sitting next to her,



Stay away from puddles. Don't touch victims of electrocution.

stepped outside. Then he fell back inside, dead, with his feet evidently still touching the ground. He had closed the circuit between wire, car and ground.

Girl A reached to help him. Sparks danced between them, and she was killed. In the back seat, Boy B, on

the left side, told Girl B: "I've got to get you out." So he tried to jump clear, but slipped. As his feet touched ground, he tried to steady himself with a hand on the car. He was killed instantly.

Girl B saw fire on the hood. Sparks came from all three victims. Desper-

ate, with doors blocked by bodies, she lowered a rear window and put a hand on the roof. She pulled herself out the window, face up. She braced her feet, and shoved as hard as she could.

It's a rough way to leave a car. She came to in a daze, unsure how she'd escaped. But she lived, because she'd managed to reach ground without also being in contact with the car. National Safety Council experts say her case shows the importance of: (1), never touching other victims and (2), jumping clear if you must jump.

Your car catches fire

Experts like New York State's Motor Vehicle Department's Charles Bostick and the National Fire Protection Assn.'s Paul Sawin have what I call the three-letter rule: GHO ("Get the hell out"). It's also the urgent advice of the U.S. Fire Administration's Hugh Maguire.

But there are right and wrong ways to GHO. First, shut off your engine. If you don't, the fuel pump will keep sucking gasoline, and your fan will keep blowing air on the blaze.

Second, *take a moment to think*. Where's the fire? In one of the seats? Then open the windows fast before upholstery fumes overcome you. Use an extinguisher. The National Fire Protection Assn. suggests keeping a 5-pound ABC (all-purpose) unit within easy reach of the driver. Extinguisher chemicals, the association says, won't hurt you.

If the fire's in the engine, it may stay there for quite a long time—unless someone pops the hood. This feeds air, and a smoldering fire can roar into a full blaze. So, if you decide to fight an engine fire, beware of a hot blast when the hood opens.

Two extinguishers are far better than one for such fires. One extinguisher can *push* fire from one side

(Please turn to page 200)



THE CHANNEL CHALLENGE: Engineering a manpowered triumph

Dr. Paul B. MacCready Jr., designer of the *Gossamer Albatross* and project leader.



In one near-fell swoop, the *Gossamer Albatross* made its lanky pilot a hero and the plane's designer a prophet of the Low-Energy Era.

by Bill Allen

Early on June 12 this year, 26-year-old, six-foot, 141-pound Bryan Allen pedaled the 75-pound *Gossamer Albatross* 22 miles across the English Channel to win the Royal Aeronautical Society of Britain's £100,000 prize provided by British industrialist Henry Kremer (perhaps worth upwards of \$222,000, depending on currency fluctuations up to the September awarding).

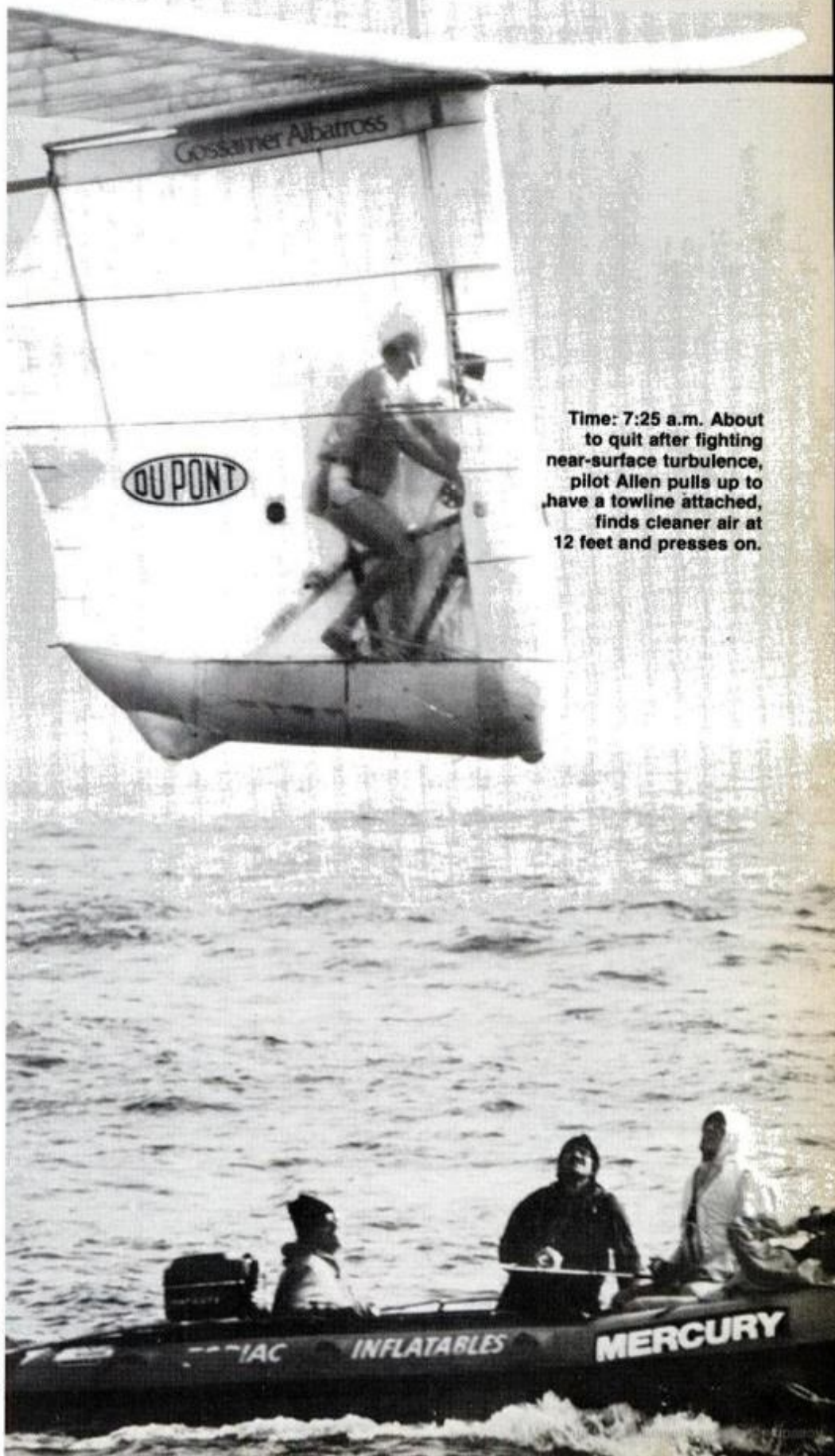
Pilot and craft flew slowly and silently—almost languorously it seemed—with the 13-foot propeller turning not even twice a second. But there was nothing leisurely about it: For 169 minutes, Allen unceasingly pumped 77 to 93 times a minute to spin the prop at 95 to 115 rpm, and at the end used just one foot as agonizing leg cramps overtook him. Maintaining a 12-mph airspeed and an estimated average 0.34 hp output (rather than the 0.27 or 0.28 required in calm air), he occasionally bucked 7- to 9-mph headwinds and once changed course by 35° to avoid an enormous tanker's turbulent air wake.

It was equivalent to you or me sustaining 21 mph on our bicycles for 169 minutes without rest.

An extra quarter mile

He could have opted for a merciful "crash" on the rocks at first landfall, but doggedly ran along shore another quarter mile or more, pulled around a breakwater, and touched down lightly on smooth beach.

A quarter mile off Cap Gris-Nez, *Albatross* designer Dr. Paul B. MacCready Jr. saw the prop slowly stop and felt "relief that it was all over, but not any great new elation" at winning. "Ever since first doing the design on the back of an envelope," MacCready said, "it was obvious that that plane could do the flight." It had been only a question of how and when. "It was just nice that it



Time: 7:25 a.m. About to quit after fighting near-surface turbulence, pilot Allen pulls up to have a towline attached, finds cleaner air at 12 feet and presses on.

succeeded on the first try . . . a miracle . . . quite surprising."

Five other contenders of various nationalities had registered for the Channel attempt and two nonregistrants were reported well along with construction (page 83, April '79). However, nobody else showed up ready to fly. It was an all-MacCready show.

"MacCready is an extraordinary catalyst," says British manpowered-flight authority Ron Moulton. Around him formed a 17-man team with widely varying aviation and bicycling experiences. Sponsorship was arranged with the Du Pont Co., which reportedly spent as much as \$700,000 to cover transportation to England, boat support and communications, and supplied some construction materials.

Englishmen volunteered boats and themselves. France organized a reception and streamlined impromptu customs procedures. Radar, distance measuring equipment, and a master navigator aboard MacCready's borrowed chase boat directed pilot Allen by radio. A doctor and resuscitator also went along. An instrument created by Polaroid engineers from the acoustically focused SX-70 camera gave altitude readings to plus or minus three inches. Germany's Dr. Richard Eppler supplied a crucial new pro-

PELLER airfoil. Thus the epic flight was an international effort—right down to the previous night's Chinese dinner which "fueled" the engine for the trip.

The event occurred 72 days shy of two years from Bryan's completion of the Kremer figure-8 course for £50,000 with the pioneering *Gossamer Condor* (*I Pedaled the Mile to Aviation's Big Prize*, page 100, Dec. '77). But MacCready's second human-powered airplane was many years ahead of his first in sophistication, although similar in the basic design.

The aluminum tubing of *Condor's* structural frame was replaced with tubes of carbon filament. You can't buy this kind of tubing, at least not with thin walls.

MacCready describes the team's solution: "You get the carbon material in a preimpregnated form, where all the fibers are lined up together in an epoxy material—a soft, flexible cloth. You wrap that in strips around an aluminum tube diagonally—one layer one way, one layer another way for three to nine layers. You put it in an oven and that softens the epoxy and makes it set hard. Then you put the whole thing in an acid bath to dissolve out the aluminum." Structural tubes were joined by butting ends over a foam insert, tightly wrapping Kev-



lar cloth around it and epoxying that.

After finding the going much easier higher up—where theory says it should be harder to fly—Allen still had to maneuver around a large ship's wake turbulence. Nearing the French coast, he was beset with agonizing muscle cramps. Pedaling with one leg, he skirted a rocky coastline, found a flat stretch of sand behind a jetty and put the *Albatross* down, scattering a horde of well-wishers. The aircraft broke up on touchdown, but homebuilt replicas may soon appear (see text).

lar cloth around it and epoxying that.

"You might be able to get a factor of two benefit in strength vs. weight with carbon filament tubing," notes MacCready," but we compromised and obtained a weight saving of 25 percent and a strength improvement of 50 percent in contrast to aluminum tubing."

Albatross was not "floppy, baggy, and wrinkled," like *Condor*. Tensitized Du Pont Mylar was used. When



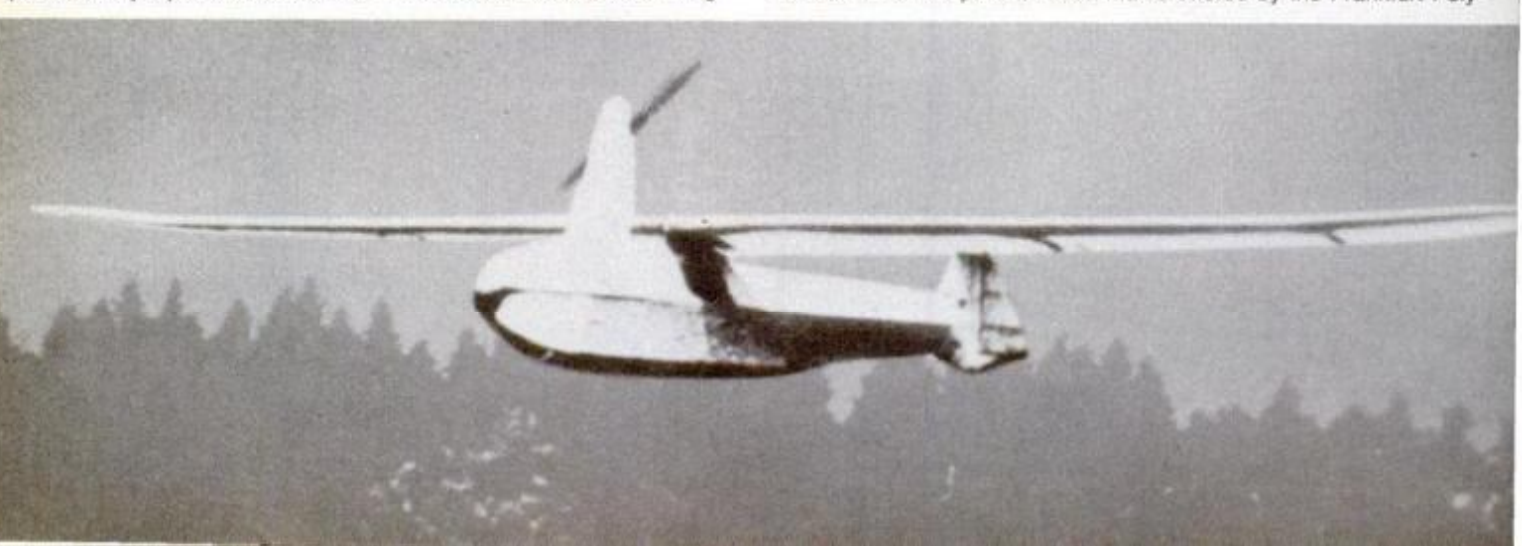
In Germany, manpowered flight is 50 years old

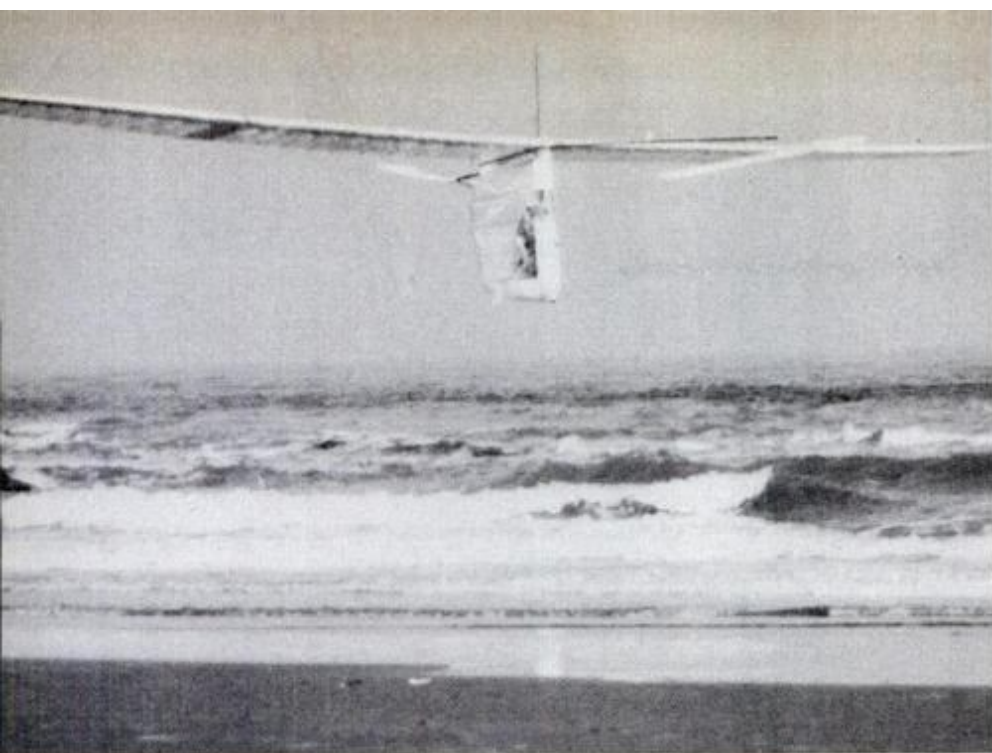
Credit for the first manpowered flight without launch assistance is usually given to a team of engineers from Southampton University, England, for a short flight in 1961. But authorities generally agree that the first actual flight occurred in Germany in 1929 when an athlete named Krause, aided by a bungee (elastic) cord launch, flew a manpowered craft some 250 yards or more. Several years later, two young German engineers investigating data on human power output compiled by the designer of that pioneering aircraft, Dr. Alexander Lippisch, built a remarkable plane known as the Haessler-Villinger *Muskelflieger* (Muscle-flyer)—or "Muffli" for short. Constructed long before modern plastics and composite materials were available, the *Muffli* weighed in at 77 pounds, only 2 pounds heavier than the *Gossamer Albatross* config-

ured for the Channel flight with its extra safety equipment aboard.

Muffli's weight included 10 pounds of ballast carried in lieu of a bungee launch-cord retrieval drum (under the rules of early German manpowered-flight competition, which allowed energy-storing launch devices provided they left ground with the aircraft). Without this added weight, a refined *Muffli* might well have been capable of a Channel flight. Even with it, it was for decades unmatched as a manpowered prototype. Following the successful Channel flight, *PM* contacted one of the *Muffli's* designers, Franz Villinger, who readily gave us some details.

"In May of 1934 I joined Junkers Aircraft in Dessau as an engineer in the stress department and there met my colleague, Helmut Haessler. He told me of the prize of 5000 marks offered by the Frankfurt Poly-





heat tightened, it shrank more spanwise than from front to rear (which would distort the airfoil). It's the same Mylar used as a base for recording tape. About \$6 worth covered the aircraft.

At its cleanest, *Albatross* had a glide ratio of 30 to 1 near ground, and 25 to 1 higher. Sink rate was a corresponding 6 and 7 inches per second (theoretically it would take half an hour to descend 1000 feet). But the year-old, oft-flown, sometimes-crashed aircraft had deteriorated to about 28 to 1 by mid-June, MacCready thinks, and turbulence may have decreased performance another 20 percent. Thus Allen found flying easier at an altitude of 12 feet even though 10 percent less power would theoretically be needed at two feet.

Training the powerplant

As with any airplane, the powerplant got as much attention as the airframe. Allen trained under Long Beach State University's exercise physiologist Dr. Joseph Mastropalo. Besides daily bicycling, Bryan periodically checked out on an ergometer—a stationary bicycle-like device which measures power output. They found that he had his best power-to-weight ratio at 137 pounds (at which he flew the 1.25-mile Kremer figure-8), but would be better tuned at 141

(Please turn to page 229)



technical Society for the first closed circuit flights of a manpowered aircraft around two points 500 meters apart. Requirements for this kind of flight were largely based on data provided by Lippisch suggesting that a man could produce 4.5 hp at peak and sustain 2 hp for five minutes. [Ed. note: Villingier and Haessler found Lippisch's figures to be inflated by about 400 percent. Their own evaluations of human power output agree almost perfectly with today's scientific data.]

"Our joint efforts led us to a wire-braced, shoulder-wing design. The wings were free to pitch with respect to the fuselage either separately or together. One wire led from the top of the propeller pylon to each wing and two wires from the bottom of the fuselage ran to the same point; the fittings on the wing spar where these wires met formed a bearing. Two short push rods connected the leading edges at the wing roots to the pilot's controls—when the wheel was turned the wings changed pitch in opposite directions for lateral control.



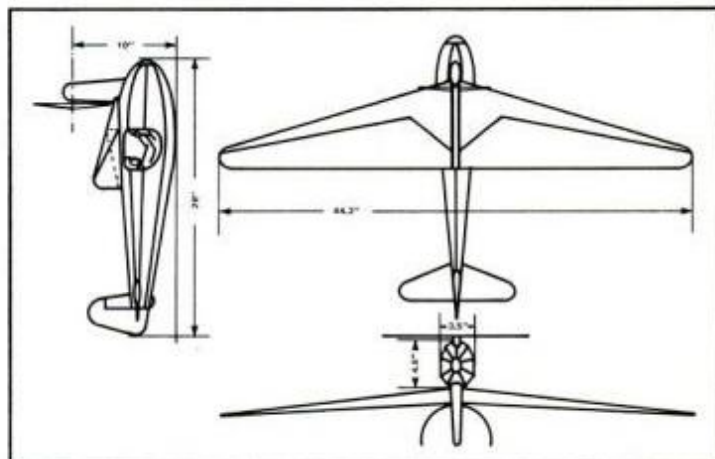
Built of spruce and bed linen, the *Muffin* was as successful in its day as *Albatross* is now. Amazingly, its wingspan was less than half that of MacCready's designs, and the much smaller propeller could turn at 600 rpm. Best flight was 2330 feet over 50 seconds in 1937.



"At first, we also used the wing for pitch control, but later added a normal tail-plane elevator. We tried to make the fuselage cross section as small as possible and so chose a pilot position tilted almost 90° back from a normal cycling position. He could see only 15° right or left of forward.

"We used knot-free spruce for all wing spars and fuselage frames—some cross sections as small as 0.16 by 0.24 inches. The wings were covered by a light, silky batiste fabric intended for fine bed linen. We made our own pedal cranks from thin tubular steel, and these weighed less than half the weight of the lightest alloy cranks available."

The *Muffin* flew often over the next several years, achieving a best flight of about 2330 feet (50 seconds) at a small airfield near Meiningen in 1937. With characteristic precision, Herr Villingier notes: "We must of course subtract the effects of the catapult start, about 165 feet, and the final glide of 246 feet. But you can say we were partially successful."



How new outboards squeeze out more performance

Two-cycle engineers have tricks to hide a herd of horses under the hood.

by Bill McKeown BOATING EDITOR

These refinements produce more than double horsepower from same-size package.

How do they do it? Where is the added horsepower coming from? There is no doubt that the increase in power is there—put the newest motor on the back of one boat and then match it against the same size and weight rig of a couple years ago. Race them side by side and the new mill is going to win. Go into a laboratory and run the same comparison tests with dynamometers that read shaft horsepower and fuel-flow meters that measure consumption. The latest engines are also going to show more output per each gallon of gas consumed.

For anyone interested in performance, getting more horses out of a block of metal can be more impressive than pulling rabbits out of a hat. "What's the secret?" PM asked the top engineers of the outboard motor industry.

Competition plus

Racing has been the proving ground, they claim, for many of the power-producing refinements. Although only a small fraction of outboard owners race their rigs, developments that have been perfected by factory engineers and teams on the speed circuits are now incorporated into every new engine.

Gary Garbrecht, director of racing and high performance for Mercury Motors, and Jack Leek, who handles the same assignment for Outboard Marine's Evinrude and Johnson divisions, put to the test improvements that may squeeze

a little more endurance and miles per hour out of an engine on a racecourse and later go into every production outboard. Hours of full-throttle competition show if the research-and-development ideas are going to perform in the field. The results for next year include the largest Mercury ever built, a new Merc 225

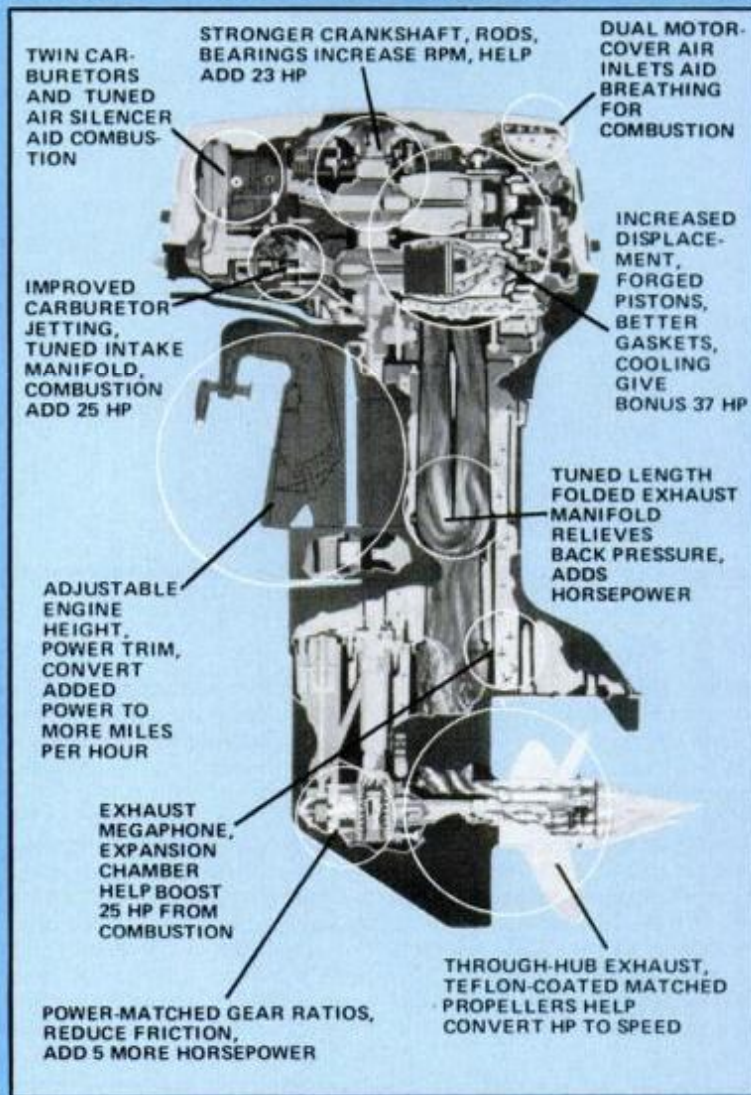
hp, plus 235s from Evinrude and Johnson and 140 hp from Chrysler. And, if the energy situation ever settles down, there are even more muscular machines waiting in the wings. The Johnson and Evinrude 235s are leaping from 149.4 to 160.3-cu.-in. displacement.

Up 180 percent

Take a look at a 50-hp Johnson Sea-Horse kicker of 22 years ago, compared with one slightly smaller for next spring. The 1958 and 1980 models are both V4s. The '58 had 70.7-cu.-in. displacement and the new one for 1980 will fit 99.6 cu. in. under the same size cowling. Cranked up to its rated 4000 rpm, that early motor turned out its respectable 50 hp. This year, at 5000 rpm, the new model is a herd of horses more—90 more, for a total of 140 hp from the compact package.

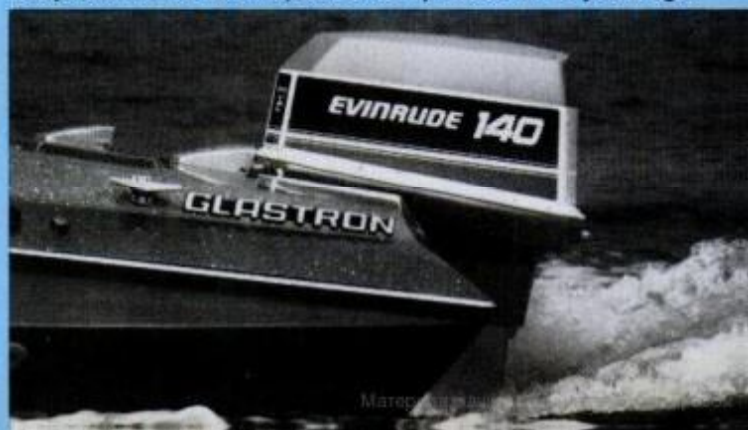
Chief Johnson engineer Don Kueny estimates sources for all that horsepower this way: About 23 hp is a result of higher revolutions per minute, allowed by a stronger crankshaft, connecting rods and bearings, all balanced by computer assistance. Improved lu-

(Please turn to page 228)



Two in-line cylinders and 50 inches of piston displacement can turn out 60 hp in this new motor, scheduled for next spring.

Enough power for fast runabouts, the 140-hp V4 with 99.6-cu.-in. displacement is as compact as 50-hp motor of 22 years ago.





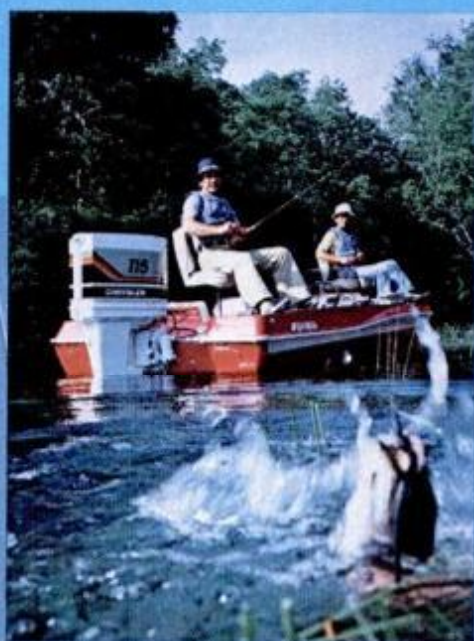
New for inflatables and other small craft, Mercury's 36-pound water-cooled 3.6 hp uses CD ignition and minimum fuel.



Largest of the Chrysler outboards, the 140-hp Charger has new styling, power trim/tilt, choice of aluminum prop options.



Johnson's 150-hp Sea-Horse—as well as 175-, 200- and 235-hp V6 models—claims improved starting, economical running.



Bass boats, like Chrysler's Fin & Fun, that handle big power, can be rigged with 115-hp outboard for long-range fishing.



Minimills run most of a day on one tank of gas. Johnson's one-cylinder 2 hp, 24 pounds, has new forged connecting rod.



Biggest Mercury ever, the new Merc 225 hp, can push a large offshore rig at a brisk pace. A 9.8 mounted alongside takes over for economical trolling at the fishing site.

At Hershey, Pa., site of the world's largest automotive flea market, one man's junk is another man's treasure.

by Michael Lamm WEST COAST EDITOR

Never say scrap!

To old-car nuts like me, going to Hershey means going to heaven. I've made the trek half a dozen times since 1970, and I plan to do it again this October—along with a quarter million other car nuts.

I got lucky this year and found a room only 40 miles away from Hershey's hallowed ground. Hershey, Pa., isn't exactly New York or Chicago when it comes to finding accommodations for 250,000 people. And the only reason I found one empty room in a Travelodge 40 miles distant was that I had started phoning for reservations in January—for a room I hope to occupy for three days beginning Oct. 4.

I've done a lot worse. The first time I made Hershey, I slept in the back of a pickup truck. In 1973, I borrowed a Ford van and lived in that. That's not to complain, mind; I figure just being



Duesenberg competes in the concours d'elegance part of the fall meet.

there is worth any inconvenience short of out-and-out pain.

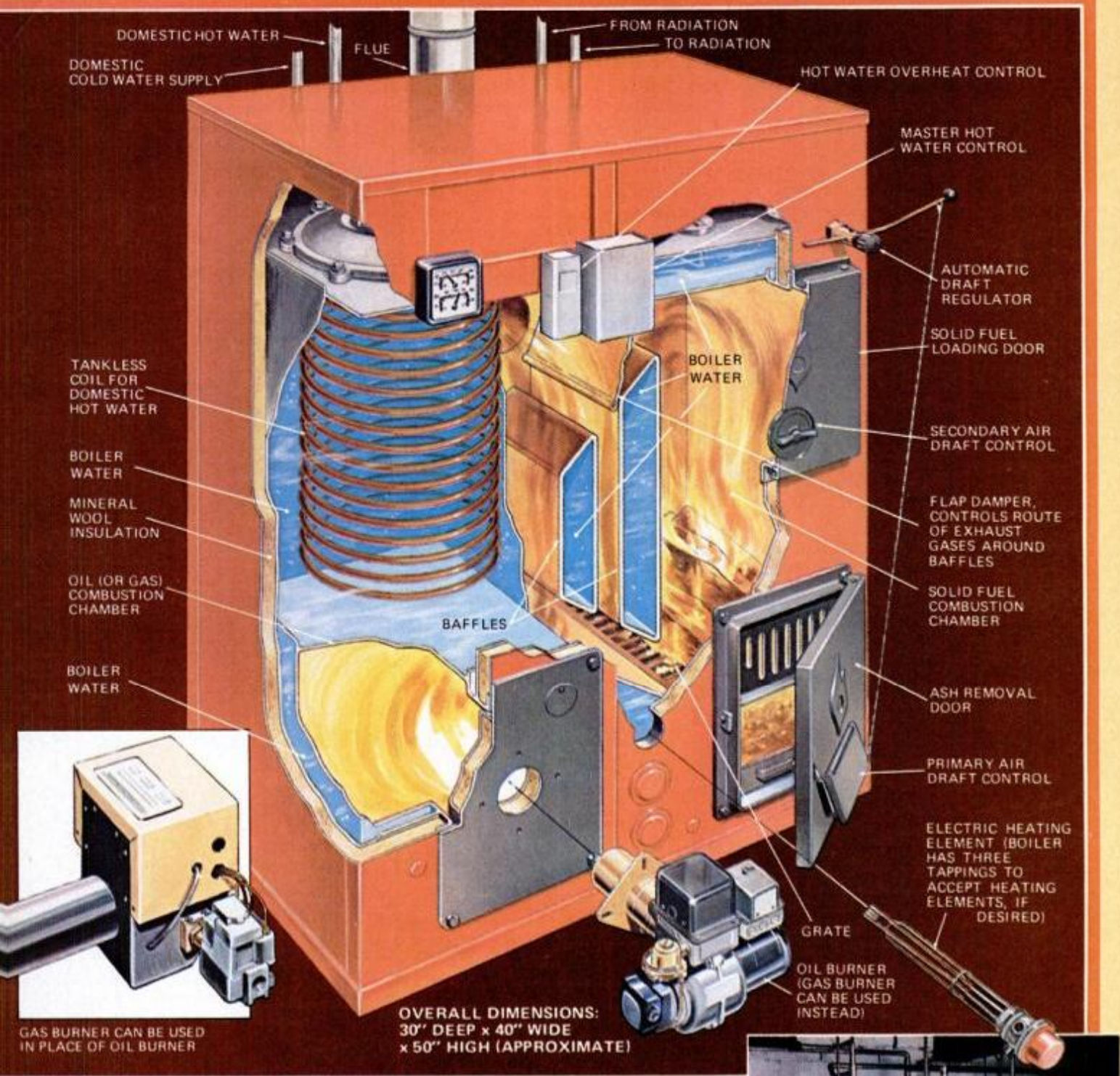
And Hershey can be a trial. I remember 1977, when it rained. The swap grounds, which cover 110 acres of gently sloping hillside, became a muddy ooze with little rivulets running into half a million shoes. Tents filled up or came sluicing down. Rusty fenders blended in with the brown of the mud.

People slogged around in big plastic trash-bag ponchos.

But most years it doesn't rain, thank goodness, and there's a great car-adventure feeling in the air—plus, sometimes, the marvelous scent of Hershey's chocolate. Hershey is Chocolate Town, U.S.A., and it's only coincidental that the tremendous Hershey swap-meet and car show have taken over Milton Hershey's planned community each first week of October.

Officially, it's called the National Fall Meet, Eastern Div., of the Antique Automobile Club of America. The AACA is one of this country's oldest and most respected old-car clubs, founded in 1935 by 14 hobbyists. Today, the club boasts 44,000 members and holds nine national meets and two national tours in various parts of the country, the biggest one of which is the Eastern Div. fall meet, hosted





OVERALL DIMENSIONS:
30" DEEP x 40" WIDE
x 50" HIGH (APPROXIMATE)

MULTIFUEL BOILER

A hot-water boiler with independent combustion chambers (above) efficiently burns gas or oil on one side, coal or wood on the other. Chamber walls transfer heat to surrounding water, which is pumped to radiators as needed. If solid-fuel fire is allowed

to die down, oil (or gas) burner will kick in automatically. Electrical heat elements can also supplement solid fuel. In addition, tankless coil produces domestic hot water. Story on how to install a multifuel boiler (right) begins on page 122.

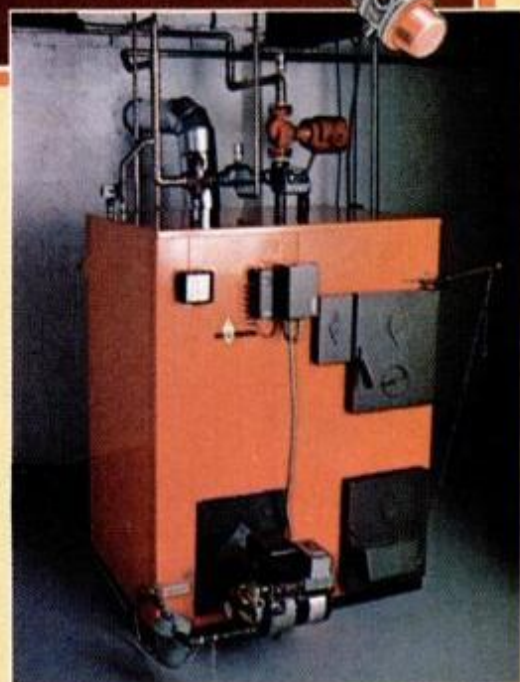
What they do; how they work

A multifuel heater is a furnace or boiler which will burn some combination of fossil and solid fuels. A typical unit will burn oil or gas, plus wood or coal. Some units can even operate on electricity, while others are restricted to wood, plus oil or gas.

The heat distribution system for multifuel units is the same as for conventional forced-air, hot-water

and steam heaters. Installation is not complicated. Most units can be connected to existing house thermostats and Class A chimneys (tile-lined or insulated stainless steel) which are in good repair. Existing flues for gas-fired furnaces and boilers may not be adequate for multifuel units—check manufacturer's specifications and your local building code before you buy.

A multifuel heater is usually



hand-fired with solid fuel. To do so, a homeowner must turn off the electric current to his oil or gas burner and feed the combustion chamber in much the same way he would a coal- or wood-burning stove. The solid-fuel chamber of most units is equipped with an automatic draft set to keep the fire at an even temperature. If the fire gets too hot, the damper closes to reduce the air sup-

ply and retard combustion. If it begins to cool, the damper opens to let in more air. In some units, the primary air is supplied by a small thermostat-activated blower.

Multifuel heaters are set up so that when the solid-fuel fire cannot meet the demand because the fuel has dwindled, the automatic gas or oil burner switches on and takes over. Some units, usually those that have single combustion chambers for both solid- and fossil-fuel burning, are designed primarily to burn solid fuel. The oil or gas burner on such units is a backup, to be used when you are away and can't feed-in solid fuel.

Units specifically designed for multifuel burning generally have two independent combustion chambers. Efficiency on the oil-burning side of two-chamber units is usually higher (5 to 10 percent) than oil-burning efficiency in single-chamber units. Firing into "that big

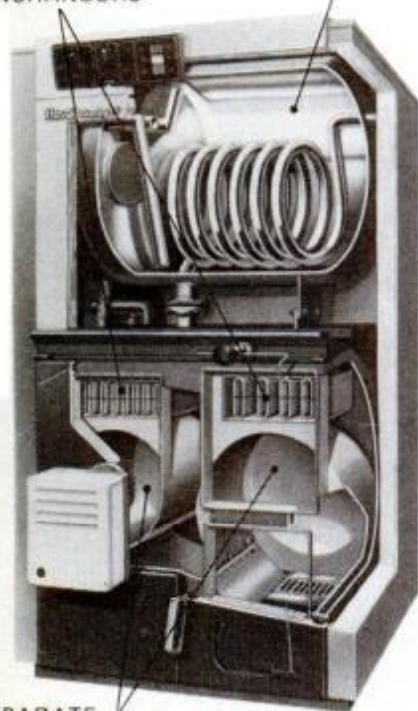
barn," as one manufacturer of oil burners puts it, tends to promote greater stack loss of heat. Enno Toomsalu, associate managing engineer at Underwriters Laboratories, agrees and states further that two combustion chambers, sized specifically for the fuel to be burned in them, will tend to be more efficient than single-chamber units for burning oil or gas.

Who tests multifuel units?

The state of Maine has the most active program for testing multifuel furnaces and boilers. Carl Flink, director of the Energy Testing Lab (ETL) at Southern Maine Vocational Technical Institute, says that his facility tests units primarily for safety. A label indicating that a unit was tested and approved by the state of Maine is your best assurance of a safe unit—providing it is installed according to your state and

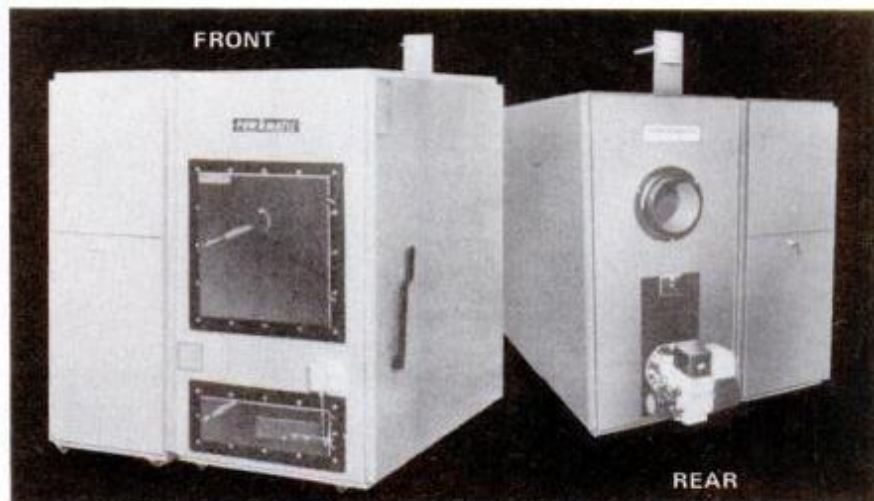
(Please turn to page 197)

THERMOLYTIC HEAT EXCHANGERS
DOMESTIC HOT WATER TANK



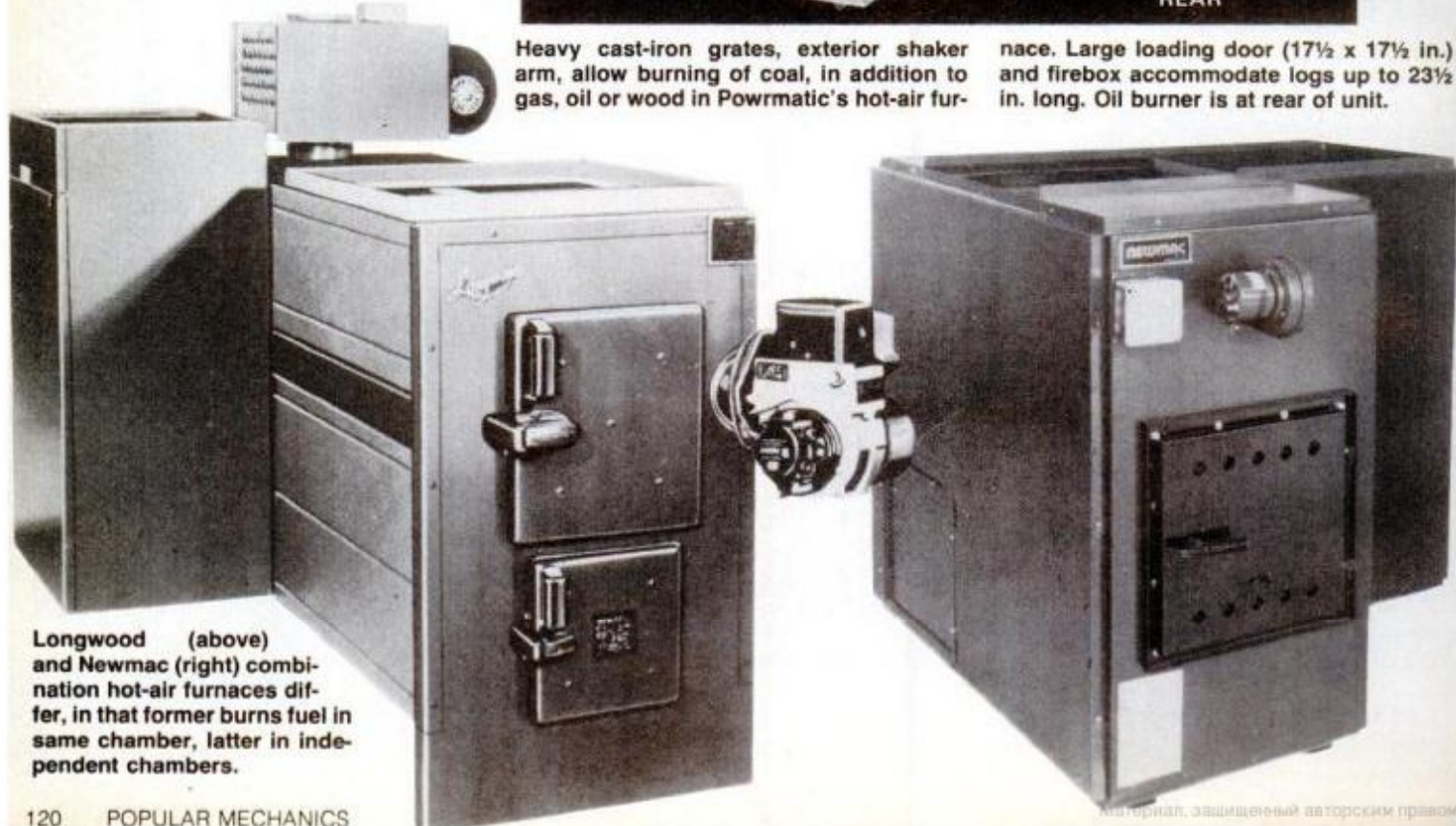
SEPARATE COMBUSTION CHAMBERS

Hoval Duolyt multifuel boiler burns wood, coal, oil, gas. Special heat exchanger design permits burning of softwoods.



Heavy cast-iron grates, exterior shaker arm, allow burning of coal, in addition to gas, oil or wood in Powrmatic's hot-air fur-

nace. Large loading door (17½ x 17½ in.) and firebox accommodate logs up to 23½ in. long. Oil burner is at rear of unit.



Longwood (above) and Newmac (right) combination hot-air furnaces differ, in that former burns fuel in same chamber, latter in independent chambers.

Add-ons convert home heaters to multifuel systems

If you just plunked down \$1200 to \$1500 for a new gas- or oil-fired furnace or boiler, you're not about to replace it with a multifuel unit, no matter how much that unit might save you. Even if your unit is four or five years old, you'd lose on the trade in. You can, however, spend \$400 to \$2900 for an add-on furnace or boiler, which can turn your existing heating plant into an efficient, economical system.

There are two important things to consider when buying an add-on. The first is whether or not to get a unit that can eventually be converted to multifuel capability. Several makers offer this as an option, so when your existing oil- or gas-fired unit needs to be replaced, all you must buy is a new burner.

The second thing you should do is decide, with your local building official and the installer, whether or not the flue for the existing unit will be adequate for use with the add-on. It must be able to handle all combustion products from both units simultaneously. UL is currently proposing that a warning be made by add-on manufacturers, stating that users who connect a solid fuel add-on to an existing gas-fired unit are risking asphyxiation. The reason behind this warning is that if the flue passage were to be blocked by creosote accumulations, deadly, hard-to-detect carbon monoxide could build up in the house. If the flue isn't adequate, and you don't have an unused flue passage, you'll need money for a new chimney.

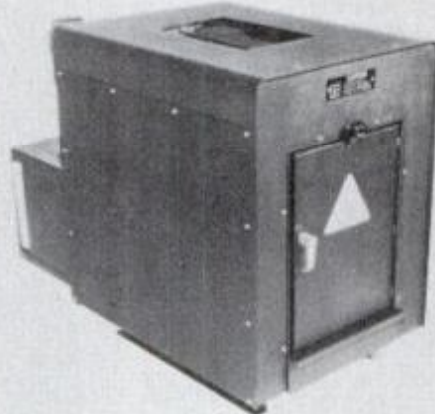
The typical furnace add-on consists of a solid-fuel combustion chamber, an air space which surrounds it and a blower which moves the heated air to either your hot-air supply duct (normal) or to your return-air duct. Add-on boilers are commonly constructed with a water-



Hoval HK solid-fuel add-on boiler teamed with existing unit provides same advantages as multifuel boiler.



Monarch's Add-A-Furnace, in sizes to suit most home heating needs, was first such unit to be UL-listed.



Multi-Fuel Energy Converter can serve as add-on to burn wood, coal, compacted leaves, peat, trash.

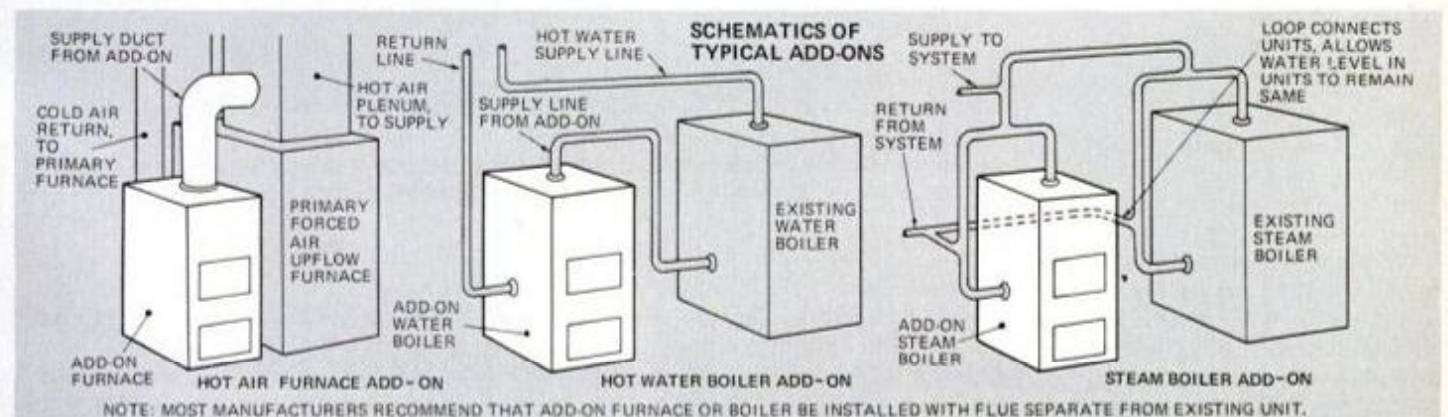


The extremely hot fire in Decton's Russell Stove burns wood (even pine) and rubbish cleanly.

filled jacket around a solid-fuel combustion chamber, or with water-filled coils welded to the inside of the firebox. Some less sophisticated models simply preheat water before it gets to the existing boilers. Other, more expensive units can take over the primary boiler function, so that the existing gas- or oil-fired

boiler will function as a backup.

In an add-on situation, two thermostats are usually necessary. One makes demands on the solid-fuel unit. The second, set a few degrees lower, will signal the original unit's oil or gas burner to fire when the solid-fuel fire isn't supplying enough heat.—J.P.



Forced-air add-ons are generally ducted into supply plenum (shown), although some makers prefer venting into return.

Add-on boiler heats return water. Switch to existing oil- or gas-fired boiler is automatic when solid-fuel fire is low.

Existing steam boiler operates when add-on is inadequate. Piping layout shown is suggested for Simplex Multitherm unit.

PM installs a multifuel boiler

Here's what it takes to make the switch to multifuel heat—and energy security—for your family.

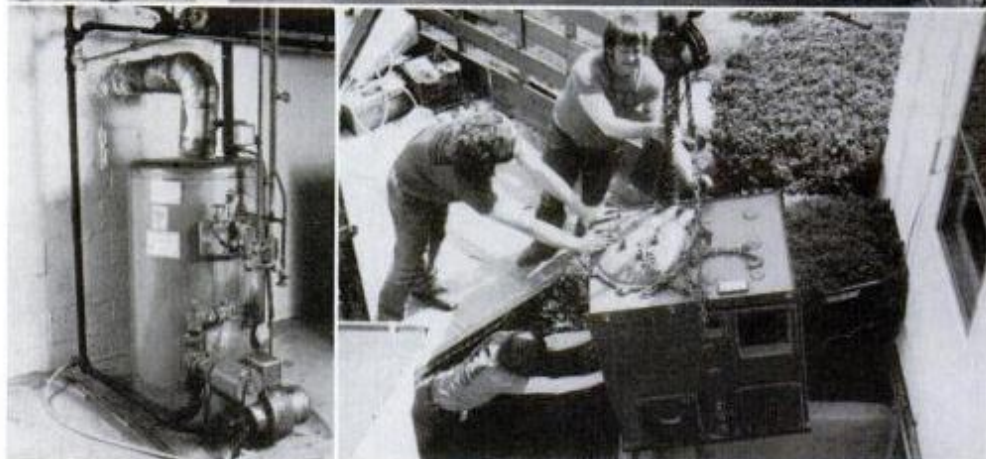
by Joseph R. Provey
ASSISTANT HOME AND SHOP EDITOR

The first time I fired up my multifuel boiler with a load of wood, it struck me that it was also the first time in my life I was taking full responsibility for providing heat for my family. It felt good, but also a little scary—a contract with the oil company had always taken care of everything. The burner fed itself and deliveries were automatic. In recent years, however, so were the price-per-gallon increases.

Now I can call the shots—without giving up the admitted convenience of oil. The HS TARM unit I chose will burn oil, gas, coal, coke or wood and even operate on electricity. I ruled out gas and electricity since the former is not available to me and the latter costs too much. Coal is a last resort even though its cost per B.T.U. is about half that of oil. (See page 118 for a description of how a multifuel boiler works.)

We scheduled and completed our installation last spring, when a service interruption was not critical and installers weren't completely booked. This fall a similar unit, completely installed, will cost about \$3400.

The initial cost was not as high as it sounds, considering the old unit would soon have to be replaced anyway. In fact, the payback period is relatively short. In my case, I am using oil to heat my domestic water during the mild-weather months and will use wood for both domestic hot water and space heating during



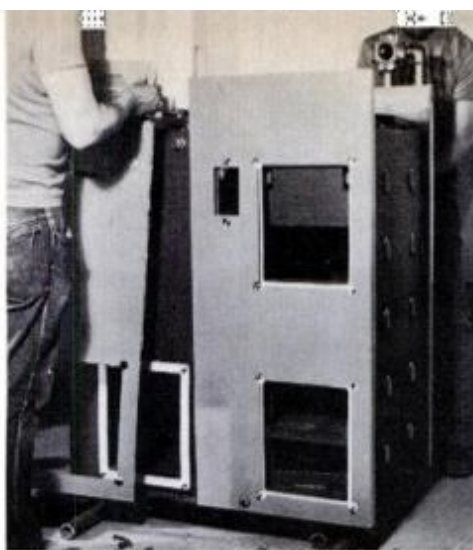
Multifuel unit (top) operates at efficiency of 84 percent (oil) or 62 percent (wood). Old oil burner (below, left) was 68 percent efficient. Door and unit sizes were compared before boiler was delivered. Basement entry eased task of getting new unit in, old one out.

the winter. The wood, even in my well-populated suburban area, costs only sweat. My oil savings will be about 600 gallons, which converts to nearly \$500 at 82 cents per gallon. Conservatively projecting the price of heating oil to rise 10 percent a year, my multifuel unit will pay for itself (beyond the cost of a new oil-

fired unit) in three to four years. A federal tax credit for wood-burning appliances would shorten the time.

We began planning our installation by looking at available units and sending for manufacturer's literature (see list on page 198). After choosing the unit which suited my needs, I checked the dimensions of

PM photos: Carl Weese
Boiler installation: Alternative Energy Associates, Inc.,
Underhill, Vt. 05489.
Consultant: John F. Connolly, inspector, Building Dept.,
Norwalk, Conn.



Installation of boiler jacket and mounting of doors and components can be done by homeowner to cut installation cost.



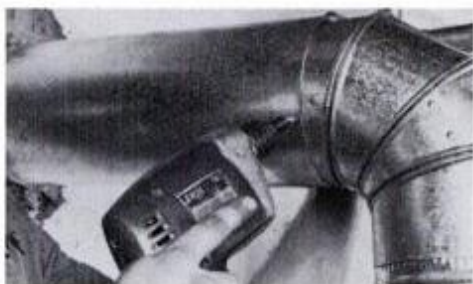
Connecting overheated control (A) and master hot-water control (B) normally requires skill of a professional.



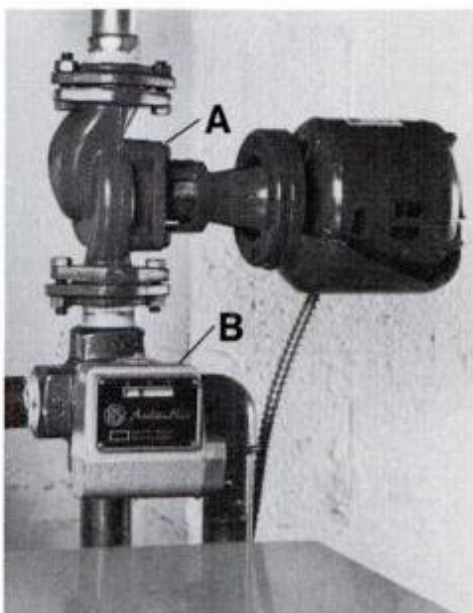
Before flue pipe was passed through wall, thimble was mortared in place. Then flue pipe was inserted and the joint sealed.



Air purger, valves and copper pipes were plumbed and soldered according to the manufacturer's recommendations.



Flue pipe sections were fastened at all joints with sheet-metal screws to keep them from separating due to vibration.



Circulator pump (A) on return line operates constantly during heating season. Auto mix valve (B) feeds more—or less—hot water from boiler to radiators, depending on house thermostat's call for heat. See text for the advantages of this system.



Oil feed line to burner was protected by slipping old garden hose (slit on one side; see inset) over the exposed tubing.

access to basement, condition and size of my chimney flue, and the size of area where the unit was to be installed. I had to be sure I could get the unit into my basement without removing a wall or floor section, that my chimney was the right size, in good repair and tile-lined, and that there was adequate space for recom-

mended clearances. Once satisfied, I visited my local building department to get a heating permit.

Working with this department was particularly important because currently no multifuel units have completed testing at the UL labs in Cleveland. Most units have been

(Please turn to page 253)

Boiler maintenance

If you are accustomed to low-maintenance fuels like gas or oil, be aware that alternative fuels (coal and especially wood) will demand more of your attention. Chimneys, for instance, must be cleaned once a year. The stovepipe between the boiler and the chimney must be removed and inspected for corrosion, creosote and soot at least twice during a heating season. The oil or gas burner should be adjusted, and the burner firebox cleaned, once a year.

Cleaning of the inside boiler walls and flue passages must be done at least every two months during the heating season. Otherwise, a buildup of creosote will slow heat transfer to the boiler water. Heeding the maker's maintenance schedule is critical to an efficient, safe multifuel system.—J.P.



Ash scoop is used for emptying. Ashes should be removed before they touch grates and restrict airflow.



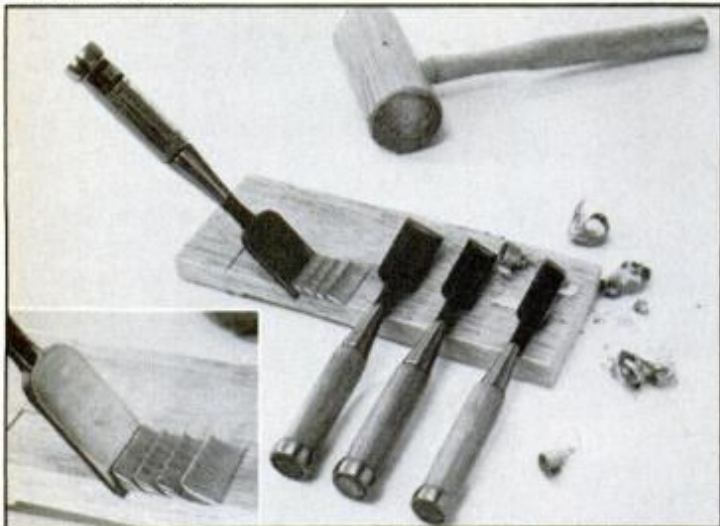
Wire flue brush and long-handle scraper were provided with unit for cleaning creosote from inside boiler.



Meter reads 23-percent moisture content in logs seasoned for 10 months—slightly high for clean burning.

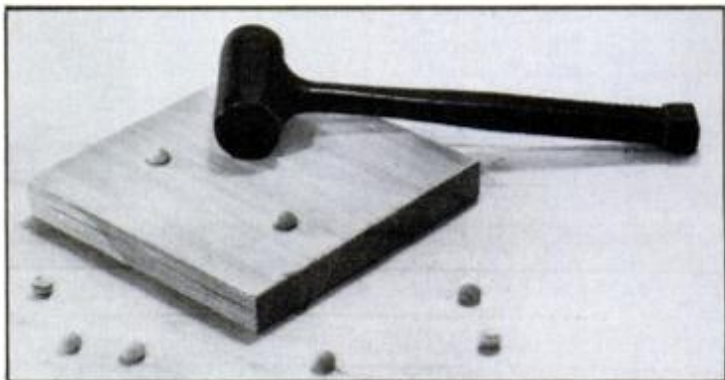
A dozen extraordinary

PM photos: Harry Wicks

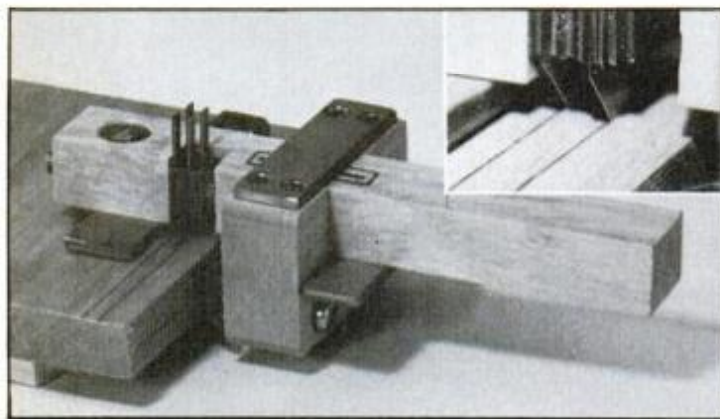


Japanese carpenter's chisels by Ooichi are made of hard and soft steels hand-forged together. Soft-steel shock absorber keeps hard cutting edge from breaking. Maker claims that the result is a longer-lived razor edge. They're sold in 10 widths from 3 mm (\$19) to 42 mm (\$37) from Woodline, the Japan Woodworker, 1004 Central Ave., Alameda, Calif. 94501.

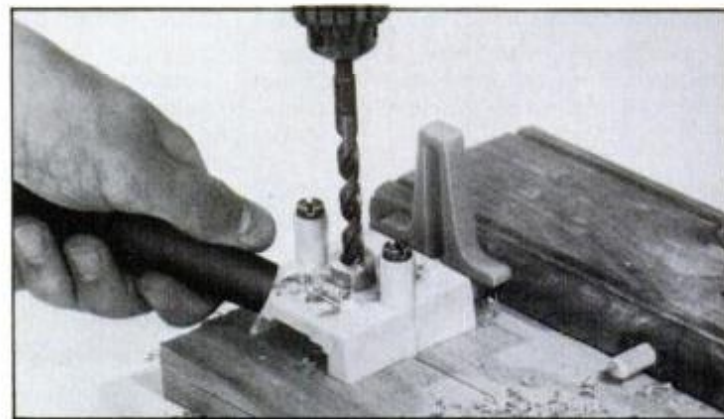
Here are 12 tools to help you perform a variety of woodworking tasks with maximum ease, yet assure top results. The handsome devices are also prime candidates for the ultimate tool collection.



As you swing this hammer, lead shot contained in its head moves forward to produce a no-bounce blow. The outer shell of composite plastic won't mar wood and can be used to hammer out minor dents in some metals. It's ideal for assembling furniture, driving lathe centers. The 14-oz., 10-in. hammer is \$15.70 postpaid. Leichtung Inc., 701 Beta Drive, No. 17, Cleveland, Ohio 44143.



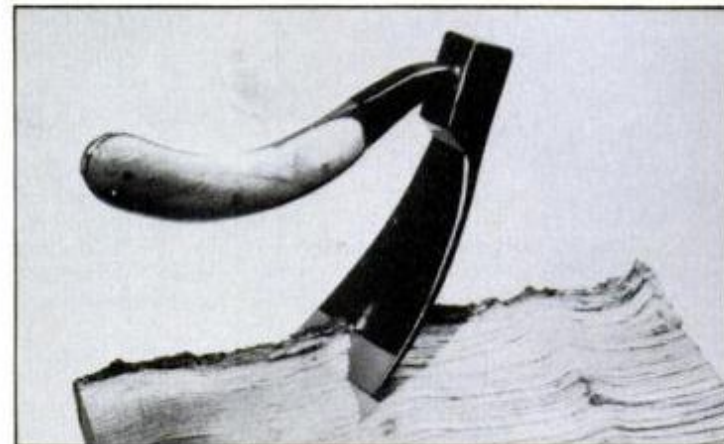
You can cut straight, circular and odd-shaped veneer veins with this inlay cutter. It cuts $\frac{5}{64}$ - to $\frac{5}{16}$ -in.-wide veins (see inset) and up to 6-in. radius. Made of beechwood with solid brass fittings, it comes with two cutting blades, clearing cutter and guide. Tool is \$99.95 postpaid from Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461.



Dowel Magic helps you bore accurate mating holes for dowels. It's especially useful for right-angle doweling. Kit includes a dowel jig, adjustable guide, twist drill with depth stop and fluted dowel pins. Separate Dowel Magic kits for $\frac{3}{8}$ -in. and $\frac{1}{4}$ -in. dowels are \$10.95 postpaid, available from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374.

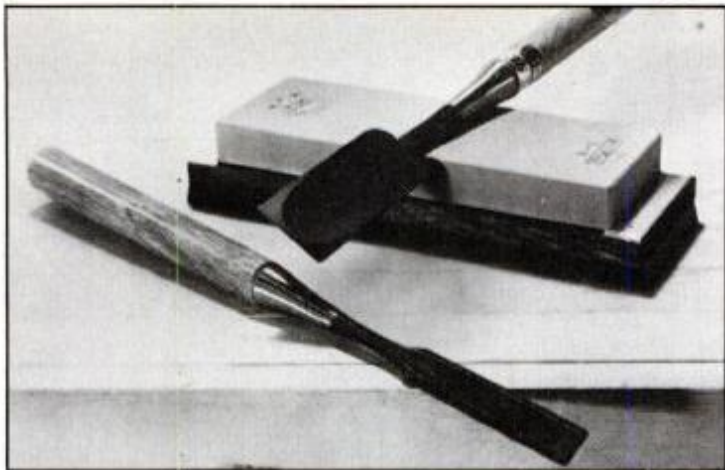


Put a precision edge on a cabinet scraper with this scraper bur-nisher by Ulmia. Its steel-sharpening wheel makes it easier to use and more consistent than hand-stroked burnishers, the maker claims. The tool's beechwood body is 6 in. long with steel guide. It's priced at \$19.95 postpaid from Fair Price Tool Co., Box 627, La Canada, Calif. 91011.

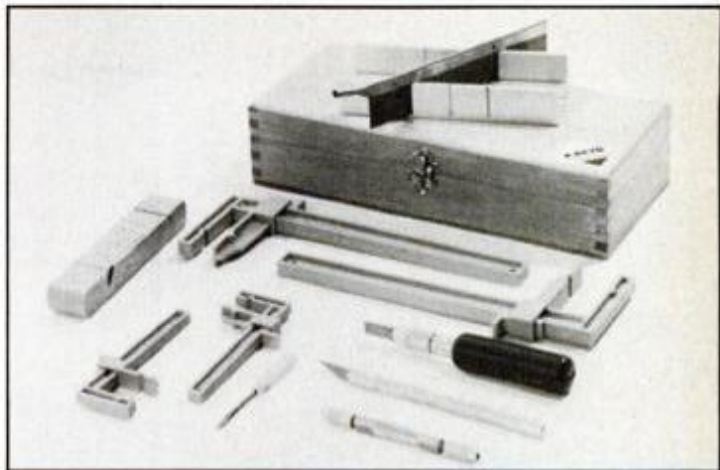


Sturdy hollowing adz has forged head and solid forged handle. Two hardwood pieces are pinned to the handle to make a comfortable grip. The gouge is 3 in. wide, forged to a No. 7 sweep. To prevent binding in the work, the head tapers back from the edge. Adz is \$43.45 postpaid from Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801.

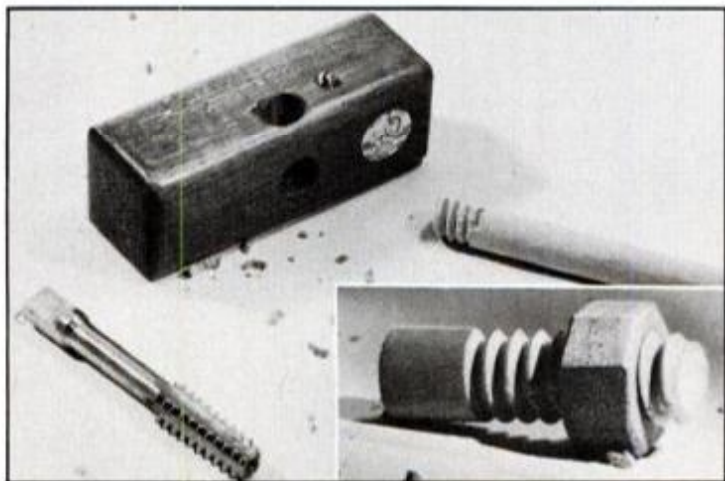
woodworking tools



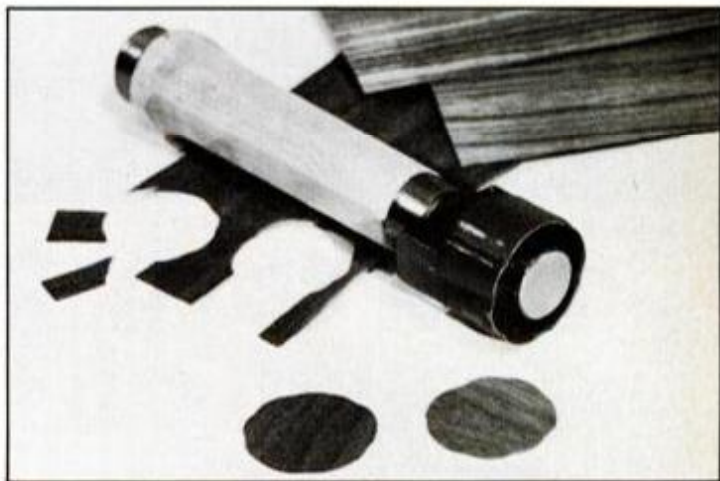
Japanese paring chisels with red oak handles are for delicate paring cuts. Blade widths range from 3 mm (\$16) to 36 mm (\$37). Two-stone sharpening on Japanese water stones is suggested for these blades made of combined soft and hard steel. Stones start at \$9. Write Woodline, the Japan Woodworker, 1004 Central Ave., Alameda, Calif. 94501 for information.



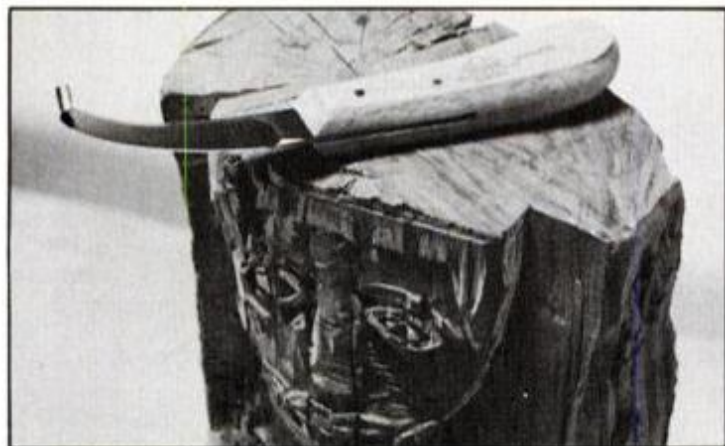
This miniaturist tool set is great for constructing miniature furniture and other detail work. Priced at \$21.95 postpaid, the set includes a contour sander, hand drill and pin vise, X-Acto knife, miterbox, jeweler's screwdriver, plastic clamps and accessories. It's from Craftsman Wood Service Co., 2727 South Mary St., Chicago, Ill. 60608.



Make your own threads in wood pieces with this woodscrew box of hard maple. It comes complete with a steel tap for threading a mating hole (see insert of nut) in sizes of 1/2, 3/8, 1/4, 3/16 and 1/8 in. The 3/16-in. size shown is priced at \$48. Woodscrew boxes are available from Wood Carvers Supply Co., 3112 West 28th St., Minneapolis, Minn. 55416.



Veneer punch lets you make professional-looking repairs in damaged veneer. Position punch over spot, give its handle a sharp hammer rap. Do the same on matching veneer to cut replacement patch (above). Punch comes in six sizes: 18 mm to the 45-mm one shown (M2709, \$50 postpaid) from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, Minn. 55374.



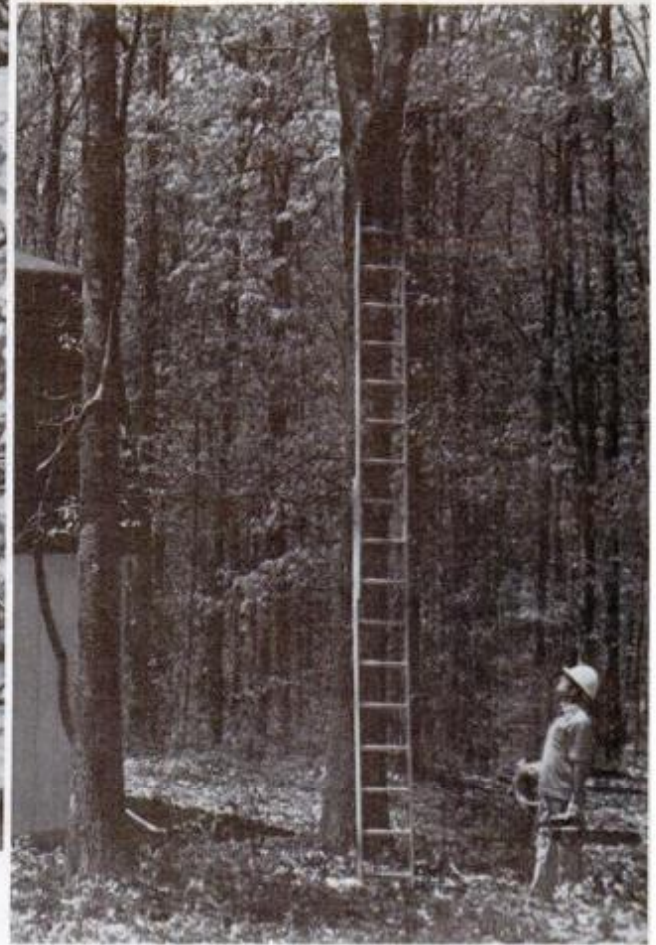
Designed for rapid roughing out, the carver's hook knife cuts on both the pull and the push strokes. The bevel is ground on the top edge only for ease of control. The wooden handle is shaped for comfortable use. The carver's hook is ticketed at \$10.40 postpaid. It's available in right- and left-hand models, from Garrett Wade, 302 Fifth Ave., New York, N.Y. 10001.



Hold this woodworker's inshave in both hands and pull it toward you to hollow, scoop or scrape concave areas. Use it to shape wooden chair seats, bowls and carvings. The curved blade is heat treated, tool steel, 5 in. wide. Hardwood handles are 6 in. long. Postpaid, the inshave is \$20.70 from Brookstone Co., 493 Vose Farm Rd., Peterborough, N.H. 03458.



Getting yourself and your chain saw up a tree, and felling offending limbs safely, takes know-how. Treeman (left) is trimming small branches before cutting heavy limb. Ladder (below) should be secure; remove it before you lower the cut limbs.



PM photos by the author

How to make the tough cuts with your chain saw

If you're not afraid to climb a tree, these methods will let you take down those hard-to-fell limbs.

by Charles E. Rhine

There are a number of reasons why a homeowner may have to remove a tree in crowded quarters. Perhaps it, or some of its branches, are so close to the house that it presents a hazard during storms. Or maybe some heavy, dead limbs pose a threat and should be removed. And, nowadays, trees that cast shadows where we plan to put solar collectors must go.

Until now, you had no choice but to call in a professional with his cherry picker when faced with the task of taking down one of the tough ones. But, you might ask, "How did the pros do it before the cherry picker came along?" On these pages we

give you the answer so you can safely remove those limbs and trees yourself.

Rope tricks

Before you can do anything, you must get up in the tree with a saw. Surprisingly, you can do this and still have your hands free for sawing, by rigging up a rope saddle and a treeman's knot. See the drawing on the facing page.

This rigging allows you to safely control your up and down movements in the tree. If you slip, or a limb breaks under your weight, you won't come tumbling down, but just dangle until you can regain your

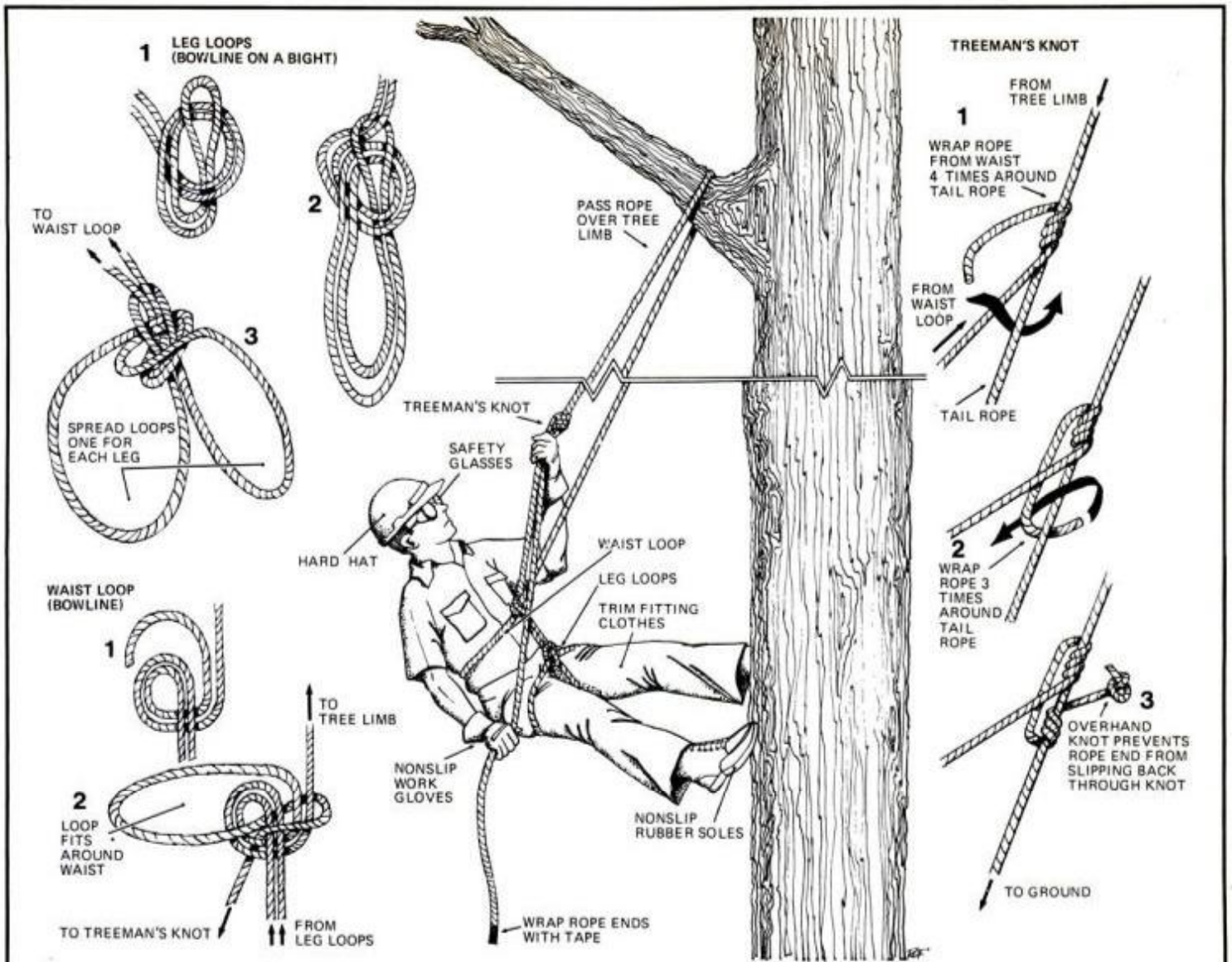
footing. To free your hands for sawing, put your body weight in the saddle and brace yourself with your feet against the tree trunk or limbs.

The big secret to taking down limbs, or the entire tree, is to do it *a little bit at a time*. Saw off sections small enough to be easily handled and let down by rope. It takes time, but it's safe.

You need at least one other person on the ground to handle the ropes, and you need at least three strong ropes in good condition. Buy new ropes if there is any doubt about the condition of the ropes you own.

All ropes should be more than twice as long as the height at which you will be working in the tree. Rope lengths of 100 feet will handle most tree work. They should be free of knots and kinks and the frayed ends should be taped, not braided or knotted. Knots will catch in a tree crotch and prevent you from pulling the rope through.

(Please turn to page 128)



What you should know about tree climbers' rigging

The knots shown here make a safe saddle. You can become familiar with them through on-the-ground practice. They must be tied so they do not slip; otherwise, they will cause the rope to tighten around you.

The saddle should have a snug, comfortable fit when your entire weight is on it. If the ropes bite into your skin too much, wrap them

with rags or leather for padding. When you get to the site, it's a good idea to retie the knots a couple of times to get a good fit.

The saddle must be tied before you can pass the rope over the support limb. To start, measure off about 12 feet from one end of the rope and fold it back on itself. Begin tying your leg loops about three feet from the bend

on the doubled end, using what the Boy Scouts call a bowline on a bight. Then proceed to the waist loop and the treeman's knot.

After passing the rope over the support limb, be certain that you test out your saddle and treeman's knot before you begin your climb.—C.E.R.

Pass safety rope over strong, high limb after tying saddle and treeman's knots.

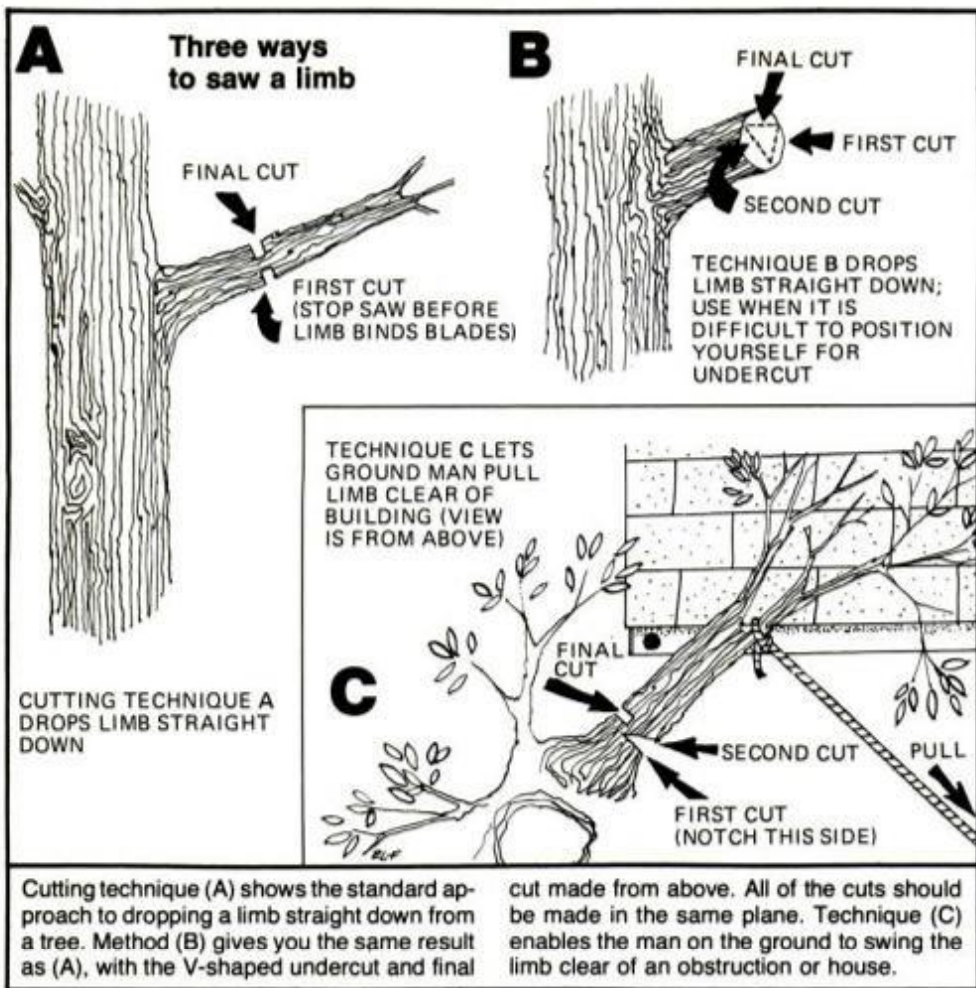


Be sure to test your safety-rope rigging near the ground before you climb tree.



Treeman's knot suspends you safely, yet allows you to go up or down in tree.





One good way to test a rope for strength is to tie one end to your car's rear bumper and the other around a tree trunk. Ease the car forward until the rope is taut, then apply a steady pulling pressure. Look for areas of excess stretching. This is also a handy way to take the kinks out of a rope or to take the stretch out of a new rope.

The most important rope is the one which will be supporting you, and with which you will tie your saddle. This should be at least 5/8-inch-diameter manila hemp rope—3/4-inch rope would be even better. Nylon or other synthetic fiber ropes are too slippery for good control with the treeman's knot.

The second rope is the one you tie to the limb to be sawed off for lowering. It should be strong enough for the weight, so use 1/2-inch rope.

The third rope is used to haul your saw up after you have placed yourself in working position, or to swing branches out of the way of obstructions. A strong 1/4-inch rope is fine.

Saw safety

Working up in a tree with a roaring chain saw can be extremely dangerous unless you have absolute control over the saw, your own

(Please turn to page 218)

How to use your chain saw in a tree



Ground man lifts saw to working position, using rope tied to saw's balance point. This lessens injury risk during climb.



Brace chain saw in tree crotch for starting. Don't maneuver with saw running.



To make cut, place your body weight in saddle and brace yourself with your feet.



Final limb-dropping cut is made with you safely out of the way of the falling limb.



To avoid damage, man in tree can aid ground man by using guide rope tied at branch balance point to help control limb.



Felling larger branches can cause the tree to sway, so brace yourself for it.



To use the sewing cabinet, it and its matching seat are rolled out into the room from beneath the counter (left). The photos below show generous storage areas that we've built into the counter, sewing cart, yarn bin and accessories cabinet.



The handsome family room at left was conceived to transform a garage into much-needed functional living space. You can select those ideas you need to let you get more use from your living area. At room center there's a daybed which converts to sleeping for two, surrounded by a desktop over store-bought file cabinets. The wall opposite the desk becomes an entertainment center when the projection screen is lowered for slide or movie viewing. PM's sewing center, with its roll-about sewing table plus an accessories cart, can be built from our plans.



ably high reflectance value; it tends to diffuse existing light and helps to brighten dark areas.)

To make our family room extra-practical, we designed it to serve as a bedroom for unexpected overnight guests. The feature that sets our room apart from the crowd is the well designed sewing center wall. Plans for the complete sewing cen-

Low-cost way to "carpet" a planked floor is simply to paint it. To counteract the cool effect of the blues used in our room, the floor was painted an off-white background and striped as shown below.



SHOPPING INFORMATION

Paint finishes: Pittsburgh Paints (see text and drawings for specific color names)
 Fabric: Waverly's Amarylis in "Sapphire"
 Sewing accessories: Talon
 Patterns: Simplicity
 Cabinet knobs and pulls: Amerock Corp. (see drawings)
 Sewing machine: J.C. Penney Stretch Stitch Model 6915.

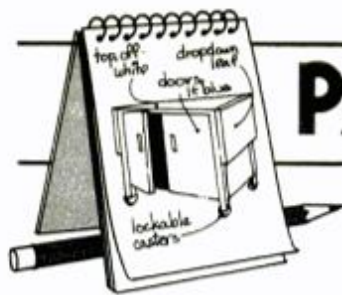
PM photos: color, Hans Van Nes

black-and-white, Rosario Capotosto

Room concept and styling: Shirley Regendahl
 Sewing center design and construction details: R. Capotosto and the author

Cabinetry: R. Capotosto
 Technical art: Eugene Thompson
 Telephone: GTE

PM's family roomful of ideas



ter are given on the following pages, and you can duplicate the wall in whole or in part.

The wall consists of two end cabinets flanking a handsome, practical countertop with hidden ironing-board storage. The attractive sewing cart, its companion bench and the accessory storage cabinet store below the counter.

Building PM's sewing center

The sewing center requires a floor space of 2x14 ft. and 8-ft. headroom. Dimensions can be altered, if necessary, to suit available space. A depth of 20 in. should be considered as minimum so that the sewing machine cabinet and chest of drawers can be stored under the counter.

The height of the end cabinets is 87 in. This permits maneuvering them into position. The 9-in. space between cabinet tops and ceiling is enclosed with a three-section cornice; the center one conceals a fluorescent lamp.

The sewing machine cabinet boasts clean lines. Its solidly supported drop leaves extend to provide a large working area of 20x60 in. A lift-out well top permits the machine to be recessed for flush surface sewing. With the top in place, the machine can be used for free-arm sewing. A small drawer in front of the well keeps small parts close at hand. The efficient doors have three-shelf storage compartments. A cushioned bench, also on casters, tucks neatly under the cabinet and stores the sewing machine.

Because it has an excellent surface for painting, we built the center of MDO (medium density overlaid) plywood. The material cuts without splintering and its inner plies are free of excessive voids. Of fir, MDO plywood has its surface impregnated with a special resin which effectively conceals the plywood's characteristic wild grain. It comes surfaced on one or both sides. Surfaced-one-side panels have a tendency to warp and should not be used in cabinetry. MDO plywood costs a few dollars more than ordinary fir plywood, but is well worth the difference. Use clear pine 1x2

stock for stiles and rails on the cabinet front and for open shelves.

End cabinets

Use a portable saw with a smooth-cutting plywood or hollow-ground blade to cut all parts. The cabinet sides are too large to dado and rabbet on a stationary saw so use a router with a straight bit instead.

Glue and 2-in. finishing nails are used to assemble the sides to the 3/4-in. cross members, while 1 1/2-in. nails are used at the shelf joints. Small pilot holes for the nails bored through the center of the dados simplify accurate nailing.

The cabinets are rather cumbersome, so try to have some help during assembly. Do it this way: Lay one side on the floor and insert the horizontal members into the dry grooves. If your joints fit well, the pieces will stand in place. Add the other side panel, also dry, then start

We built the center of MDO (medium density overlaid) plywood. The material cuts without splintering....

one nail at each joint. Remove the side panel, apply glue, then the nails. Set all nailheads.

With help, flip the unit over, keeping the unglued side in contact with the cross members. Again, start the nails, remove the side panel, apply glue, then nail. Check for squareness before the glue sets. If the unit is out of true, wrack it into alignment and nail a few strips of wood diagonally across the corners to hold unit square while the glue dries.

The cabinet will be a bit shaky until the back panel is attached. Install the latter using an ample number of either 1-in. galvanized nails or 1 1/4-in. threaded nails; both offer superior nail-holding power.

The front frame is made with half-lap joints. To mark the pieces accurately for the joints, temporarily tack-nail them into place, then mark with a knife or sharp pencil directly at the intersections. Use a dado head on a radial-arm or bench saw to cut the joints. Next, mark and cut the mortises for the hinges. The depth of the mortises should be equal to half the thickness of the closed hinge. The doors need not be mortised.

Glue the horizontal frame members into place, then add the verticals. Use finishing nails and set the heads. Install the hinges onto the frame, then place two 1 1/2-in. finishing nails onto the frame to serve as spacers. Place the door onto these nails and proceed to mark the exact hinge locations. Mark the holes for the hinge screws in the door edge and drill pilot holes.

Yarn bin

Cut two panels for the sides and four equal-size pieces for the horizontal members. Use a dado head on a table saw to cut 1/4-in. deep by 1/2-in.-wide dados and rabbets in the end pieces. Dados, 1/4 x 3/8 in., are cut into the horizontal panels. Glue the ends to the horizontals.

Apply a small bead of glue in each groove, then, starting at the bottom, insert a partition and drive a 3/4-in. brad through the groove about 1 in. from each end. Use a nailset to seat the nails flush. To save time, prime and paint all inside surfaces before assembly. Take care to avoid getting paint in the grooves.

Drawer chest

Cut all drawer members to size, then cut the dado in the side and front members to receive the bottom panel. On the sides only, cut a 1/4 x 3/4-in. dado on the outside surfaces. Assemble in this fashion: Glue and nail the sides to the backpiece. Apply glue to the grooves, then slide in the bottom. Add the front. Drawer guides of 3/8 x 1 1/16-in. hardwood are installed in the sides of the chest. Paraffin applied to drawer grooves will make drawers slide smoothly.

Make the partitions and drop them into place; they need not be glued. Use cove molding as shown to make the thread-spool racks for the top drawer.

Assembling the counter

Attach the sides to the back, then add the top and bottom. Cut the piece for the front, then run a shallow saw kerf, 1/8 x 1/8 in., lengthwise to simulate the drawer tops. Since stopped grooves must be made for the "drawer" ends, a router with a 1/8-in. straight bit is used. Clamp a guide board in place to guide the router. Install a 1 1/2-in. x 6-ft. continuous hinge along the bottom.

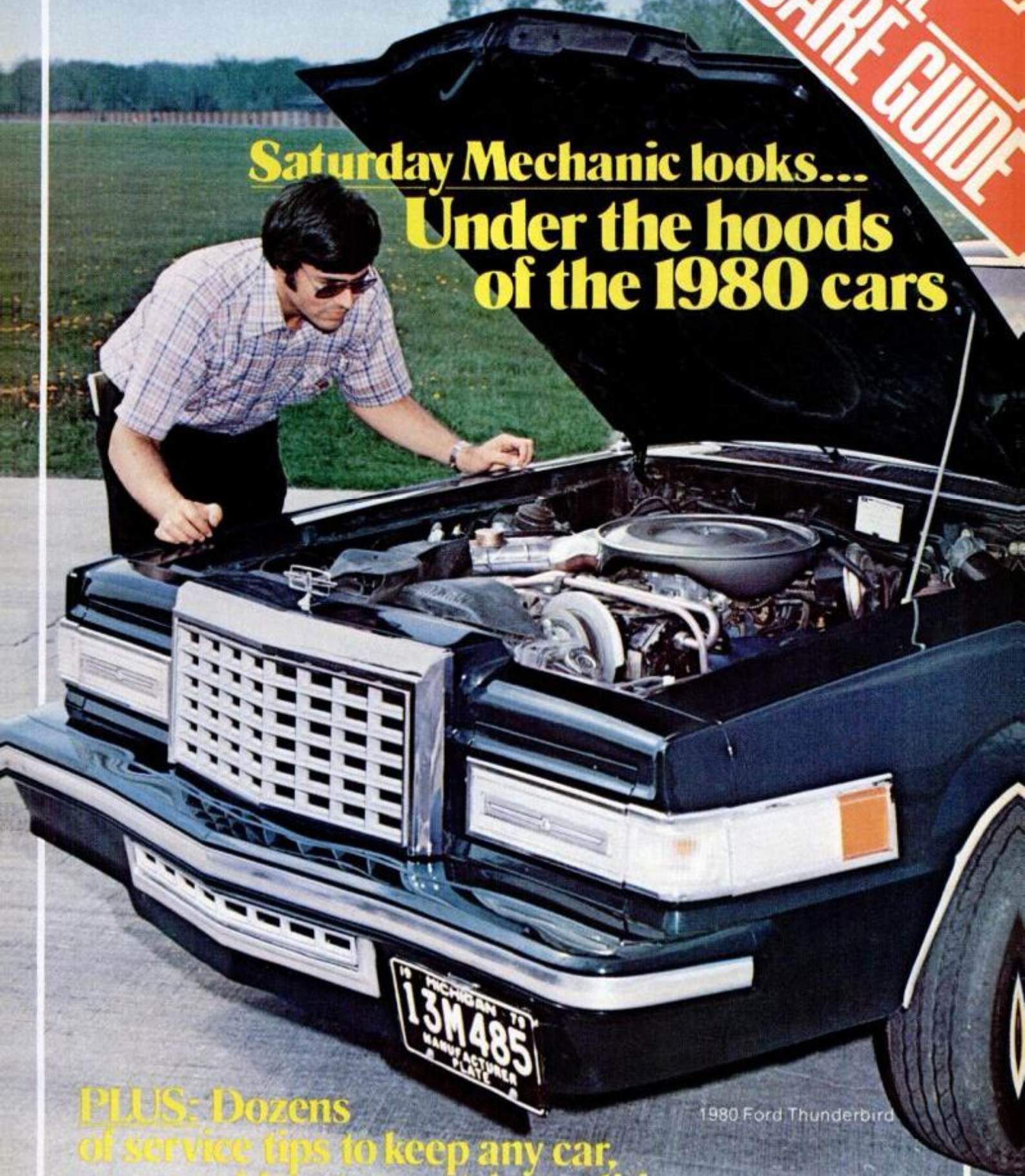
Roll-out bench

Except for the 3/4-in. plywood bottom, the bench is of 1/2-in. stock. The

(Please turn to page 184A)

FALL
CAR CARE GUIDE

**Saturday Mechanic looks...
Under the hoods
of the 1980 cars**



1980 Ford Thunderbird

PLUS: Dozens
of service tips to keep any car,
new or old, in top-notch condition

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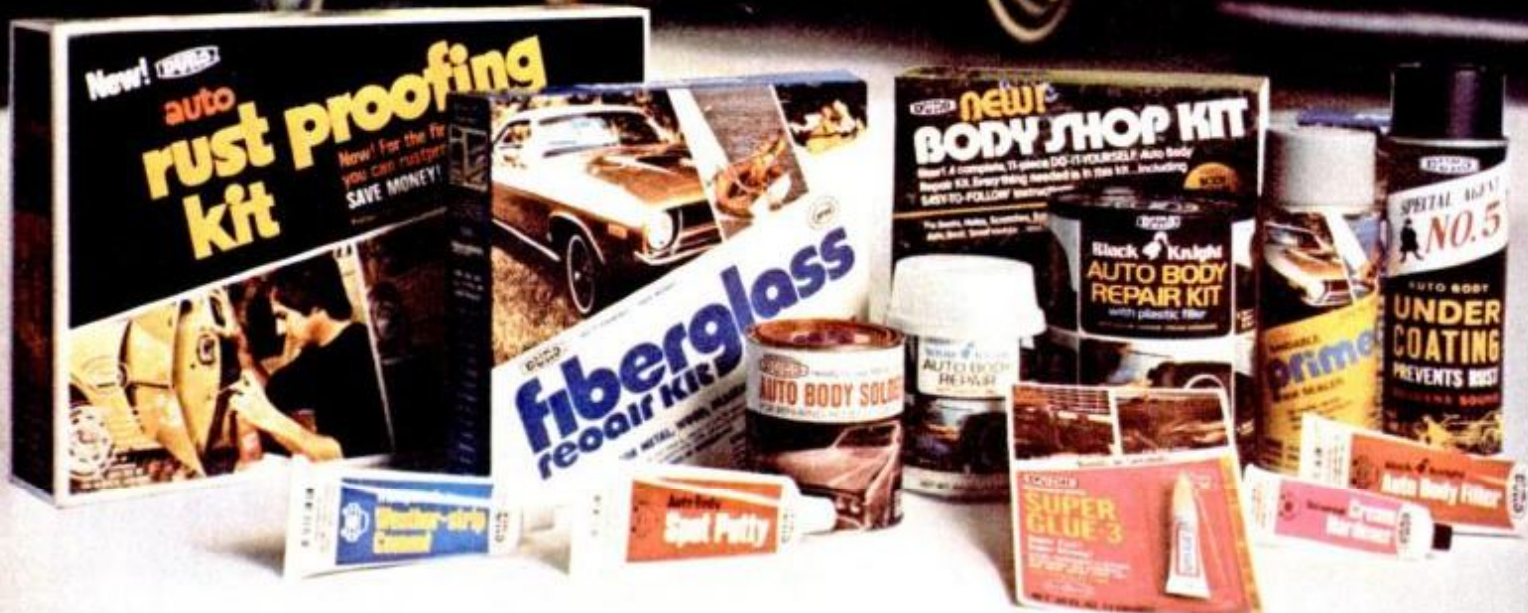
squeaking and eases strain on bearings and bushings.

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Servicing the Ford and Lincoln-Mercury models

The big 1980 story is in electronics. Ford will have four major computer systems in 1980: three under the hood, one in the dash.

Two of the systems involve EEC-III, Ford's electronic engine control in its latest stage. When Ford first showed us EEC-II (Aug., '78), we were told it could be tested, and ignition timing could be checked, using ordinary shop equipment. When all the loose ends were tied, the system was certified only with special Ford test equipment. Ford engineers called us (long after our story was out) with the bad news. The special equipment approach wasn't popular, to say the least, and Ford is engaged in fence-mending with independent service shops. Result: Ford is working to develop diagnostic procedures that use conventional shop equipment most Saturday mechanics should have (volt-ohmmeter, dwell-

tach, and so on), according to Dave Brockman, a supervisor in the EEC program.

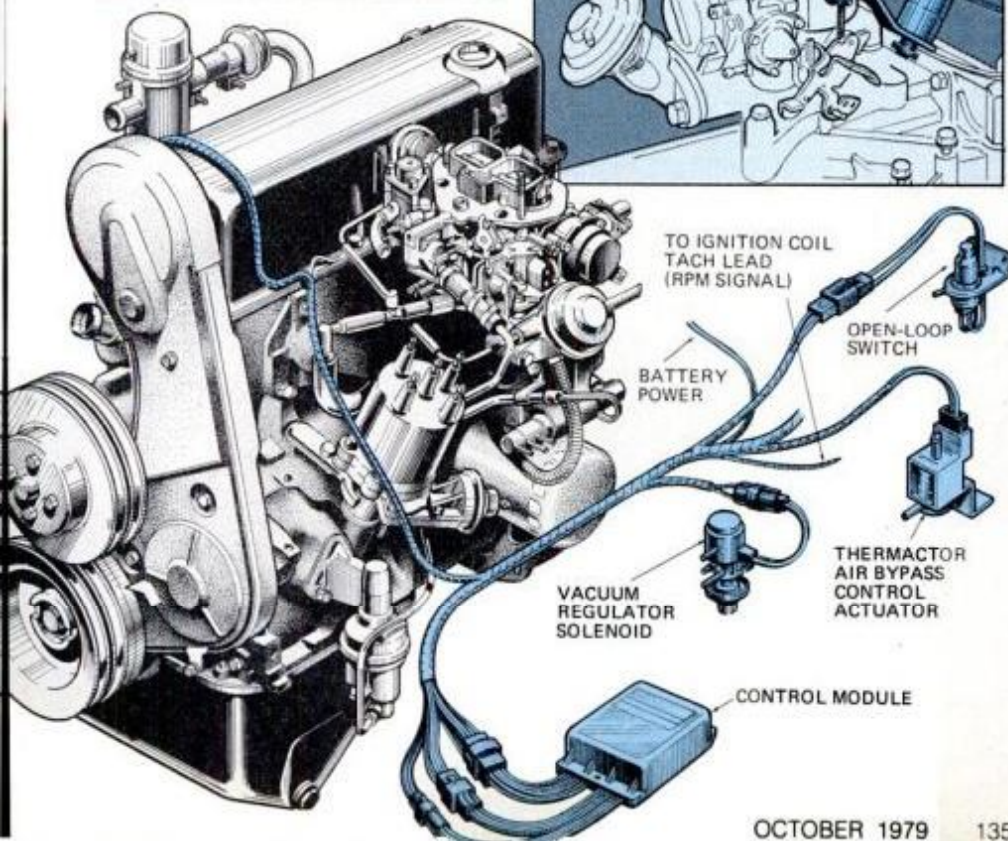
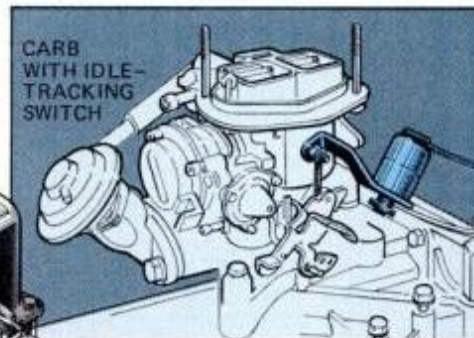
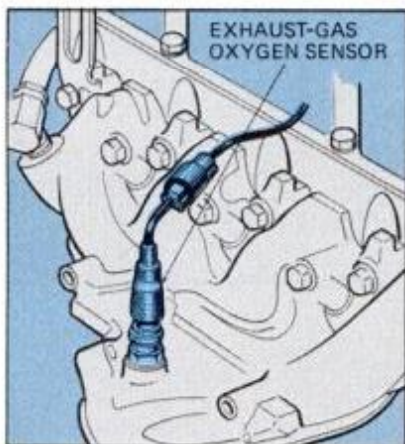
Ford hopes to have the test procedures worked out for 1981 EEC-equipped cars, then will backtrack to produce manual checkouts for earlier systems, too. Eventually, it will put the diagnostics on board, as GM is doing, so not only won't you need special equipment, but the on-board computer will help in trouble-shooting.

To prove its intentions are right, Ford pointed to two developments: first the MCU (Microprocessor Control Unit), which will appear on 1980 California cars with the 2.3-liter Four (Fairmont-Zephyr, Mustang-Capri, Pinto-Bobcat), and throttle-body injection. As it is being introduced, MCU does no more than run a solenoid vacuum valve that regulates vacuum supply to a fuel mixture on a feedback carburetor, plus the air pump.

The MCU control module (a small computer) receives an rpm signal from the electronic ignition, an exhaust-gas-oxy-

(Please turn to page 138)

Location and connections for all components of Ford Microprocessor Control Unit (MCU) on 2.3-liter Fours in California, are shown. Unit controls air-fuel ratio by changing air-fuel mix of feedback carb for best three-way catalyst efficiency.



Contents

Saturday Mechanic:

- Servicing the Ford and Lincoln-Mercury models
- Servicing the General Motors models
- Servicing the Dodge, Plymouth and Chrysler models
- Servicing the American Motors models

Service tips:

1. Lubrication
2. Ignition
3. Fuel system
4. Emissions control
5. Battery
6. Brake system
7. Transmission
8. Tires and wheels

Prepared by the editors of Popular Mechanics with technical art by Fred Wolff, Ken Taylor and Pat Ruggero. Design of the Fall Car Care Guide by Don Mannes.

Материал, защищенный авторским правом

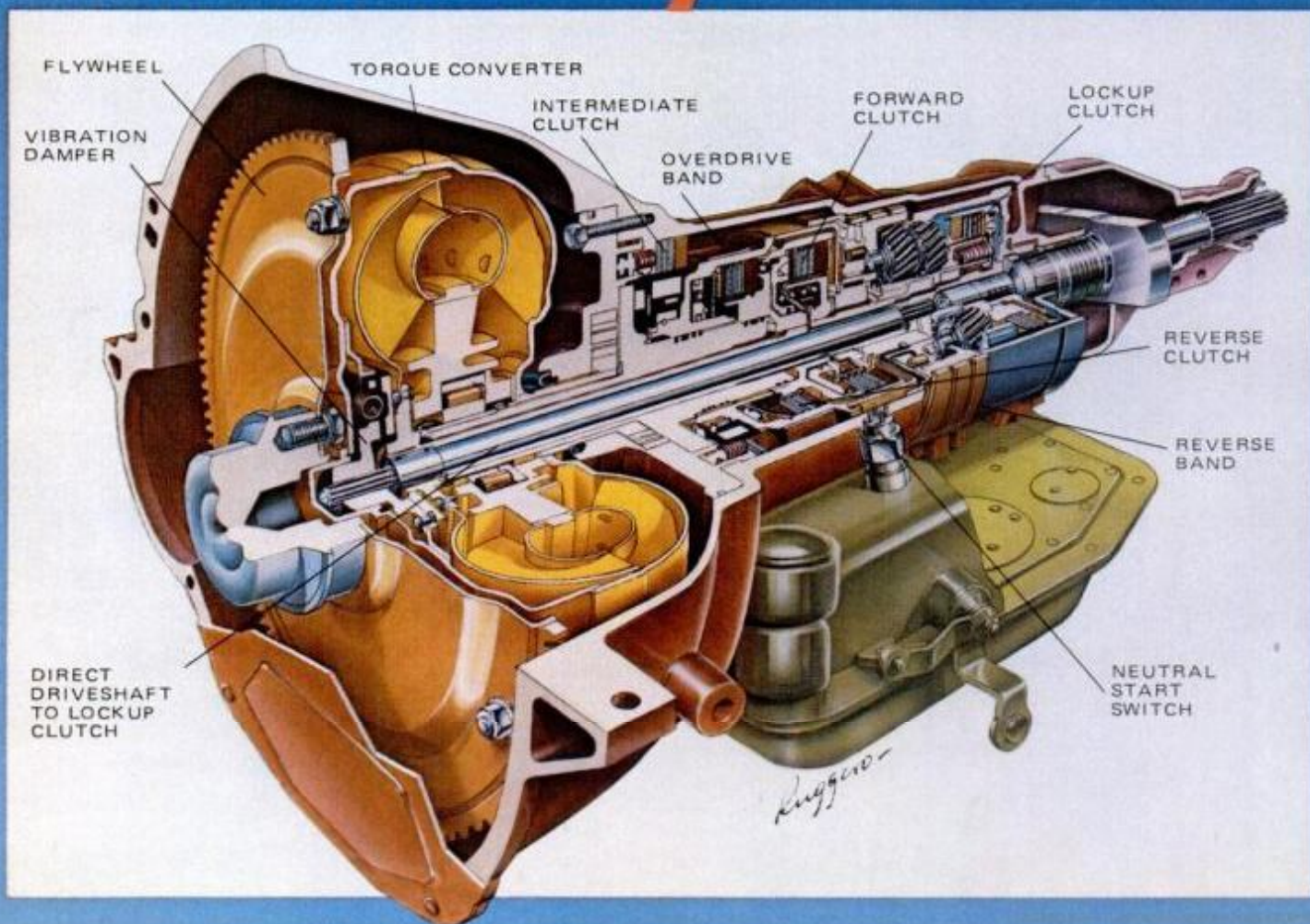
Spotlight on the 1980 T-Bird

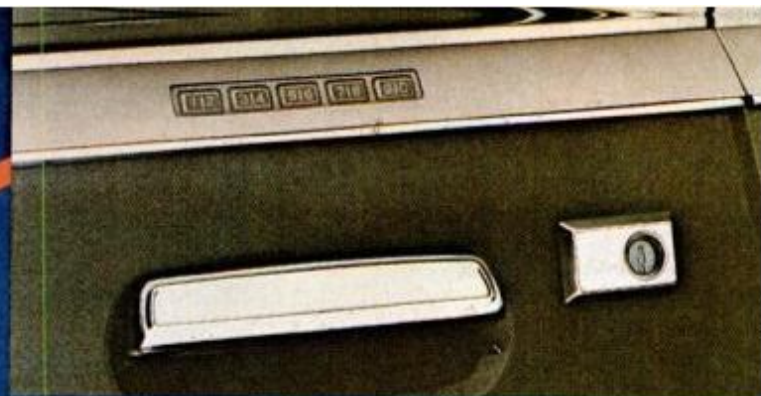


PM Art: Ken Taylor

Automatic overdrive transmission

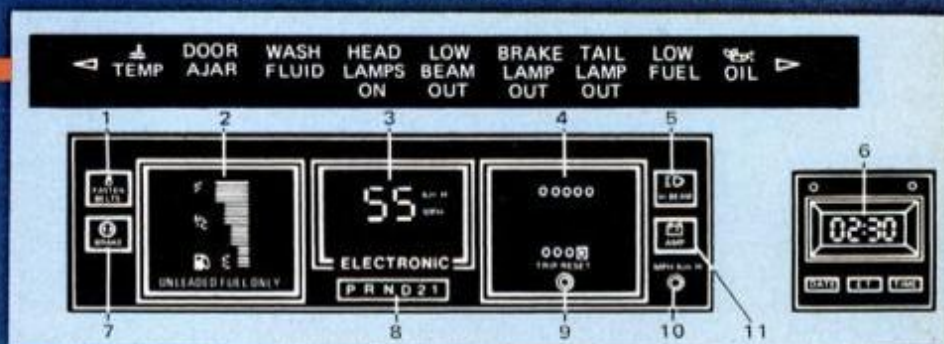
Automatic transmission with overdrive fourth adds to fuel economy. Transmission has no-slip power flow in overdrive, more efficient torque-converter blade design for less engine load at idle. Shift quadrant has six positions: P, R, N, D, 3 and L. In D, transmission shifts through all forward gears. In 3, the overdrive gear is locked out.





Keyless Entry System

Pushbutton door locking, unlocking and trunk release is done from outside driver's door. Row of five buttons is connected to a minicomputer programmed for your five-digit, coded number. At night, buttons are backlit, and interior lights are turned on by pushing the first-digit button.



- 1 Seat-belt warning
- 2 Electronic fuel gauge
- 3 Electronic speedometer
- 4 Odometer
- 5 Hi-beam indicator
- 6 Electronic day/date clock
- 7 Parking brake warning
- 8 Shift indicator
- 9 Odometer/reset button
- 10 Mph/kmph selector
- 11 Alternator warning



FUEL-PRESSURE
REGULATOR

THROTTLE
BODY

COLD-START
FUEL
ENRICHMENT

SCHRADER
VALVE

INJECTOR
CONNECTOR

INJECTOR

Electronic instrument panel and message center

Digital speedometer readout dominates center position of new electronic instrument panel. Accuracy is greater than that of conventional speedos and annoying fluctuations in digits with small changes in speed are eliminated by a damping circuit. Switch converts readout from mph to kilometers per hour. Electronic fuel gauge features accurate fluorescent bargraph display. Information displayed on main panel is shown by keyed numbers (above left). Above main panel in upper tier of dash is diagnostic warning-light module with indicators for such functions as headlamps left on, brake lamps out, low washer fluid and so on.

Electronic fuel injection

Replacing conventional carburetor on 5.0-liter V8 is throttle-body fuel-injection system. Fuel under high pressure is supplied to injectors which direct atomized spray of fuel into airstream above throttle plates. Fuel-pressure regulator maintains

constant 39 p.s.i. at injectors. Excess fuel is returned to fuel tank. With EFI, fuel distribution to each cylinder is improved for better economy, lower emissions and optimum drivability. As with a carb, air cleaner fits over throttle body.

Servicing the Ford and Lincoln-Mercury models

gen pulse from the oxygen sensor in the exhaust manifold, a foot-on-the-gas-pedal signal (indicating curb idle or fast idle) from something on the carb called an idle-tracking switch, and, finally, a vacuum signal from a vacuum-operated "open loop" electric switch.

The system is designed to go into "open loop" (fixed mixture setting) whenever the engine is cold, at warm idle (foot off the gas pedal), or at wide-open-throttle.

The idle-tracking switch on the carburetor tells the computer if the throttle linkage is against its stop, because when your foot is off the pedal, the switch plunger is pushed open by the throttle linkage.

An electric switch, pulled open by engine vacuum and closed by a spring, provides the signals to the computer on engine temperature and whether or not the throttle is wide open. The switch receives vacuum from a thermostatic vacuum switch threaded into the water jacket (which in turn gets vacuum from a port at the carburetor throttle plate).

When the engine is cold, the thermostatic vacuum switch is closed and no vacuum can get to the vacuum-electric switch, so this switch remains closed. When the engine is warm, the thermostatic vacuum switch opens and vacuum can get through. As soon as you hit the gas pedal, the vacuum pulls on a diaphragm, which opens the electric switch. At wide-

open-throttle, carburetor vacuum drops and the electric switch closes.

To execute the mixture decisions it makes, the control module actuates a solenoid vacuum regulator, which is the vacuum-electric switch in reverse. Electricity from the module controls the solenoid-operated (electromagnetic) regulator, which permits or blocks the flow of engine vacuum to a diaphragm device in the carburetor. The diaphragm is tied to a tapered metering rod in a fuel or air bleed passage. When the diaphragm moves, so does the rod.

When the solenoid vacuum regulator is closed (no vacuum), the metering rod is set for a rich mixture. When the regulator is wide open, allowing maximum vacuum flow (5 inches), the mixture goes lean. In practice, the regulator normally provides an in-between amount and only small changes occur. Even if the system fails completely, the mixture range it covers is so small few motorists can detect it.

The air-pump system control also is a solenoid wired to the control module. The control module supplies or denies current to the solenoid, which allows airflow to the exhaust manifold or opens a vent to atmosphere or, on California cars with three-way catalysts, is part of a system that can switch airflow to a point between the catalysts. This arrangement is somewhat similar to what Ford has used on EEC, which is installed on 302- and 351-cube V8s.

MCU is a true computer. It's designed to provide checkout data with nothing more sophisticated than a volt-ohmmeter. There are two wires with connectors hanging from a harness at the right rear of the engine compartment. Ground the wire with the brown connector and probe the wire with the gray connector. Then follow a specified procedure and you'll get readings on the meter that you can interpret, such as a steady dither, pulsation from

zero to half-scale, a steady reading at a certain number and so on. Each meter reading is a signal from the MCU memory and you just read the instructions in the shop manual to interpret it. If you exhaust the test range of the two connectors, the instructions tell you to head for the control module connector. Take it apart, probe the terminals as instructed, and anything that wasn't isolated earlier will be now.

Although most of the computer signals to the meter are with the engine at warm idle or certain test speeds, the computer also can signal with the engine off. Therefore, you can tell if the MCU system is a cause of a starting problem and, if it is, where in the system to look.

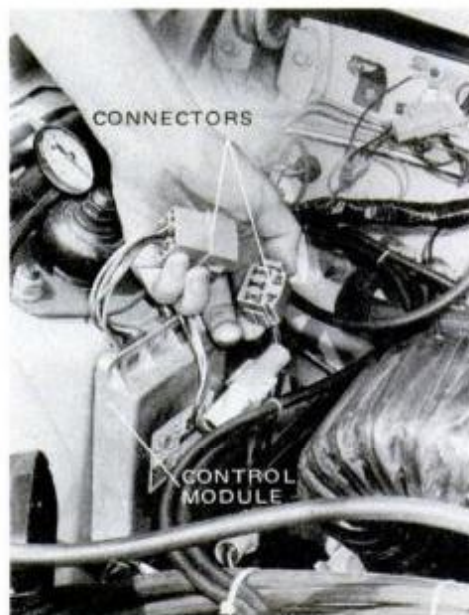
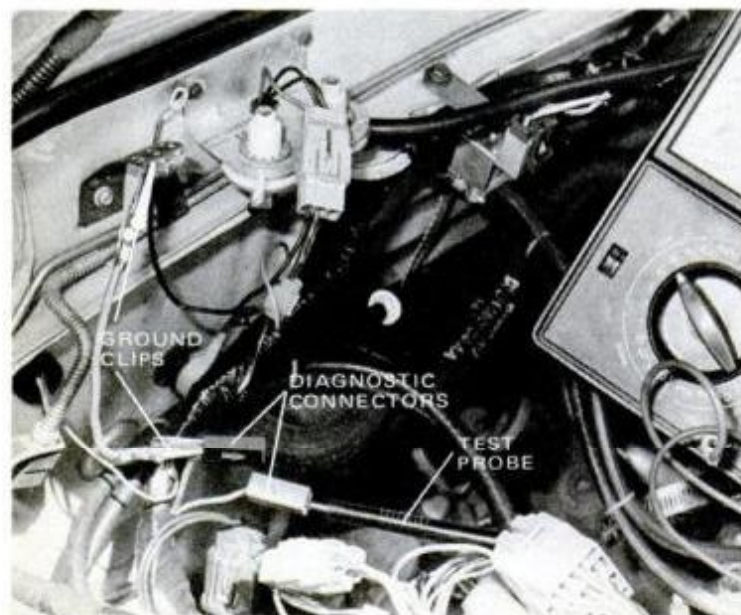
Throttle-body injection

Throttle-body fuel injection is on 1980 Lincoln Continentals with the 302 V8. This computer-controlled system uses a pair of electric injectors in a two-barrel throttle body that replaces a four-barrel carburetor. Fuel is supplied from an in-tank electric pump to the throttle body, where a regulator controls the pressure to 39 p.s.i.

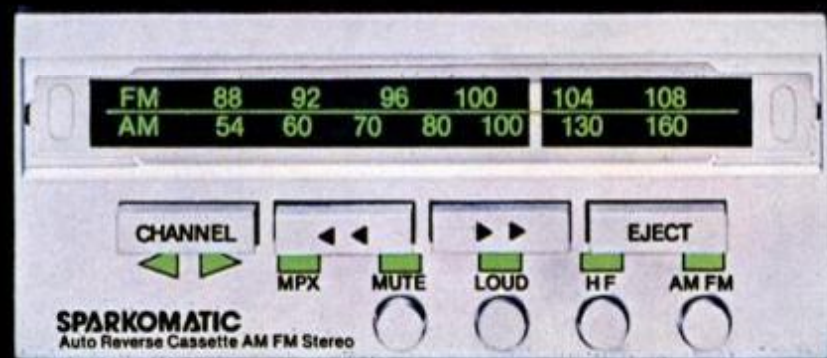
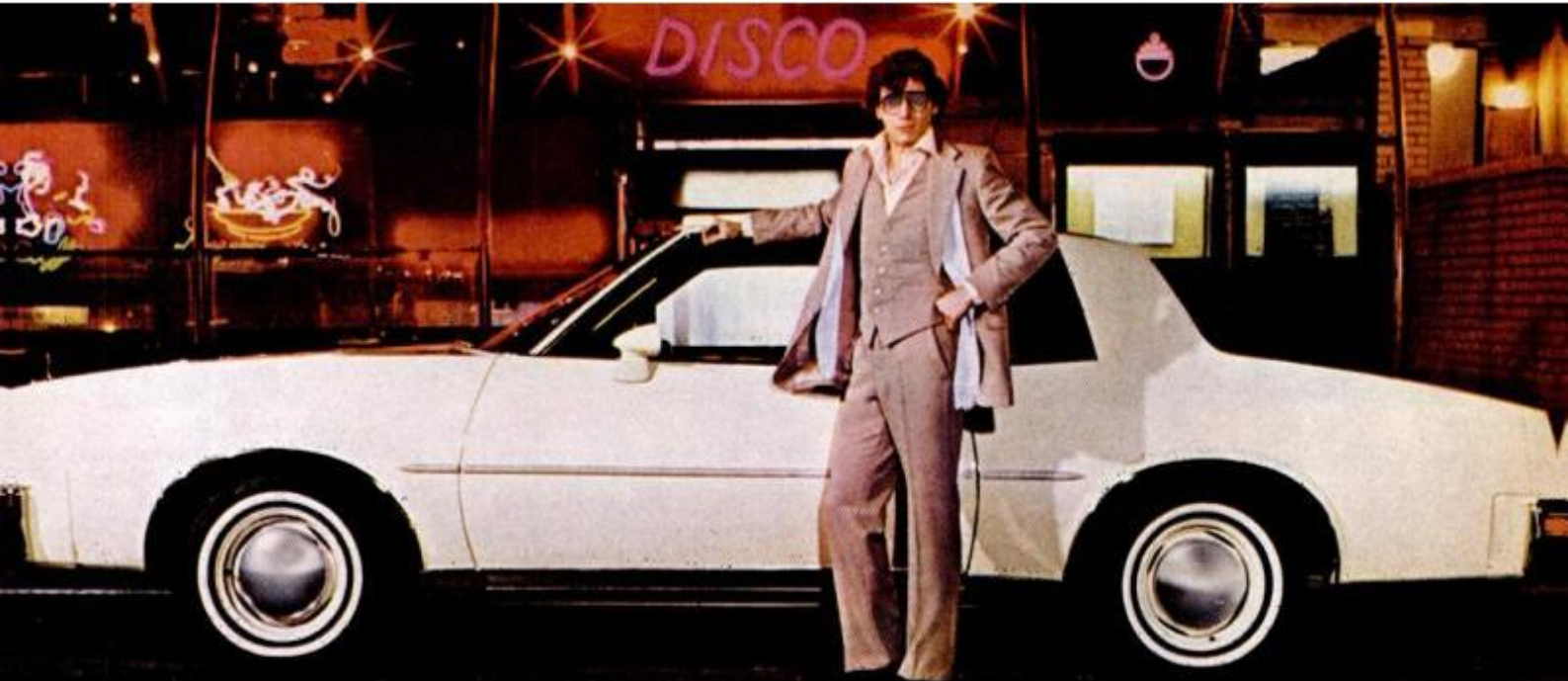
The pressurized fuel flows to the injectors, which are a solenoid type. When the computer supplies current, the solenoid pulls on a plunger, opening the injector and allowing the fuel to spray out. Although throttle-body injection doesn't provide as uniform a distribution to all cylinders as an individual injector at each port, it does offer improved mixing. As a result of the better mix, compared with a carburetor, the distribution to each cylinder is more efficient.

The computer is a variation of EEC-III, which is very close to EEC-II. This means you must use the Ford EEC tester for most of the system, until the manual procedure is available. Throttle-body injection, however, can be tested indepen-

(Please turn to page 173)



Checkout of MCU oxygen sensor, idle-tracking switch, solenoid vacuum regulator and open-loop switch can be done with volt-ohmmeter (far left). The two diagnostic connectors are at right rear of engine compartment. Further checks can be performed at the MCU control module connector (left). Control module location is under hood, as shown here or, on some Ford models, under the dash.



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**CARS
1980**

Servicing the GM models

The Cadillac Seville is GM's only really new model. The car is spun off the front-drive Toronado-Riviera-Eldorado, but no one can accuse Caddy of copying any domestic car with its very controversial rear-end styling. And its new fuel-injection system is the most advanced on today's market.

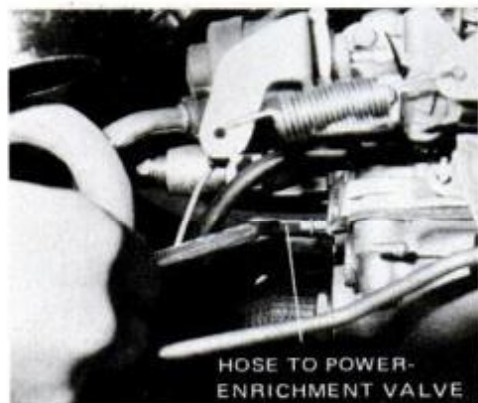
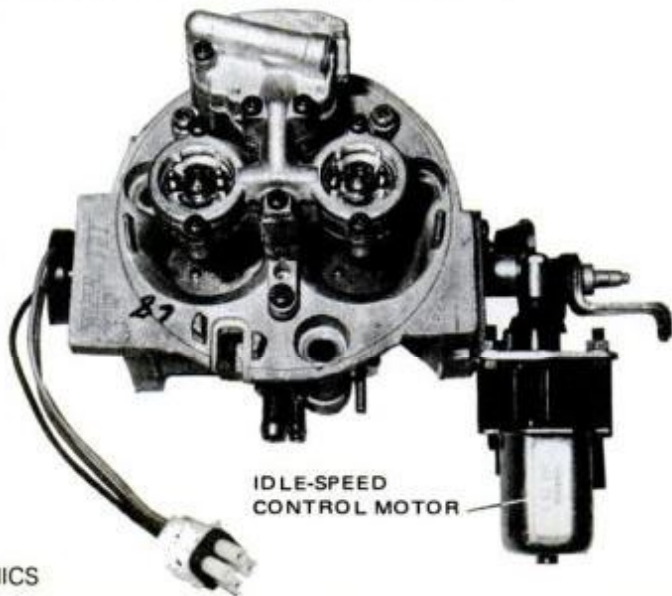
This system is the throttle-body type—two barrels with an injector for each one, replacing the carburetor. In Caddy's case, it replaces the eight-injector system that will be used only in California (along with the 350 V8). The two-injector system is installed on gasoline-powered Eldorados and Sevilles, which have a smaller (six-liter, 368-cu.-in.) version of the seven-liter (425-cu.-in.) V8 used on larger Caddies through 1979. (A four-barrel carburetor version of the 368 V8 is used on the larger Cadillacs in 1980).

Throttle-body injectors are the solenoid type controlled by a computer, and there is a Schrader valve for fuel-pressure checks (in the fuel line, not on the throttle body), much like the Ford system. The resemblance ends there.

Cadillac's injectors operate at only 10 pounds per square inch (p.s.i.), a clear-cut engineering achievement. Previously, all of the electronic-injection systems (including the one with eight injectors used by Cadillac) has operated at about 39 p.s.i. for an optimum spray pattern. The lower pressure not only is safer but increases system reliability.

The Caddy system also is the first available nationwide (except California) to eliminate completely the idle-speed adjustment in favor of an automatic control,

Replacing carburetor on a Cadillac Seville is a throttle-body fuel-injection system that uses two injectors and an automatic idle-speed control (right). A motor-driven plunger actuates the throttle linkage to set the idle speed for whatever value the computer determines. Fuel-pressure check in the lines is made at a Schrader valve (far right).



Turbocharging the 301 Pontiac V8 requires changes to handle 30-percent power boost. You'll find a power-enrichment valve control and detonation sensor on intake manifold (below). Check hose to valve (below, left) if engine hesitates on acceleration.

POWER-ENRICHMENT VALVE CONTROL

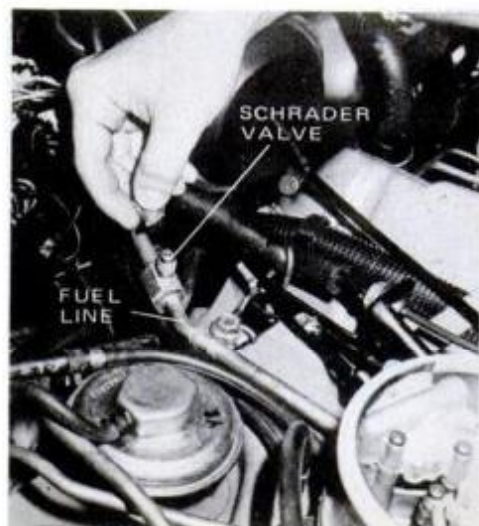
DETONATION SENSOR

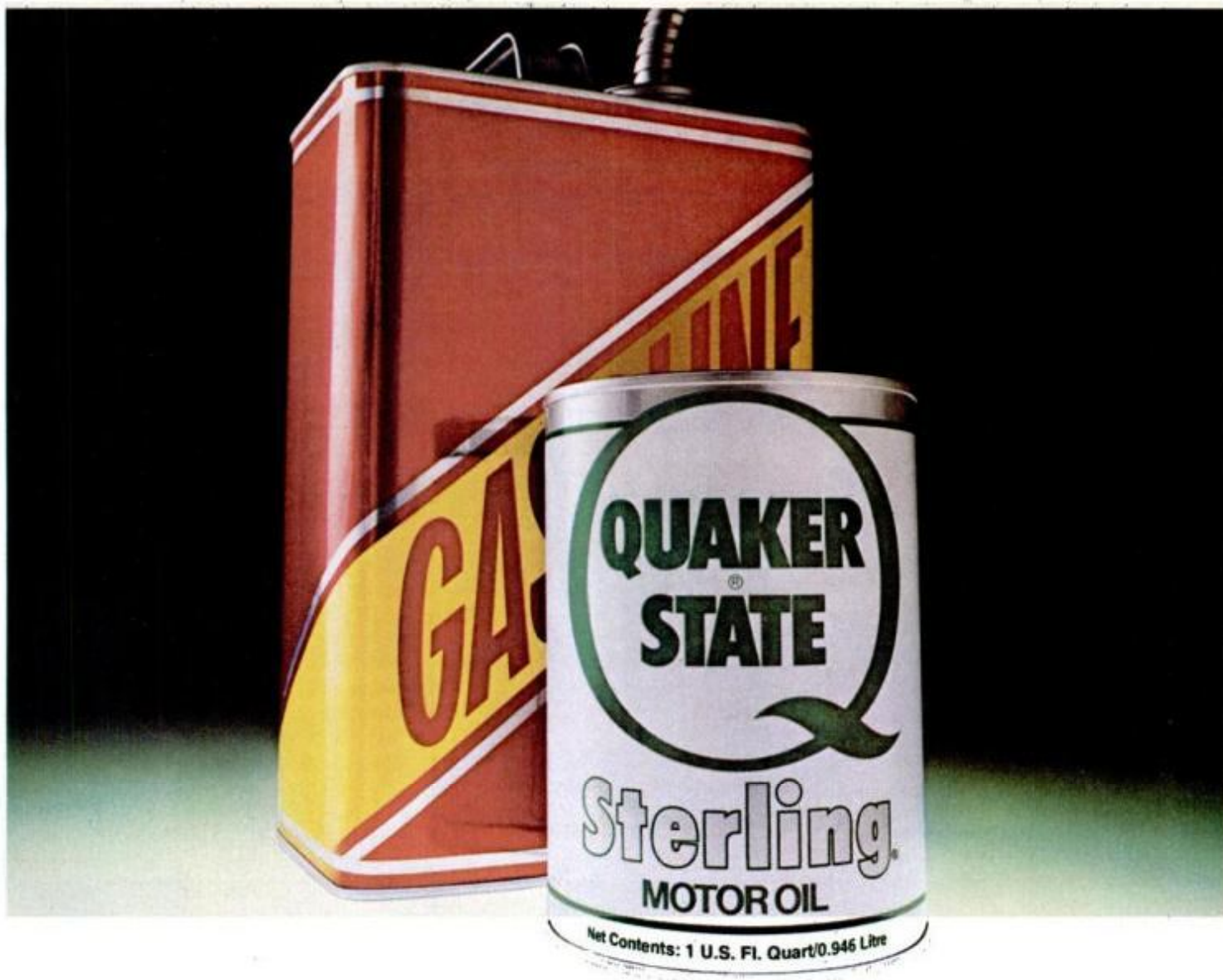
with a motor-driven plunger that bears against the throttle linkage. Controlled by the computer, the motor can move the plunger to hold whatever idle speed the computer says is right for operating conditions. Turning on the airconditioning increases engine load, and the computer automatically compensates for the drop in idle speed by operating the motor plunger until idle speed is back up to specs. Idle speed is just a number in the computer memory, so the computer also makes adjustments to compensate for aging of parts in the linkage.

Chrysler has had automatic idle control in a throttle-body injection system in several hundred field-test cars out for a year or so. You'll see variations of computer-controlled idle speed on carburetors or throttle-body injection systems on many cars sometime next year. But right now, the Caddy is the only one you can buy almost everywhere.

Cadillac's computer draws information from sensors for coolant temperature, air/fuel mixture temperature (threaded into the intake manifold), intake-manifold

(Please turn to page 142)





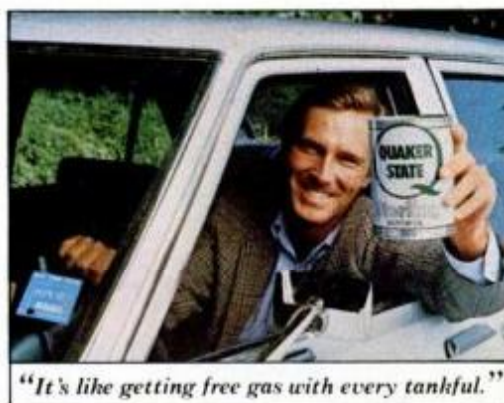
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"It's like getting free gas with every tankful."

Servicing the GM models



Temperature controls optional on Buick Electra use all-electronic, touch-switch panel, computer and motors (not vacuum switches, diaphragms) to work flap doors, ducts.



Easier servicing of GM airconditioning systems is the advantage of a new pressure switch. It's found on the accumulator.

pressure (actually a partial vacuum) and barometric pressure, plus engine speed from the ignition system.

If any sensor fails, the computer substitutes a predetermined value that will permit acceptable engine operation. If the computer loses its ability to compute, it automatically substitutes a predetermined fuel-delivery rate, idle setting and spark advance, so the car can limp home.

In most cases, system failures will not be in the computer, so the computer can be used to diagnose failures in the circuits it controls. In this department, Caddy has

an arrangement that could turn even the affluent owner into a do-it-yourselfer.

The car has an automatic-temperature-control air conditioner with a digital display panel. If the CHECK ENGINE light on the dash goes on, just press the WARMER TEMPERATURE and OFF buttons on the a.c. panel simultaneously, and you'll wed the display panel to the computer. If anything is wrong, a failure code number will be displayed in place of the temperature reading. A chart will tell you what has gone wrong.

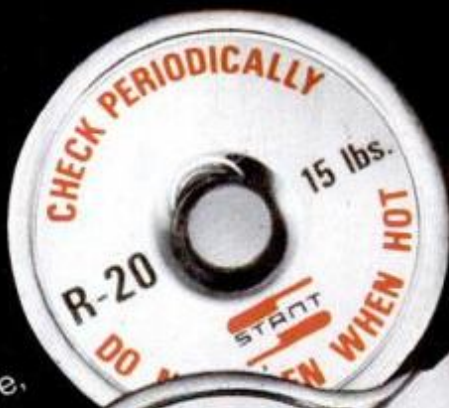
The computer will diagnose problems in fuel and ignition systems. It doesn't

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When your car is checked for fall, whether you do it or your service station does, take a good look at the radiator cap, or one of low quality, may not keep your cooling system pressure within safe limits. So when you replace the cap, take another good look. Look for Stant. Don't settle for just any cap. And for extra safety, install a Stant Lev-R-Vent® Pressure Cap... the safest, most dependable radiator cap available anywhere. And for expert tips on cooling system care, write for "The Stant Cooling System Fact Book." Send 25¢ to:

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check the exhaust-gas recirculation (EGR), which is also under its control, but that's just an off-on solenoid that can easily be tested manually.

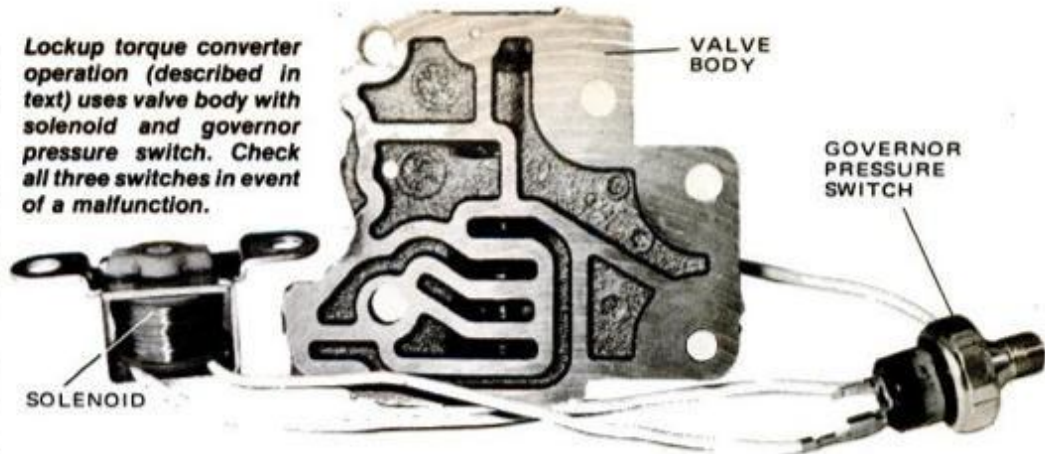
The new Cadillac computer is even a step ahead of what the rest of GM has just started using: a Computer-Controlled Catalytic Converter, or C-4 for short. The C-4 made its debut in California on some late 1979 3.8-liter Buick V6 engines and the early-1980, front-drive compacts. In the 1980 model year, it will go in most California cars and some 3.8-liter Buick V6s in the other 49 states.

The C-4 is a digital computer in a car with a three-way catalyst system, and although the one currently out does no more than run a feedback carburetor system, it is capable of a lot more. As it presently stands, however, C-4 uses these sensors:

- Coolant temperature.
- Oxygen in the exhaust gas.
- Throttle position, or . . .
- A string of three vacuum-electric switches that indicate idle, part-throttle and wide-open throttle. The switches are connected somewhat differently from engine to engine.
- Engine-speed signal from the distributor.

The key signal is from the oxygen sensor, for it is the one that indicates the ratio of the mixture that burned in order to form the exhaust gas.

Lockup torque converter operation (described in text) uses valve body with solenoid and governor pressure switch. Check all three switches in event of a malfunction.



The computer uses information it gets from the sensors to operate a solenoid in the carburetor. When the solenoid is fully energized, it pulls down tapered metering rods, in fuel and air passages, to lean out the mixture. When the solenoid gets a current signal, a spring moves the rods the other way, to enrich the mixture. Because the signal is one that varies in pulse time, it can be checked with a dwell meter.

So although your dwell meter is obsolete for electronic ignition, be certain to hold on to it. Apparently it will be making something of a comeback.

Under cold engine, idle and wide-open throttle, as with other feedback carburetor systems, the fuel-mixture adjustment is fixed (on the rich side), a condition called "open loop." When the mixture is under

computer control, the condition is called "closed loop."

C-4 is designed to be largely self-troubleshooting. Even as it becomes more complex, adding electronic spark advance, air pump, EGR and many other controls in 1981, you'll be able to find out most of what's wrong from the computer.

If the CHECK ENGINE light comes on, look under the dash for the computer and you'll see a wire with a green connector hanging down. Ground that wire with a jumper and a bulb on the dash will flash out a code. If you get, for example, one flash, pause, then five more flashes, that's one and five, or No. 15. Check a trouble-code chart and it says "Open in coolant sensor circuit."

The engine must run a while before this

(Please turn to page 176)

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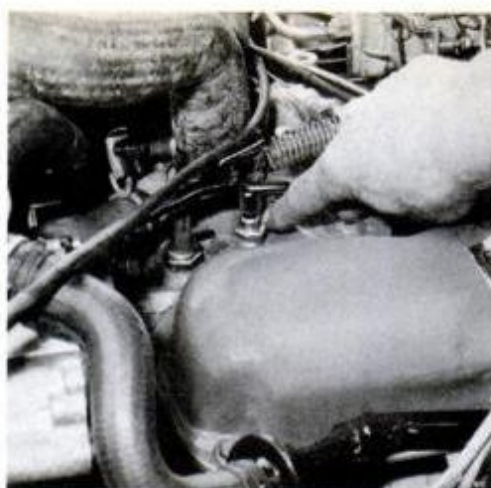
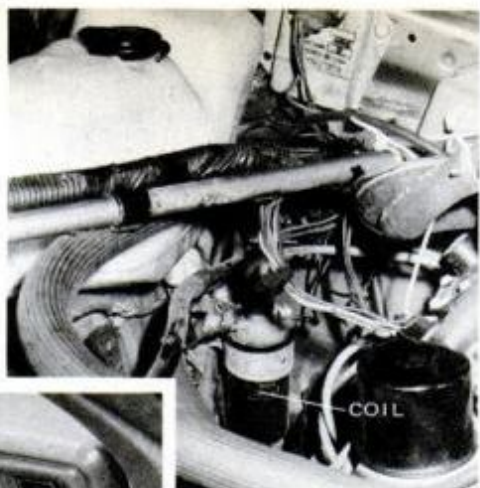
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Mirada and Cordoba glovebox (left) removes easily, leaving a huge opening for access to heater and air conditioner ductwork, some vacuum controls and electrical connectors. On the slant Six and 318 engines, you'll find the coil more accessible (above, left). Periodic checks of the NOx sensor (above, right) are quick because of its easy-to-reach position.

Servicing the Dodge, Plymouth and Chrysler models

Stiffer 1980 emission controls brought back the air pump on 1980 Chrysler products, and most other cars, as well, but many other underhood changes will make the Chrysler lineup easier for you to service.

The change that Saturday mechanics probably will applaud the loudest is the relocation of the ignition coil on compacts and intermediates with the slant Six or 318 V8. The coil now is at the right rear of the engine compartment, and there's no problem getting to the terminals to disconnect the primary wires, or hook up a meter for ignition system testing. On the

1979-and-earlier Sixes, the coil is mounted low, difficult to reach.

The pre-1980 318 is almost as bad. The coil is right next to the rear-mounted distributor, and unless you take off the air cleaner assembly, making a connection or disconnection is a struggle.

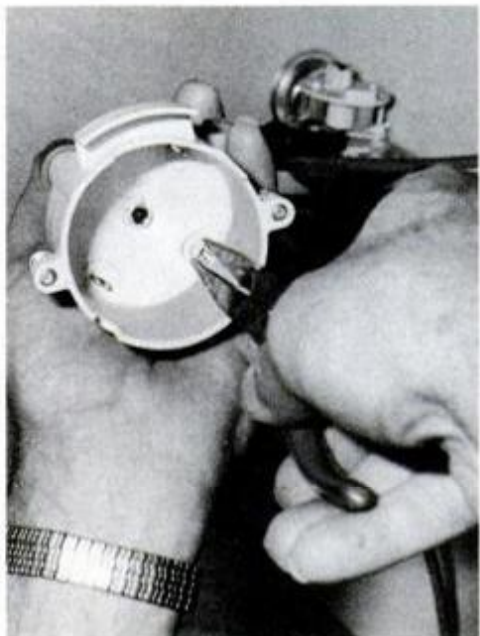
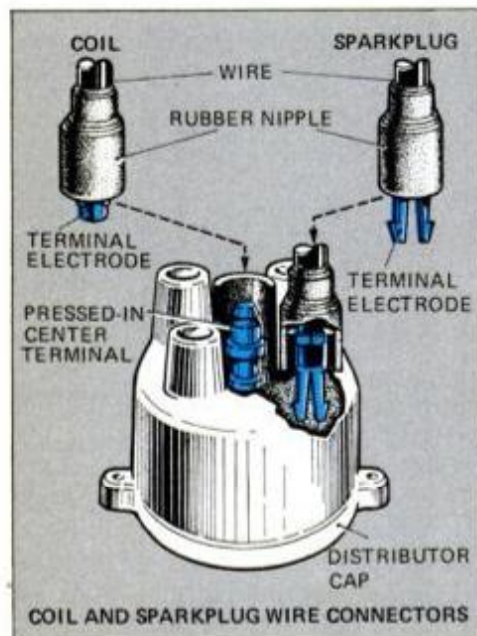
Chrysler has made a number of other ignition changes, including a detonation-sensing spark-retard system on 1980 V8s, which already are equipped with a spark-advance computer. The computer sets spark advance at the maximum possible at all times, so there is the chance of a knock under various conditions.

The knock sensor is threaded into the intake manifold. You can check the system by hammering on the intake manifold next to the sensor. The sensor signals retard in four steps of 2.7° (about 11° total). The faster you rap, the greater will be the retard, which you can measure accurately with a timing light (or the rpm drop with a tach).

The front-drive Omni-Horizon also receives some significant changes in the ignition system. The computer is gone for 1980 (it will be back in 1981), replaced by a simple vacuum and mechanical-advance distributor.

The Omni-Horizon distributor cap also has a unique method of holding the sparkplug wires. The usual ring of plug wire terminals is gone, and instead there's just a bunch of holes. Each plug wire terminal has an electrode with two spring tangs that fit through the hole. The tangs then expand and lock against the inside of the cap. The wire can't come out unless you remove the cap, reach inside, squeeze the tangs together with pliers and push out. Not only do the tangs lock the wire in place, but they serve as a contact for the transfer of the high-voltage electricity from the rotor tip.

The new design eliminates the common problem of engine misfire caused by



Distributor caps on the Omni and Horizon have a positive-locking feature that secures sparkplug wires. Terminal electrodes on the sparkplug wires must be squeezed from the inside of the cap to release them.

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FALL CAR CARE

MANUFACTURERS

By Peter Noznesky, Chairman of the Board
Automotive Parts & Accessories Association

For the past seven years during the month of May, "Car Care Month" has been co-sponsored by the Automotive Parts & Accessories Association and POPULAR MECHANICS.

The active support of Manufacturer and Retailer members of the APAA is an indication of the high level of interest in car care products and service.

In recognition of the continuing need for Car Care information throughout the year, "Fall Car Care" has been added to the program beginning this year.

Hundreds of newspapers have cooperated by featuring special Car Care sections providing information to help improve the quality of car maintenance and efficiency.

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Champion Spark
Plugs



Easy Car Care,
Chilton Auto Repair
Manual



Spark Plugs,
Oil Filters,
Air Filters,
Batteries,
Spark Plug Wire Sets,
Tune-up Kits



Dowgard



Rain Dance Car Wax,
Rally Car Waxes



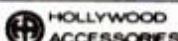
Spark Plugs, Batteries,
Oil Filter, Shock
Absorbers, Ignition
Wire Sets, Tune-up Kit



Halogen Headlights,
Regular Headlights,
Miniature Lamps



Holley Performance
Carburetors,
Holley Dominator
Intake Manifolds
Holley Economaster



Snoopy Air Freshners



J/Wax Car Plate



*Kendall's 10-W40



Wheel Locks



Radial-Matic
Shock Absorbers

Nation/Ruskin, Inc.

The Squeegee



PEAK Antifreeze &
Coolant, Cooling System
Protector, Cooling System
Sealer, Gas Line
Antifreeze, Cooling
System Cleaner
Cooling System Flush



PRODUCTS COMPANY

DEMPC Kit,
Emission Control
Tune-up Kit



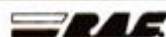
Olin Safety Flares



The Hot One
High Oil Temperature
Filter, Purolator Import
Car Filters, 15,000 Mile
Dual Oil Filter



Sterling Motor Oil,
Deluxe Motor Oil,
Super Blend Motor Oil,
HD Motor Oil,
Oil Filter, Air Filter



RAC Digital Dwell-
Tach-Tester,
RAC Digital
Volt/OHM/AMP Tester,
RAC "Dual-A-
Pressure" Foot Pump,
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Timing Light



Two-Fister Set



Basic Car Care
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STP Gas Treatment,
STP Son of a Gun!
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Rislone Engine
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Inductive Timing Light,
Complete Tune-up Kit



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Conditioner



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Socket Set



TMT-The Teflon Motor
Treatment



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Wix Oil Filters



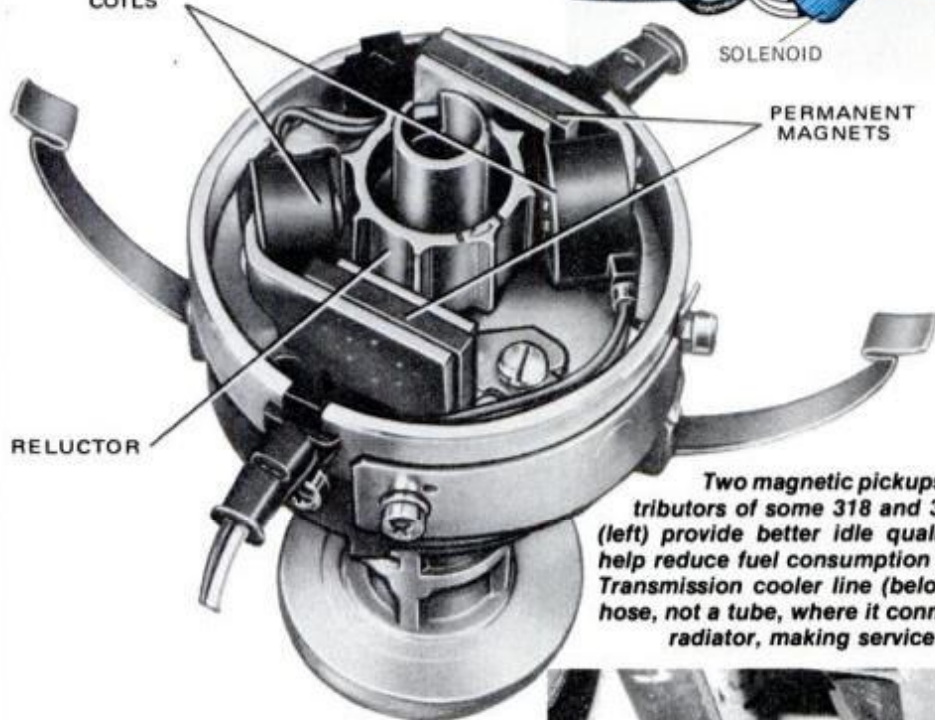
Body Shop Kit,
Pizazz,
Super Glue-3



ESPREE'S Mag
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Wheel Polish,
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Wheel Cleaner Kit

Servicing the Dodge, Plymouth and Chrysler models

PICKUP
COILS



Two magnetic pickups in distributors of some 318 and 360 V8s (left) provide better idle quality and help reduce fuel consumption at idle. Transmission cooler line (below) is a hose, not a tube, where it connects to radiator, making service easier.

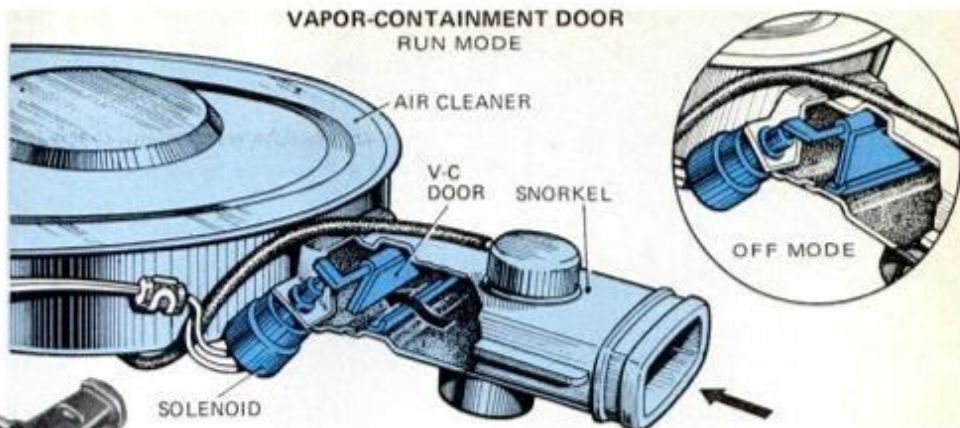
loose plug wire connections and corroded terminals in the cap. If you want to check a plug wire for resistance, you don't have to disengage it from the cap. The terminal in the cap is the same one that's in the plug wire, so just clip your ohmmeter directly to it.

The coil wire is installed in the conventional manner, on a contact pressed into the center of the cap. This allows easy removal for ignition system testing.

Easy-out

The Cordoba and Dodge Mirada are the company's new models for 1980, and they feature front-service dashboards. One new item is a glovebox that comes out after removal of a few screws, providing a huge access area to heater/airconditioning ductwork, some vacuum controls and electrical connectors.

All 1980 Chrysler products will have another serviceability feature that should prove popular: The tubing from the automatic transmission to the oil cooler in the bottom of the radiator is not all metal with a threaded connection. Rather, the tubing ends about 6 inches short of the radiator, and the remainder of the connection is flexible hose, connected to the tubing and the oil cooler necks with worm-drive clamps. No more worrying about corroded



Door in snorkel prevents vapor escaping into atmosphere. In run mode, solenoid opens door 21°, then airflow takes over.

(without feedback carburetion) has an electronic wrinkle that resembles the original Lean Burn computer system: a distributor with two pickup coils—one for starting and idle, a second for off-idle.

The original idea of the start pickup was to provide an extra measure of reliability and divorce the computer from the starting operation. The engine can start and run on either pickup, so if the off-idle pickup fails, you just won't get spark advance and performance will be poor. If the start pickup goes, you'll start on the off-idle pickup, but it will be tough because you'll get twice as much spark advance as from the start pickup, and that will put a strain on the starter. In either case, the problem will be obvious and can be pinpointed with a timing light. Both pickups are easily removed from the distributor.

In 1980, however, the dual-pickup design provides an important extra benefit: smoother idle. By starting and idling the engine on a separate pickup, Chrysler can lock the ignition system to the engine at idle. Engine speed actually varies slightly through each single revolution at idle, and by the time the computer can make a correction (at the end of a revolution), it's too late.

Evaporative emissions

Tough new evaporative emission standards in California have produced some changes at the air-cleaner housing. On most models, the air-filter element is a special two-layer design: an inner pleated paper sheet and an outer fiber, treated with carbon particles to absorb fuel vapors that evaporate from the carburetor barrel when the engine is off. The filter elements are gray because of the charcoal, so they almost look dirty when new. Take a look so you can make a comparison between gray and dirty.

On four-barrel carburetor V8s, there is a vapor-containment door in the air-cleaner snorkel instead. When the engine is off, the door swings closed and prevents vapor escape through the snorkel

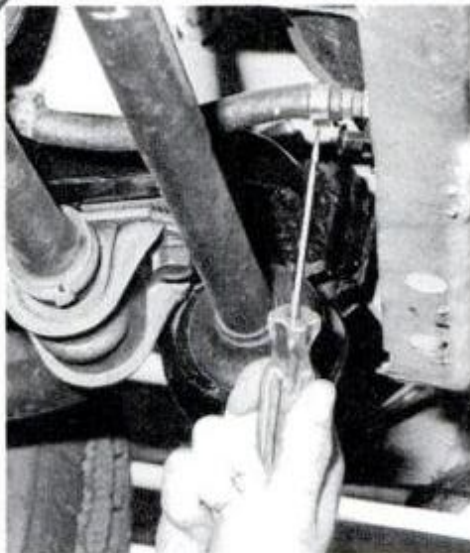
(Please turn to page 180)

ed connections and possible damage to the oil cooler when you have to remove the radiator for cooling system and front-of-engine service.

California cars

As usual, the boys in California get first crack at a lot of complex hardware on 1980 Chrysler products (and on the other makes, too). The carburetor is a feedback type, controlled by a digital computer that also operates the electronic spark advance.

The computer system used on all California V8s and the 49-states 360 V8



**CARS
1980**

Servicing the American Motors models

Would you believe little American Motors leading the industry into computer-controlled feedback carburetion? Well, it's true. All AMC-made Sixes in California and the other 49 states will be equipped with a computer, a carb with electrically-adjusted fuel mixture and a three-way catalyst. The other domestic carmakers have the system only on most California cars.

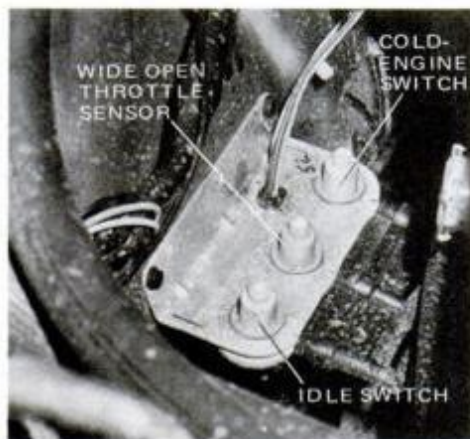
AMC doesn't need the system to meet 49-state emission controls on the Six, which is the only engine it still makes (the V8 is discontinued and the Four is bought from GM). However, the computer system does provide better drivability and fuel economy.

The computer is the Micro-processor control unit (MCU) from the same family that Ford uses on its California four-cylinder engines. However, the plumbing and wiring are strictly AMC.

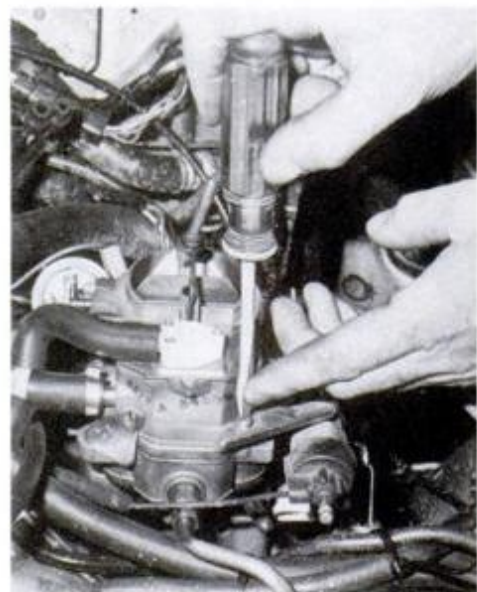
The most obvious difference between Ford and AMC installations is that AMC uses a stepper motor to control the fuel mixture, instead of vacuum as on the Ford system. The stepper, which can move forward or backward into any one of 100 positions, operates a pair of tapered metering rods that control fuel mixture richness by moving in or out of air bleed passages.

Three control switches

Next, the AMC system has three vacuum-electric switches, all in a row on the



Carb fuel mixture settings are controlled by vacuum-electric switches (above) on right side of engine compartment of Sixes. Remove the cover to reach the mixture-control on the feedback carb (right).

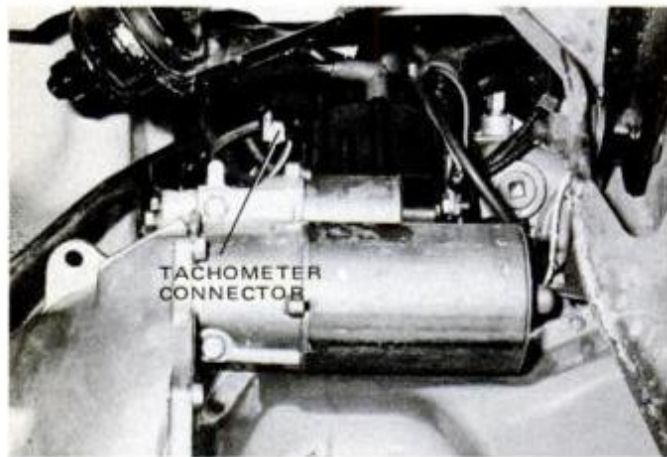


right side of the engine compartment. These switches open and close in response to changes in vacuum to provide signals to the computer. When triggered, each gives an "open loop" signal to the computer to tell it to stop controlling and put the carb on a predetermined fuel-mixture setting.

The rearmost switch provides the signal for open loop when the engine is cold. Its vacuum switch is connected through both a bimetal air temperature switch in the air cleaner and a coolant temperature switch threaded into the water jacket. The air switch is closed at under 55° F. ambient, the coolant switch at under 160° F. When either is closed, carburetor vacuum can't pass to the vacuum-electric switch, and so the switch remains open on all but

California models, on which it is normally closed. The computer interprets the lack of current flow (or current flow on California cars) as a cold engine signal and goes to open loop. When the air and coolant thermostatic switches open and allow vacuum to flow, the vacuum-electric switch closes (opens on California cars) and the signal that goes to the computer from the switch operation causes the computer to start controlling the carburetor mixture.

The middle vacuum-electric switch is a wide-open-throttle signal. On all cars the switch is open with vacuum flowing through. When the throttle is wide open and vacuum drops below 4 inches, the switch closes and current flows through to signal the computer. (Please turn to page 180)



Tachometer connector on the Pontiac-built four-cylinder engine (above) is viewed from underneath the car. It's a nightmare to reach, so AMC designed in a wiring harness with protective connectors that places a tachometer connector in a more convenient location. It's now inside at the top of the engine compartment, as shown at right.



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Lubrication

As one automobile model year has followed another, new cars have needed less servicing than their predecessors. Remember the 2000-mile motor-oil change recommended for, among others, the 1955 Ford? Now, 25 years later, many Ford models go 10,000 miles or six months between oil changes, whichever interval comes first.

Sparkplugs are another example. Until 1975, it was normal to replace plugs every 10,000 or 12,000 miles. Since then, the catalytic converter, unleaded gasoline and the electronic ignition system have lengthened intervals between engine tune-ups and spark-plug changes. In a new General Motors car, you can drive 22,500 miles before new sparkplugs are called for.

However, despite these and other advances, car care remains an important part of owning a new, as well as an older, model. Failure to maintain a car leads to

- Recurring mechanical headaches.
- Increased cost for fuel and repairs.
- Reduced vehicle life.

More often isn't too often

Those who are conscientious about caring for their cars often ask: "In maintaining a vehicle, should I follow the interval recommendations suggested by the manufacturer, or should I perform services more frequently?"

The more frequently you do certain services, the greater your chance of averting trouble. This does not mean you have to replace sparkplugs, air-cleaner filter, drive belts, shock absorbers and other parts before they have outlived their usefulness. A part should be replaced on an as-needed basis when an operational problem or an inspection tells you it is no longer performing properly.

There are other services that you should do on a mileage or time-period basis. These include oil and oil-filter changes, other fluid changes (automatic transmission, for example) and lubrication. They contribute to longer car life if done more frequently than the manufacturer recommends.

Engine lubrication and fluid-level inspection

The engine and some associated parts (brakes, radiator, transmission, for example) are fluid reservoirs. Fluids are a car's lifeblood. Without them, the car will not run or should not be run. This section discusses motor oil and how to change it; then, how to check some important fluid levels.

Oil lubricates engine components, reducing friction between moving parts and minimizing wear. Oil also cleans the engine, helps cool it, protects it against rust, and seals the cylinders. Most engines, depending on size, take a maximum of four to six quarts of oil.

Oil is stored in the oil sump (also called oil-

pan or crankcase), which is a storage pan attached to the bottom of the engine. An oil pump siphons the oil through a pickup and filtering screen in the sump, and pumps it into the oil filter.

The oil filter does the job of removing dirt particles held in suspension by oil. Eventually, the filter becomes loaded with contaminating matter. Thus, it has to be replaced.

Manufacturers insist that an oil filter need not be replaced every time oil is replaced. "Every other oil change is sufficient," they contend.

However, there are some who don't see the logic of contaminating four to five quarts of fresh oil with the one quart of dirty oil remaining in the oil filter.

Pressure forces the oil from the oil filter into

intervals reflect this critical point. If the car is driven under "severe" conditions, manufacturers suggest cutting the recommended interval in half. Severe conditions include using the car mainly for stop-and-go city driving, pulling a trailer or driving in desert areas.

Owners manuals provide manufacturer-suggested intervals. They also give the viscosity and type oil the manufacturer feels is best for your individual driving conditions. However, additional information regarding oil may be useful.

What viscosity numbers mean

Numbers you find on cans of oil—such as SAE 10W-50, SAE 30—are viscosity (or weight) numbers, which indicate the thickness of the oil. The higher the number, the thicker the oil.

SAE stands for Society of Automotive Engineers, which established the grading system, and W means the oil is intended for use in cold weather. The W designation is particularly important to keep in mind when temperatures drop to 32° F. or below. Above that level, oil having a viscosity number without the W works satisfactorily.

When you start an engine in cold weather, oil with a low viscosity number (for example, SAE 10W, SAE 5W-30, SAE 20W-40) flows readily, reducing friction that might otherwise make starting difficult. Oils with high viscosity numbers (SAE 30 or 40) become thick in cold weather and usually make it harder to start your engine.

However, there is a drawback to using oil with a low viscosity number. As the engine gets hot, oil gets thinner. An oil with low viscosity to begin with may not give the engine the protection it needs.

Since more than one grade of oil is usable over any one temperature range, you have to decide which is best.

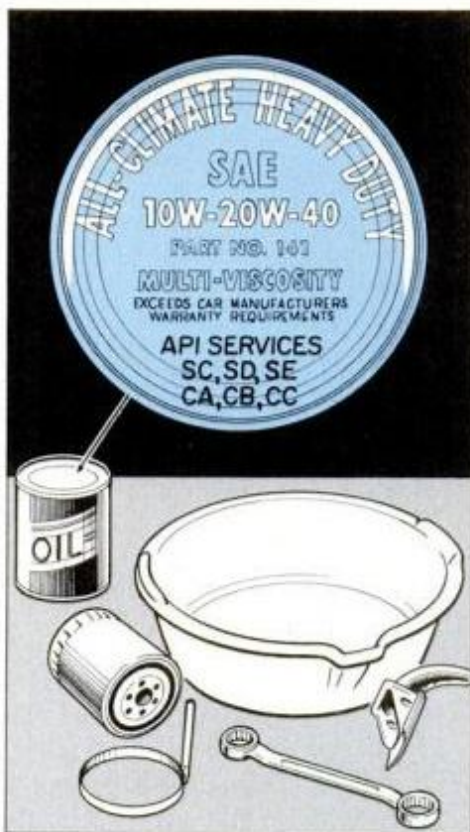
One of the most important points to consider in selecting the right viscosity of oil for your car is the type of driving you do. For instance, 10W oil may be ideal if you live in a cold part of the country and drive under ideal conditions. But if you make long trips and carry heavy loads in the car, you will need the cold-starting advantages of a 10W oil plus a higher viscosity oil to protect engine parts. You would, therefore, select a 10W-30, 10W-40, or 10W-50 oil.

Another factor to think about in choosing oil is whether to buy a multigrade or single-grade product. Single-grade oil is less expensive, but there are other considerations.

Multigrade vs. single-grade oil

Multigrade oils are those that have two numbers, such as SAE 5W-30, SAE 10W-30, SAE 20W-50. Multigrade oil allows engine starting in cold weather while providing the protection of high-viscosity oil when the engine is hot. Its

(Please turn to page 152)



Equipment you need for changing oil and filter. Get the right oil—"read" the can.

the engine and through galleries and passages to main bearings, connecting-rod bearings, camshaft bearings, rocker arms and other parts. In the process, the oil picks up and retains particles, and the oil additives and detergents begin wearing out. To avert engine damage that may be caused by a buildup of sludge formed by dirt-laden oil, oil should be changed before a critical point is reached.

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FALL CAR CARE GUIDE SERVICE TIPS

Lubrication

biggest advantage is that you don't have to change oil as the seasons change.

Multigrade oils contain special additives called polymers. As engine heat rises, the polymers change the character of the oil to prevent oil from thinning too much. Such oils are convenient, too, but no multigrade has quite as much high-temperature viscosity as the corresponding single grade. For instance, 10W-40 oil isn't as thick in a hot engine as a single-grade 40.

"You get a little better protection at high temperatures with a single-grade oil," Shell Oil Co. states. However, to take advantage of this protection, the oil generally has to be changed from one grade to another as the seasons change. An exception to this involves use of SAE 20W-20 oil.

Incidentally, if your car is burning oil, you can cut consumption until you are able to repair the engine by using a high viscosity single-grade oil.

What API letters mean

The American Petroleum Institute (API) tests motor oil for its ability to prevent wear, rust, corrosion, sludge and contamination. The oil is then classified. Letters designating the API recommended oil for your car should appear on the can of oil you buy. Classifications (see below) should be observed in selecting

API OIL CLASSIFICATION SYSTEM

Letter Designation	Description	For Use in (model year)
SA	Straight mineral oil.	Not recommended.
SB	Straight mineral oil with anti-oxidant and anti-cuff properties.	Not recommended.
SC	Meets automobile manufacturers' warranty requirements.	1967 and prior years.
SD	Meets automobile manufacturers' warranty requirements.	1970 and prior years.
SE	Meets automobile manufacturers' warranty requirements.	1980 and prior years.

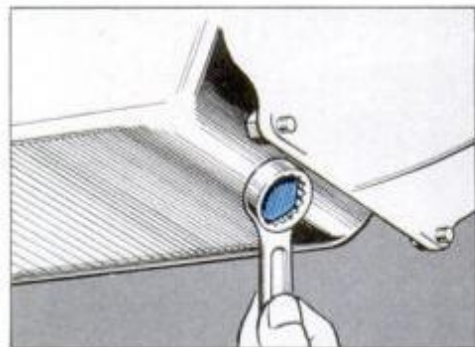
the right oil for an engine, since the right oil helps prolong engine life.

How to change oil and filter

Note: Do this after the engine has been run and is warm. The engine should be turned off.

1. Place a waste pan under the crankcase drain plug. The car wheels may remain on the floor or the front may be raised. Engage the parking brake, place the automatic transmission in PARK or the manual transmission in gear, and place chocks around the rear wheels to keep the car from moving.

2. Loosen the crankcase drain



With engine warm, remove the oilpan plug and let the old oil drain out—all of it.

plug. You can probably use an adjustable open-end or box wrench. Then, unscrew the plug by hand.

If the drain plug is countersunk, get a special drain-plug wrench of the correct size. Trying to loosen the plug with a conventional wrench may ruin the plug or damage the oilpan.

3. Wait for the crankcase to empty. This usually takes about three minutes, but don't be hasty. The more dirty oil you allow to drain, the less dirty oil remains in the engine.

4. Screw the drain plug carefully back into the oilpan and tighten it by hand. Then, with a torque wrench, tighten the plug to 20 foot-pounds. If you don't have a torque wrench, tighten the plug snugly with the conventional (special) wrench, but do not over-tighten it since you may distort the oilpan.

5. Place a waste pan under the oil filter, and use an oil-filter wrench to turn the filter counterclockwise. If the filter is frozen in place, hammer a chisel



Remove oil filter. It should come off easily; if not, see instructions in text.

through the filter canister and smack the chisel handle with a mallet. This will loosen the filter. Remove and discard the old filter.

6. Clean the filter seating surface on the engine. Make sure none of the old gasket material stays stuck to the surface. Use a putty knife to scrape off gasket material.

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Before installing new filter, spread oil over gasket to help seal filter in place.

7. Spread some clean engine oil on the gasket of the new filter and on the filter seating surface. This helps seal the filter to the surface.

8. Hand-tighten the filter, being careful not to cross or strip threads. Tighten the filter until the gasket just touches the seating surface. Then, hand-tighten the filter an additional one-half to three-quarter turn. Do not use a wrench; it may distort the filter.

9. Fill the crankcase through the oil filler to the capacity called for in the owner's or service manual. Check the dip-stick oil level to see that oil is at the full mark.

10. Start the engine and run it at fast idle for a minute or two. Turn off the engine and check for leaks at the crankcase drain plug and oil filter. If there is a leak, tighten the plug or filter a bit more. If the leak persists, the component is damaged.

Fluid level inspection

Inspect fluid levels after changing oil. The following outlines how to check the brake master cylinder, automatic transmission and cooling system, but don't forget the battery, differential, power-steering reservoir and other fluid components your car may have.

Brake master cylinder. Release the clip or bolt holding the master cylinder cover, and lift off the cover. The brake fluid level should be 1/4- to 1/2-inch below the top of the cylinder.

If fluid is needed, draw it from a fresh container of the type of brake fluid specified by the manufacturer. Do not use brake fluid that has been stored in a can which has been opened. Fluid may be contaminated. Be careful not to get dirt in the master cylinder.

Automatic transmission. Each manufacturer recommends a somewhat different procedure:

1. American Motors. Warm up engine and transmission (10-mile drive or longer); idle the engine; place the transmission selector in NEUTRAL; check the level.

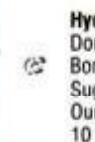
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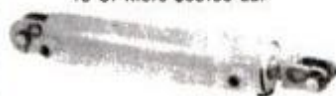
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FALL CAR CARE GUIDE

SERVICE TIPS

1

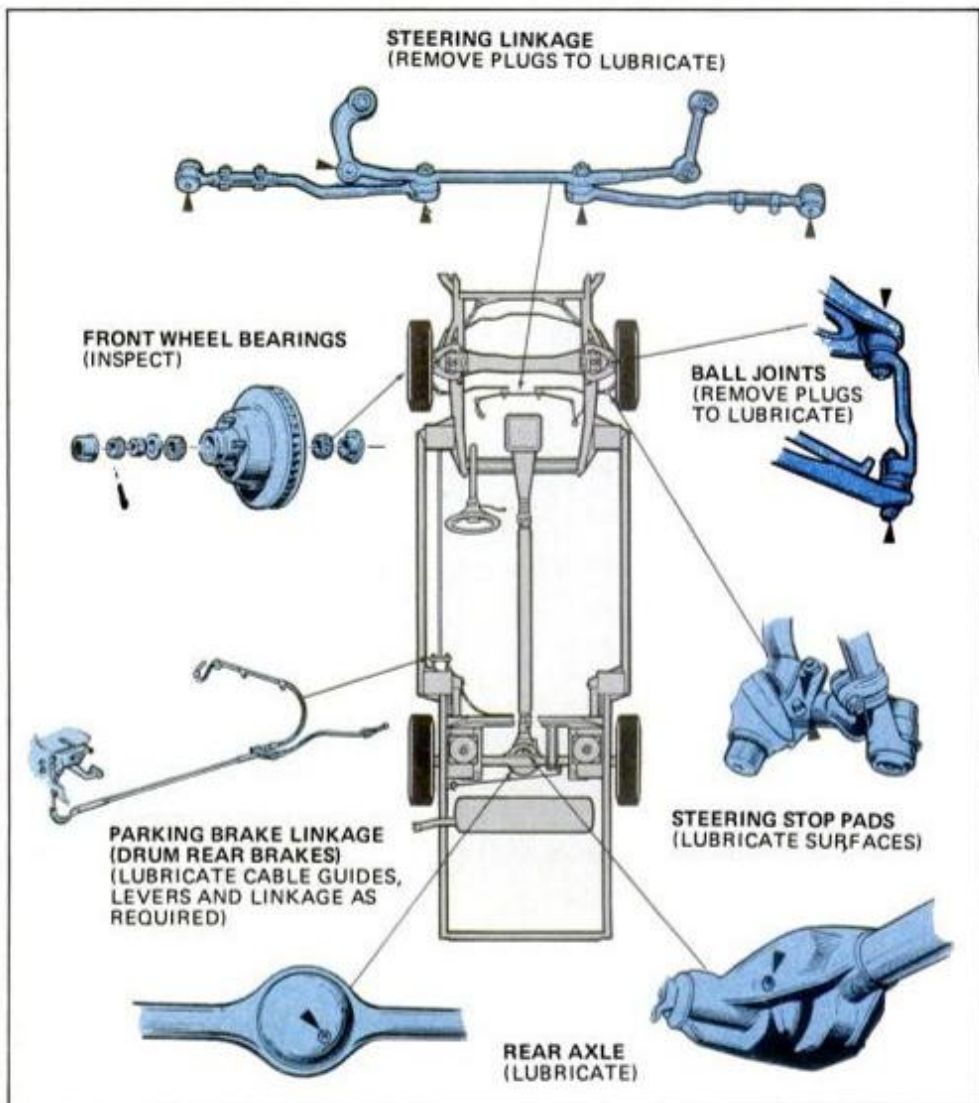
Lubrication

2. Chrysler. Warm up engine and transmission (10-mile drive or longer); idle the engine; move shift lever slowly through each gear position, pausing at each until the gear engages; move the shift lever back to NEUTRAL; check the level.

3. Ford. Warm up engine and transmission (10-mile drive or longer); idle the engine; move shift lever slowly through each gear position, pausing at each until the gear engages;

the dipstick, consult the owner or service manual.) Reinsert the stick, seat it fully, withdraw again and read the level. In all cases, except GM, the level should fall between the FULL and ADD marks. Do not add fluid unless the level is below the ADD mark.

With a GM car, touch the fluid with clean fingers. If fluid is cool, the level should be 1/8- to 3/8-inch below the ADD mark; if fluid is warm, the level should be close to the ADD mark; if fluid is



This is a typical lubrication guide that you find in service manuals.

move the shift lever back to PARK; check the level.

4. General Motors. The engine and transmission may be cold, warm or hot (see below); idle the engine; place the shift lever in PARK; check the level.

For all makes of cars, withdraw the dipstick and wipe it with a clean rag. (If you can't locate

hot (uncomfortable to the touch), the level should fall between the ADD and FULL marks.

To add fluid in all cases, insert a clean funnel in the dipstick tube and pour in the type of fluid recommended by the manufacturer in the owner or service manual. Automatic transmission fluid that is suitable for one car may not be suitable for another.

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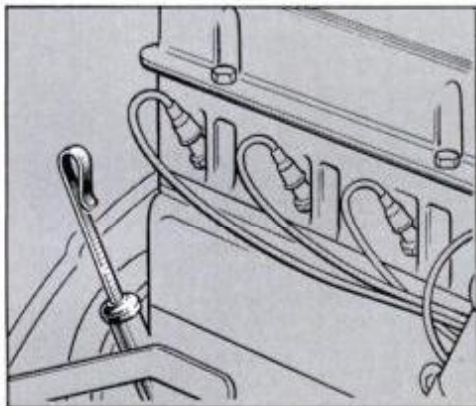
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Do not allow fluid level to go above the FULL mark. Excessive fluid in the transmission may create an aerating condition, causing gear slippage.

Cooling system. Most new cars have coolant recovery systems. Coolant level is checked by looking through the clear-plastic coolant recovery tank. Many tanks have two level marks—COLD and HOT. If the level is below the mark for the engine temperature when



In rear-wheel-drive cars, the automatic transmission dipstick is located at the rear of the engine. In the front-wheel-drive models, it's placed up front.

you check the coolant, add coolant to the coolant recovery tank.

If an engine is not equipped with a coolant recovery system, check the coolant level by removing the radiator cap when the engine is cold. The coolant should be 1½ to 3 inches below the top of the filler neck.

Chassis and body lubrication

Refer to the lubrication chart for your car, which you may find in the service manual. If you cannot find it you can do without it by checking pivot points for grease fittings and using the list below for greasing other parts.

How to lube chassis ball joints

1. Grease fittings (often called zerk fittings) allow you to attach a grease gun to pump grease into ball joints, which are load-carrying, and into swivel points on a car's chassis. Some ball joints have been made with rubber plugs instead of grease fittings. These plugs should be removed, discarded and replaced with fittings.

2. Wipe the grease fitting clean; otherwise, you may pump dirt into a suspension or steering ball joint. Dirt increases wear and causes premature failure.

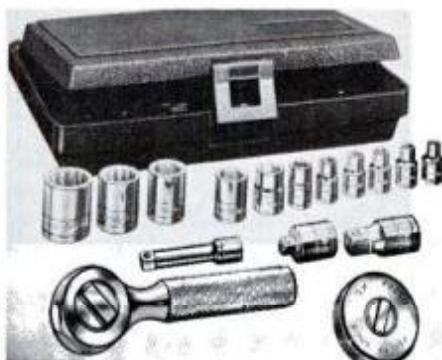
(Please turn to page 156)

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Lubrication

3. Attach a hand grease gun filled with chassis grease to the fitting.

4. If you are lubricating a Chrysler or General Motors car, pump the handle of the grease gun slowly until grease oozes from the bleed hole in the base of the ball joint seal or until the seal swells.

5. If you are lubricating an American Motors or Ford car, pump the handle of the grease gun slowly until the ball-joint boot starts to swell. You can see or feel the swelling.

6. If grease oozes out more than slightly between the tip of the grease gun and zerk fitting, replace the fitting, which is probably clogged.

Greasing other parts

There are many parts of a car that should receive grease to prevent squeaking, corrosion and premature wear. Points common to all cars that should be lubricated when the chassis is greased, and the lubrication to use, are the following:

- Hood-latch mechanism and hinges—light oil or white lithium grease.
- Door lock rotor and strike plate—light oil or white lithium grease.
- Door hinge pins—light oil.
- Lock cylinders—powdered graphite.
- Weather strips and window channels—silicone spray.

Seat tracks—CRC, WD 40 or white lithium grease.

Rubber bushings (stabilizer bar, shock absorbers, springs)—rubber lubricant.

Parking-brake cable—CRC, WD 40 or white lithium grease.

Depending upon the model, the following parts may require lubrication:

- Transmission shift-linkage pivot points.
- Steering stop plate.
- Clutch-release idler lever.
- Clutch-linkage pivot points.
- Clutch-fork joint and cross shaft.
- Gear-shift control mechanism.
- Kickdown-linkage pivot points.

2 Ignition

Manufacturers of cars with electronic control ignition systems (often referred to as ECS, solid-state ignition or breakerless ignition) do not offer maintenance schedules for ignition systems, since ECS is practically maintenance-free. However, when you have to replace sparkplugs (see below) always inspect the ignition coil (in models other than GM), distributor cap and high voltage cables as precautions.

How to inspect the ignition coil

Note: Coils in AMC, Chrysler and Ford electronic ignition systems are similar to each other and to ignition coils of the nonelectronic (breaker-point) systems. Coils, which are inspected and replaced the same way, are mounted on the engine or fender well. They are easily seen. However, the coil of GM's High Energy (electronic) Ignition (HEI) system is inside the distributor. It cannot be checked using the method described here, but requires the use of an ohmmeter. Testing an HEI coil is not necessary unless there is an ignition failure.

1. Grasp the high tension (secondary circuit) cable boot at the coil tower. Twist and pull until the boot pops loose. Do not pull on the cable, only on the boot. Pulling the cable damages the cable.

2. Inspect the coil tower and coil body for cracks. A ribbon of carbon indicates a slight crack. If a slight crack or major break is present, replace the coil.

3. Clean the cable and the terminal inside the coil tower by rubbing with a pen-

cil eraser or a distributor terminal brush. Use an air hose, if it's available, to blow away foreign matter. If an air hose is not available, use an ear syringe.

4. Make sure the two primary-circuit wire terminal connections are clean and tight.

5. Push the secondary cable into the coil tower as you pinch the boot to release air.

How to inspect the distributor cap

To inspect a distributor cap properly, remove it from the distributor and examine it on the inside. A ribbon of carbon indicates a crack. The distributor cap in your car is attached in one of the following ways:

1. Distributor caps used on GM cars are generally held by two spring-loaded L-shaped lug hooks. To release the hooks, engage the slot with a screwdriver, press down on the lug and turn about one-half turn.

2. Distributor caps used on AMC, Chrysler and Ford cars generally use two spring-metal bailing clips. To release the cap, insert a screwdriver between the distributor body and clip. Twist the screwdriver, snapping the clip free. Do not insert the screwdriver between the cap and clip, since you may crack the cap.

3. If a distributor cap isn't held by L-shaped lug hooks or bailing clips, it is held by two machine screws. Engage the screws with a screwdriver and turn counterclockwise until the cap is released.

To inspect and clean secondary cable and distributor cap terminals, disconnect one cable at a time. Reattach the cable to the distributor before removing the next cable. Use a pencil eraser or distributor terminal brush, as you did to clean the coil. Don't forget to clean *all* distributor terminals—those inside the cap and inside towers. Terminals of the HEI distributor cap are not inside towers, but are exposed.

If you have to replace a damaged distributor cap, follow these instructions to keep from accidentally attaching a cable to the wrong tower and upsetting the firing order of sparkplugs:

1. Hold the new distributor cap next to the old cap so hold-down fastener positions and markings of both coincide.

2. Disconnect and install one cable at a time. To make sure the cables are firmly installed in the new cap, twist and turn them as you press downward. Pinch boots to release air.

How to inspect high-voltage (secondary circuit) cables

When a high-voltage cable fails, voltage jumps to ground through defects in cable insulation before reaching the sparkplug. This results in sparkplug misfire, which causes poor engine performance and increased fuel consumption. Bad cables are a primary reason for hard starting in wet weather.

Points to keep in mind concerning inspection and replacement of sparkplug cables are as follows:

■ Cable insulation fails primarily because of

(Please turn to page 158)



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FALL CAR CARE GUIDE SERVICE TIPS

2 Ignition

age and heat. The internal core of a cable is damaged when someone pulls on the cable as it is removed from a sparkplug or the distributor.

■ Damage to insulation can be seen. Remove each cable, in turn, and bend it. If you see small cracks or the insulation seems brittle, replace the cable.

Note: It is usually recommended that if one cable has to be replaced, you replace all cables. However, a set of new cables for an electronic ignition system can run as much as \$10 per cable. Our recommendation, therefore, is to buy cables on a one-to-one basis; that is, one new cable for one damaged cable.

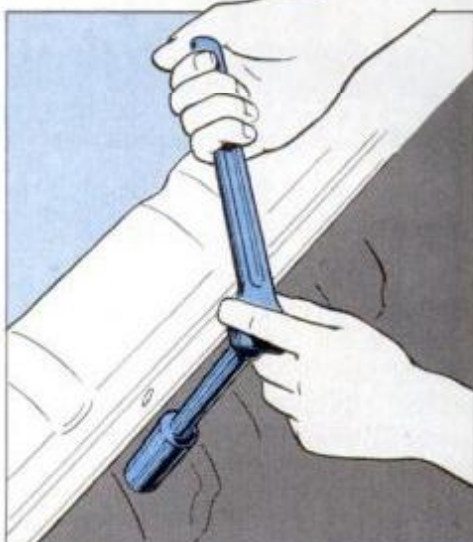
■ If you suspect that the core of a cable has been damaged, test the cable with an ohmmeter. Remove the cable and connect the ohmmeter leads to the terminals. The resistance level of cables varies according to the length of the cable. This value may be obtained from the car service manual. Generally, resistance of 50,000 or more ohms indicates the cable is damaged.

■ When replacing cables, notice how they are routed. Cables are usually held by a bracket on the engine to keep them separated, and

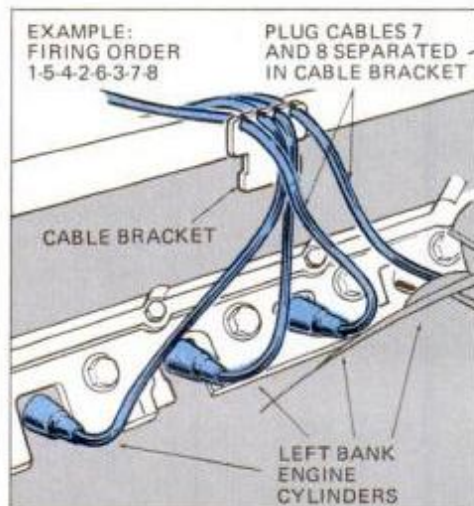
serving 7 and 8 are placed at opposite ends of the cable bracket.

How to replace sparkplugs

1. Work when the engine is cold to avoid being burned.
2. Disconnect the battery ground cable.
3. Remove one sparkplug cable. Pull the boot, not the cable.
4. Loosen and blow dirt from around the sparkplug port with a rag soaked in cleaning solvent and a vacuum cleaner or air hose.
5. Loosen the sparkplug, with the correct size sparkplug socket and a ratchet wrench. Repeat the cleaning procedure.



Use of right tools to remove sparkplugs is necessary to avoid the possibility of breaking off a plug in the engine.



Connect cables so those serving cylinders that fire consecutively are separated.

also keep them away from hot spots. Cables are separated to prevent cross fire.

Cross fire results when high voltage is induced from one cable to another. This induced high voltage causes the sparkplug to fire out of turn. Induction results from the strong magnetic field which surrounds a cable. When cross fire occurs, the engine runs rough.

Cross fire is most likely to occur in sparkplugs that fire in consecutive order. In the illustration, note that cylinders 7 and 8 fire in consecutive order. (The firing order of the engine is 1-5-4-2-6-3-7-8.) For this reason, cables

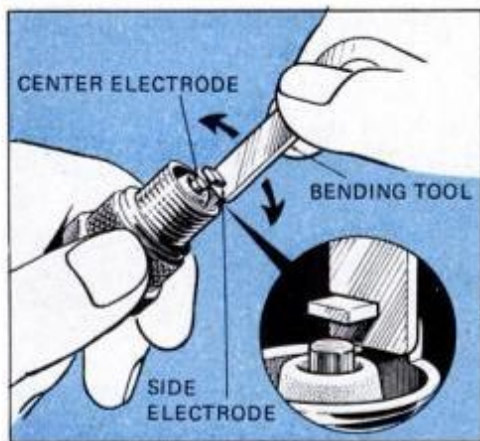
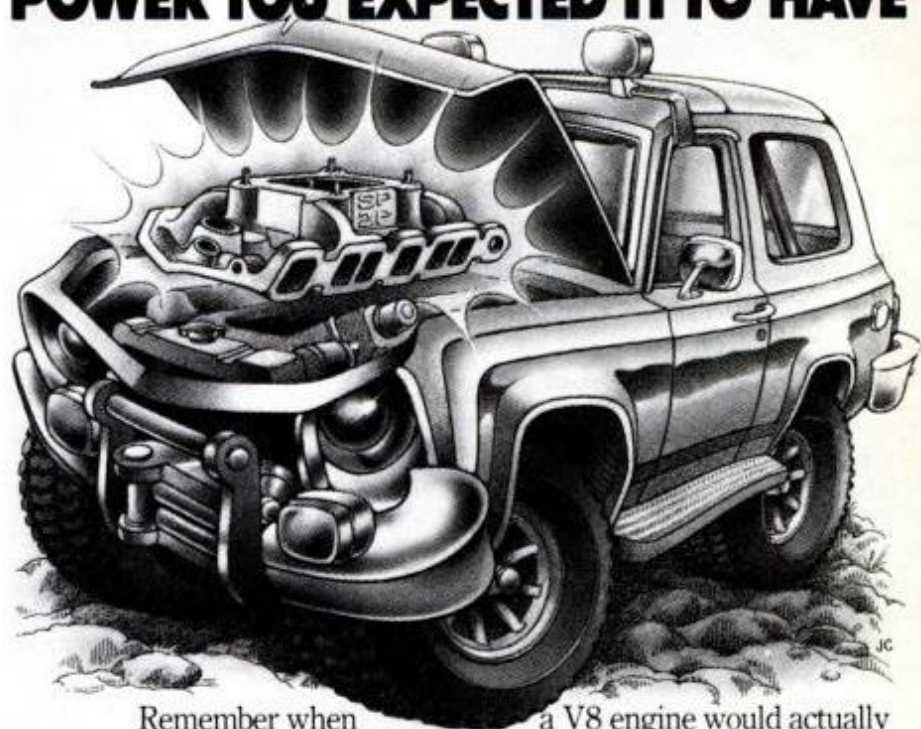
sure. Then remove the plug by hand. Cleaning is especially important to keep particles from falling inside the cylinder as plug is removed.

6. If a sparkplug is in an area where space is tight and your hand doesn't fit, loosen the plug with the socket. Then, try to slip a length of carburetor vacuum line hose over the sparkplug terminal. Use the vacuum line hose as an extension to turn the plug out.

7. Set the electrode gap of the new plug with a sparkplug feeler gauge. Bend the side electrode to attain correct gap with the sparkplug bending tool, which is part of the feeler gauge. Do not use pliers or any other tool. The plug will be ruined. Gap is set correctly when you feel a slight resistance as you move the feeler gauge in and out between electrodes.

8. Screw the new sparkplug into the engine by hand. Be careful not to cross and strip the threads. Use vacuum-line hose to turn the plug in a hard-to-reach spot. If you

THIS SIMPLE REPLACEMENT WILL GIVE YOUR V8 THE POWER YOU EXPECTED IT TO HAVE



Gap new plugs to specification before installing. Use only the special bending tool.

have a torque wrench, tighten plugs to the manufacturer specification given in the service manual. If you don't have a torque wrench, use a sparkplug socket and ratchet to tighten plugs having gaskets one-quarter-turn. Tighten plugs with tapered seats (no gaskets) $\frac{1}{16}$ turn.

Important: If you are working on an aluminum engine, lubricate the sparkplug threads with a little high-temperature grease to avoid stripping sparkplug port threads.

How to set ignition timing

With an electronic ignition system, check ignition timing once a year. Set timing of a non-electronic system when you do engine tune-up. To set timing, follow this procedure:

1. Connect the timing light to No. 1 sparkplug and to the battery. No. 1 sparkplug of an in-line engine is the first sparkplug at the front of the engine. If you have a V6 or V8 engine, check the service manual to determine if No. 1 sparkplug is at the right-front or left-front cylinder bank. Generally, Ford and Lincoln-Mercury engines have the No. 1 sparkplug at the right-front, while GM, AMC and Chrysler engines have it at the left front.

2. In most cases, you have to disconnect the vacuum-advance hose, or hoses, at the distributor vacuum advance. Plug the hose (or hoses) with a golf tee or pencil.

Note: The vehicle emissions tuneup specification label in the engine compartment establishes the conditions under which the manufacturer wants timing done.

3. Find the timing marks which may be on the crankshaft pulley or on the harmonic balancer. Some models, mainly imported cars, have timing marks on their flywheels, which are observed through peepholes. Wipe the marks clean. If marks are difficult to see, highlight them with chalk or white paint.

4. Start, run engine until normal operating temperature is reached.

(Please turn to page 160)

Remember when a V8 engine would actually respond when you stepped on the gas? Had pull to spare for safe passing and heavier loads? Ran evenly? Times have changed. Engines today run at lower rpm and have less power.

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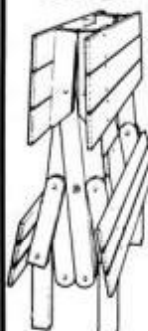
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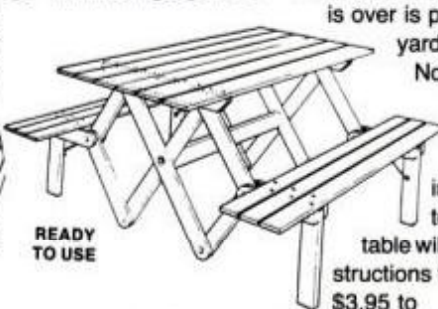


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2 Ignition

5. If the carburetor has the means for setting slow idle speed, connect a tachometer and check to see if the idle-speed setting is to specification. If the engine is operating much above this speed, the centrifugal advance weights in the distributor will start to function, throwing timing off the mark.

6. Aim the timing light at the timing marks and note the reading.

7. If you find that the pointer isn't at the number of degrees called for by manufacturer specifications, turn off the engine. In the specification, you will find

one of three letter designations: TDC means Top Dead Center (0 degree timing); BTDC means Before Top Dead Center (spark is advanced—that is, it occurs before the piston reaches top dead center); ATDC means After Top Dead Center (spark is retarded, occurring after the piston has passed top dead center).

8. Loosen the distributor clamp bolt or screw. You may need an offset distributor wrench to turn the bolt.

Important: Do not remove the bolt. Loosen it only enough to let you turn the distributor.

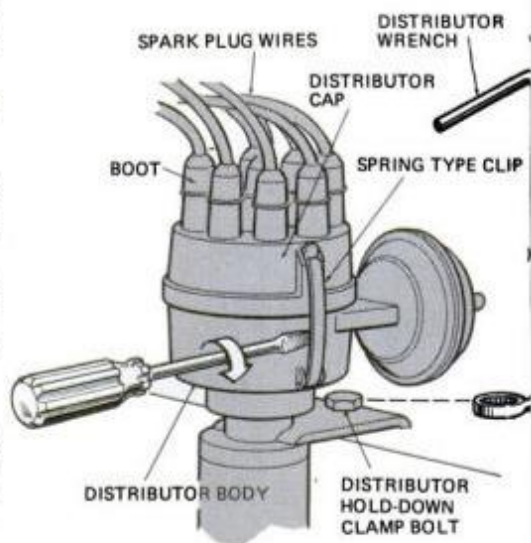
9. Restart the engine.

Caution: When the engine is running, keep your hands away from the fan and drive belts. Never wear a necktie or loose clothing under the hood with the engine operating.

10. Aim the timing light at the marks, as you slowly turn the distributor slightly to the left or right to bring the specified timing mark in line with the pointer.

To loosen "inaccessible" hold-down bolts so ignition can be timed, use a special distributor wrench. To loosen spring clip holding distributor cap, use screwdriver.

11. When timing is set, turn off the engine and tighten the distributor holddown bolt or screw. Recheck the timing to make sure it wasn't knocked off the mark when tightening.



3 Fuel system

Automobile manufacturers are on the verge of installing adjustment-free carburetors in all cars. Some 1979 and many 1980 models already have the innovation. However, these carburetors, like their predecessors, require service involving filter maintenance, choke-system service and tightening carburetor fasteners. Carburetors that are not adjustment-free also need the idle speed checked occasionally.

How to service filters

There are four filters associated with the fuel system: fuel filter, air filter, positive crankcase ventilation (PCV) filter and fuel evaporation control filter. The PCV and fuel-evaporation-control filters are discussed in *Emissions Control Systems Service* (page 164).

The job of the fuel filter is to filter contaminants from fuel before fuel enters the carburetor. The fuel filter, therefore, helps keep small fuel passages in the carburetor free from foreign matter and moisture.

When a fuel filter becomes partially clogged, an engine loses power and may stall at times. If the filter is badly clogged, gas is kept from the carburetor, and the engine won't run.

Some car manufacturers recommend replacement every 7500 miles; others, every 15,000 miles; still others, every 30,000 miles. If you replace the fuel filter in your car every 10,000 to 15,000 miles, you should avert a breakdown caused by a clogged filter.

Three types of fuel filters are used. Some cars use a pleated paper filter inside a metal canister, which is inserted in the fuel line between the fuel pump and carburetor. It is called an in-line fuel filter.

Another type is a pleated paper filter which is

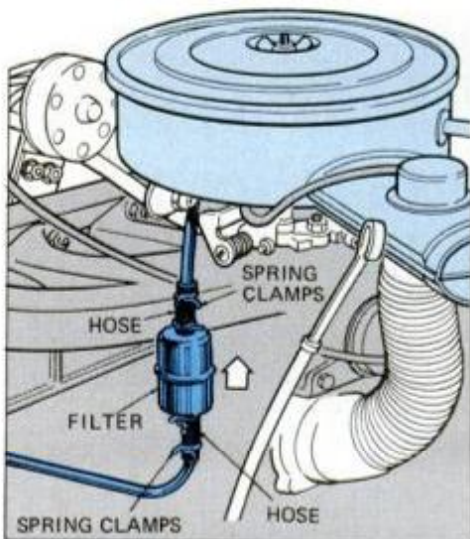
placed inside the carburetor inlet housing. It is called an internal fuel filter.

The third filter—also pleated paper—is inside a canister that screws into the fuel inlet of the carburetor, with the fuel line connected to the canister inlet. This is a combination type; it is both outside and inside the carburetor.

You cannot clean a fuel filter. An old filter should be discarded and replaced.

In-line fuel filters

These are used mainly on AMC and Chrysler Corp. engines. The filter is attached to the fuel line with pieces of hose and springs or screw clamps. To replace an in-line filter:



In-line fuel filters are held by spring clamps to fuel hose leading to carburetor.

1. Squeeze clamp tangs with a pair of pliers or special spring clamp pliers designed for this job, so you can slide clamps off hoses. The special spring clamp pliers are sold by auto parts and accessories dealers.

2. Pull hoses off the fuel line to release the filter. Discard the filter.

Caution: Do this job with the engine cold and the battery ground cable disconnected to prevent possible combustion of dripping gasoline. Place a can or rag under the filter to catch gas. No smoking!

3. Notice the fuel-flow arrow imprinted on the new filter. Install the filter so arrow points toward carburetor. Seat hoses over inlet and outlet fuel lines.

4. Expand clamps with pliers and seat them. Make sure that clamps do not grip hoses on the raised beads (flanges) of the canister tubes, which may prevent a firm grip and cause a leak.

5. Start the engine, let it run a few minutes and check for leaks. If a leak exists, reposition clamps. If a leak persists, install new clamps and hoses.

Important: Hoses used with a fuel filter are made of special synthetic material to withstand underhood heat, vibration and the deteriorating effects of gasoline. Replacement hoses should be of this type.

Internal fuel filters

These are used mainly by General Motors. However, a Cadillac with electronic fuel injection has a filter canister mounted in the fuel line between the fuel pump and carburetor. Raise the car to get at this filter.

To replace an internal fuel filter, do this:

(Please turn to page 162)

WHY OUR OIL SHOULD BE STANDARD EQUIPMENT ON ALL SMALLER CARS.

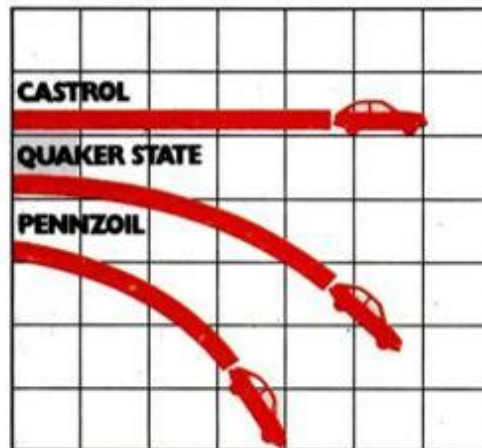
Smaller cars demand even more of a motor oil than big cars do. Their 4 and 6 cylinder engines run at considerably higher revs throughout their entire performance range. So there's more heat and friction in the engine.

All this can cause extra wear, tear, and 'shear' (thinning out of the oil)—what engineers refer to as "viscosity breakdown." As the viscosity of the oil breaks down it loses more and more of its ability to protect a smaller car's engine from its own self-destructive tendencies.

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The test was conducted in a laboratory by an independent testing firm. Each one of the oils was an SAE 10W-40. After the equivalent of roughly 2,000 miles they found that while Quaker State and Pennzoil had both shown significant breakdown, Castrol hadn't broken down at all.

So while there are lots of oils to choose from, only one should be standard equipment on smaller cars. Castrol—the oil that doesn't break down.

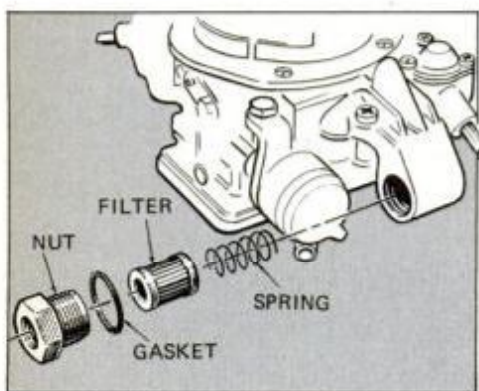
After all, if your motor oil breaks down, who knows what could break down next?



Castrol
**THE OIL ENGINEERED FOR
SMALLER CARS.**

Fuel system

1. **Observe safety precautions** outlined above.
2. **Remove the air cleaner.**
3. **Grip the flats of the fuel-inlet line with a wrench** while holding the large fuel-inlet fitting at the carburetor with another wrench. These flats are made of soft brass. Be careful not to damage them as you unscrew the fuel inlet fitting.
4. **Remove the fuel filter and coil spring.** Discard the filter. Retain the spring



Internal fuel filters are inside of the carburetor inlet, making it necessary to remove the fuel line and fuel inlet nut.

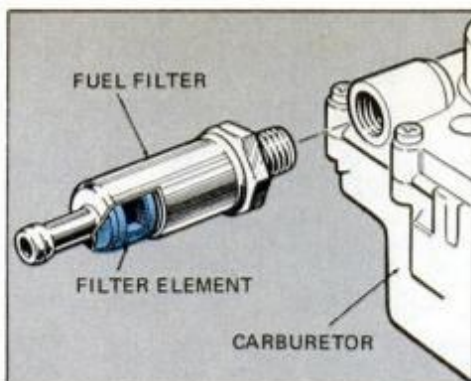
unless it has lost tension. You will find a gasket behind the fuel inlet fitting. Replace the gasket.

5. **Check that the new filter has a small fuel-inlet check valve inside the assembly.** This valve prevents gas leakage and possible fire in the event of roll-over. Be sure that this valve is present.
6. **Insert the coil spring in the carburetor,** then the filter. The check-valve end of the filter must face toward the fuel line.
7. **Install a new gasket on the inlet fitting** and install the fitting on the carburetor. Tighten the fitting snugly, but do not over-tighten since gasket or fitting damage may result. If a torque wrench is available, tighten the fitting to 18 foot-pounds.
8. **Connect the fuel line,** start the engine and check for leaks.

Combination fuel filters

These are used mainly by Ford Motor Co. However, some Ford models use internal filters. If you don't find one kind, look for the other. To replace a combination filter, do this:

1. **Observe safety precautions** outlined above.
2. **Remove the air cleaner.**
3. **Check clamps to see what kind is used**—spring, screw or crimped. Use pliers to pinch the ends of a spring clamp. Expand the clamp and slide it off the hose. Unscrew screw-on clamps. If a crimped clamp is used, cut



Combination filters screw into carburetor inlet, but are outside of the carburetor.

through the crimped portion of the clamp with a pair of side-cutters.

4. **Unscrew the filter.** Clean threads in the carburetor inlet to remove any remaining metal slivers.

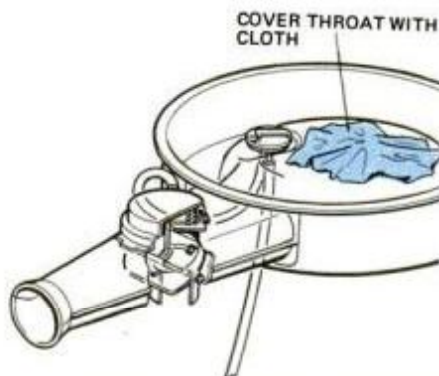
5. **Place screw or spring clamps over the inlet fuel line** and install a new piece of hose on the filter tube. Thread the filter into the carburetor and tighten snugly. Attach the hose to the fuel line, placing clamps so they are over fuel line and filter flanges.

6. **If the new filter comes with crimp-type clamps, use a special pair of pliers to install it.** Pliers are designed to grasp the crimped section of the clamps that are squeezed together to form a tight grip between the fuel line and hose. Position clamps over the hose. Squeeze each clamp until the points of the V-shaped part of the clamp barely touch. Leave a gap no larger than .06 inch. Don't overtighten the clamp. Special crimping pliers may be obtained from an auto parts and accessories dealer.

7. **Run the engine and check for leaks.**

How to service carburetor air filters

The carburetor air filter cleans dust and grit from air before air enters the carburetor. If particles were permitted to get inside the engine,



Remove air cleaner lid, then cover carburetor throat opening with clean cloth to keep out debris, and remove filter.

they would cause damage to internal parts. Dirt that clings to the air filter eventually causes it to clog. A clogged filter chokes off air to the carburetor. This causes unnecessary consumption of gasoline. According to Chrysler Corp., "A 20-percent drop in fuel economy is not uncommon with a clogged filter."

Most car manufacturers recommend air filter replacement at 24,000 to 30,000 miles, or every 24 months. However, you should clean and inspect the filter at six-month intervals. This is especially important if the car is driven in dusty or sandy areas since heavy airborne dirt hastens the time an air filter should be replaced.

To replace the carburetor air filter, do this:

1. **Remove the air cleaner cover.** Most covers are attached with a wingnut. However, some later model cars have two and, in some cases, four nuts holding the cover.
2. **Place a clean cloth over the carburetor-throat opening before you remove the filter.** This prevents abrasive particles from dropping into the engine. Remove the filter.
3. **Using low-pressure compressed air, try to dislodge loose dirt,** if the air filter has been in service less than the recommended number of miles. Point the air hose nozzle toward the inside part of the filter and apply short bursts of air.
4. **Tap the flat of the filter gently** against a hard surface if compressed air is not available.
5. **Hold a droplight in the center of the filter.** If the filter looks dirty through the light, despite compressed air or tapping, replace the filter. If the filter looks oily, a malfunction of the positive crankcase ventilation (PCV) system exists. Crankcase pressure builds up when the PCV system is clogged. This pressure forces oil back through the system and into the air cleaner. Service the PCV (see *Emissions Control Systems Service* page 164), and replace the air filter.

6. **Dampen a cloth with solvent or clean engine oil,** and wipe out the air cleaner housing.

7. **Remove the cloth covering the carburetor throat.** Center the filter in the housing.

8. **Install the cover and tighten the wingnut** or hold-down nuts to hold the unit snugly. Do not overtighten. Excessive tightening of the cover can bring pressure to bear on and distort the carburetor throat, which will cause the choke valve to stick.

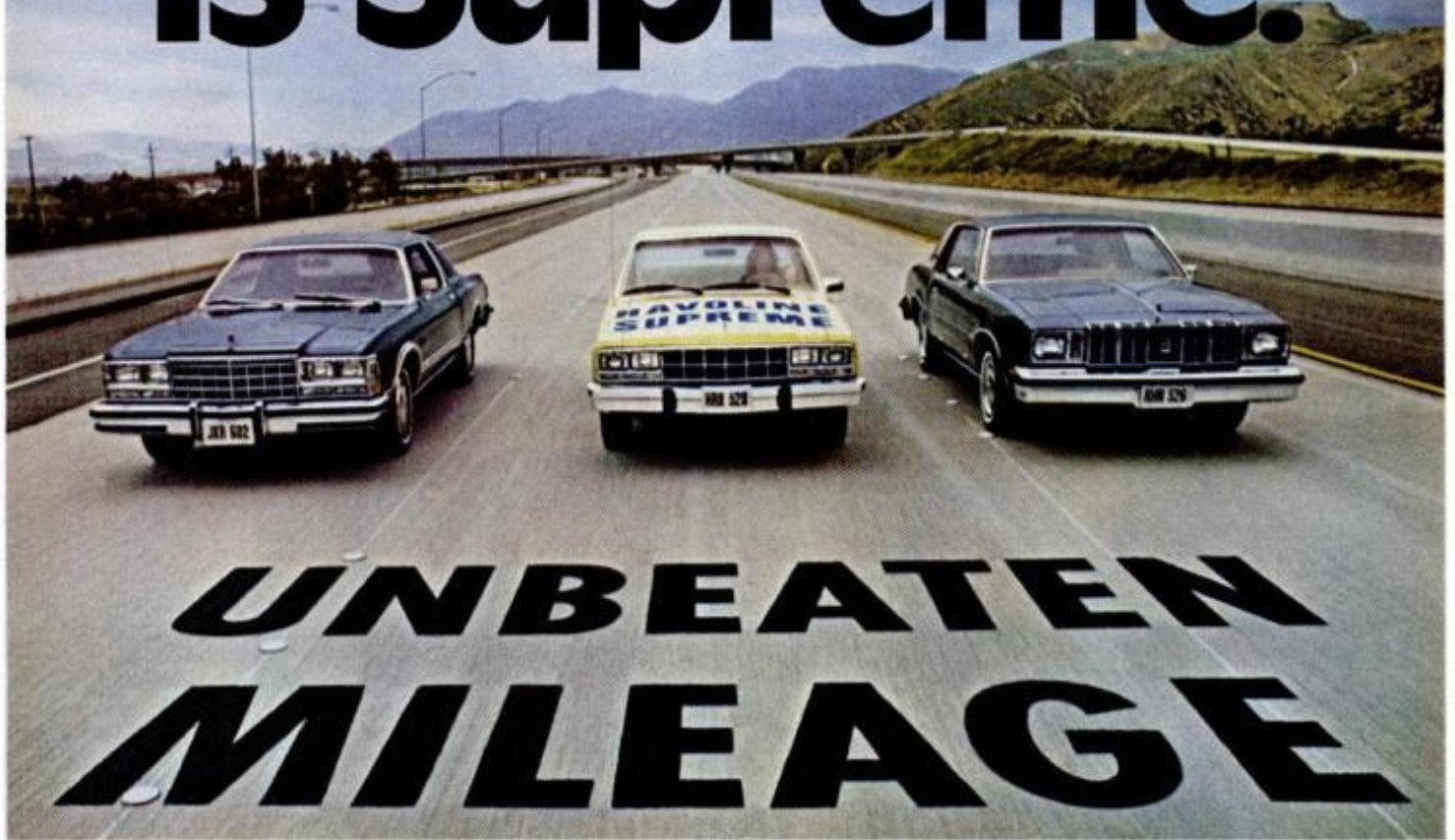
How to service chokes

1. **Remove the carburetor air cleaner** (see below) with engine cold and turned off.
2. **Open the carburetor throttle valve(s)** by grasping the throttle lever at the side of the carburetor or by having someone in the car press the accelerator pedal to the floor and then release it.
3. **Move the choke valve slowly from closed to open position.** Then, release it. The choke valve should snap shut. Do this a few times.
4. **If the choke valve binds,** varnish and gummy residue deposits may be the cause. Spray the choke valve pivots and carburetor linkage with carburetor cleaner, and wipe clean with a dry cloth.

Important: Tighten carburetor fasteners

This service is frequently overlooked. Carburetor fasteners, especially mounting bolts, [\(Please turn to page 164\)](#)

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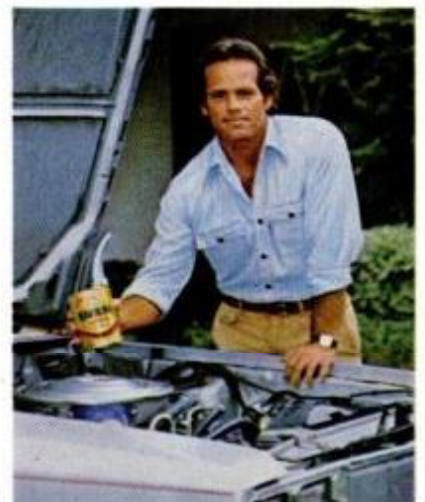


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3

Fuel system

can vibrate loose. When this happens, air seeps in around the carburetor to upset the fuel/air mixture, causing poor engine performance. When servicing filters, tighten mounting bolts and carburetor screws.

How to remove the air cleaner

Carburetor air cleaners can be complicated to remove. Here is how to take the assembly off the carburetor so no damage is done:

1. Remove the wingnut or hold-down nuts holding the air cleaner to the carburetor.

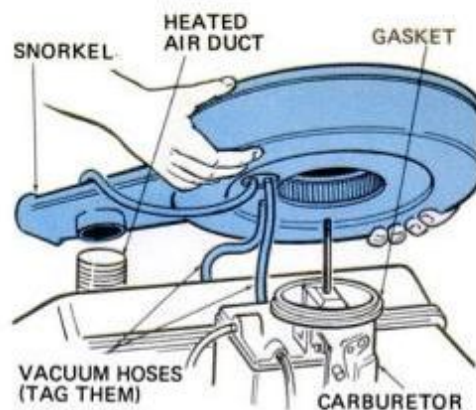
2. Disconnect hoses attached to the air cleaner. As you do, tag each hose with a piece of masking tape and mark tape with a code so the hose can be reattached to the correct fitting.

3. Lift the air cleaner assembly up and off the carburetor.

4. Most carmakers have an air cleaner mounting gasket which fits on top of the carburetor throat. It must be reinstalled before the air cleaner is put back in place.

5. If your air cleaner has a heat tube attached to the snorkel, carefully twist and turn the tube off the mounting flange on the underside of the snorkel and set it aside. This tube is held with a clamp.

6. If your air cleaner assembly has a fresh-air intake duct in addition to a heat tube, detach the air-intake duct from the snorkel, before you remove the air cleaner



You can remove a typical air cleaner by unscrewing the assembly, tagging hoses, separating unit from air duct and lifting.

from the carburetor. Just lift the tab between the snorkel and duct, and separate the two. Then remove the air cleaner.

4 Emissions control

It makes good sense to maintain emissions controls periodically from the time a car is new. In addition to increasing air pollution levels, neglected emissions control devices cause poor gasoline mileage, hard starting,

stalling, hesitation on acceleration, and dieseling. Dieseling is engine run-on after the ignition is turned off.

Servicing the following emissions control units falls within the skills of a Saturday mechanic:

- Fuel-evaporation canister.
- Positive crankcase ventilation (PCV) valve, hoses and filter.
- Thermostatic control valve in the air cleaner snorkel.
- Exhaust gas recirculation (EGR) valve.

How to service the fuel-evaporation system

The fuel-evaporation-control system prevents gasoline vapors from entering the atmosphere. Vapors coming from the fuel tank and carburetor are stored in a charcoal canister when the engine is off, and are burned when the engine is running.

The only part of the system requiring service is the charcoal canister. In some cars, imports particularly, the canister should be replaced at 50,000 miles.

In other cars, usually domestic, canisters are fitted with a filter that should be inspected and replaced if covered with dirt. If the filter is blocked, gasoline vapors escape into the air. A gasoline odor is one sign that the filter requires servicing.

To service the filter, do this:

- 1. Find the canister,** which is mounted either at the right or left front of a car engine compartment. In a light truck or van, the canister may be in a different location.
- 2. Remove the bracket or strap**

The fuel canister filter is often forgotten. To replace it, just remove canister and turn the filter upside down. Tag the lines so that you know which goes where.

holding the canister. Turn the canister upside down. You may have to remove the hoses attached to the canister. If so, mark hoses with tags to assure proper reconnecting. Such designations as "left," "center" and "right" may be used.

3. Slip the filter from the canister housing. In some cases, the filter is held by a spring wire.

4. Inspect the canister housing which, if cracked, should be replaced. If the canister is not damaged, slip in a new filter.

5. Reinstall the canister.

6. Examine hoses. Replace those that have cracked or hardened. Fuel-evaporation-control system hoses are made to withstand fuel vapor. If replacement is necessary, buy only fuel-resistant hoses.

This service should be done when you have an engine tune-up.

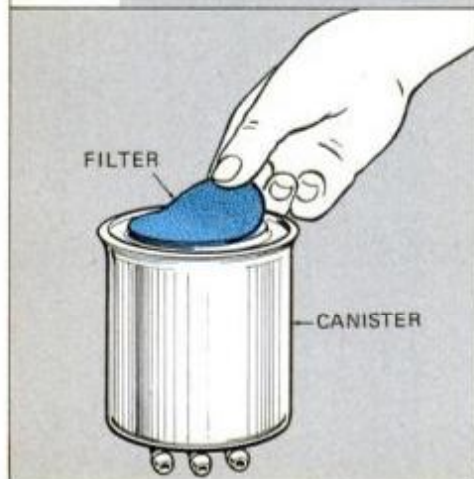
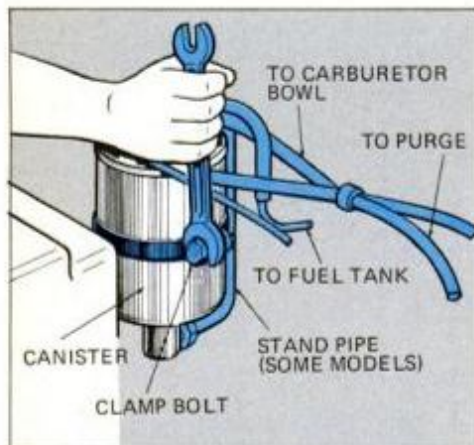
How to service the PCV system

If the PCV system gets blocked, pressure builds up in the crankcase and may force oil out of the oil filter tube and past the engine oil seals. The result is loss of oil. Naturally, a clogged PCV system also contributes to air pollution.

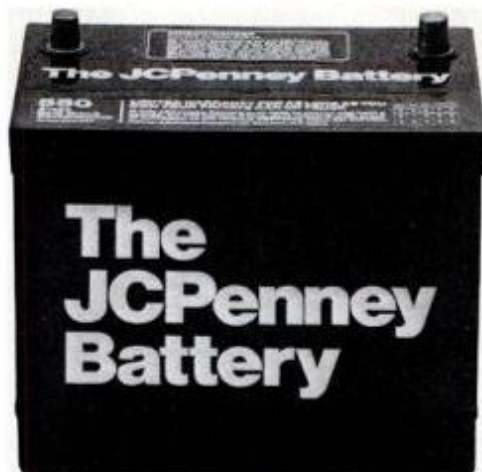
The heart of the PCV system is the PCV valve, which controls the rate at which vapors in the engine crankcase are allowed to return to the intake manifold. If the PCV valve sticks on the vacuum side of the valve, the flow of air through the valve is restricted. This enriches the air/fuel mixture entering the cylinders, reducing fuel mileage.

If the PCV valve sticks in mid-position, too much air passes through the valve. This makes the fuel mixture too lean and causes rough engine idling. If the valve sticks so it can't move back to close the crankcase port, an engine

(Please turn to page 166)



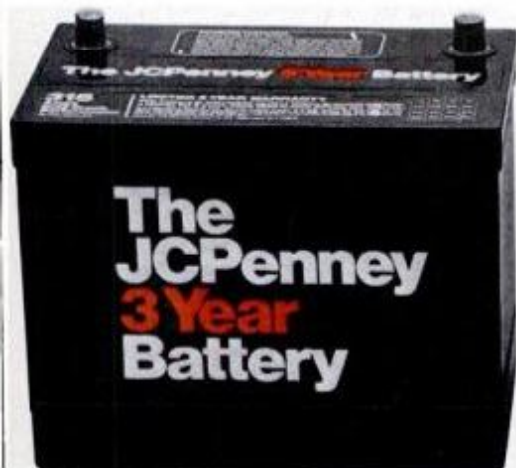
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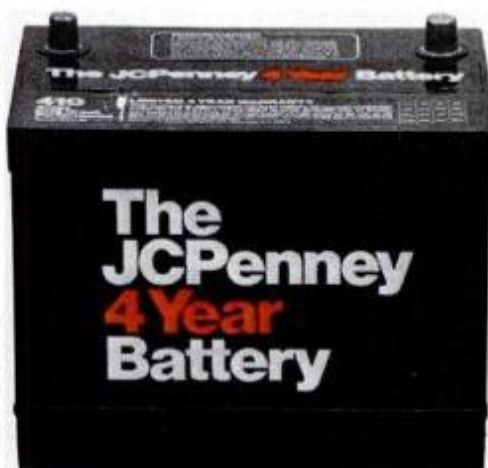
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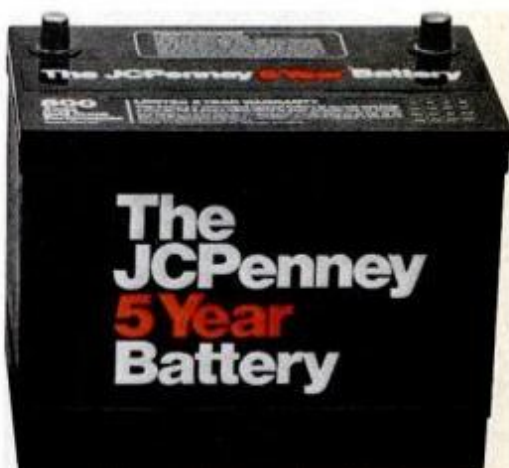
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4 Emissions

backfire may cause an explosion in the crankcase.

A combination of shaking and checking for vacuum usually reveals whether a faulty PCV valve exists. When you tune up the engine, do this test:

1. Pull the PCV valve from its position in the valve cover or intake manifold. Shake the valve. If it rattles, it generally indicates a functioning valve. However, this is not a foolproof test.

2. Start the engine and cover the end of the valve with your thumb. If there is no vacu-



An easy way to test a PVC system is to shake the valve to see that it rattles and (engine running) check for vacuum by covering valve end with your thumb.

um ("pull" on your thumb), the valve may be plugged or the PCV system hoses may be blocked.

3. Remove and clean out the hoses. This can be done by ramming a cloth wad through them. If hoses are cracked or have hardened, replace them.

4. Test for vacuum after the hoses are reconnected. If there is still no vacuum, replace the PCV valve.

Sludge can be cleaned from a PCV valve by shooting in PCV cleaner. However, there is no way to determine accurately if the spring inside the valve is weak and no longer metering out the proper volume of air. For this reason, car manufacturers recommend replacing the valve every year.

A part of the PCV system often overlooked is the PCV inlet filter, which is generally positioned in the side of the main body of the air cleaner. This filter cleans the air before it enters the crankcase and should be replaced at the same time as the air cleaner filter.

In some cars, the filter pad may be lifted out of a small pocket in the air cleaner. With most installations, the following procedure is necessary:

1. Snap out the retaining clip that holds the PCV filter container to the air cleaner. This clip is at the end of the PCV hose connected to the filter.

2. Remove the container.

3. If possible, take the filter pad from the container. Discard the filter. In some cases, the entire assembly has to be replaced.

4. Wash the container and let it stand until dry.

5. Oil the new filter pad sparingly with your engine oil and then place it into the container.

6. Attach the container to the air cleaner with the retaining clip.

Testing thermostatic control valves

The thermostatic control valve in the air cleaner snorkel controls the temperature of air entering the carburetor during cold weather. Maintaining temperature within tight limits makes it possible to calibrate the carburetor on the lean side. This reduces hydrocarbon emissions, improves engine warm-up and cuts down on the chance of carburetor icing during the warm-up period.

This system, which is sometimes referred to as the heated inlet air system, consists of a vacuum diaphragm that sits on top of the air cleaner snorkel, a temperature sensor which is located inside the air cleaner and a control valve installed in the snorkel. These are the steps to follow:

1. Check the functioning of the system with the engine cold and the air temperature below 50° F. Remove the duct con-



One way to see if the snorkel valve is working properly is by hand-testing. The valve should be closed when the engine is started and be open thereafter.

nected to the snorkel, if there is one, and put your hand inside the snorkel. See that the control valve moves freely.

2. Start the engine. As the engine warms up, the valve should move in the direction opposite to that when the engine was cold.

3. If the control valve doesn't operate in this way, test the vacuum diaphragm with a vacuum pump. If the vacuum diaphragm functions properly when tested, replace the sensor.

4. Test control-valve action once a year.

How to service the EGR valve

American Motors Corp.:

1. Remove the EGR valve from the engine.

2. Scrape deposits from the valve base using a wire brush.

3. By hand, compress the valve diaphragm to determine if the poppet valve is functioning. This is established by the valve moving freely. If the poppet valve sticks, discard the EGR valve.

AMC recommends this service every 30,000 miles.

Chrysler Corp.:

1. Remove the EGR valve from the engine.

2. Inspect the poppet valve and seat for carbon. If any deposits are discovered, continue servicing as detailed below. If not, reinstall the valve.

3. Apply manifold heat-control valve solvent to the poppet valve and seal, but be careful not to spill solvent on the valve diaphragm. Allow solvent to loosen deposits. If solvent is spilled on the diaphragm, replace the EGR valve. Solvent causes irreparable damage.

4. With a vacuum pump, apply vacuum to the valve vacuum nipple to open the valve. Then, use a knife to scrape off carefully all deposits from the seat and poppet valve.

Chrysler recommends this service every 15,000 miles.

Ford Motor Co.:

1. Remove EGR valve from the engine.

2. Outfit an electric drill with a short piece of speedometer cable. Insert the end of the cable into the valve cavity located between the poppet and the seat.

3. Turn on the drill. Employing a circular motion, loosen deposits.

Ford recommends this procedure when one of the following engine problems occurs: rough idling, stalling, rough acceleration under light throttle application, excessive fuel consumption, stalling under deceleration and detonation.

General Motors:

1. Remove the EGR valve.

2. Hold the valve diaphragm down and plug the vacuum tube.

3. Release the diaphragm. The poppet valve should not close until 20 seconds or more have elapsed. If it does, replace the EGR valve.

4. Check for deposits on the poppet valve and seat. If they are present, tap the end of the poppet valve with a plastic hammer and shake deposits from the unit.

5. Look for deposits in outlet holes. Clean them out carefully with a knife or screwdriver.

6. Scrape mounting surfaces of the EGR valve and the engine with a wire brush.

GM recommends this procedure when one of the following engine problems occurs: rough idling, stalling, rough acceleration under light throttle application, excessive fuel consumption, stalling under deceleration and detonation.

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Section 5

Battery

Original equipment and after-market automobile batteries may be placed in one of three categories:

- The top-terminal battery, which has been the most popular in the past, is in wide use. Generally, it consists of a case containing a series of cells, with each cell composed of several plates. Cells are joined together by connectors, and at each end to battery terminals (posts). In a 12-volt battery, there are six cells, each giving out two volts.

- The side-terminal battery has terminals on the side, rather than on top where terminals are more susceptible to corrosion. Otherwise, the side- and top-terminal batteries are the same.

- The maintenance-free battery, which is original equipment in most 1980 models, does not require maintenance of electrolyte level. Some maintenance-free batteries may look similar to a conventional battery, but access ports to the cells are sealed. The battery may be jump-started and may, on occasion, have to be charged.

Safety first

When working on or around a battery, be careful. All batteries, including maintenance-free batteries, are vented and emit hydrogen, an explosive gas. Never smoke or create a spark near a battery. Avoid, for example, touching tools to both battery posts at the same time. Always disconnect the ground cable—the negative one—first, since touching the positive cable with a tool when the ground is connected is more likely to cause sparks.

Another important precaution is to wear safety goggles and rubber gloves when servicing the battery. Battery (sulfuric) acid causes severe burns. If battery acid gets on the skin, flush it with water. If battery acid splashes in an eye, flush with water and consult a physician immediately.

Also, don't wear rings or other metal jewelry when working near a battery. An accidental touch of jewelry to a battery post may cause a short circuit and give you a severe burn.

Inspecting a battery

- Electrolyte level—In nonmaintenance-free batteries, check the electrolyte level when you check the oil level. Frequent checking is particularly important during hot weather since gassing, which causes the electrolyte level to drop, is heaviest then.

Electrolyte level should be at the circular or triangular lip on the bottom of each fill hole. If the level falls below this, uncovered plates will deteriorate rapidly. If the level is above this, excessive gassing occurs. Gassing is the emission of hydrogen, which causes corrosion on the battery case and terminals. Corrosion, in turn, acts as a path, through which the battery self-discharges.

If a battery needs water, use distilled water or rainwater caught in a glass container.

Chemicals and contaminants in tap water result in deposits that shorten battery life.

- Battery cables—No wires should show. If insulation is torn, cracked or brittle, replace cables. Corrosion (gray or black deposits) on cable terminals must be cleaned off, because it will insulate cable ends from the battery posts, keeping the engine from starting.

- Battery case—Remove the battery from the car using a battery carrier. Inspect the case. If it is cracked, discard the battery.

Reminder: When removing a battery, disconnect the ground cable first. When replacing the battery, connect the ground cable last.

- Battery box—Inspect the battery box in the engine compartment. Clean off corrosion and see that the battery box is connected tightly.

Removing a battery

If battery cables are the bolt-type, loosen nuts with a box wrench. Other types of wrenches may round off a nut. If a nut sticks, apply some oil. Never try to force a clamp from a battery post. The post can break.

When the bolt is loose, use a cable puller to raise the clamp off the terminal. If the cable is damaged or the bolt stripped, replace cable.

If battery cables are the spring-type, squeeze the ears of the clamp with pliers and rotate the clamp as you lift it up. If the clamp is damaged, replace the cable.

If the battery has on-side terminals, loosen the hold-down bolts with a box wrench and remove the clamp from the terminal.

Cleaning a battery

As long as the battery shows no sign of corrosion, washing with water will suffice. The battery may remain in the car as you play water on

it from a garden hose. If corrosion is on the battery, remove the battery and wash it down with a mixture of baking soda and water.

Cover the vent holes in battery caps. Baking soda solution must not enter the battery, since it neutralizes acid. Wash the top, sides and bottom with a stiff bristle brush. Then, rinse with water.

Cleaning cable terminals and battery posts

Use a terminal- and post-cleaning brush to clean the cable terminals and battery posts of top-terminal batteries. If this special tool is not available, use sandpaper or a small knife. However, repeated use of sandpaper or a knife may enlarge the holes in cable terminals and "whittle down" posts.

Use a small wire brush to clean cable terminals and battery contact surfaces of side-terminal batteries.

Reinstalling cables on batteries should be done in the following manner to avoid damage and assure that the starter motor receives full voltage:

- Bolt-type cable clamps—Push the clamps as far down on the battery posts as they will go, but do not hammer clamps onto posts. Irreparable damage may result. Tighten each clamp carefully, using two open-end wrenches—one to hold the bolt and one to turn the nut. Assure good contact by tightening securely. Spread a light coat of petroleum jelly on the terminals and posts to retard corrosion.

- Spring-type cable clamps—Using pliers, grasp each clamp by its ears, opening the clamp hole. Seat the clamp fully on the battery post by rotating and pressing down, until the clamp will move no further. Do not hammer clamps onto the posts.

- Side-terminal clamps—If you have to replace a cable, make sure the bolt you use is the same length as the original bolt. A longer bolt may split the terminal. Attach the cable, tightening the bolt securely.

Quick battery check

You can frequently determine if the battery is delivering sufficient voltage to crank the engine by turning on the headlights and observing light output. If the lights seem dim when turned on, the battery is probably in an undercharged state, or has a loose or corroded cable. Check the cables. Then, test the battery with a hydrometer or battery analyzer.

If your headlights are bright when you turn them on, but dim as the engine is cranked, the battery may be undercharged, a loose or corroded battery cable may be affecting voltage, or there could be a malfunction of the starter-motor circuit.

If headlights are bright when you turn them on and they stay bright, but the starter motor doesn't turn, there is a malfunction in the starter-motor circuit.



Scrub the battery top, sides and bottom with a mixture of baking soda and water.

Brake system

You should check the condition of your brakes at least once a year to avert costly repairs and insure your safety. The purpose of inspection is to catch and replace brake linings before they wear badly, allowing shoe metal to be exposed. Shoe metal (the shoe is the part to which linings are bonded) rubbing against the metal brake rotor (disc) or brake drum can quickly score the rotor or drum. It is at this point that brake repairs become expensive.

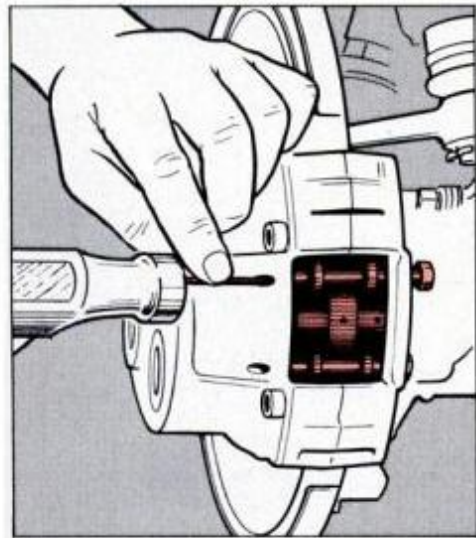
A thorough brake check also calls for inspecting brake lines and the wheel cylinders of drum brakes. This inspection is a precautionary measure to avert a sudden leak of fluid that would cause a loss of braking.

Inspecting linings (pads)

Most cars are equipped with disc brakes at the front wheels and drum brakes at the rear.

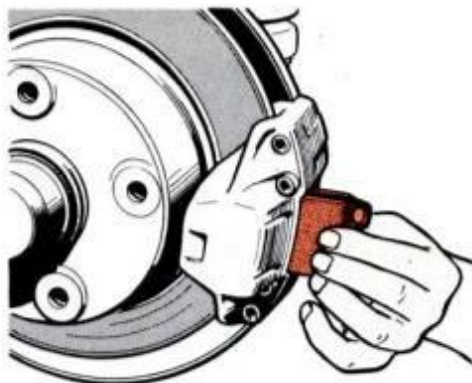
To inspect disc-brake pads:

1. Remove the wheel and tire assembly, exposing the disc and caliper. The caliper holds the pads.
2. Loosen and remove guide pins in the caliper to release the pads.



Remove the disc-brake pads by knocking out retaining pins in the caliper.

3. Remove one pad from the caliper. You may have to push the piston into the bore to do this. If so, wrap a cloth around a screwdriver to prevent scarring the piston and place flat of screwdriver against the piston.
4. Use a gauge to measure pad thickness at several spots. Thickness at all locations should be at least 3/16 inch. If it isn't, replace pads in both brakes. Whenever one pad has to be replaced, so should all pads on same axle to assure equal braking action.
5. If the one pad is okay, check the other in the same caliper. Then, check pads in other caliper on opposite wheel.
6. Inspect rotors, too. If one is scarred,



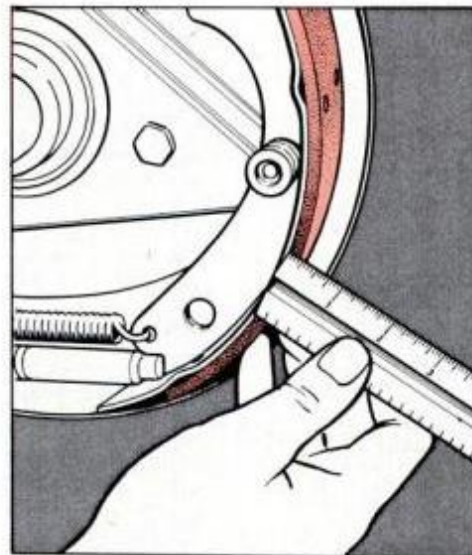
Check for brake-pad thickness. If there is little lining left, replace the pad.

it should be turned on a disc-brake lathe, but the minimum thickness specification for the rotor, which is usually stamped on the part, should not be exceeded.

7. When replacing pads, use a cloth-covered screwdriver to push the piston back into the bore.

To inspect drum-brake linings:

1. Remove the wheel-tire-brake drum assembly, revealing brake shoes.
2. Use a gauge to measure the thickness of the two brake linings at



Measure brake-lining thickness and make sure that the drums are not scarred.

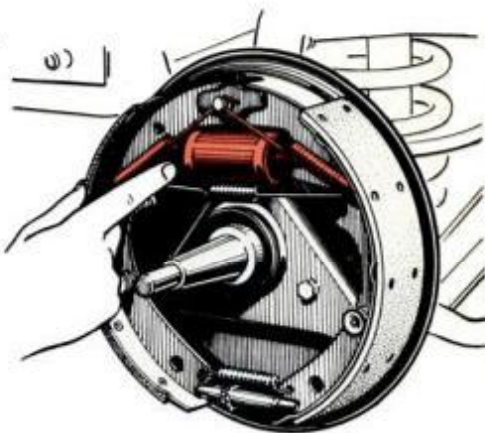
several spots. Shoes don't have to be removed to measure lining thickness. Thickness at all locations should be at least 3/16 inch. If it isn't, replace linings in both brakes on the same axle. They should be replaced, even though only one is worn, to assure equal braking action.

3. Inspect the brake drum. If scarred,

it should be turned on a drum-brake lathe. If turning removes metal beyond the minimum thickness specification stamped on the drum or given in the service manual, replace the drum.

Inspecting cylinders and lines

When you inspect drum-brake linings, pull back the wheel-cylinder covers. If fluid leaks, replace or overhaul the cylinder. A leaky cylinder

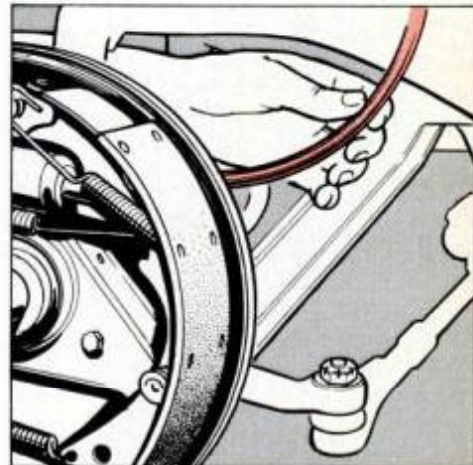


Pull back covers of a wheel cylinder to see if the cylinder leaks and is defective.

der causes loss of brake fluid. The fluid will get on linings and drums, causing brakes to grab.

Check hydraulic hoses that feed fluid to brakes (drum or disc). If you see small cracks, replace the hose. Make certain a hose is not kinked, thus preventing fluid from reaching brakes.

As you inspect hoses, have someone in the car step on the brake pedal. If there is a weakness in a hose or at a fitting, you'll be able to spot a leak.



Check hydraulic lines carefully. Replace any found to be cracked, kinked or split.






















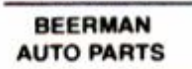























FALL CAR CARE

HEADQUARTERS

Quality automotive products are available from these APAA member retailers. Many are offering money-saving specials as part of the Fall Car Care promotion, including some of the excellent products featured in this CAR CARE GUIDE.

Check your local newspaper for Fall Car Care sections featuring car maintenance hints and the products that keep your car running properly. It will direct you to your neighborhood Fall Car Care Headquarters where all your car care needs can be satisfied.

Automotive Parts & Accessories Assn.
Member Retail Outlets

 A & A WESTERN, INC.	IL	 ARROW AUTO PARTS SUPPLY	MO	 Bosco's DEPARTMENT STORES	PA	 DART DRUG	MD, VA, DC
 ACE HARDWARE	STORES IN ALL 50 STATES	 AUTO GIANT STORES DISCOUNT AUTO PARTS	PA	 Boyer AUTO SUPPLY CO.	MI	 DART HOME	MD, VA
 ACTION AUTOMOTIVE	MI	AUTOMOTIVE SPECIALTY PARTS	MI	BUCHANAN	AL	 EVERYTHING AUTOMOTIVE	NY
 ADVANCE/AUTO	VA, TN, NC, SC	 Avellino's Tires & Auto Service Centers	NJ, PA	 BS SALES		 FAGEN Auto 2.0 Parts	IL
 AID	NY, CT, NJ, FL	 BATE	KY	 CAL AUTO STORES	CA	FAIRVIEW AUTO STORES OF QUEENS VILLAGE	NY
 ALS AUTO SUPPLY	WA	 B&R PERFORMANCE	NY	C & L AUTO PARTS OF BELLWOOD	IL	 Fleener auto Stores.	IN, OH, KY, TX
 APCO AUTO PARTS & MACHINE	AZ	 BEERMAN AUTO PARTS	MD, VA, WV, PA	 CAR-TUNE AUTO PARTS	NM	 FOREST CITY AUTO	IL, NY, OH, PA
 Auto Parts DISCOUNT Auto Parts & Supply Stores	CA, NV, HI	 BIG WHEEL AUTO STORES	MN, WI	 CASH AUTO PARTS	WA	 Frank's AUTO SUPPLY	PA
		 BLUE STAR AUTO STORES	IL, IN	 Cash & Carry Parts, Inc.	PA	 Fred Meyer THE AMERICAN STORE	WA, AK
				CENTRAL HARDWARE	IL, IN, MO, TN	 Gem	HI
				 FARM & FAMILY CENTER	DE, IN, IA, KY, MD, MA, MO, NB, NY, NC, PA, TN, VA, WI	 GIANT DISCOUNT AUTO STORES	MI
				 CHAMPION AUTO STORES	MN, IA, MT, NB, ND, SD, WI	GIANT DISCOUNT AUTO PARTS	GA
				IN MAINE: CONSUMER AUTO PARTS	ME, NH	GOLD & SON'S AUTOMOTIVE	MI
				NEW HAMPSHIRE: CHAMP AUTO PARTS		 GRAND/AUTO	CA, NV
				 cap CONSUMER AUTO PARTS	MA	 Guarantee Auto	IN
				 CRAZY JOE'S	NC, SC	 GANDERMAX	IN
				 Crown/Auto	MN	 Hi-Gear DISCOUNT AUTO CENTERS	MD, VA
				CUSTOM CYCLE & VAN SUPPLY	IN	 HILL PISTON SERVICE	MI, OH, IN
				 Holiday Int'l Auto Centers	MN	 Holiday Int'l Auto Centers	MN

Honest Charley	FL
JACKS AUTO SUPPLY	TX
JACK'S AUTOMOTIVE, INC.	MI
JOE'S AUTO SUPPLY INC.	WA
MUFFLER	PA
KARPARTS	OH, KY
King AUTO SUPPLY	CA
Kmart	All except AK
KRAGEN Auto Supply	TX
Lafayette	MI
LANG'S AUTO PARTS	IL, IN
Lee Stone, Inc. Dempster Auto Store	IL
LEVIN'S AUTO SUPPLY	CA
MAJOR MOTOR SUPPLY CO.	IL
MAPLE	MA
MARINO'S HOME & AUTO INC.	PA
Mars	MA
MJ AUTO	IL
MID-WEST AUTO SUPPLY	IA
MONROE TO WARD	AL, AK, AZ, AR, CA, CO, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, MD, MI, MN, MO, MT, NB, NV, NH, NM, NY, NC, ND, OH, OK, OR, PA, SC, SD, TN, TX, VA, WA, WV, WI, VT, WY

M & L MOTOR SUPPLY COMPANY	MN, WI
MOTOR SUPPLY COMPANY	MN
MR. AUTO DISCOUNT CENTER INC.	PA
MR. AUTO	VA
MURPHY'S MART	GA
MURPHY'S MART	AL, IN, MD, MS, OH, PA, VA
national auto	NY, MA
NAYLOR AUTO PARTS CENTERS	TX
OTASCO	AL, AR, FL, GA, KS, KY, LA, MS, MO, OK, SC, TN, TX
Penn-Jersey AUTO STORES	NJ, PA, MD, VA, DE
Parts World DISCOUNT AUTO STORES	NV
PEOPLES AUTO PARTS CO.	MI
PEP BOYS	CA
PHIL'S STORES INC.	OH
Pk	TX
Prange-way	WI
PREXLER'S AUTO PREP CENTER	IL
PROGRESSIVE TIRES & AUTOMOTIVE	MI
Protecto	OH

PUBLIC DISCOUNT AUTO PARTS	IL
Renninger's	PA
RICHLIN	CT
R&S AUTO	NJ, PA
ROSE AUTO STORES	FL
ROXBURY AUTO PARTS	WA
SEL-LO AUTO PARTS	GA
SCHUCK'S AUTO SUPPLY	OR, WA
STAR AUTO PARTS & ACCESSORIES	IL
STATEWIDE AUTO SUPPLY	ID, OR
STRUM AUTO SUPPLY	IA, IL
THERESA AUTO PARTS	WI
THRIFTY AUTO PARTS	CA
THRIFTY AUTO STORE	LA
THRIFTY AUTO SUPPLY	WA, ID
TIENDAS DEL OESTE, S.A.	CA
TRAK & AUTO	DC, MD, VA
True Value HARDWARE STORES	AK, AL, AR, AZ, CA, CO, CT, DE, DC, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NB, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, WA, WV, WI, VT
TOP AUTO	WA, AK

Half-Price Oil	CT, FL, HI, IL, IN, IA, ME, MD, MA, MI, MN, MS, NH, NY, NC, ND, OH, PA, RI, TX, UT, VT, WI, CAN
U AUTO-DO-IT AUTO PARTS CENTERS	FL
Valley Fair	NJ
VAN NESS AUTO SUPPLY	CA
VARIETY AUTO SUPPLY INC.	IL
V & S AUTO PARTS	PA
WEBER AUTO PARTS CO.	CA
WESTERN AUTO	AL, AK, AZ, AR, CA, CO, CT, DE, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NB, ND, NV, NH, NJ, NM, NY, NC, OH, OK, OR, PA, RI, SC, TN, TX, UT, VA, WA, WV, WI, VT, WY
WHITLOCK AUTO SUPPLY	WI, OK, KS
Woolco	AL, AZ, AR, CA, CO, CT, DE, FL, GA, IN, IL, IA, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NB, NV, NH, NJ, NM, NY, NC, OH, OK, PA, RI, SC, TN, TX, VA, WI, WY
Woolworth	AL, ID, ME, MN, NC, VT, FL, IL, MI, MT, TX, WY
WORLDWIDE AUTO PARTS	OH, PA
Yadro auto parts	IL
Zayre	AL, CT, FL, GA, IL, IN, IA, KY, ME, MD, MA, MI, MN, MS, MO, NH, NJ, NY, NC, OH, PA, RI, TN, VT, VA, WI
Zayre shoppers' city	MN

Section 7

Transmission

The interval at which to service an automatic transmission varies, from year to year and from manufacturer to manufacturer. Automatic transmission service may be called for every year, every 100,000 miles, or a longer interval.

If a car is used under one or more of the following conditions, an automatic transmission runs hotter—and service should be performed once a year or every 15,000 miles:

- Driving in heavy city traffic, where temperature remains at 90° F., or above, for a prolonged period.
- Driving in hilly or mountainous areas.
- Pulling a trailer frequently.

To service the automatic transmission, raise the car and drain the transmission and, if possible, the torque converter. Some transmissions are equipped with drain plugs. If there is no drain plug, you drain the transmission by removing all bolts from the pan and dropping the pan. Incidentally, metal particles or sludge

in the bottom of the pan may reveal a transmission problem in the early stage.

Replace the filter which is attached to the transmission body. Some transmissions use screens, which may be cleaned in solvent and reused.

Reattach the drain plug or pan securely and fill the transmission with fluid. Do not overfill.

Transaxle service

A car equipped with front-wheel drive has a transaxle. The transaxle is a unit containing the manual transmission, or an automatic transmission and differential assembly in a single housing, internally sealed off from each other. Servicing manual and automatic transaxles requires different procedures.

■ Manual transaxle—Inspect the fluid twice a year. Fluid level should be up to the filler hole plug opening.

Fluid usually requires changing only if it becomes contaminated, or the car is taken to a

different climate. Use fluid of the correct viscosity for the anticipated temperature. For example, Chrysler Corp. recommends the following fluids for manual transaxles:

Anticipated Ambient Temperature Range	Recommended Fluid Viscosity
Above -10° F.	SAE 90, SAE 80W-90 or SAE 85W-90
As low as -30° F.	SAE 80W or SAE 80W-90
Below -30° F.	SAE 75W

■ Automatic transaxle—Check manufacturer recommendations regarding the frequency of transmission fluid and filter changes. This service is performed in the same way as for automatic transmissions.

Manufacturers suggest the differential fluid level be checked twice a year. The fluid should be to the bottom of the filler-hole plug.

If you add fluid to an automatic transaxle, use only the type that's recommended by the manufacturer.

8 Tires and wheels

Premature tire failure is often avoidable. In most cases, it results from neglect.

The easiest tire service, checking tire pressure, is also the most important. Buy yourself a good tire gauge and use it often. Check inflation when tires are cold. Correct tire pressure, which is given for your car in the owner's manual and on the tire inflation decal mounted on the vehicle, is necessary for maximum tire mileage, responsive steering and safe driving. Don't forget to check the spare-tire pressure, if the car has a conventional spare.

Inspect tire treads every so often for unusual signs of wear. The illustrations show the types of tire tread-wear patterns you may find, and what they mean.

Get into the habit of inspecting tires for cuts, bruises and bulges. This precaution could help prevent a blowout. If you aren't sure damage is serious, have a tire specialist check it.

Other facts you should be aware of:

■ When cleaning tires, never use gasoline, mineral oil or an oil-based solvent. Don't use a wire brush, either. Warm, soapy water applied with a soft bristle brush is okay, and so is steam cleaning at a car wash.

■ Vibration felt in the steering wheel may signify that the front tires need to be balanced. Vibration felt through the seat may mean rear tires need balancing. Spin-balancing is best.

■ Tire and automobile manufacturers recommend tire rotation. GM, for example, recommends rotation every 15,000 miles, after the initial rotation is done at 7500 miles. New cars are generally equipped with radial tires. If four radials are being rotated, move tires front to back and back to front on the same side of the car. If a conventional spare tire is part of the rotation plan, the recommended procedure is: spare tire to right rear wheel; right rear tire to right front wheel; right front tire to spare position; left rear tire to left front wheel; left front tire to left rear wheel. Check air pressure after rotation.

■ If a car with radial tires pulls to the right or left, and inflation pressure isn't a factor, cross-

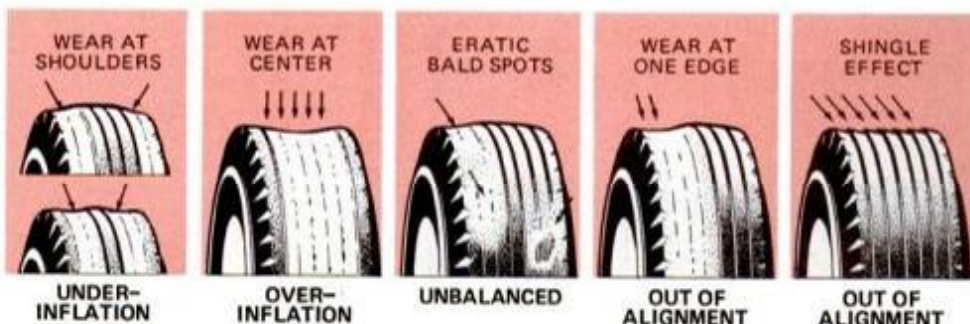
switch the tires from side to side, before spending money for front-wheel alignment

Wheel service

Check wheels for damage from power wrenches. After several bursts, wheel holes may become distorted and brakes damaged.

Tighten wheel nuts with a torque wrench to manufacturer recommendations, given in the service manual. If a torque wrench isn't available, use a heavy-duty lug wrench to tighten nuts as much as possible.

In tightening wheel nuts, turn them up by hand. Then, using the wrench, secure them in criss-cross order to seat the wheel. After nuts are secured, give each a final tightening. **PM**

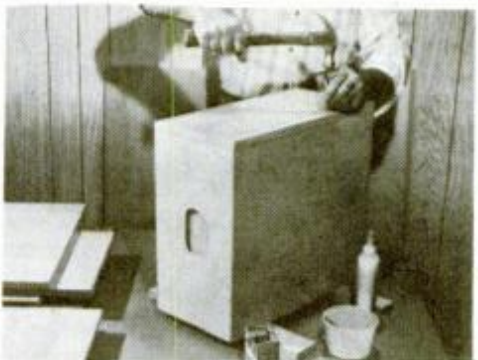




Chest is sized to fit most station wagons; it is shown here in a Datsun 810 wagon.



At home, table-mounted unit can be auxiliary food center. It wall-mounts, too.



Completely assemble all six sides of the end cabinets. Neat-fitting doors are created by sawing box into two parts. Be sure all nails are located out of the blade's path.



Set nailheads, fill the holes and sand all surfaces smooth before making the saw cuts that separate the doors.

PM TAKES YOU TAILGATING

(Continued from page 117)

At home you can park the chest in your family room. Use it as an auxiliary food service center when the guys come over for the Monday night game or as a portable beverage and snack bar at any party.

Where every inch counts

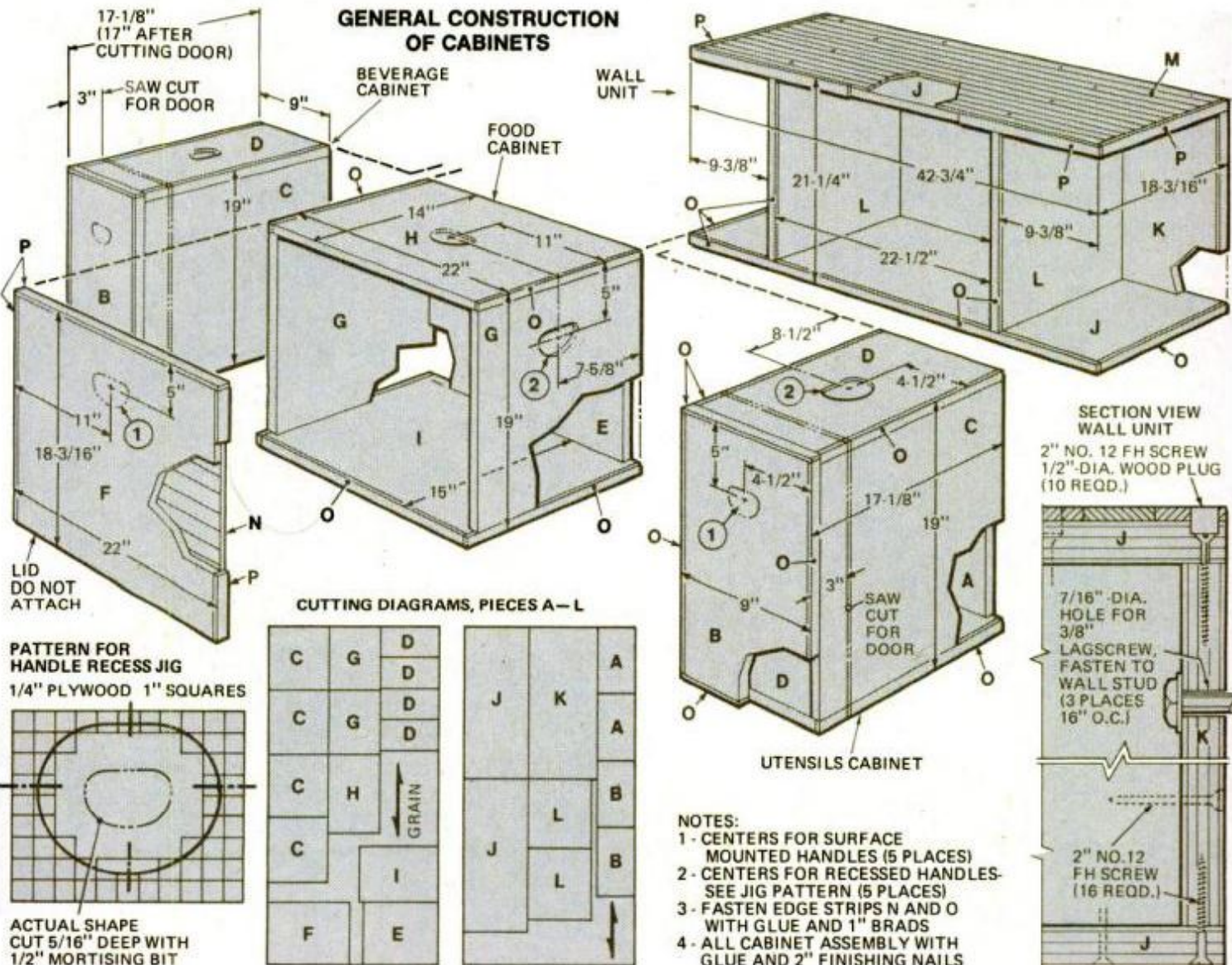
PM's chest makes use of just about every cubic inch for storage. The food cabinet has two separate, insulated compartments for storing perishables and/or keeping pre-cooked dishes warm. Its front panel (F), with maple butcher block on one side, does double duty as a sandwich

(Please turn to page 182)

PM photos: Color, Arnold Beckerman
Black-and-white how-to, Rosario Capotosto
Technical art: Eugene Thompson
Construction: R. Capotosto from sketches by Lester Walker, A.I.A.

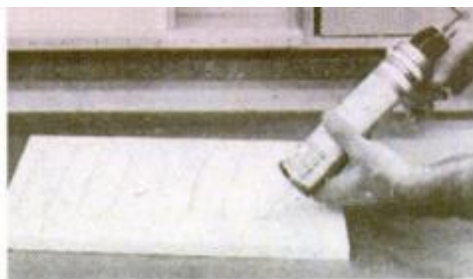
FOR MATERIALS LIST FOR TAILGATE CABINETS, TURN TO PAGE 184

GENERAL CONSTRUCTION OF CABINETS





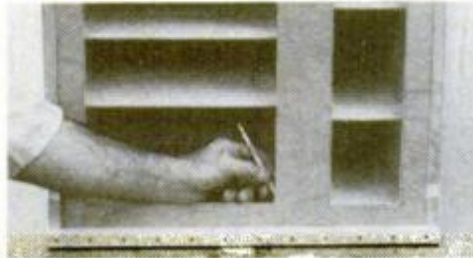
To separate the doors, set the table-saw fence and cut through the narrow ends first. Then proceed to cut the long sides. To prevent the blade from scraping against the door at the end of the final cut, insert cardboard spacers into the upper saw kerf beforehand and use tape over the kerf.



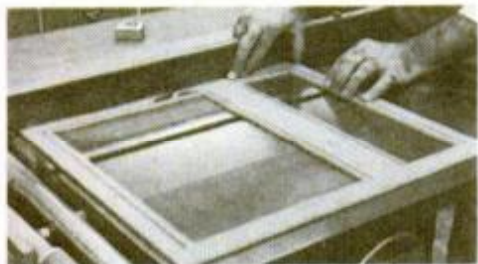
Apply glue to polystyrene foam insulating panel with gun-type applicator. Be sure adhesive is of the type formulated for foam. Paint the exposed sides and edges of insulation with latex enamel to make them easier to clean and to prevent deterioration.



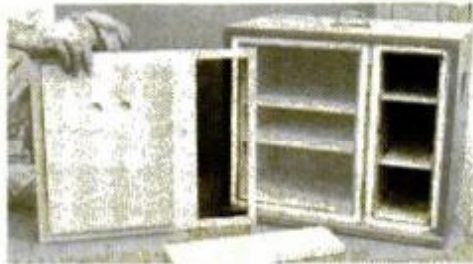
Test-fit dowel shelves in insulated compartments. Remove to paint. Dowels need no glue; press fit holds them in place.



After cutting rough (undersized) openings in front (C), trace exact openings using bottom (E) and sides (D) as guides.



Finish cuts on face framing are made with the table saw. Set the fence, lower the blade. Then position work, turn on power, slowly elevate blade, advance the work.



Insulating panels, with edge strips in place, should be slightly larger than their respective openings so they will fit in snugly. Sand the strips to exact size.

PM TAKES YOU TAILGATING

(Continued from page 181)

cutting board or as a serving tray.

Circular cutouts in the beverage cabinet keep bottles from bumping and breaking. Similarly, the tableware cabinet utilizes dividers to keep dishes from arriving at the stadium in pieces. Deep doors on the end cabinets are equipped with hooks and holders for mugs, utensils and bar equipment, plus a rack for napkins. These spaces can be rearranged to suit your own needs.

Where to start

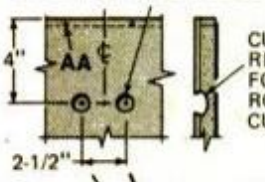
You will need two 4x8 sheets of $\frac{3}{4}$ -in. lumber-core plywood. We used birch cabinet-grade plywood for the prototype, but wood choice is optional. Since the plywood will cost approximately \$100 (about half of what you'll spend on the entire project), carefully follow the cutting diagrams on page 181.

Lay out the cutting lines and tack-nail a straight board to the panel for guiding the saw while you make the cuts. Use a circular saw set to a depth so the blade will just cut through the $\frac{3}{4}$ -in. plywood. Be sure the saw kerf is on the waste side of the cutting line for each pass. When you reach intersecting lines, finish off the cut square with a sabre saw. Final accurate sizing can be done

MATERIALS LIST FOR FOOD STORAGE CABINET APPEARS ON PAGE 184.

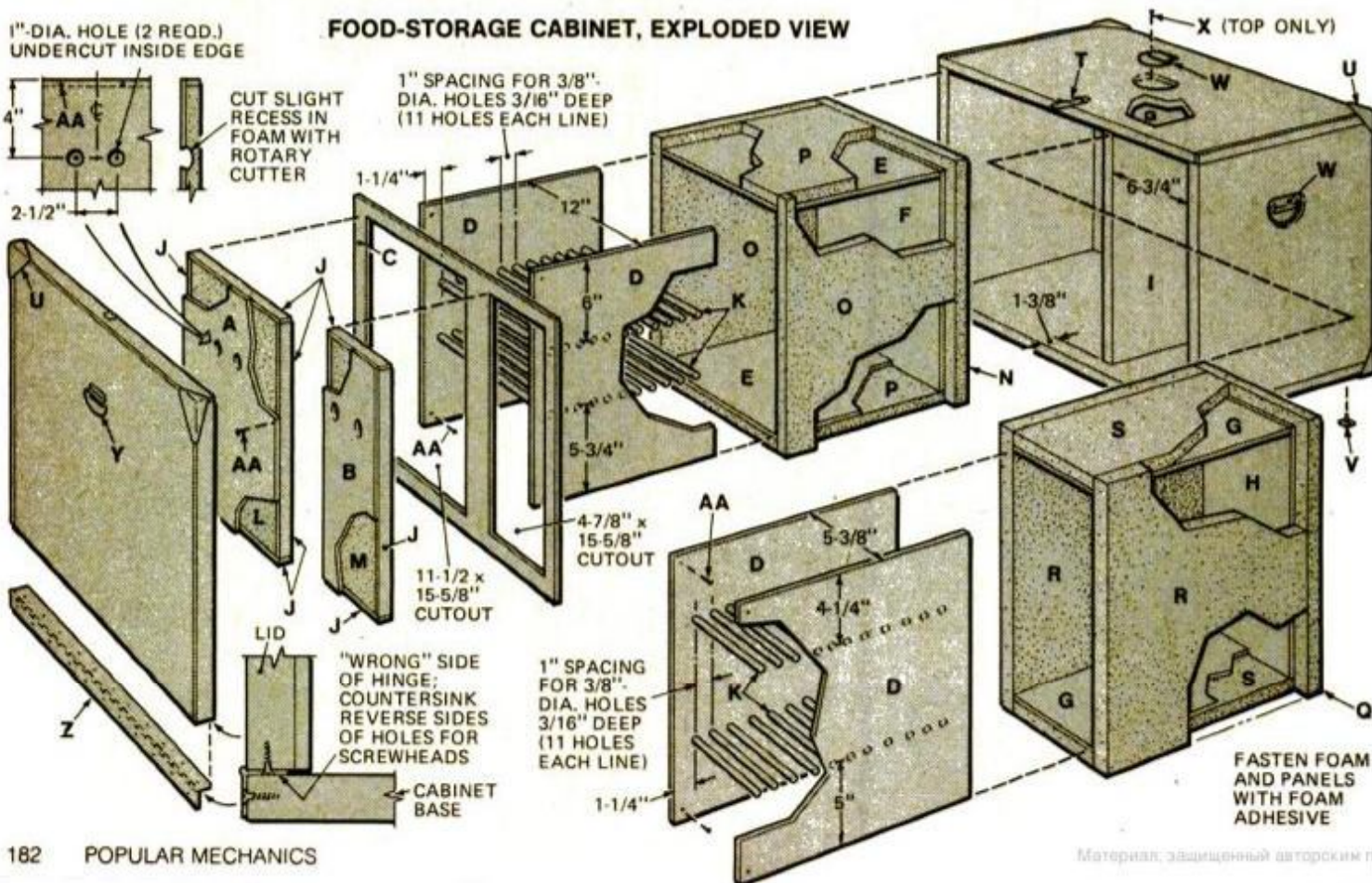
FOOD-STORAGE CABINET, EXPLODED VIEW

1"-DIA. HOLE (2 REQ'D.) UNDERCUT INSIDE EDGE



CUT SLIGHT RECESS IN FOAM WITH ROTARY CUTTER

1" SPACING FOR 3/8"-DIA. HOLES 3/16" DEEP (11 HOLES EACH LINE)



with the help of your table saw. Edge strips (O and P) ripped from 4/4 southern maple stock are used to conceal plywood edges. Set the table-saw rip fence for a 3/16-in. cut and rip all the required strips from warp-free boards.

Use a few finishing nails to hold the edge strips in place when gluing them to the panel. Not all edges require strips, so check the drawings. Attach strips to the ends of H, I and D, to the front of I, to the ends and sides of B, to the fronts of L and to the sides and front of J. Leave strips off the edges of both cutting boards (F and J) until the maple strips (M and N) have been glued in place and the edges trimmed. The maple strips closely match the birch veneer and are easily worked with tools where required.

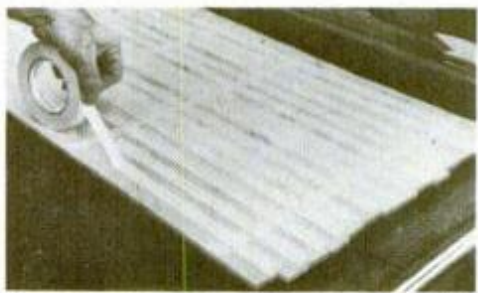
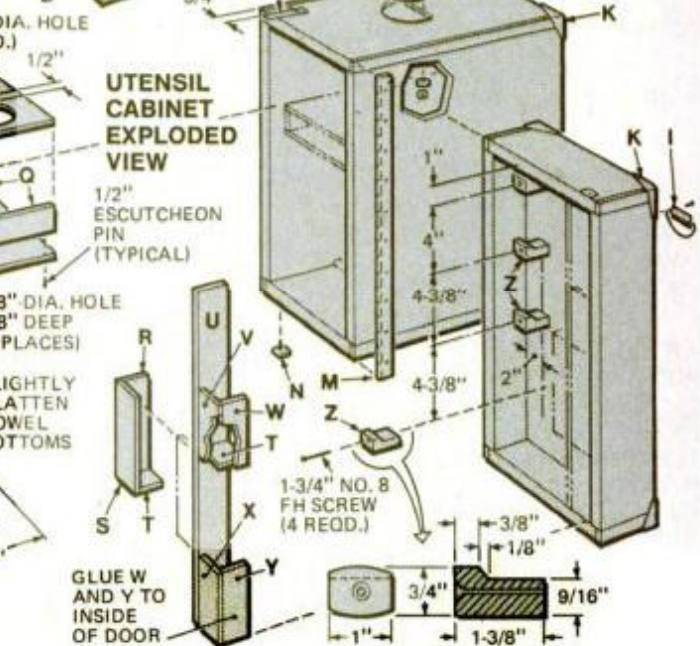
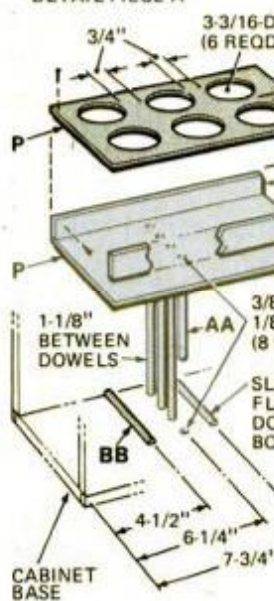
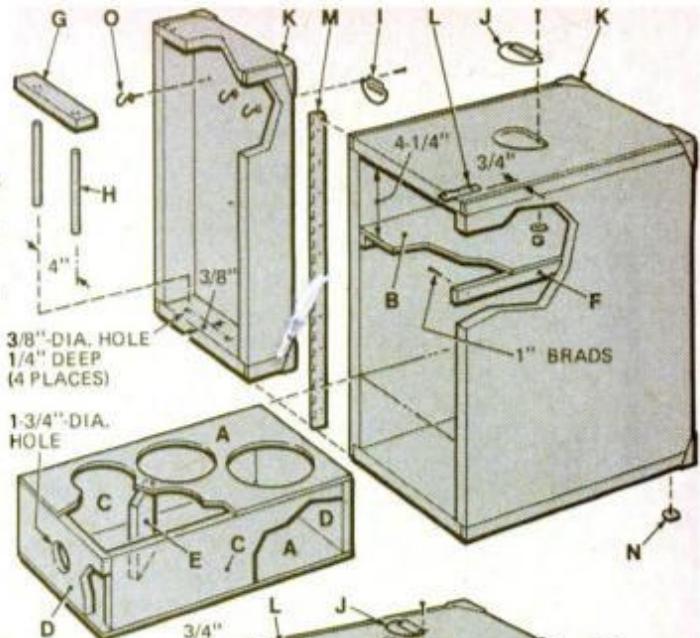
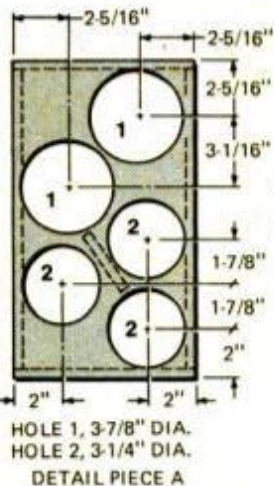
Recesses for the handles should be made before the boxes are assembled. For a quick, accurate job, use a template jig (for pattern, see plans on page 181) to guide the router and a 1/2-in. mortising bit. The router should have a 5-in.-dia. shoe. If yours is different, adjust template dimensions to suit. Use brads to secure the template to the workpiece.

Sand all exposed interior surfaces before assembling the cabinets. Use a pad sander or wrap sandpaper around a block and rub with a steady flat motion. Take care that you don't round the corners of the

(Please turn to page 184)

MATERIALS LIST FOR BEVERAGE CABINET APPEARS ON PAGE 184.

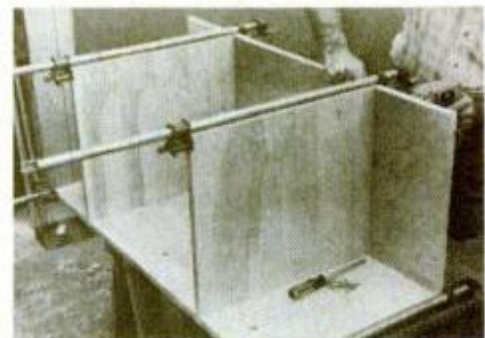
BEVERAGE CABINET EXPLODED VIEW



To assemble cabinet top with strips (M), use masking tape on the good side. Then flop workpiece and spread strips (tape acts as a hinge) to apply glue in between.



Strip assembly is then glued to plywood (J). Use wax paper between clamping blocks and work to prevent accidental bonding.



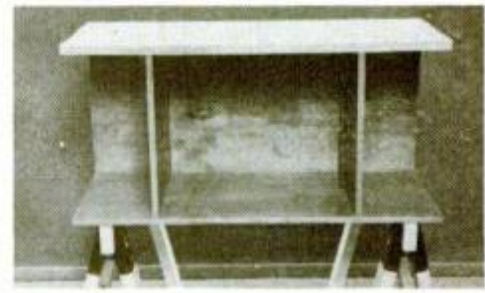
Clamping dividers (L), as shown, makes it easier to bore pilot holes for screws.



Bore holes for plugs (to hide screwheads) before boring pilot holes for screws.



Use brush to apply small amount of white glue in holes for plugs; tap into place.



Supporting unit can be mounted on wall as shown in plans. Other method: Make key-hole-shaped holes for easy demounting.

(Continued from page 183)

pieces that are to be butt-joined.

Assemble the three cabinets using 2-in. finishing nails and a thin layer of glue at all butt joints. Start by attaching the sides to the back. Next, attach the tops and bottoms. Then add the fronts to the end units.

The end cabinets are constructed as completely closed boxes which are then carefully ripped on the table saw to produce the 3-in.-deep doors. This method results in matched grain and precise-fitting doors. When nailing the units together, be sure to keep the nails out of the anticipated cutting lines.

To separate the doors from the end cabinet boxes, set the saw fence at 14 in., with the door portion as the cutoff. Working with one box at a time, cut through the smaller end sections first. Make the third cut on one of the sides. Before making the final cut, insert and tape cardboard spacers (the exact width of the kerf) into each end of the kerf on the first side. Also, apply several pieces of masking tape over other portions of the kerf. This prevents the cutoff section from accidentally pressing against the side of the blade at the completion of the cut.

Cutting polystyrene panels

Polystyrene rigid insulating panels are used to insulate the center unit. The best way to cut the foam is with the table saw. The blade you use *must have set teeth*. Do not use a hollow-ground blade—it'll positively bind and could cause an accident. Note: Because of chest weight, the top handles for the chest are attached with 1-in. rh nuts and machine screws, instead of with the screws supplied with the handles. As a result, the handle for the center chest must be installed *before* the insulation goes in. This allows you to use a wrench on the nuts.

The dowel shelf assemblies should also be completed before installing the insulation. The best way to insure exact alignment of the dowel holes between side pieces (D) is to tape the pieces together and drill 1/16-in. holes through both pieces at each dowel location. Then, using a brad point drill bit (which bores a flat-bottomed hole), counterbore holes 3/16 in. deep x 3/8 in. in dia.

Press the sides onto the dowels (glue is not necessary). Spray-paint the shelf assemblies before proceeding.

Plywood 'skin' for foam

When you're ready to make the installation, apply foam panel adhesive

to the backs of the insulating panels and set them in place. The foam panels are not made to take abuse, so a 1/4-in.-plywood protective skin must be applied over them. Install pieces E, F, G and H first using the adhesive. Then install the shelf assemblies; since the fit is snug, they do not need gluing.

The front frame piece (C) on the center section can be made to fit perfectly in only one way—by marking the cutting lines from the inside with the piece in place. Make a rough cut to clear out most of the waste. This will enable you to get a pencil on the inside to trace exactly along the sides of the enclosure.

Applying butcher block surfaces

To make the butcher block surfaces, cut the panels (F and J) slightly long so the ends can be trimmed to size after the maple strips (M and N) have been glued on. Use masking tape to hold all the strips together. Plastic resin glue is the best for this job. Mix it slightly thinner than usual so it won't set up too fast. Spread it over both surfaces and make sure to get it on the edges between the strips.

The wall unit is put together with screws and glue. Counterbored holes are made in the top to allow the screws to be recessed and plugged. Use bar clamps to hold the parts together while boring pilot holes for the screws. To assemble, connect the uprights to the back, add the bottom and then the top. See the plans for fitting out the insides of the end cabinets. Install all remaining hardware.

Finishing touches

The insides of the prototype chest were painted a yellow enamel. To achieve the light tone on the chest's exterior surfaces, they received a wash coat of 1 part sanding sealer to 8 parts thinner before being stained with Benjamin Moore's Fruitwood stain. Finally, two coats of a satin-finish polyurethane varnish were applied. Do not stain the cutting boards. Use a finish specially formulated for surfaces that contact food, such as Constantine's Wood Bowl Seal, or rub with mineral oil. **PM**

MATERIALS LIST—FOOD CABINET

Key	No.	Size and description
A	1	1/4 x 11 1/2 x 15 1/4" fir plywood
B	1	1/4 x 4 1/2 x 15 1/4" fir plywood
C	1	1/4 x 17 1/2 x 20 1/2" fir plywood
D	4	1/4 x 12 x 15 1/16" fir plywood
E	2	1/4 x 12 x 12" fir plywood
F	1	1/4 x 12 x 16" fir plywood

G	2	1/4 x 5 1/2 x 12" fir plywood
H	1	1/4 x 5 1/2 x 16" fir plywood
I	1	1/2 x 12 1/2 x 17 1/2" fir plywood
J	(as reqd.)	3/4 x 1 1/16" maple (rip from 1" stock)
K	44	3/8"-dia. x 5 1/4" dowel
L	1	1 1/16 x 10 3/4 x 14 1/8" polystyrene rigid-panel insulation
M	1	1 1/16 x 4 1/2 x 14 1/8" polystyrene rigid-panel insulation
N	1	1 1/16 x 13 1/16 x 17 1/2" polystyrene rigid-panel insulation
O	2	1 1/16 x 12 1/4 x 17 1/2" polystyrene rigid-panel insulation
P	2	1 1/16 x 12 x 12 1/4" polystyrene rigid-panel insulation
Q	1	1 1/16 x 6 1/2 x 17 1/2" polystyrene rigid-panel insulation
R	2	1 1/16 x 12 1/4 x 17 1/2" polystyrene rigid-panel insulation
S	2	1 1/16 x 5 1/16 x 12 1/4" polystyrene rigid-panel insulation
T	1	Brass hasp (Brainerd No. 840XC)
U	6	3/4 x 1 1/4 x 1 1/4" brass corners (Constantine No. 32H3A)
V	4	Plastic glide tack
W	3	Brass-plated handle (Brainerd No. 0234XC)
X	4	1/4 x 1" rh bolt, washer and nut
Y	1	1 1/4 x 2" solid-brass handle (Stanley CD5336N01)
Z	1	1 1/2" x 2 1/4" brass-plated continuous hinge
AA	8	1/2" escutcheon pin

Misc.: polystyrene foam adhesive.

MATERIALS LIST—GENERAL CABINET

Key	No.	Size and description
A	2	3/4 x 7 1/2 x 17 1/2"
B	2	3/4 x 8 1/2 x 18 1/2"
C	4	3/4 x 16 1/2 x 17 1/2"
D	4	3/4 x 8 1/2 x 16 1/2"
E	1	3/4 x 17 1/2 x 20 1/2"
F	1	3/4 x 18 x 21 1/2"
G	2	3/4 x 14 x 17 1/2"
H	1	3/4 x 14 x 21 1/2"
I	1	3/4 x 14 1/16 x 21 1/2"
J	2	3/4 x 18 x 42 1/2"
K	1	3/4 x 19 1/2 x 42 1/2"
L	2	3/4 x 17 1/4 x 19 1/2"
M	14	1/4 x 1 1/4 x 42 1/2" maple (rip from 6/4 stock)
N	14	1/4 x 1 1/4 x 21 1/4" maple (rip from 6/4 stock)
O	(as reqd.)	3/16 x 3/4" maple strips (rip from 1" stock)

*Birch veneer, lumber-core plywood was used in prototype.
Misc.: 10, 1/2"-dia. wood plugs; 26 No. 12 x 2" fh screws; 13, 1/4 x 3" lagscrews (for wall mounting of unit); 1" brads; 2" finishing nails and glue as required.

MATERIALS LIST—BEVERAGE AND UTENSIL CABINETS

Key	No.	Size and description
A	2	1/4 x 7 1/2 x 13 1/2" fir plywood
B	1	1/4 x 7 1/2 x 13 1/2" fir plywood
C	2	3/4 x 3 1/2 x 12 1/2" fir plywood
D	2	3/4 x 3 1/2 x 7 1/2" fir plywood
E	1	3/4 x 3 1/2 x 3" fir plywood
F	2	1/2 x 3/4 x 13 1/2" maple
G	1	1/2 x 3/4 x 7" maple
H	2	3/8"-dia x 5" dowel
I	2	1 1/4 x 2" No. 1 solid-brass chest handle (Stanley CD5336)
J	2	brass-plated handle (Brainerd No. 0234XC)
K	16	1 1/4 x 3/4 x 3/4" brass corner (Constantine No. 32H3A)
L	2	hasp (Brainerd No. 840XC)
M	2	1 1/16 x 19 1/4" brass-plated continuous hinge
N	8	plastic glide tack (do not install on doors)
O	3	brass cup hook
P	2	1/4 x 7 1/2 x 12 1/4" fir plywood
Q	2	1/4 x 1 1/4 x 12 1/4" fir plywood
R	1	1/4 x 1 1/2 x 5 1/4" fir plywood
S	1	1/4 x 1 1/4 x 5 1/4" fir plywood
T	2	1/4 x 1 1/2 x 1 1/2" fir plywood
U	1	1/4 x 1 1/4 x 17 1/2" fir plywood
V	1	1/4 x 1 1/4 x 3 1/4" fir plywood
W	1	1/4 x 1 1/2 x 3 1/4" fir plywood
X	1	1/4 x 1 1/4 x 3 1/4" fir plywood
Y	1	1/4 x 1 1/2 x 3 1/4" fir plywood
Z	4	3/4 x 1 1/2 x 1 1/2" maple
AA	4	3/8"-dia. x 5 1/2" dowel
BB	2	3/8"-dia. x 5 1/2" dowel

Misc.: 4 No. 8 x 1 1/4" fh screws; 1" rh machine screw, washer and 4 nuts (for handle J); 1" brads, 1/2" escutcheon pins, white glue and 2" finishing nails.

FAMILY ROOMFUL OF IDEAS

(Continued from page 184A)

This is done with a table saw and sabre saw. The outline shown is dimensioned for the J.C. Penney model No. 6915 Stretch Stitch sewing machine. If your machine is different, alter the dimensions to suit. Important: The spacing between the top and subtop may also have to be altered depending on the flush-plate height of the machine to be mounted.

Bore four 1-in.-dia. holes at the corners of the cutout outline. Set the table-saw rip fence as required, depress the blade, then position the work and turn on the power. Slowly elevate the blade to make the blind cut to within 1 in. of each hole. Finish cuts to the corners and make the curved cut with a sabre saw.

If you salvage the dropout piece, you'll have a perfect-fitting well-top insert. Make diagonal cuts at the

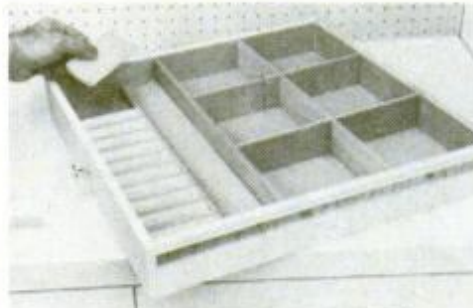
(Please turn to page 184D)



Insert the verticals starting at the bottom. A minimum amount of glue and two nails at each end will anchor them securely.



Standoff cleats support the yarn bin to create a clean, floating effect. No back panel is required on the bin.



Cove molding is used to make thread-spool racks. The angled edges are trimmed off to make the pieces butt neatly.



Parts are painted after assembly. A power screwdriver comes in handy on jobs like this with its continuous hinges.

MATERIALS LIST—CHEST OF DRAWERS

Key	No.	Size and description (use)
A	2	3/4 x 20 x 20" plywood (cabinet top and bottom)
B	2	3/4 x 20 x 24 1/2" plywood (cabinet sides)
C	1	1/2 x 18 1/2 x 24 1/2" plywood (cabinet back)
D	2	1/2 x 6 x 18 1/2" (drawer fronts)
E	1	1/2 x 5 x 18 1/2" (drawer front)
F	1	1/2 x 4 x 18 1/2" (drawer front)
G	1	1/2 x 2 1/4 x 18 1/2" (drawer front)
H	4	1/2 x 6 x 18 1/2" (drawer sides)
I	2	1/2 x 5 x 18 1/2" (drawer sides)
J	2	1/2 x 4 x 18 1/2" (drawer sides)
K	2	1/2 x 2 1/4 x 18 1/2" (drawer sides)
L	2	1/2 x 5 1/2 x 17 1/4" (drawer backs)
M	1	1/2 x 4 1/2 x 17 1/4" (drawer back)
N	1	1/2 x 3 1/2 x 17 1/4" (drawer back)
O	1	1/2 x 2 1/2 x 17 1/4" (drawer back)
P	5	1/4 x 17 1/4 x 18 1/2" lauan plywood (drawer bottoms)
Q	1	1/4 x 4 x 18" (partition)
R	1	1/4 x 4 x 17 1/4" (partition)
S	2	1/4 x 3 x 17 1/4" (partitions)
T	1	1/4 x 3 x 18" (partition)
U	2	1/4 x 2 x 17 1/4" (partitions)
V	2	1/4 x 2 x 11 1/4" (partitions)
W	10	3/8 x 1 1/8 x 18 1/2" maple or birch glides
X	1	2 1/2 x 17" cove molding (tray)
Y	1	2 1/2 x 4" cove molding (spool tray)
Z	11	1 1/2 x 4" cove molding (spool trays)
AA	1	1/2 x 3/4 x 4" pine (filler block)
BB	4	casters, Shepherd Nova No. 9019, 2 1/4" wheel, bright brass
CC	5	drawer pulls, Amerock BP 551-3
DD	10	No. 8 rh screws (adjustable door stops)

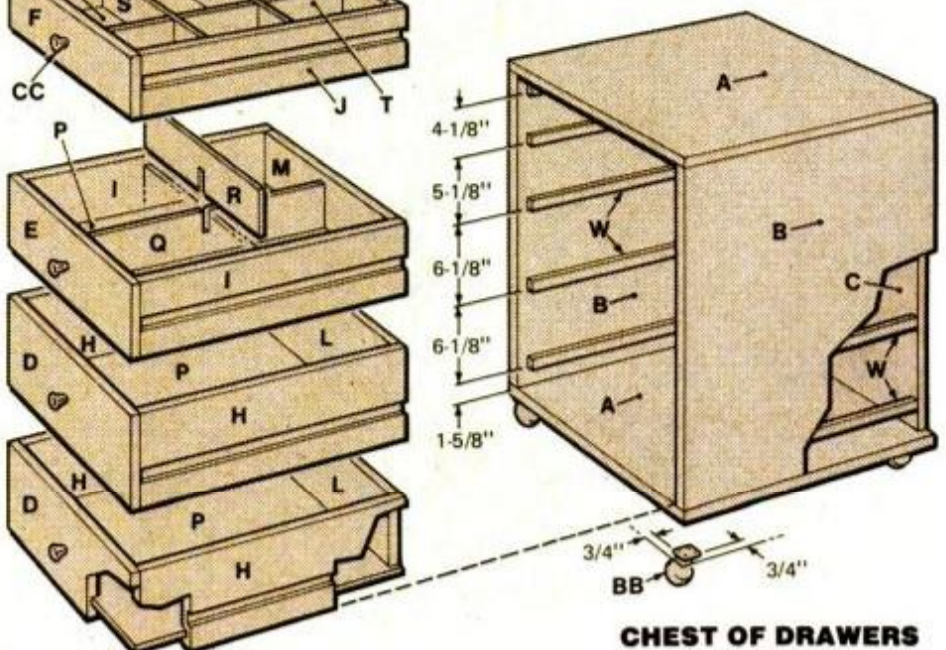
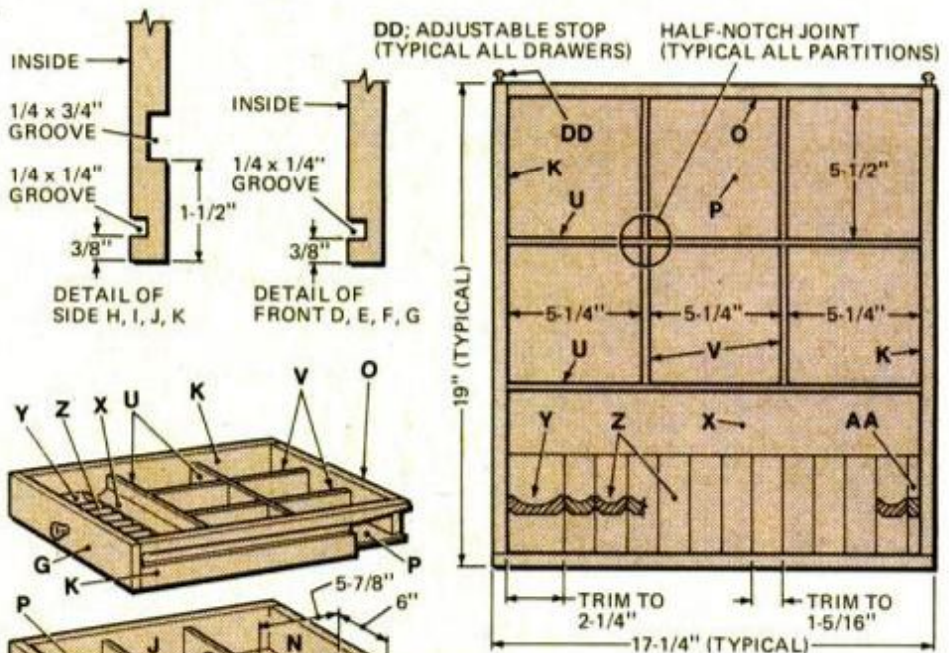
YARN BIN

A	4	1/2 x 23 1/2 x 42 1/4" (cross members)
B	2	1/2 x 22 x 23 1/2" (sides)
C	10	3/8 x 7 x 23 1/2" (partitions)
D	5	3/8 x 6 1/4 x 23 1/2" (partitions)

CENTER UNITS

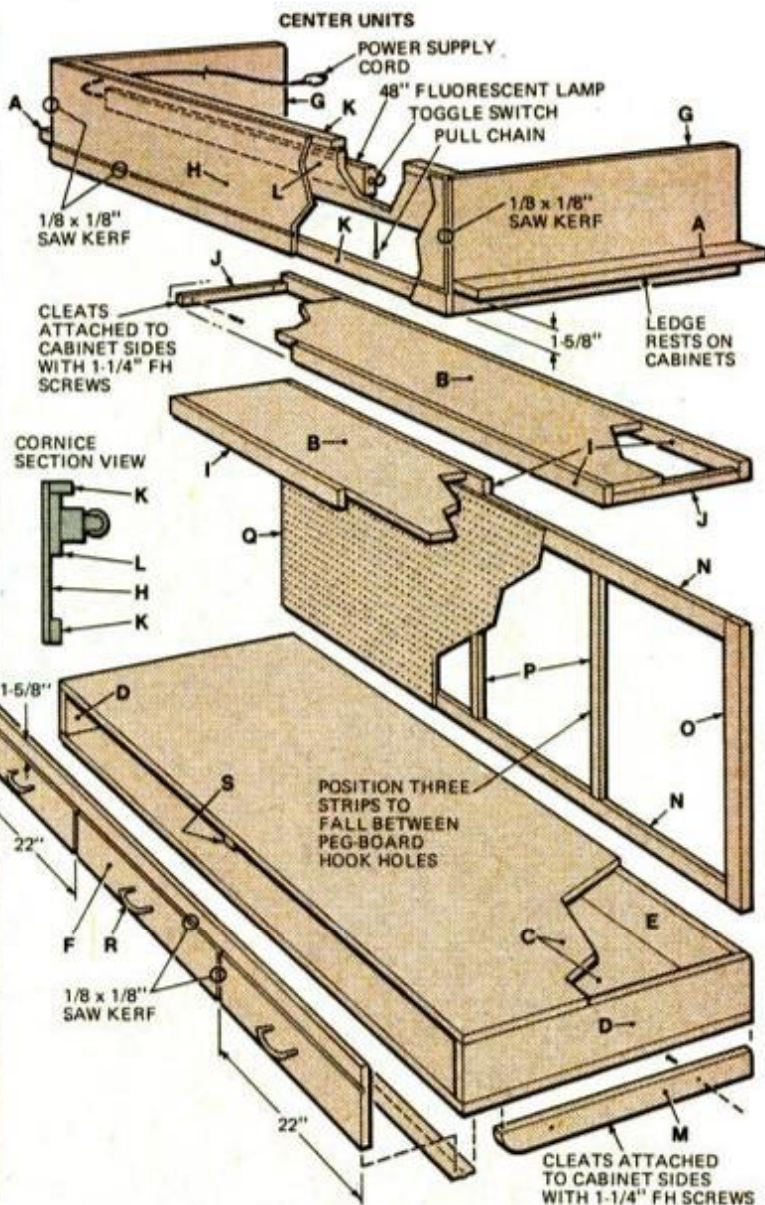
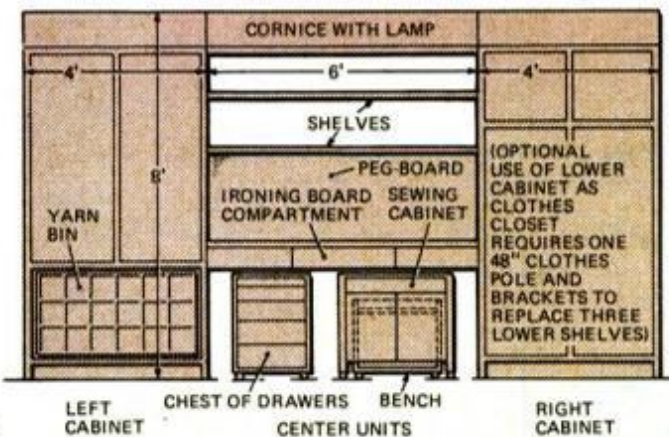
A	2	3/4 x 4 x 22 1/4" plywood (cornice ledges)
B	2	3/4 x 10 1/2 x 72" plywood (shelves)
C	2	3/4 x 23 1/4 x 72" plywood (countertop and bottom)
D	2	3/4 x 4 1/2 x 23 1/4" (counter sides)
E	1	3/4 x 4 1/2 x 70 1/2" (counter back)
F	1	3/4 x 6 x 71 1/4" (counter front)
G	2	1/2 x 10 1/4 x 22 1/4" plywood (cornice ends)
H	1	3/4 x 10 1/4 x 72" plywood (cornice front)
I	4	3/4 x 1 1/2 x 72" pine (shelf edges)
J	4	3/4 x 3/8 x 10 1/2" pine (shelf cleats)
K	2	3/4 x 1 1/2 x 71" furring (cornice cleats)
L	1	3/4 x 3 1/2 x 71" pine (cornice lamp support)
M	2	3/4 x 1 1/2 x 20 1/2" furring (counter cleats)
N	2	3/4 x 1 1/2 x 69" furring (perforated-board framing)
O	2	3/4 x 1 1/2 x 24" furring (same as above)
P	3	3/4 x 3/4 x 21" pine (same as above)
Q	1	1/2 x 24 x 72" (perforated-board framing)
R	3	drawer pulls
S	1	magnetic catch

Misc.: 12 No. 10 1 1/4" rh screws, 48" fluorescent lamp, toggle switch, pull chain.

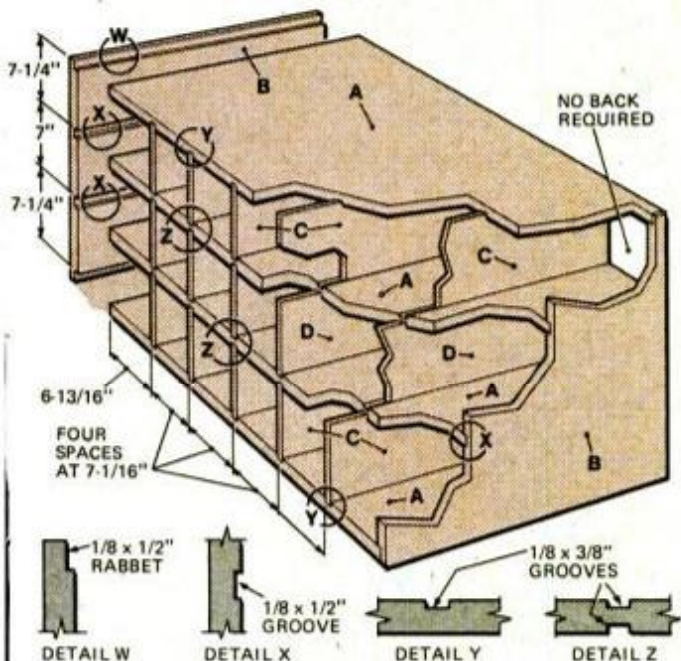


CHEST OF DRAWERS

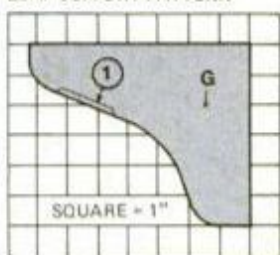
GENERAL ARRANGEMENT



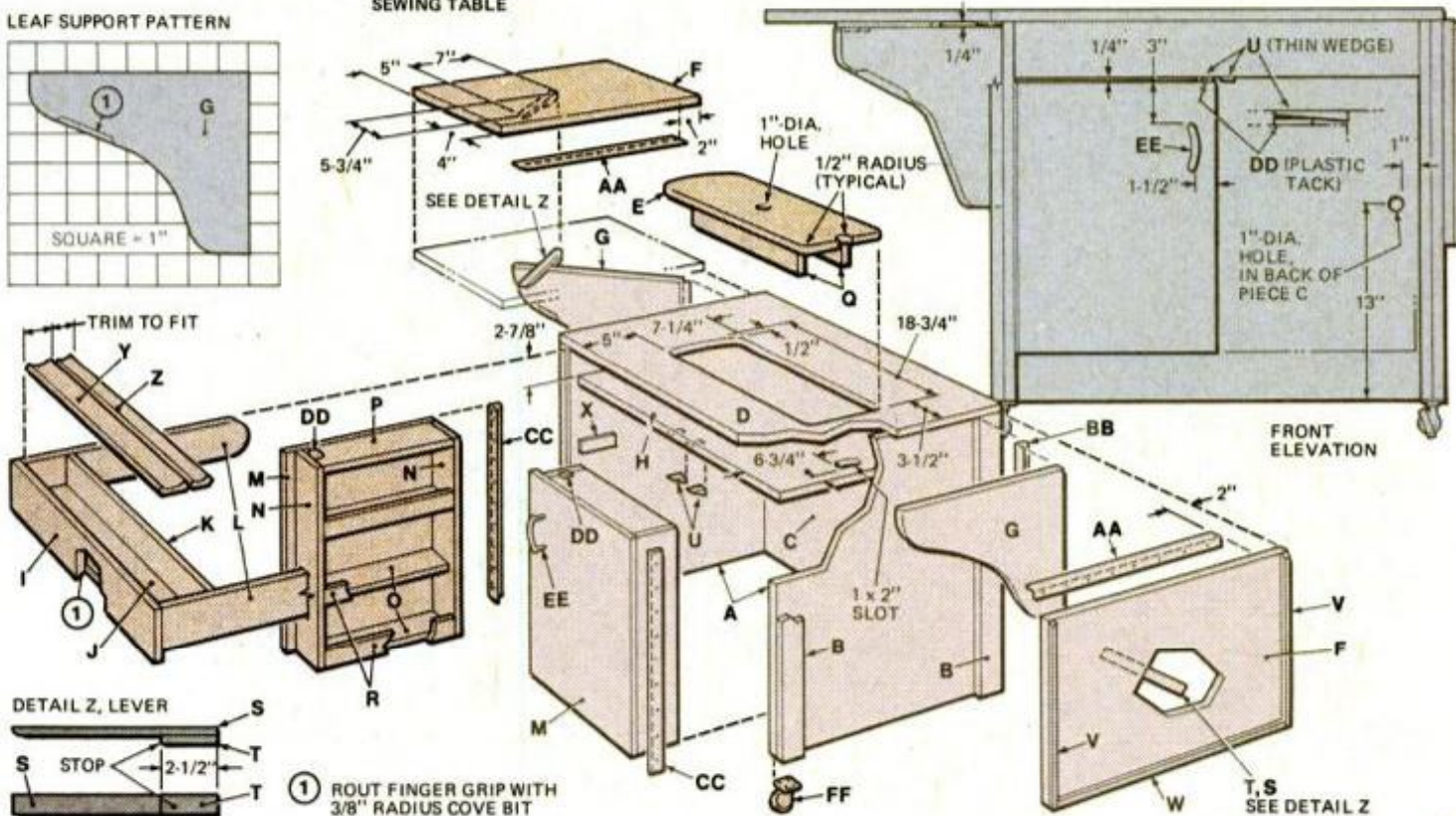
YARN BIN



LEAF SUPPORT PATTERN



SEWING TABLE



FAMILY ROOMFUL OF IDEAS

(Continued from page 184B)

corners to clear away holes. Glue-in small corner blocks; trim to size.

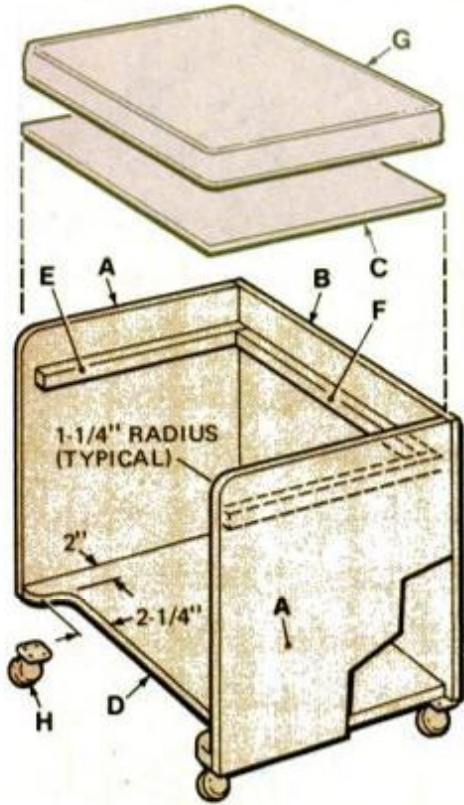
It would be very difficult to drill the holes for the drop-leaf hinge screws in the tabletop after it is attached because of the closeness of

the cabinet side. Therefore, do this in advance. Also, temporarily turn in the screws so they'll be easier to drive in the tight space during final assembly (after painting).

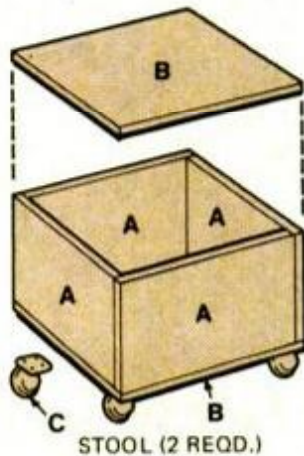
A router with cove bit is used to cut a finger grip on the edge of the leaf support. A cove is also routed at the bottom back edge of the small drawer because a pull is not used for this drawer (it would tend to snag

(Please turn to page 192)

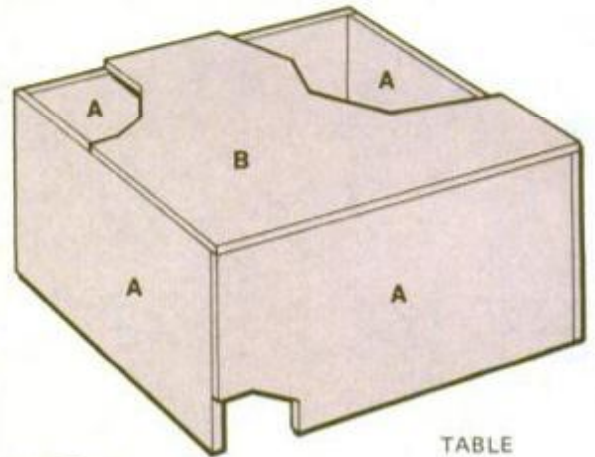
SEWING CABINET BENCH



Ironing and pattern-cutting boards store neatly behind the drop-down false front.

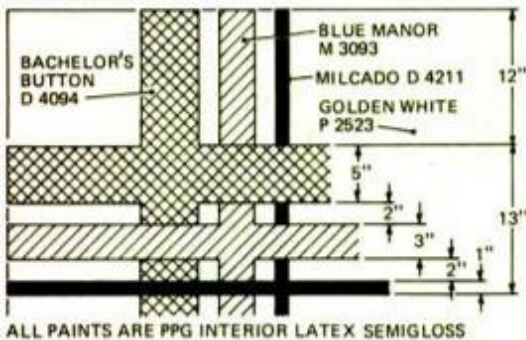


STOOL (2 REQ'D.)

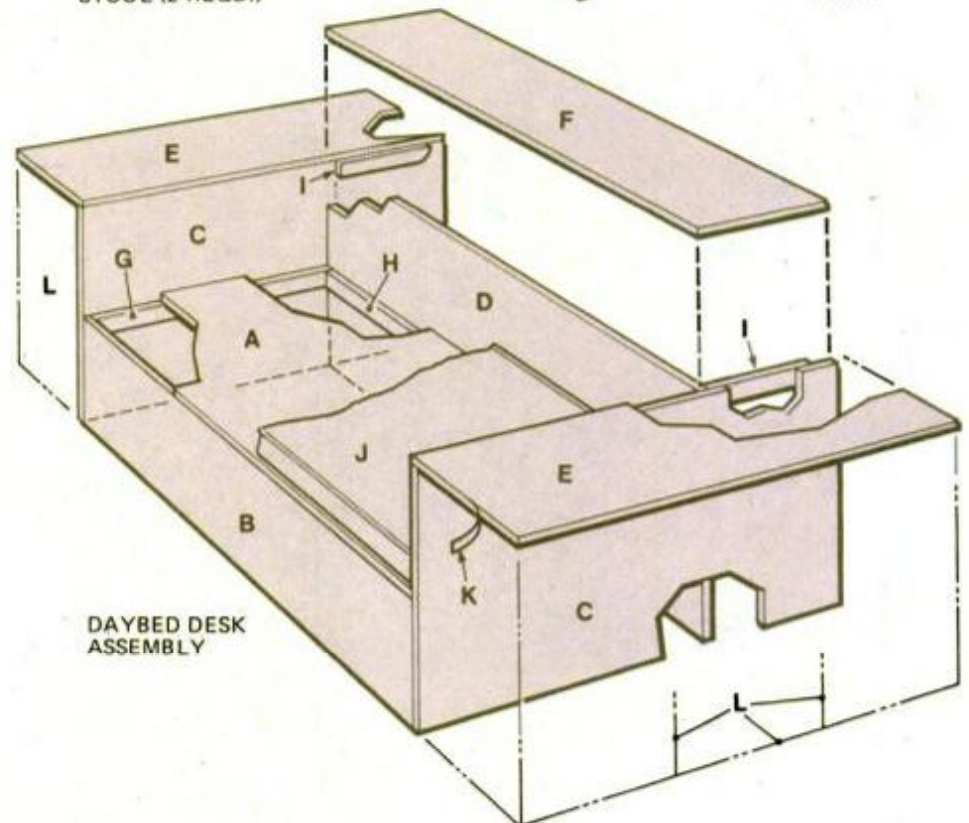
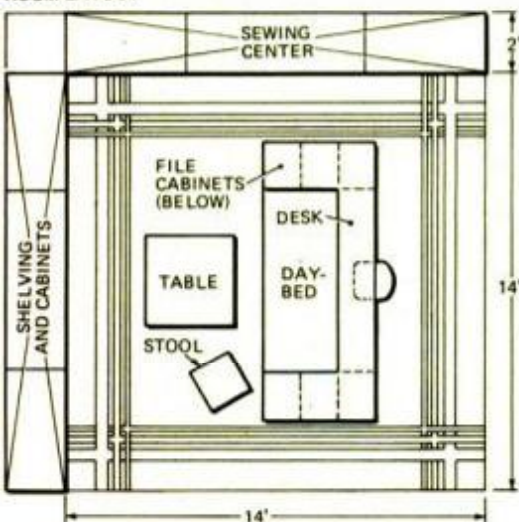


TABLE

PAINT LAYOUT



ROOM LAYOUT



DAYBED DESK ASSEMBLY

MATERIALS LISTS—STOOL

Key	No.	Size and description
A	4	3/4 x 10 1/4 x 17 1/4" plywood
B	1	3/4 x 18 x 18" plywood
C	4	Ball-type casters, Shepherd Nova No. 9019

TABLE

A	4	3/4 x 20 1/4 x 35 1/4" plywood
B	1	3/4 x 36 x 36" plywood

DAYBED/DESK

A	1	3/4 x 30 x 75" plywood
B	1	3/4 x 13 1/4 x 75" plywood
C	2	3/4 x 28 x 45" plywood
D	1	3/4 x 28" x 75"
E	2	3/4 x 19 x 45"
F	1	3/4 x 15 x 75" plywood
G	2	3/4 x 1 1/2 x 29 1/4" furring
H	1	3/4 x 1 1/2 x 73 1/2" furring
I	2	3/4 x 1 1/2 x 12" pine
J	1	4 x 30 x 75" foam lounge pad
K		1/4" veneer tape as req'd.
L	6	15"-wide x 18"-deep x 28"-high metal file cabinets

Misc.: 2" finishing nails, glue

SEWING CABINET BENCH

A	2	1/2 x 14 1/2 x 18 1/4" plywood
B	1	1/2 x 18 1/4 x 23" plywood
C	1	1/2 x 14 1/2 x 22"
D	1	3/4 x 14 1/2 x 22"
E	2	3/4 x 3/4 x 13 1/2" pine
F	1	3/4 x 3/4 x 20 1/2"
G	1	2 x 14 1/2 x 22" foam cushion
H	4	Ball-type caster, Shepherd Nova No. 9019

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NEVER SAY SCRAP! (Continued from page 115)



As the sun sets over Hershey, the treasure finders load up for the long trek home.

mity: the hordes of enthusiasts who show from all sections of the United States and by the plane-load from England and Europe—chartered flights, you know; the 1500 vendors in 4800 10x30-foot rented swap spaces, who put out their wares on ground cloths or card tables; the 110 acres that the meet covers; nor the nine miles of aisles that none of us ever manages to cover completely, try as we might during those tumultuous, euphoric three days.

How it began

Not that it's always been this big. Hershey (and we all call it simply *Hershey*) began its flea-market section in the mid-1950s. One of the early parts vendors was Frank T. Snyder—and I remember him well because we met years later through the Society of Automotive Historians. Frank had brought some Model T parts to the 1956 or '57 AACA Fall meet, perhaps hoping to sell them to his fellow members.

Like so many of us, Frank was an inveterate string saver. He's owned a lot of Model T Fords, and he never threw any parts away. The bits and pieces, in fact, started filling up his garage, then his basement and attic, and finally the rooms of his New Jersey home.

Frank's wife got tired of walking and cleaning around all the Model T junk, so one October she prevailed on Frank to load it up and see if his AACA brethren down in Hershey would take it off his hands—which he reluctantly did.

Frank had no trouble selling his Model T leftovers, and pretty soon everybody else started bringing parts, then whole cars, and finally anybody who could rent a U-Haul began arriving with not only his own junk, but stuff he's actually bought from farmers and wrecking yards as cast-offs.

So, by 1958, Hershey's fabulous gold

mine of old-car goodies was firmly established, and it's now a multimillion-dollar enterprise, the likes of which exist nowhere else on Earth. I mean that literally, because many millions of dollars change hands daily, and the AACA and Town of Hershey share in the bounty, too.

The telephone company runs cables all over the swap grounds and sets up portable booths. I remember standing in line behind a fellow from Syracuse, N.Y., one year. I was waiting to use the phone and overheard his conversation. He called his wife collect and then began pleading with her to fast-wire him \$75,000 so he could buy a Pierce-Arrow roadster. He had to convince her what a good deal this car was and how quickly he'd have to have the money before somebody else beat him to it. He did one helluva selling job, and I believe his wife—who obviously thought at first that he was absolutely bonkers—finally did send the money.

My own searches at Hershey have been more modest. I looked for and found a nonreproduction quail radiator cap for my Model A in 1974 (\$100). I bought a mint grille medallion for my 1952 Hudson Hornet (\$8), but I never did find upholstery material for that car. That surprised me, because almost everything ever made for any old car turns up eventually at Hershey.

Harrah's treasure hunt

Before collector Bill Harrah died, he and his teams never missed Hershey. I recall looking for and always seeing Harrah's big orange-and-green 18-wheeler parked up on the knoll. His people—half a dozen at least—were issued Xeroxed lists of parts needed by Harrah's huge Reno museum. These lists ran to many pages and often included pictures.

Each searcher would also be given cash and a walkie-talkie, and when he

(Please turn to page 188.)

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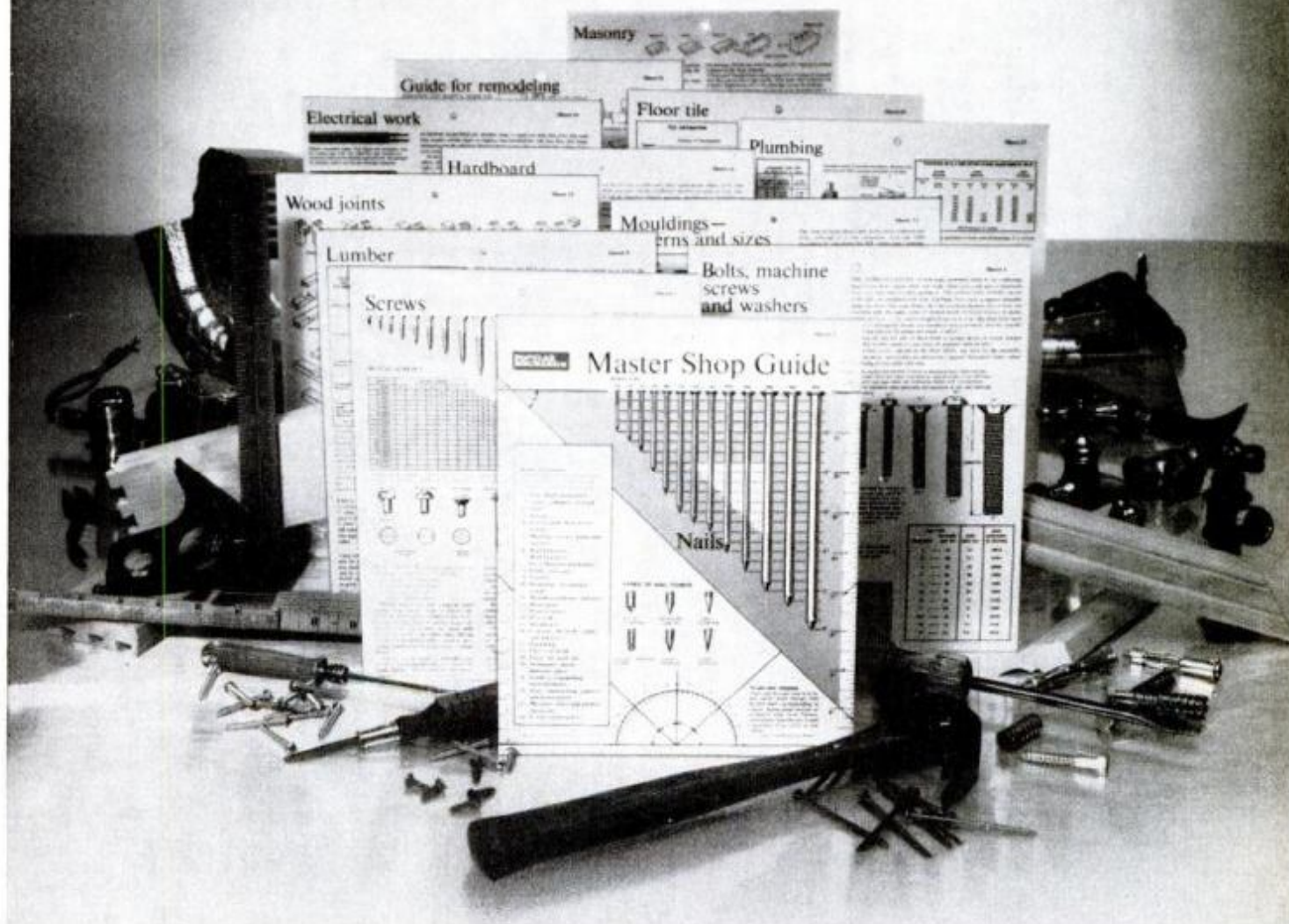
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WHEN THE LIGHTS GO OFF THE COURTESY LIGHT GOES ON.

NEVER SAY SCRAP!

(Continued from page 186)

found a treasure, he'd call up to headquarters, give location, condition, and price, and if everything seemed right, he'd buy whatever it was. Then each summer, Harrah's Automobile Collection would stage a swap-meet of its own in Reno and sell off any duplicate or unwanted parts.

I consider Hershey not only a hobby event (*the hobby event*) but a sociological phenomenon as well. A hundred Ph.D. candidates could write theses on Hershey. Hershey is grass-roots American culture; an expression of American affluence and leisure activity; it's people having fun individually and collectively.

I've never seen anyone drunk at Hershey. I've never seen any rowdiness. It's not like a conventioning crowd or a gathering of sports spectators. It's very family oriented. I've noticed, too, that women nearly always carry the check-books. There's a friendliness, an outgoingness I've never seen anywhere else; surely not in such crowds.

Hard bargainers trust you

There's also an odd combination of *caveat emptor* and honesty at Hershey. The swapper who's selling you that trunk rack for your 1932 Packard is going to get all he can for it—gouge you, if possible—and yet he'll leave that same trunk rack plus thousands of dollars' worth of other parts in a heap under a tarp, unattended for three nights running, and he knows nobody's going to lift it. True, there are rent-a-cops on night patrol, but if someone wanted to steal something (day or night), it'd be easy enough to do.

This year, the swap-meet starts officially on Wednesday, Oct. 3, but you can bet that unofficial business will begin on Tuesday night. Many people feel you get the good *stuff* early and the good *deals* late. The flea market is most crowded on Fridays, and then Saturday the *concours* judging takes over (354 judges plan their vacations around this event, as do multitudes of AACA show and swap officials. It's all of a labor of love, generously and handsomely donated each year. It seems so effortless, yet I know it isn't.)

If you're planning to come, wear your skuzziest clothes, your most comfortable walking shoes, and a hat. Bring a camera, lots of film, and some cash. Prepare to be royally entertained, but also prepare for traffic jams and odd turns of weather.

There's good eating on the grounds, but if you don't have a place to sleep near Hershey, don't figure on finding one.

Oh—about admission to the swap grounds and *concours*: There's none. It's free to the public—one of the best things in life that still is. For more information on the event itself, write to the Antique Automobile Club of America, 501 West Governor Rd., Hershey, Pa. 17033. Phone (717) 534-1910.

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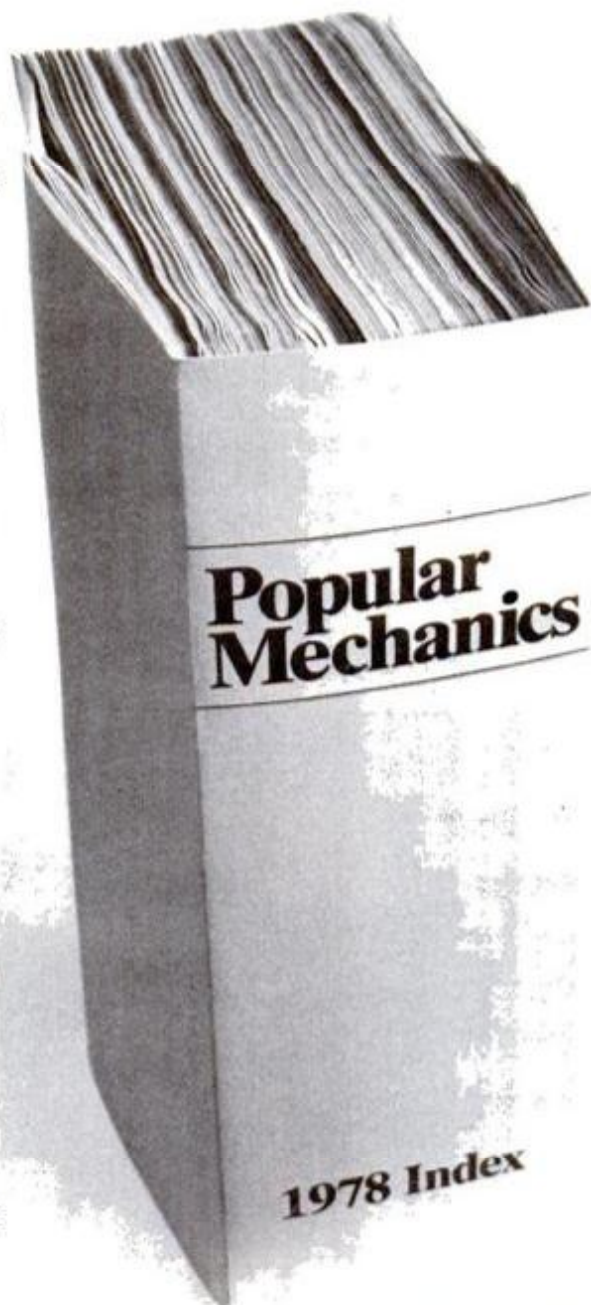
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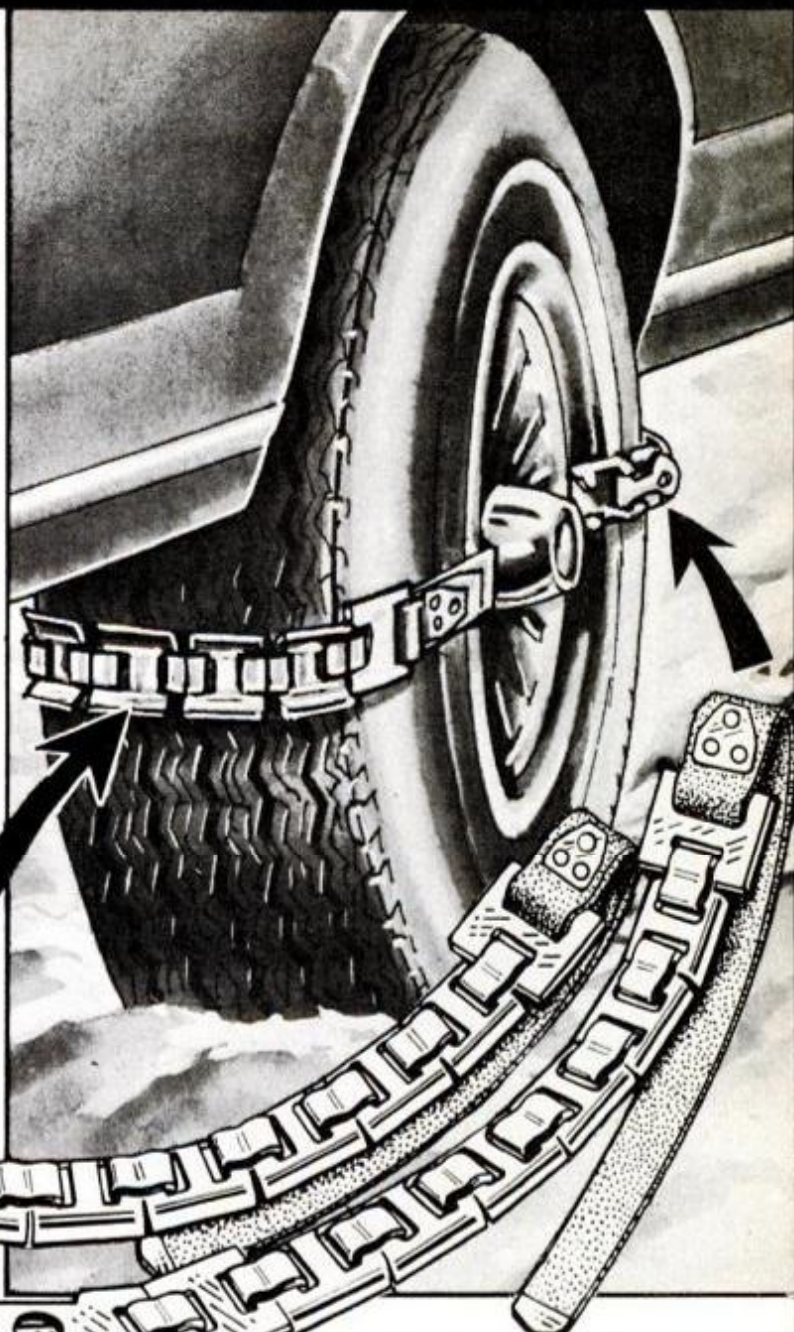
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FAMILY ROOMFUL OF IDEAS

(Continued from page 184D)

cloth during a sewing session). When you assemble shelved doors, start by attaching the front strips to the shelves, then add the sides and finally the fronts.

Installing the cornice

The cornice is made in three parts. The end sections utilize 1/4-in. lauan cutoffs from the cabinet backs. The center unit is faced with 3/8-in. plywood. A kerf cut along length and at ends produces shadow lines for a

decorative effect. A 4-ft. fluorescent lamp with toggle switch and short pull chain completes the project.

Coffee table, stools, daybed

These pieces are all built using sturdy 3/4-in. MDO plywood cut and assembled as shown in the drawings. Assembly is with glue and 10d finishing nails; set nailheads and fill depressions with wood patch before painting. If desired, the stool tops can be fitted with a pair of cleats below and permitted simply to "float" in the cube.

Install veneer tape or glue and

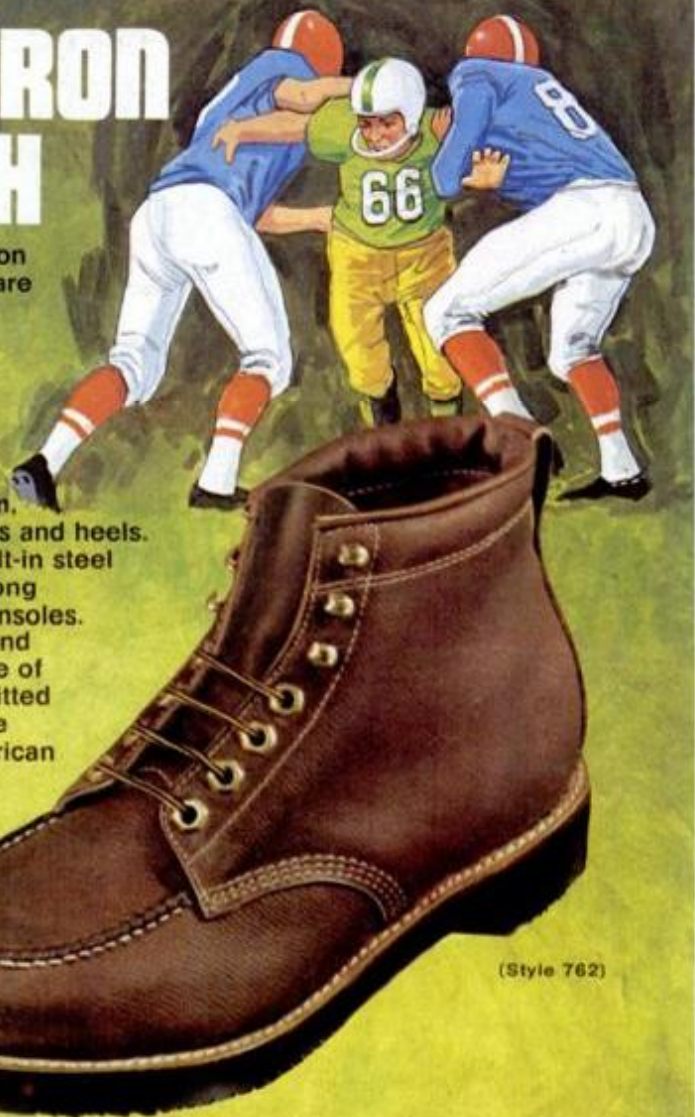
tack strips of 1/4-in. lattice on all exposed plywood edges to hide plies.

To finish the units, do this:

- Sand all surfaces smooth, dust off and wipe with a tack cloth.
- Prime all exposed plywood edges with a pigmented shellac such as Bin or Enamelac.
- Prime-paint all surfaces with a white water-base interior enamel undercoater.
- Apply color paints of your choice or duplicate our blue room using the color photos on pages 130 and 131 as a painting guide. Here is a list of the colors we used: From Pittsburgh Paints' DesignaColor System, blue colors (from darkest to lightest) are Bachelor's Button D4094, Blue Manor M3093, Tiny Thistle P2097, and Sweet Bluette P2095. Floor is Golden White P2523; orange striping is Mikado D4211.

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MATERIALS LIST—END CABINETS

Key	No.	Size and description (use)
A	2	3/4 x 23 1/4 x 47" plywood (tops)
B	4	3/4 x 22 1/2 x 47" plywood (cross members)
C	4	3/4 x 23 1/4 x 87" plywood (sides)
D	4	3/4 x 2 1/4 x 4" (kickplate end fillers)
E	2	3/4 x 4 x 46 1/2" (kickplate)
F	2	3/4 x 4 x 43" MDO plywood (cornice bases)
G	6	1/2 x 22 1/2 x 47" MDO plywood (shelves)
H	2	1/2 x 21 1/2 x 54 1/2" MDO plywood (doors)
I	2	1/2 x 17 1/2 x 21 1/2" MDO plywood
J	2	1/2 x 21 1/2 x 60" MDO plywood
K	2	1/4 x 9 x 48" lauan plywood (cornices)
L	2	1/4 x 47 1/2 x 82 1/2" lauan plywood (backs)
M	4	3/4 x 1 1/2 x 87" clear pine (facings)
N	6	3/4 x 1 1/2 x 48" clear pine, (facings)
O	1	3/4 x 1 1/2 x 48" clear pine (facings)
P	1	3/4 x 1 1/2 x 83" clear pine (facings)
Q	2	1 1/2 x 1 1/2 x 15" common pine (yarn bin cleats)
R	2	1 1/2 x 2 x 20" common pine (yarn bin cleats)
S	1	3/4 x 1 1/2 x 5" pine (door stop)
T	1	1/2 x 1 1/2 x 5" pine (door stop block)
U	2	1/2 x 1/2 x 2" pine (door stops)
V	6 pr.	1 3/8 x 2" brass butt hinges
W	6	Pulls, Amerock BP419-3
X	6	Magnetic catches
Y	8	1 1/2" No. 10 fh screws
Z	2	3/4 x 1 1/2 x 48" furring (cornice cleats)

MATERIALS LIST—SEWING TABLE

Key	No.	Size and description (use)
A	2	3/4 x 20 x 25 1/4" (sides)
B	4	3/4 x 2 x 25 1/4" (side legs)
C	1	3/4 x 25 1/4 x 26 1/4" (back)
D	1	3/4 x 20 x 30" (top)
E	1	3/4 x 7 1/2 x 18 1/4" (well top)
F	2	3/4 x 15 x 20" (drop leaves)
G	2	3/4 x 12 x 14 1/2" (leaves)
H	1	3/4 x 18 1/2 x 26 1/4" (subtop)
I	1	1/2 x 3 1/2 x 26 1/4" (drawer front)
J	1	1/2 x 3 1/2 x 25 1/4" (drawer bottom)
K	1	1/2 x 2 1/4 x 25 1/4" (drawer back)
L	2	1/2 x 2 1/4 x 18 1/4" (drawer sides)
M	2	1/2 x 13 1/4 x 18" (door fronts)
N	4	1/2 x 3 1/2 x 18" (door sides)
O	6	1/2 x 3 1/2 x 11 1/2" (door shelves)
P	2	1/2 x 3 1/2 x 11 1/2" (door tops)
Q	2	1/2 x 2 1/4 x 13 1/2" (well-top cleats)
R	6	3/4 x 1 1/4 x 11 1/2" (door shelf backs)
S	2	3/4 x 3/4 x 9" (leaf levelers)
T	2	3/4 x 3/4 x 2 1/2" (leaf leveler stops)
U	2	3/4 x 1 x 1 1/2" (wedges)
V	2	1/4 x 1/4 x 15"
W	1	1/4 x 1/4 x 19 1/2"
X	2	1/4 x 1 x 3" (spacers)
Y	1	1 1/8 x 2 1/4 x 25 1/4" cove molding
Z	1	1 1/8 x 1 1/2 x 25 1/4" cove molding
AA	2	1 1/2 x 15 1/4" continuous hinges
BB	2	1 1/2 x 12" continuous hinges
CC	2	1 1/2 x 18" continuous hinges
DD	2	1/4 x 1/2 x 3/4" plastic tacks
EE	2	door pulls
FF	4	2 1/4" plate-type casters, Shepherd Nova No. 9019

MULTIFUEL HEATERS

(Continued from page 120)



Charmaster's wood/oil/gas combination furnaces with $\frac{3}{16}$ -in. steel fireboxes come complete, wired and ready to install.

Oil or gas burner can be mounted (see inset) on MB Solo boiler add-on when existing fossil-fuel-type boiler wears out.

local codes in effect at the time.

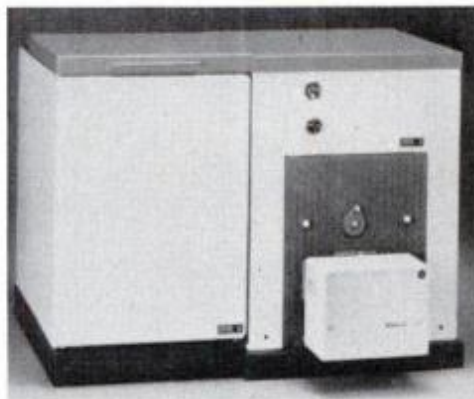
At the time this article went to press, no multifuel furnace or boiler had been UL-listed. Several units are currently being tested there and UL engineers have assured me that a listing for one will come shortly, and with others to follow. They were not at liberty to divulge the manufacturers.

At the moment, there is no national program certifying efficiency ratings on the various multifuel units. The only figures you have to go by are those published by the manufacturers—along with the fact that *any unit which is listed by UL or approved by the ETL must be at least 75-percent efficient when burning oil.*

Features to consider

While researching multifuel units on today's market, we found several that have innovative features worth a special mention.

The Hoval Duolyt boiler (cutaway shown on page 120), has what the maker calls "thermolytic" heat exchangers. These harmonica-like flue passages collect soot during the start-up and slow-down phases of the heating cycle. As the combustion chambers are fully fired, soot and creosote which have collected are burned off by the extremely high temperatures. These exchangers scrub the exhaust gases clean, allowing the boiler to be run at higher efficiencies (86 to 88 percent when a unit is oil-fired) and at cooler stack



Four-fuel Polymatic hot-water boiler by Franco-Belge generates 120,000 B.T.U./hr. (oil or gas), 100,000 (coal), 80,000 (wood).

temperatures than possible for conventional units.

The Hoval boiler also produces domestic hot water in a way that minimizes lime buildup and scaling. Primary boiler water is pumped through a coil, which transfers heat to a storage tank as required by an aquastat. This allows the homeowner to keep the domestic water temperature below 140° F., the point at which lime begins to accumulate.

The special thermostat available with Oneida's wood/oil combination furnace (cutaway view of furnace on page 118) is another good idea. This thermostat tells the homeowner which fuel he is burning and will be especially helpful in saving fuel oil, since it indicates when solid fuel needs replenishing.

The Charmaster combination furnace (see photo above) does not burn in the same way as most other multifuel units. Instead, it restricts the

(Please turn to page 198)

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MULTIFUEL HEATERS

(Continued from page 197)

draft to produce a 4- to 6-inch bed of charcoal, which not only gets the most from the wood fuel, but lets you reload less frequently. The Charmaster unit also saves you sawing and splitting, since the combustion chamber accepts unsplit logs up to 11 inches in diameter and 30 inches long.

Longwood's Dualfuel furnace (photo on page 120) is similar to the Charmaster, because the draft is restricted in an effort to build up a deep bed of charcoal. In this unit, wood and oil (or gas) burn at the same time. The manufacturer claims that this method allows you to heat your home at a ratio of 25 percent oil to 75 percent wood. Oil or gas can also be used exclusively when wood-firing the unit is not possible.

For more detailed information on what's involved in the actual installation of a multifuel unit, see the article beginning on page 122. **PM**

MANUFACTURERS LIST*

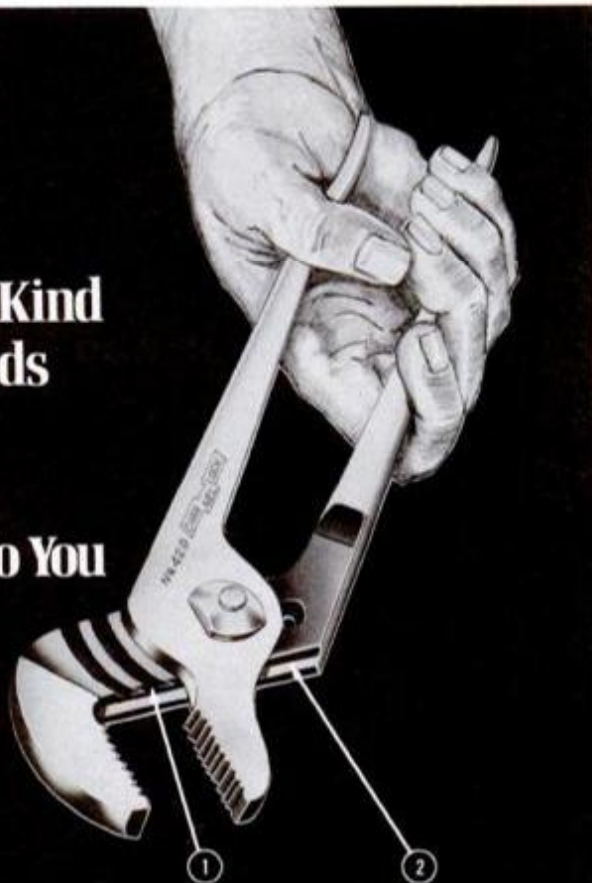
For the types of units made by a manufacturer, refer to key:

- A: Multifuel forced-hot-air furnace
- B: Multifuel hot-water boiler
- C: Multifuel steam boiler
- D: Solid-fuel furnace add-on
- E: Solid-fuel hot-water add-on
- F: Solid-fuel steam add-on

- American-Energy Marketing Associates Inc. (Simplex Multi-therm units), Dept. M, 4642 Crossroads Park Dr., Liverpool, N.Y. 13088; B, C, \$2900; E, F, \$2500.
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- Charmaster Products Inc., 2307 Highway No. 2 West, Grand Rapids, Minn. 55744; A, \$1700-\$1900.
- Combo Furnace Co., Div. of Northern Heating, 1707 West Fourth St., Grand Rapids, Minn. 55744; A, \$1400-\$1500; B, \$1800-\$1950; D, \$900.
- Daka Corp., Industrial Park, Pine City, Minn. 55063; D, \$400-\$850.
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- The Defiance Co., Chassell, Mich. 49916; D, \$795.
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- Powmatic Inc., 2906 Baltimore Blvd., Finksburg, Md. 21048; A, \$1700.
- Ram Forge, Brooks Me. 04921; E, \$655.
- Riteway Manufacturing Co., Box 153, Harrisonburg, Va. 22801; A, \$1500-\$3200; B, \$1600-\$4400.
- Shenandoah Manufacturing Co. Inc., Box 839, Harrisonburg, Va. 22801; D, \$525.
- Sam Daniels Co. Inc., Box 868, Montpelier, Vt. 05602; A, \$2000-\$3000; D, \$1300-\$2300.
- Suburban Manufacturing Co., Box 399, Dayton, Tenn. 37321; D, \$550-\$575.
- Tekton Corp. (HS Tarn units), Conway, Mass. 01341; B, \$2050-\$3100; E, \$1500-\$2200.

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HOW TO ESCAPE A TRAPPED CAR

(Continued from page 108)

to the other. And many are good for only 8 or 10 seconds. The best strategy for engine fires is to "double team" the blaze with two persons fighting it with extinguishers from opposite sides.

If the fire is in one of "our flimsy gas tanks," as Dr. William Haddon, an insurance industry safety expert says, then you have a lot less time to act. An explosion may come at any instant. So don't fight it—GHO.

Gas-tank fires, when just starting, have been quenched with extinguishers. But experts don't advise trying. "I wouldn't tackle a gas-tank fire with an extinguisher," Paul Sawin says. Your best hope: Firemen will arrive with foam, which *does* work.

Your car plunges in water

Officer Ed Zelinder of Florida's Dade County Sheriff's underwater rescue squad once drove a car into a river at 40 mph to see what would happen.

"I thought it would be like landing on a featherbed," he says.

He was wrong. "It was like hitting concrete," he recalls. There was a

great splash. The explosion of water did what a man with a baseball bat couldn't have done easily: It smashed the windshield in.

The car went down and landed on its top, then fell on its side. "I couldn't open the door," Zelinder says. Luckily, he got the opposite door open just as three divers arrived to rescue him.

"It's nothing you ever want to have happen to you," he says.

But just in case, here are some guidelines:

The most important thing to remember is: *Most cars float.* Everyone knows that Volkswagens do, but in a series of tests for the Red Cross and the Michigan State Police, Prof. Bernard Kuhn of Eastern Kentucky University found many others do, too. And they usually—although not always—float right side up. Some stay afloat for a minute or two, a few even longer. Kuhn found that some cars may take eight minutes to sink a mere 12 feet.

So your best strategy is: Get out the windows, sunroof, deck or hatch as soon as possible. Don't try to open doors. Water outside locks them shut when it rises a mere 18 inches above the sills. If you could open the door, your car would fill a lot faster.

Miami's Ed Zelinder has found cars on their tops, deep in mud, and even standing on their radiators. But in 85 percent of all cases, Prof. Kuhn found, even cars that enter the water on their sides, or in roll-overs, actually flip right side up before sinking.

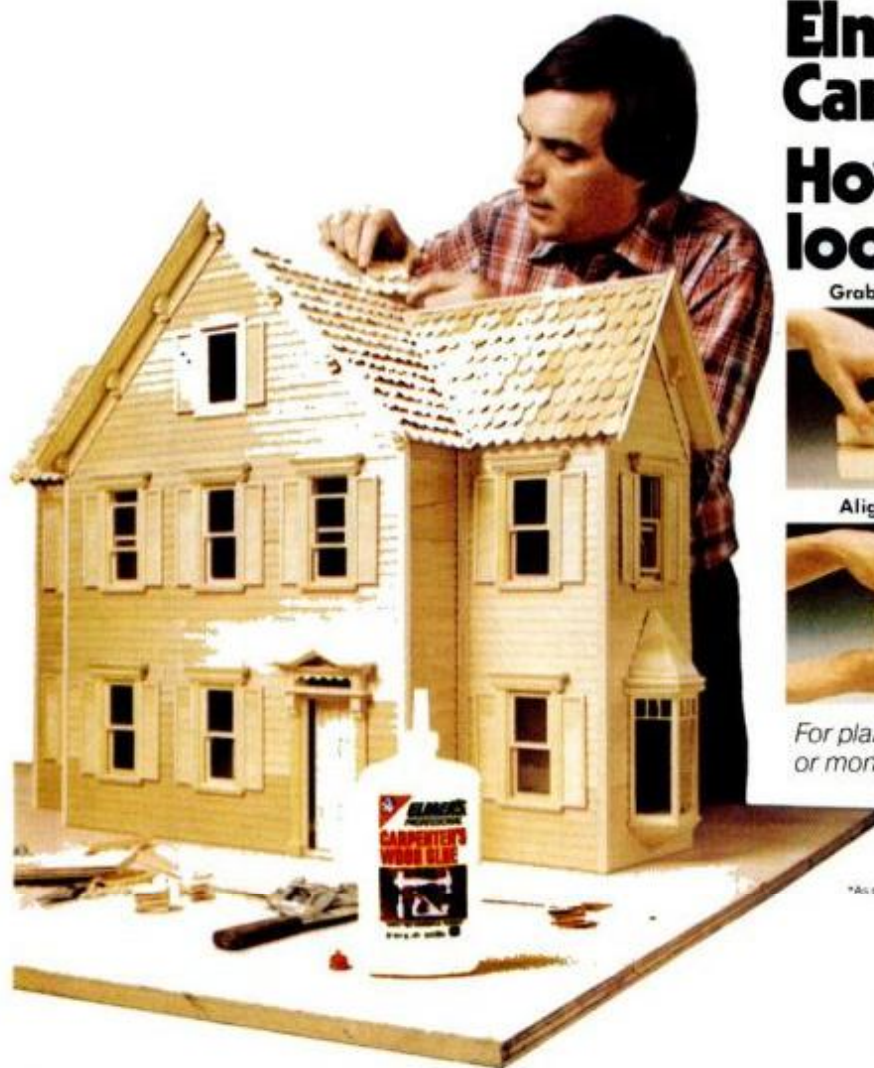
But suppose you can't escape before your car sinks. What happens?

Water comes in through cable channels and control passages. The car fills more slowly if windows are closed. As it settles, it tilts toward the engine at about a 60 percent slant. An air bubble often forms and may, at this point, travel to the back or trunk, in a front-engine car.

On the way down, if possible, turn your lights on. They may help searchers locate you.

The car now hits the bottom. Often, it will settle on four wheels, right side up. As it levels off, the air bubble may return from the trunk or rear window area. There have been cases where this air kept people alive 20 to 30 minutes until rescuers could get to them.

But even if there are no rescuers, you may now find it easy to open a door (as water fills the car and equalizes pressure), and swim up to safety. **PM**



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ELECTRIC CARS

(Continued from page 96)

The \$4500 Commuta-Car is the latest version of a design that was once marketed by Sebring-Vanguard of Florida as the Citicar (See *PM Owners Report: Electric Cars*, Page 90, March '77). Now the Commuta-Car occupies a place among General Engines' product line of electric mopeds, bike motors and scooters. It is a two-seater built from the ground up as an electric car. It's not a conversion to electric using an existing body and chassis.

Obviously, electric vehicles are not touring cars. They are designed for urban-suburban use; that is, for short trips. Which is okay. Most of us are short-trippers.

"Short-range, multistop urban driving is the type of driving most of us do," says Edward A. Campbell, executive secretary of the Electric Vehicle Council.

But before you rush to place an order for an electric car, there are several facts you should be aware of. You may decide it's best to wait until more electrics are off the drawing boards and on the road.

Lack of service facilities is one of the main drawbacks of present-day electric-vehicle ownership. Those in the industry are quick to point this out.

Few dealers

Says Campbell: "The attitude of most of us in the electric-vehicle industry is that use of electric vehicles, for the time being, should be confined to a sheltered environment; that is, to fleets having motor pools where electric components can be serviced. At this moment, we don't encourage private individuals to purchase electric vehicles unless they are handy, since few dealers are available to provide services."

Says Bill F. Bales, vice-president of marketing for Jet Industries Inc. of Austin, Tex., one of the largest manufacturers of electric vehicles: "Our customers are commercial fleet operators. The only exception is if a private party buys a car through one of our distributors where servicing can be performed."

Jet Industries has one distributor in Los Angeles, one in San Francisco and one in St. Louis—not exactly a GM-size organization. Bales' father, William L., who founded Jet Industries, was one of the first electric-golf-cart manufacturers. In 1960, he sold his electric-golf-cart company, Tri-Power Corp., which had manufactured 40,000 golf carts and industrial vehicles in the 1950s. He then

started the Chapparral Snowmobile Co., which was sold in 1970. Then, in 1971, he started Jet Industries.

The U.S. General Accounting Office (GAO) agrees with Campbell and Bales. "Today's electric vehicles need to be placed in controlled environments where failures due to their relative immature state of technology will not adversely reflect on the inherent potential of the electric-vehicle concept," says a GAO report.

GAO also points out that a new electric vehicle costs "substantially" more than an average new conventional car. For instance, Jet Industries presently makes four van models, without airconditioning, and will soon manufacture another van and a four-passenger sedan, without airconditioning. The price of the least expensive van is \$9000. The price of the most expensive van is \$16,500. The price of the sedan will be about \$13,500.

One reason for this higher cost is that electric vehicles are not mass-produced. Another reason is that most electric-vehicle manufacturers buy bodies from conventional automobile manufacturers. Bodies for the four van models made by Jet Industries are supplied by Chrysler Corp. and Fuji of Japan. The sedan that the company is planning to manufacture is a Dodge Omni 024.

In many cases, the vehicles electric-car manufacturers buy to convert come complete with internal combustion engines. An electric ve-

hicle manufacturer has to pull the guts out of the vehicle and sell the engine back to the car manufacturer, to another company or to a private party.

Wiring in the vehicle has to be revamped to handle the electric motor, speed controller and, sometimes, an on-board battery charger. (Some models are recharged with a console-type battery charger that is not integrated into the vehicle.) Drive trains that come with the original cars have to be regearred so gearing dovetails with the torque of electric motors.

As you can imagine, these modifications run up the cost. And initial cost is only one economic factor that has to be weighed. Another is the cost of replacement batteries.

Battery cost high

Batteries have an average life of 30 to 36 months. Each battery costs between \$40 and \$70. Smaller-model vehicles use approximately 17 batteries. Larger models use about 24 batteries. Replacement batteries can cost an owner from \$680 to \$1440 every 30 to 36 months.

Furthermore, although the chance of major-component failure is slim if the car is serviced regularly, replacement parts are expensive if a major breakdown occurs.

To give you an idea of the type of regular servicing an electric vehicle requires, the following is what Jet Industries recommends for the d.c.

(Please turn to page 208)

What it's like to drive the Williams homebuilt electric

by Michael Lamm

WEST COAST EDITOR

Bill Williams invited me over to drive his electric Datsun one sunny afternoon last June.

It takes no special training to drive an electric car, but you do develop a certain knack within a few blocks. "On level ground, get out of low gear as quickly as possible," Bill told me. This I did, shifting to second after a short power burst.

Under hard acceleration, the pulse-width-modulated controller lets out a loud whistle, which I personally found distracting. But other drivers might enjoy it. It's louder than a turbo-charger but in the same vein.

The converted Datsun accelerates with adequate briskness for all but the tightest situations. Within a few minutes, I learned how to enter busy thoroughfares. There's no problem keeping up with stop-and-go traffic. At red lights, everything shuts down—no waste of energy at all. Nothing "idles." Then when the signal turns green, down goes the accelerator and off goes the car—very smoothly, without clicks and jerks I've noticed in other electrics.

The Williams car cruises effortlessly in town at 40 mph. Bill has driven 55 on the freeway. The electric has a normal range of 40 miles when used around town.

I found the electric Datsun's worst enemy to

be hills. Mild grades—those normal in city driving—offer no great challenge, although I did find myself speeding up or downshifting to third several times. On one particularly steep hill during our photo session, Bill needed to use second. Again, it's just a matter of learning the car's capabilities and then compensating. The transmission makes this vehicle much more flexible.

All in all, I came away from my drive with nothing but admiration for the car and its constructor. It's a beautifully neat, clean conversion—very professional. It costs about a penny a mile to run it. An overnight charge always leaves the batteries topped up.

Bill Williams commutes 12 miles a day to and from Hewlett-Packard. So, for his purposes, it's a perfect blend of economy, utility, performance and hobby. And never again will he have to wait on gas lines.

SPECIFICATIONS—ELECTRIC CAR

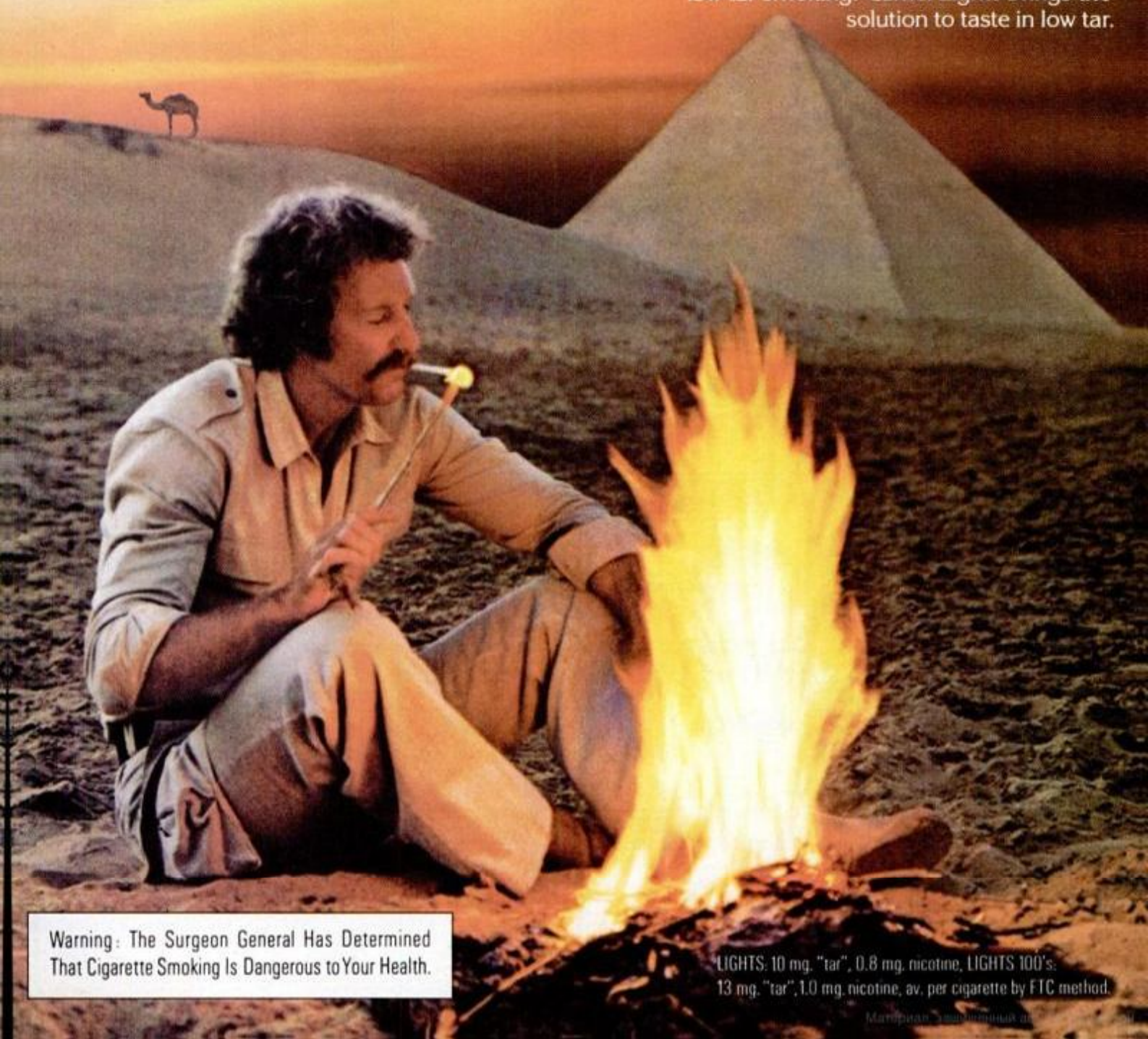
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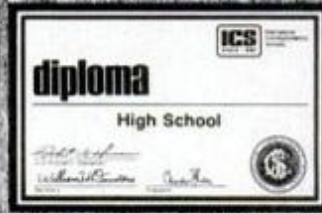
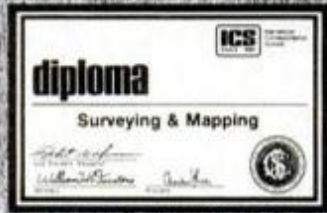
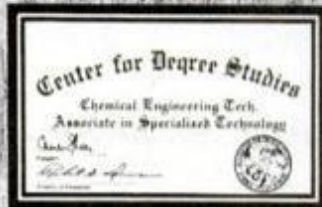
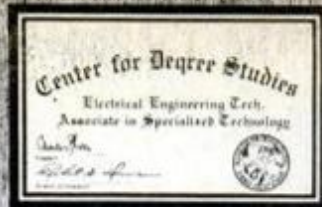
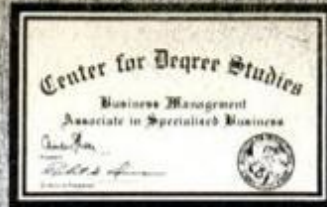
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ELECTRIC CARS

(Continued from page 202)

electric motor of the Model 600 Electric Van.

- Replace bearings every few years.
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- Check brush condition periodically. Replace worn brushes.
- Check commutator runout periodically, undercutting mica when commutator wear results in flush or protruding mica.
- Clean the interior and exterior of the motor periodically.

Those having service facilities have no trouble maintaining electric vehicles. That's one reason why more electric vehicles are beginning to appear in fleet use.

For example, the U.S. Postal Service electric-vehicle fleet presently consists of 380 units. Other electric-vehicle fleets include American Telephone and Telegraph Co., 45 electric-powered Jeeps and GMC models; Tennessee Valley Authority, 10 electric Volkswagens; the Long Island Lighting Co., 47 vans manufactured by Jet Industries; and General Telephone and Electronics, 75 vehicles manufactured by Jet Industries.

Range still a problem

Another drawback to present-day electric vehicles is their limited range between battery chargings. There is no sign of an imminent breakthrough in technology that would permit electric vehicles to extend this range, generally conceded to be 40 to 45 miles.

Lead-acid batteries have been the main energy source. Although battery technology is progressing, it is slow. For instance, ESB Corp. of Philadelphia, Pa., has developed an advanced lead-acid battery, now being tested, which increases the average range by about 30 percent.

Lead-acid batteries will probably continue to be the main electric-vehicle energy source for the foreseeable future. Other batteries have more range, but serious drawbacks.

Consider the zinc-nickel oxide battery. It affords two to three times the performance capability of a lead-acid battery. However, according to the General Motors Research and Development Laboratory in Warren, Mich., "Current estimated prices of zinc-nickel oxide batteries are considerably higher than lead-acid batteries and, at present, they have a comparatively shorter life."

Still, GM is optimistic about the zinc-nickel oxide battery and is targeting the mid-1980s for the in-

roduction of its first model.

There has been mention, recently, of using photovoltaic cells to power electric vehicles, to which Dr. Brown Williams of the RCA Research Laboratory in Princeton, N.J., says: "No chance."

A photocell is a wafer-thin, three-to four-inch plate (or "cell") that is sliced from a chemically treated silicon crystal. When exposed to light, it gives off minute amounts of direct-current electricity. Dr. Williams, an expert in photovoltaic-cell technology, says, "The amount of photocells needed to power a vehicle wouldn't fit on the car roof."

Although electric cars driven by photocell-made electricity aren't likely, hybrid electric cars may soon make an appearance in the United States. A hybrid is an electric vehicle with an "alternative" fuel.

The most common hybrid combinations are battery-gasoline and battery-diesel. In Italy, for instance, a hybrid bus made by Fiat is being tested. The six-cylinder direct-injection diesel engine is turned off in emission-congested areas, allowing the vehicle to run on batteries.

A system called regenerative braking is another advance being worked on. Its purpose is to permit an electric vehicle to extend its battery-powered range.

Regenerative braking uses the kinetic energy generated when vehicle brakes are applied. In one version, the kinetic energy is applied to a motor-generator. The energy is converted to electricity which is used to charge batteries as the car is being driven. This extends the mileage range by at least 10 percent.

In another version of regenerative braking, energy generated by braking is recovered through a flywheel mechanism. This mechanical energy is then converted to d.c. energy and returned to the batteries.

Now that you have an update of facts about electric vehicles, you have to decide for yourself to buy one ready-made now, wait until later in the '80s, or remove the power train of a conventional car and build one on your own. **PM**

BUILD YOUR OWN ELECTRIC

(Continued from page 97)

Volkswagen transaxle, and therefore required custom machining to fit the current Datsun transmission. I considered retaining the four-speed transmission (plus reverse) a must, not only for flexibility, but also for the efficiency several forward gear ratios (3.757, 2.169, 1.404 and 1).

As this adaptation progressed, I still had plenty to do. Procuring and/or building parts

(Please turn to page 210)

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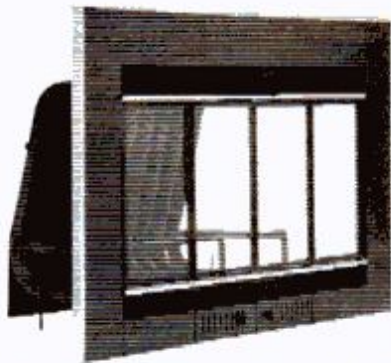
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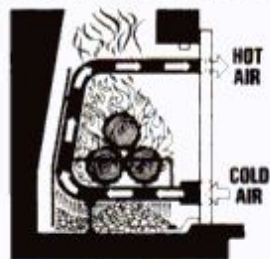
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BUILD YOUR OWN ELECTRIC

(Continued from page 208)

for the interior and motor compartment progressed week by week as I visited electronic surplus parts dealers and also purchased parts from other EAA members. The interior was modified to contain a 12-volt-hour meter, controller temperature gauge, electronic accelerator foot pedal and a central metering panel for selective monitoring of all desired voltages and currents (propulsion and auxiliary batteries, motor armature and field). Two battery chargers were also built, one 12-volt and one 72-volt, to be able to keep the already installed batteries charged while the rest of the car gradually came together.

Following completion of the interior, I concentrated on preparations beneath the hood (motor compartment) for installation of the new transmission and electric motor.

From the onset of this conversion project I knew that I wanted to incorporate smooth electronic control for delivering battery power to the electric motor. This is why I patiently waited and worked with Frank Willey, another EAA member, for completion of his final design of a pulse-width-modulated controller. Frank, a retired Lockheed electrical engineer, had been perfecting his controller design for over five years as technological improvements became available. The controller is rated for 400 amps. at d.c. voltage from 36 to over 120 volts—ideal for the Datsun.

Meanwhile, Bob Steinfeld finished the transmission adapter plate. It took only about one week to link up the clutch, adapter plate, electric motor and transmission and install them in the car. Patience dominated as work continued with installation of two 12-volt cooling fans—one to cool the 2CM77 main electric motor and one to cool the controller. Then a mounting surface was made for the motor compartment components (like the controller). This mounting surface was made from ¼-inch clear plastic so you can see the electric motor and related components beneath the surface. A display light was also installed to provide good visibility beneath the mounting surface. The controller cover was also made from clear plastic to show the beautiful 22-inch-long heat sink and 24 power transistors. Nothing was to be hidden.

The controller and remaining components (two 400-amp. and two 15-amp. shunts for the interior meters, special 14000-mfd./100-volt capacitor, and terminal strips) were then carefully installed on the mounting.

Approximately 1200 hours and \$1570 were spent before I was ready at last to see if the new Datsun would actually run. All individual systems had each been thoroughly tested by themselves, but not together. "What if it blows up, catches fire or, even worse, does nothing?" I thought.

I turned on the ignition and gently pressed down on the electronic accelerator, applying power to the controller and main electric drive motor. I heard a beautiful whine as I excitedly gave it more throttle and the motor increased its rpm. I shifted into first gear and again gently pressed on the accelerator.

What a triumphant feeling as the car smoothly moved forward and I found myself driving down the street for the first time without gasoline power! I had accomplished what many people had said was very foolish or impossible. Today these same people wish that they, too, had an alternative to the gasoline-powered automobile.

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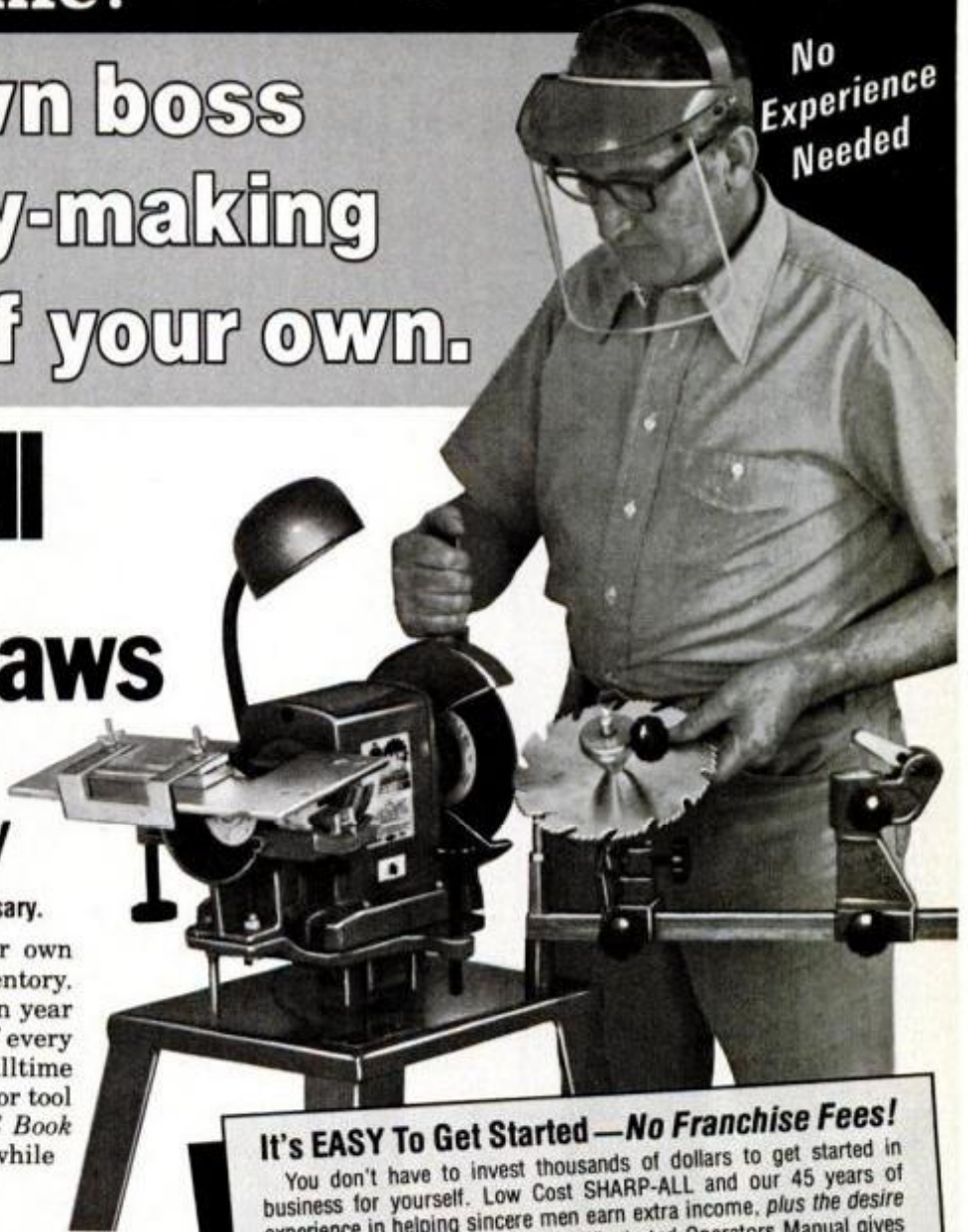
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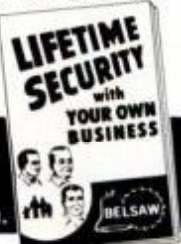
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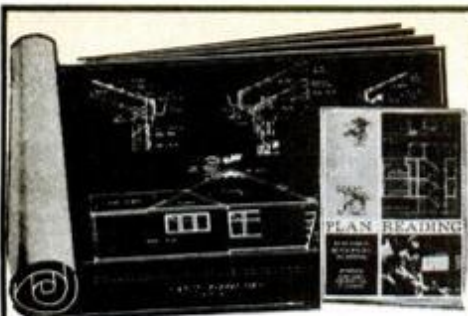
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DO-IT-YOURSELF DISASTER

(Continued from page 89)

rushing downriver pushed me southward, closer to the other vessel. I increased speed to improve rudder control, sprinted to the helm and made a hard turn to starboard, upriver. The other ship blasted me with one long and several short horn signals. It was close enough now so that I could have hollered to the crew. But the huge ship looked deserted and ghostly. I froze for the collision. Frank jumped in front of me with his camera. "What do I do?" I asked him.

"You moved your mouth," he said.

Then, without a sound, the image of the other ship began to shimmer. Its lines blurred. Portions of it disappeared. It was the computer's way of saying, "You lose." But the circuits were forgiving. In another instant, the ship had slipped behind us as if there had been no disaster. The harbor scene returned to normal.

Like many modern simulators, the Kings Point facility has a serious training mission—to take men and simulated machine through potential disasters and to reveal how to avoid the disasters.

In one program, for instance, tanker crews practiced approaches to and departures from Valdez, Alaska, southern terminus of the Alaskan pipeline. None of the class had ever navigated the windy mountain-guarded Valdez narrows. But in the course of a week on Long Island, they experienced 18 different scenarios, including loss of power at the entrance to the Alaskan harbor. The potentially life-saving lesson: Sit still, don't do anything, and let the prevailing wind blow you away from land. Don't try to steer out to sea or you'll run right into the base of a mountain.

When to sit back and think

Curiously, that lesson parallels advice given powerplant operators learning how to handle an accident like Three Mile Island. "We train people to know when to sit back and think about it," said Norm Eliot, who heads the training program centered on a Link-designed control-room simulator. Even when parts of the system break down, he said, nuclear plants are built to run safely by themselves for at least half an hour, automatically correcting for failures.

At Three Mile Island, he said, operators made the situation substantially worse within the first 11 minutes of the crisis by turning off the emergency core cooling system

at a time when pressure around the core was dropping.

I tested a nuclear powerplant's ability to recover from an accident—somewhat worse than the one at Three Mile Island—during a brief stint as a control-room operator. An instructor punched instructions for the crisis into a computer which made gauges and alarms behave like instruments in a real control room. He called for a complete break in the 28-inch-diameter pipe carrying water from a steam generator to the reactor vessel. The water cools the nuclear core.

Immediately, control room dials revealed that radioactive water had flooded out of the pipe, gushing onto the floor of the sealed building housing the reactor. In a separate building, the steam-driven turbine, which had been producing 953 million watts before the accident, now produced zero power, according to a centrally located dial. The alarm bell rang continuously. Small square alarm panels lit up all over the wall.

The instructor turned the crisis over to me.

System fights its problems

I pushed buttons acknowledging the alarm bell and shutting it off. Almost immediately, it began jangling again, sounding incongruously like a stuck doorbell, to warn of other problems. But as dangerous as things seemed, the system had begun fighting the problems. An emergency core-cooling system had turned on automatically, for instance, supplying water into the nuclear reactor core, providing cooling. Before I had done anything, the reactor was stable. "What would happen if I miscalculated now and turned off the emergency cooling system?" I asked.

"Okay, we'll torture it," the instructor said, and he helped me lop off a dozen switches on the console and wall behind it. Basically we had told the reactor system to call off its firemen. Now the number of warning lights tripled. The warning bell wouldn't shut up. He made things even worse by turning off a pump circulating cooling water—or whatever was left of it after the break—around the core.

I waited for the meltdown.

It never came. Instead, dials indicated that another backup system had begun spraying cooling water inside the structure housing the reactor. The spray system alone was able to confine the problem within the three-foot-thick walls of the building. "The crisis," the instructor

(Please turn to page 214)

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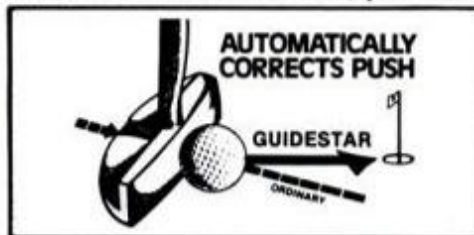
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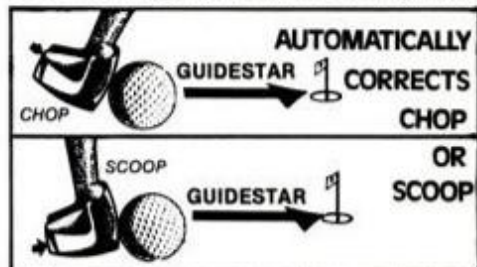
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DO-IT-YOURSELF DISASTER

(Continued from page 212)

said, "is very manageable." And I hadn't done anything right.

If backup systems are so efficient, why did Three Mile Island happen? All the answers aren't in yet. But the Babcock & Wilcox analysis—checked out on the simulator—suggests the nuclear power industry's worst moment was caused by a combination of problems. Some of the problems were mechanical—a valve jammed open, for instance, releasing pressure in the system and allowing water that carries heat from the core to boil away. And some were human errors. For one, operators should not have interfered with the emergency backup systems during the first 11 minutes of the crisis.

A spokesman for the Nuclear Regulatory Commission told PM that the Babcock & Wilcox analysis jibed with preliminary findings by the commission, a federal agency regulating nuclear powerplants.

The Babcock & Wilcox simulator can take crews safely through dozens of potential crises ranging from turbine shutdown to near meltdown. Its mission is training. Other simulators are for research only, including much of the gear at Wright Patterson Air Force Base in Ohio.

I was pilot of a new A 10 cockpit simulator, for one, designed to run through bombing missions flown slow and low—just above the trees and below radar detection. My coach was Richard Geiselhart, program manager of the Crew Station Design Facility at the base. Crouched outside the cockpit as I cruised over simulated 3000-foot mountains, Geiselhart said Soviet advances in radar technology had driven the altitudes of training missions closer and closer to the ground. "And when the Russians get look-down radar, we'll go back up," he said.

Unlike other simulators I had commanded, the A 10 was wired into a model board. A tiny TV camera on a boom in another room tracked my course over a wall-sized three-dimensional land. The board looked like an electric train table on its side, but instead of trains, the terrain was dotted with targets—industries, ships, weapon sites.

Flying over a mythical land

The land is mythical (although it bears resemblance to the mountains of eastern Europe) and I found that flying over it at 250 knots, with a coach standing outside the cockpit, is surreal.

"Is there a target around here?" I asked. "Over this ridge," Geiselhart

said. "Come down in altitude. See him?" In a valley on the other side of the snow-covered ridge was a small industrial complex. I pushed the nose toward it and Geiselhart reached over the side of the cockpit and pulled a trigger on the stick, firing a Maverick missile. The scene in the cockpit window blurred and quivered. "Um," Geiselhart warned, "you're going to hit the ground if you're not careful." I pulled back gently. "Okay," he said. "Now would you fly north or south of here? Otherwise we'll run out of visual." Once again, I had reached the edge of the simulator's flat Earth.

"Is there a landing field near here?" I asked.

"You can't land this one," Geiselhart said casually. You turn it off, and the camera hangs at rest over the mythical mountains.

Base vs. base in war games

There are computer experts here at Wright Patterson who dream of a new generation of simulators a few years from now that will make this A 10 look like a Model T. They're talking about "gaming areas"—simulated land over which mock missions are flown—covering 10 or 11 million square miles. Technology already exists to tie many tactical simulators together over these huge playing fields, and then to stage squadron against squadron or base against base in war games arbitrated by computer.

As some simulator systems grow, others will shrink. It won't be long, the wizards at Wright Patterson told me, before simulators will be small enough to install in real cockpits. Then, before pilots fly an actual mission, they'll be able to run through it sitting in their planes on the ground. Scenes of combat, filled out with the latest intelligence reports, will flash onto the windshield, or on the inside of a special helmet visor. These portable simulators should reduce the usual high rate of attrition among pilots during the early days of combat.

They're even working on an inflatable cushion here that changes seat pressure during simulated pullups and dives. Blowing up the cushion gives the pilot a floating sensation corresponding to a dive. Deflating the cushion drops the pilot onto a hard surface. The feeling: I'm pulling up.

The nearly perfected cushion responds almost immediately—in about 30 thousandths of a second—adding yet another touch of realism, improving the chances for safety, letting even a tyro like me fly by the simulated seat of his pants. **PM**

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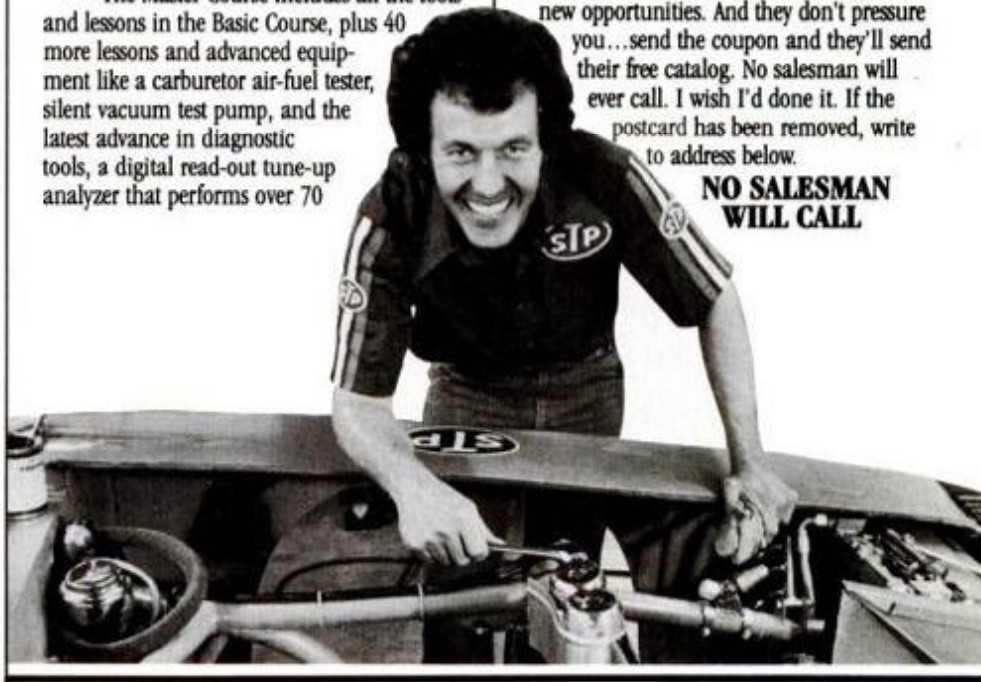
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HOW TO MAKE THE TOUGH CUTS (Continued from page 128)

movements and the movement of the limb you want to drop. If, at any time, you have doubt about your ability to do all three safely with a chain saw, by all means use a hand saw. At any rate, for best control, use only a lightweight chain saw.

If you try to use a chain saw, be sure to heed these safety hints:

- Wear a hard hat, and if using a loud saw, ear protection.
- Check out your saw on the ground. Make sure it starts easily, and that the chain does not turn when the engine is idling.
- Up in the tree, don't start the engine until you have positioned yourself to make the cut, and switch off the engine the moment the limb drops. Don't try to maneuver in the tree with the saw running.
- Brace the saw firmly in a tree fork when you start it.
- Keep a safety rope tied to the saw handle at its balance point. Have the other end of the safety rope secured or controlled by the ground man. Keep enough slack in the rope so that if you drop the saw, it will remain suspended several feet below any position you might slip to, yet not present any danger to someone on the ground. This way, if you lose control, you can drop the saw to use your hands to steady yourself without damaging the saw.
- Be sure the safety rope on the saw and your own safety rope are

away from the path of any movement of the limb rope when the limb drops or swings.

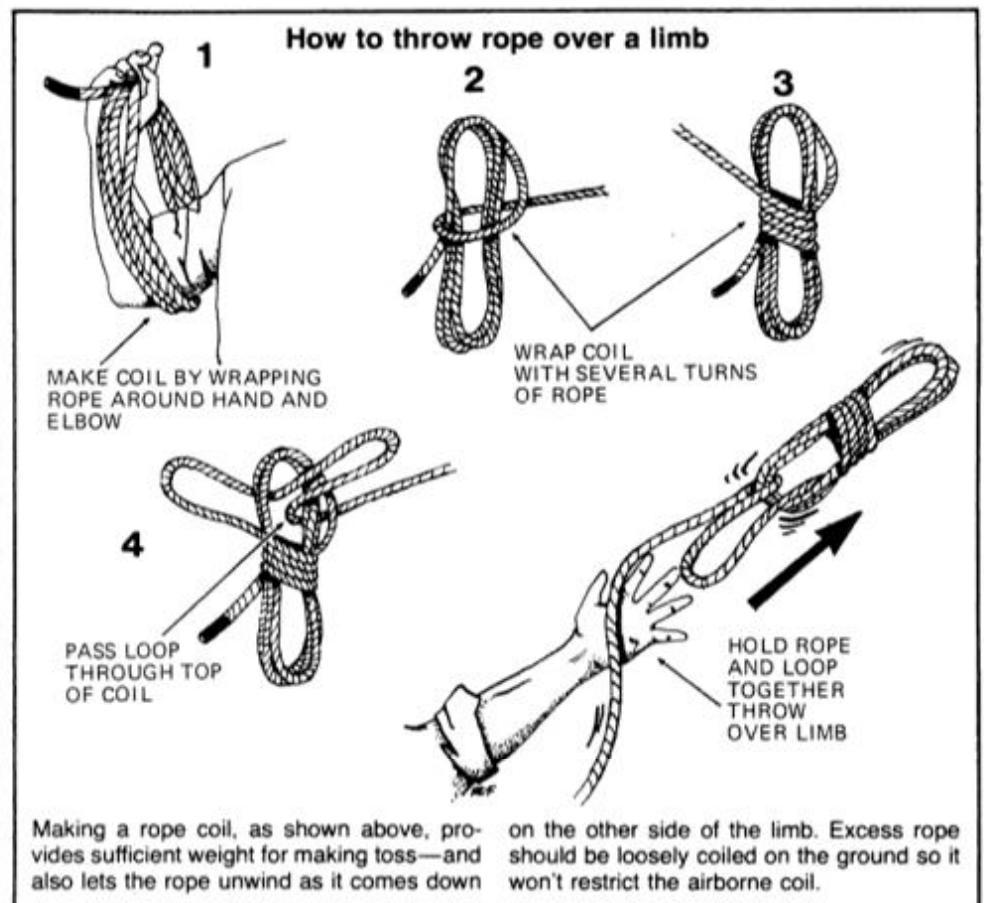
Tree climbing

The saddle method of tree climbing described here is much safer for tree trimming work than using the climbing spurs and safety belt worn by telephone linemen. The spurs (some linemen call them hooks) get clogged with bark chips, so that you cannot get a good bite on the tree trunk. Linemen's belts can hamper your mobility.

Be aware that you have to take greater precautions when working in an old or weakened tree than when you're in a sound, young one. Peeling bark and fungus growth are signs of dead or dying branches, and limbs with these symptoms should never be depended on for support. It's easier to spot dead branches when the tree has its leaves. It's also a good idea to know the type of tree you are working in. You need to take more care in weak-wooded trees such as poplar, silver maple or willow than in elm, oak or hickory.

If the branches are wet, there is greater danger of slipping when you climb. And if the temperature is low, the branches are more brittle.

Most important: Always make sure your safety rope is properly attached and supported by a limb sound enough to hold your weight.



You can use an extension ladder to climb up into the branches. However, you may want it removed after you are in the tree to clear the way for lowering branches.

To get your safety rope across a suitable branch, it can be tossed over, using the method illustrated on page 218, or you can climb the ladder and put it over by hand. Just be sure that the tree crotch is not so tight as to prevent the rope from being pulled through easily.

Tie your saddle in one end of the rope and attach it to the tail rope, using the treeman's knot. The knot should be only a foot or so from your saddle knots, within easy reach of your hand.

Always test your saddle and tree-man's knots before going up in the tree. You can do this by suspending yourself just above the ground.

Trimming hints

There is no standard method for trimming a tree. Generally, trimmers start at the top and work down, dislodging caught branches as they descend. However, you may want to get some of the larger lower branches out of the way first.

When you saw off a branch, leave a stub one or two feet long to aid you in your climbing and rope handling. It can be cut off on your final descent if the entire tree is not to be taken down.

Remember, too, it's easy to underestimate the weight of a large limb, with all its twigs and leaves. It can be a very dangerous force. So, first cut off as many outer branches from the limb as possible and take the limb down in sections.

If you saw off a fairly large limb, the tree is relieved of considerable weight. This can cause the entire tree to sway back and forth quite violently. You must anticipate this and be prepared to switch off your chain saw immediately, and position it safely, while you brace yourself against the swaying.

For best control when lowering limbs, the limb rope should be tied at the balance point of the section you cut off. You'll have to estimate this. It's easy to misjudge the balance point, so be ready for one end of the limb to drop lower than the other.

Always leave a few feet of slack in the limb rope when you tie it off. There should be enough slack to let the limb drop below the working area, yet prevent it from coming down far enough to damage anything below.

Finally, you must pay close attention to your ropes at all times. Make sure they don't cross, tangle or hang up on branches. **FM**

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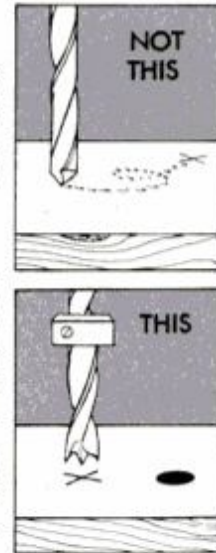


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There is no turntable on this Sony HST-49 unit. The amplifier section can be connected to other components through inputs and outputs on the back—here is a compact you can customize.



Featuring good speakers and a damped cassette door, this Sony JXT 6440 tested out well. Jacks for microphones serve a dual purpose; you can use amp as a PA system and for recording.

COMPACT STEREO

(Continued from page 95)

All of them have cassette recorders and AM/FM receivers, and five have turntables. Remember, this is all packed into one module, with all the controls on one surface. We did not look at any units with 8-track cartridge players, as we feel that they are not on the same quality level as cassette recorders and offer a more rigid format for playback. Most don't even offer a recording option.

Here's the alphabetical rundown: ■ **Emerson M2550 AM/FM-MPX/turntable/cassette recorder.** The front-loading cassette recorder is on the same panel as the dial and control knobs, making all operations easy and convenient. (This was standard on all systems we tested.) The turntable, automatic or manual in operation, is on top, alongside a rack that holds 15 unboxed cassettes. When *Eject* is pressed on the cassette controls, the little door opens on a damping mechanism that stops a "thump" at the end of its travel.

There are two mini phone jacks for microphones. Two easily read VU meters aid in recording. One of the meters additionally serves as the radio signal-strength indicator when the cassette deck's *Record* function is not in use. The turntable on the M2550 is a BSR, as are all of the five we tested. *Bass* and *Treble* knobs are supplemented with a *Loudness* switch, and *Tape in* and *Tape out* phono plugs on the back provide for connection of additional equipment. Emerson sells small speakers which you can order with its compacts.

■ **Panasonic SE-5508 AM/FM/turntable/cassette recorder, with speakers.** This compact is basically similar to the Emerson in outward appear-

ance, except that there is no cassette rack on top. The VU meters on the front are used for cassette recording and one of them, again, is the radio signal-strength meter. The loudspeakers used were the best of all we heard from the various compact lines—they have both warmth and accuracy.

A switch for adjustment of the tape bias (*Normal* or *CrO₂*) is a thoughtful feature. The turntable's cartridge has a "flip-flop" stylus that makes it possible to play 45s and old 78s, as well as regular LPs. Two sets of speakers can be played, but not together. The cassette door and tone arm are nicely damped.

■ **Realistic Clarinette 96 AM/FM/turntable/cassette recorder with speakers.** This is one of several Radio Shack systems. Despite similarity to many other systems, it, too, has unique features. A hinged dust cover protects both the changer and an on-top cassette rack. When the cassette machine is switched to *Record*, an LED flashes red and stays on until the mode is disconnected. Miniature-phone-sized microphone inputs are on the front panel with highly visible recording-level meters.

Separate from these meters is one for tuner adjustment. For FM tuning, it centers the needle when the station is tuned exactly; for AM, a signal-strength readout on the same needle lets you get maximum reception. For recording from the AM band, an AM bias switch eliminates much of the "whistle" that is part of the AM broadcast sound. Slide controls (rather than knobs) control volume, balance, bass and treble. The sole drawback to this system is the poor quality of the speakers. (Try talking a Radio Shack storeowner into a trade for a better set.)

■ **Sony JXT 6440 AM/FM turntable/cassette recorder, with speakers.** Superficially, this compact resembles the preceding two. It has both a cassette rack and a turntable dust cover, but the cover has a large opening at the back which partially defeats the purpose of the protection. The two speakers have an airy, lightweight sound suited to most background music, but not to rock or classical.

The cassette door has a well damped travel suspension and the recorder has a switch for Dolby encoding and decoding, which we found to work very well. A *CrO₂/Normal* switch adds to the flexibility of tape handling. We found this Sony to give some of the best sound we heard on our rounds of various compacts, especially when driving some fairly good speakers.

The mini phone jacks for microphones allow not only recording in the home, but, using the one mike the company provides, use as a PA, as well. The radio sensitivity is good. Unless you connect the antenna terminals to an antenna, the system uses your home's electrical wiring as its antenna. *Loudness* and *Hi Filter* switches help you tailor the sound to your taste.

■ **Sharp AM/FM/turntable/cassette recorder, with speakers.** The turntable and its dust cover (no cassette rack) top this attractive unit. It comes with Sharp's own speakers, which unfortunately did not measure up to any of the others we auditioned. They should be used only as second or rear speakers. An unswitched a.c. outlet, FM antenna terminals, and two auxiliary pairs of input jacks are on the back.

There are no *Tape Out* jacks, so all

(Please turn to page 222)



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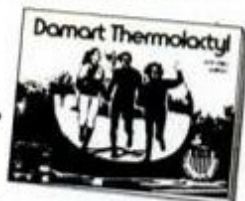
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COMPACT STEREOS

(Continued from page 220)

taping must be done using the system's recorder. The microphone jacks take regular phone-plug-size connections. The VU meters for recording are easily monitored and are separate from the receiver's signal-strength meter.

A novel circuit called the Automatic Program Search System (APSS) seeks the intervals between recorded pieces of music and senses them, stopping the tape when it reaches a blank spot. This facilitates finding the beginning of a song in the middle of the cassette. Radio sensitivity is low, but adequate.

■ **Sony HST-49 AM/FM/cassette recorder.** This is the only system that has no turntable, and it also has no speakers. You can buy any kind of speaker, turntable or changer you want. This unit is one result of the growing popularity of the high-quality stereo cassette as a main music source. The amplifier can also be connected with other equipment through its *Auxiliary, Phono and Tape Out/Tape In* jacks. Connect to an open-reel machine or other cassette deck to have easy tape copying.

The HST-49 occupies somewhat less space than most compacts because of the absence of a turntable—an advantage where space is limited. There is no Dolby circuit, but biasing for normal, FeCr and CrO₂ tapes is included. FM antenna connections of 75 and 300 ohms are easily accessible on the back. Four speakers will connect to the system, but only one pair runs at a time.

A special feature is Sony's *Program Sensor*. Five locations on each of the radio dial bands are available for automatic indication of stations you select in advance. You simply match the dial indicator with one of the preset locations to pick the station. No more continual hunting for an elusive broadcaster! Listeners in urban areas will appreciate this feature. Rural residents far from strong FM signals will miss an FM mono switch—this aids in getting a clean signal where a stereo one is too fuzzy (it's too bad this was not included on more of these systems). All things weighed carefully, this is a fine little music center and worth your consideration.

This is hardly an exhaustive survey of what's on the market, but it gives you useful information about what is typically available—and it may favorably revise your opinion of compact systems in general. It is still amazing what advances the past decade has made in the area of multi-use sound systems.

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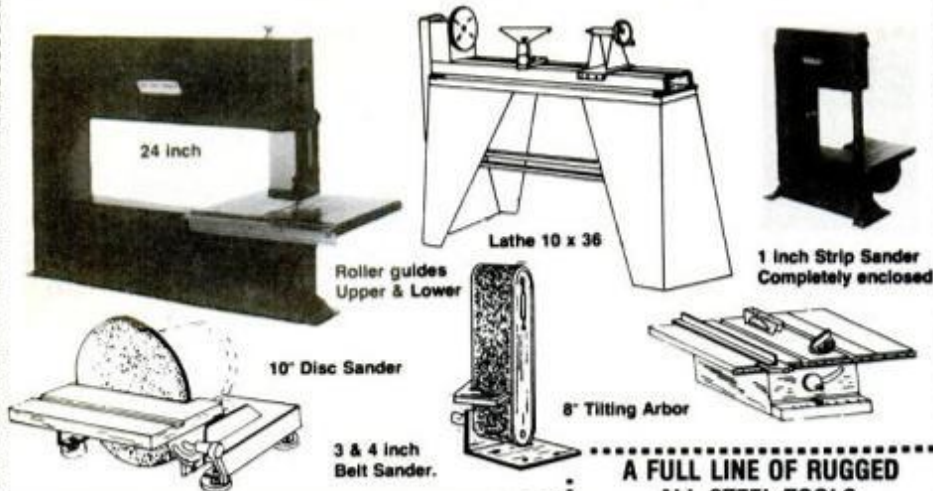
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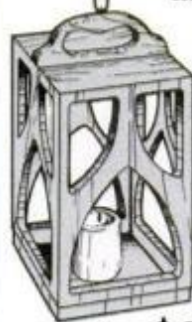
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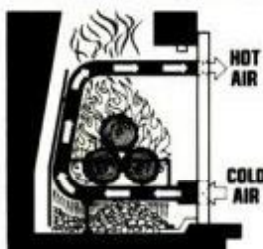


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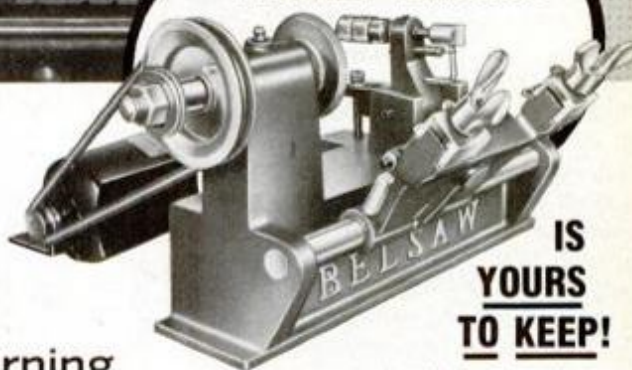
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and the Citation is no exception. Yet overall quality and workmanship received marks far above the average. Some 63.5 percent, in fact, rated workmanship at *good to excellent*.

"Considering that 1980 is the first year for the Citation, and considering how good it really is, the next few years should be terrific," exclaims a New York veterinarian.

"Everything fits the way it should," observes a Michigan retiree, and a junior designer in Chevrolet's own engine group confides, "Mine is a Thursday-built car and shows good workmanship. Doors, hood and all panels are well aligned. I've found no assembly problems at all."

I must point out that fully a third of all Citation owners had no complaints of any sort with their cars, that 21.7 percent wouldn't change a thing even if they had the opportunity, and that half had experienced absolutely no mechanical troubles—all of which speaks extremely well for so new a car.

But half of all Citation owners also *did* cite mechanical problems, and worse than that, 50.2 percent rated their dealers' service departments as *average to poor*. That's considerably worse than AMC dealers, worse even than Jaguar dealers,

and about on a par with Ford dealers, as seen through the eyes of Pinto owners. In any case, it's not a good showing and not in keeping with owners' opinions of the car itself.

The most prevalent mechanical malady involved the Citation's carburetor—*notably hesitation and hard cold-starting*. Balky shift linkage to the manual four-



Few complaints from rear riders; 97 percent rate back seat good to excellent.

speed transmission was also mentioned.

On the service scene, the following comments were representative: "The balky carburetor was corrected after two attempts, and the service manager admits he's learning about Citations."—Texas pilot.

"My dealer eventually fixes things, but it takes two or three visits. I call it typical Chevy service. The shop is crowded, and there are always long lines and waits."—Michigan science writer.

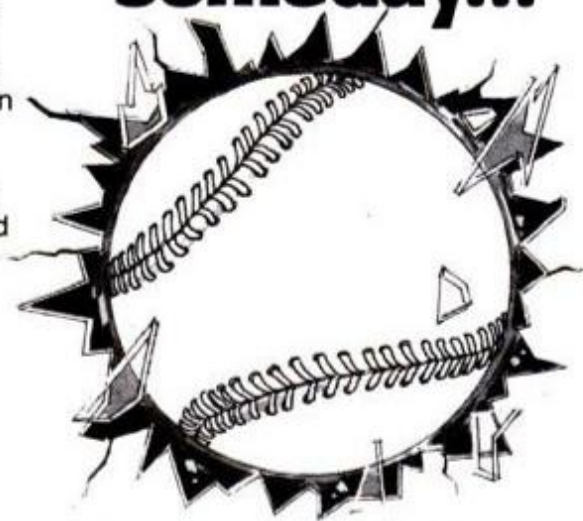
On the other hand, not all owners gripe when it comes to service. A South Carolina papermaker writes, "Excellent dealer shop. Each time we had trouble, they came to our assistance promptly, lent us a loaner, and were all friendly and courteous."

Several drivers commented spontaneously on the Citation's performance. "The four-cylinder engine with four-speed," remarks an Ohio physician, "is surprisingly powerful." And a North Carolina retiree echoes, "The V6 with automatic is very peppy."

Handling, too, got a pat on the back from most owners. An Oregon telephone assigner states, "I just love this car's handling on curves. Also, the aerodynamics are amazing. I've owned a lot of automo-

You'll need to fix a broken window someday...

so you should know about **DAP '33' Glazing Compound**. It's the sure and easy way to set new window panes in unprimed or primed wood sash—and in metal sash. You can depend on it for a weather-tight seal between glass and sash that stops drafts and helps reduce your heating bill. The seal stays firm, yet flexible. And it won't crack or chip.



and when you do... all you gotta know is

Other fix-up answers from DAP? To repair scratches and gouges in furniture or woodwork, fill with **Duratite Plastic Wood Dough**. Virtually shrinkproof, it comes in 8 wood colors plus natural. For fastening paneling to studding or furring strips use **DAP Panel and Dry Wall Adhesive**. You'll save time, reduce the need for nailing and simplify panel alignment. To make rusted bikes, mowers or garden sheds look like new again apply **Derusto Protective Coating**. There's a special primer built into the color for extra protection against rust.



DAP Derusto

biles, but this one by far out-coasts any of the others."

A Tennessee mechanical designer mentions, "With this Citation's front-wheel drive, I can go down the interstate for half a mile without moving the steering wheel. It's that steady on the road."

As we always do, we asked owners to list changes they'd like to see in their cars. The largest percentage recommended no

changes at all, but among those who did, the standard AM radio came in for the harshest criticism. Buyers used to have to accept the Delco radio with their new Citations, but more recently they can have it removed as a "delete option." In any case, 8.8 percent of our respondents wanted better reception plus AM/FM/MX capability.

A New York housewife: "It's a soundly

built car. General Motors obviously put a lot of hours and thought into the Citation."

And a Wisconsin plumbing contractor penned this note across the back of his questionnaire: "I am very pleased with my Citation—its performance, the way it handles, its roominess, its gas mileage. And I'm pleased, too, to own such a fine, American-made automobile." **FM**

SUMMARY OF 1979 CHEVROLET CITATION OWNERS REPORTS*

Total miles driven 699,552	Specific likes:	Comfort opinion (front seats):	Dealer service opinion:
Average miles per gallon	Economy 70.2%	Excellent 46.9%	Excellent 19.9%
2.5-liter Four	Handling 47.9	Very good 40.3	Good 29.9
In town 24.7	Roominess 36.6	Good 11.5	Average 21.3
Long trips 30.9	Ride 29.4	Fair 0.8	Fair 10.9
2.8-liter V6	General comfort 26.5	Poor 0.4	Poor 18.0
In town 20.9	Specific dislikes:	Comfort opinion (rear seats):	Number of vehicles owned:
Long trips 25.8	No complaints 33.3%	Excellent 39.6%	Citation only 36.8%
Engine choices:	Paint/finish 4.8	Very good 40.0	Two cars 49.8
2.5-liter Four 68.9%	Transmission 4.4	Good 17.4	Three cars 9.7
2.8-liter V6 31.1	Gas mileage too low 4.4	Fair 2.6	Four or more cars 3.6
Transmission choices:	What changes would you like?	Had any mechanical trouble?	Makes of cars owned:
Automatic 81.1%	No changes 21.7%	Yes 50.0%	Chevrolet 45.5%
Four-speed manual 18.9	Better radio 8.8	No 50.0%	Ford 17.3
Body style choices:	Different seat shape/style 7.4	What type of trouble?	Pontiac 8.3
Five-door hatchback sedan 63.7%	Better workmanship 6.0	Carburetor/cold starting 24.8%	Oldsmobile 7.7
Three-door hatchback sedan 22.0	Better materials 6.0	Transmission 14.0	Buick 7.7
Two-door Club Coupe 14.3	Workmanship opinion:	Brakes 10.7	Age distribution of owners:
Two-door X11 0.0	Excellent 22.8%	Air conditioner 7.4	Under 30 21.4%
Why did you choose the Citation?	Good 40.7	Oil leaks 6.6	30-49 years 37.5
Economy 73.6%	Average 18.7	Dealer repairs satisfactory?	50-plus 41.1
Space utilization 25.2	Fair 9.3	Yes 50.5%	Would you buy another Citation?
Front-wheel drive 22.8	Poor 8.5	No 49.5	Yes 88.7%
Styling 19.9			No 11.3
Overall size 16.7			

*Percentages might not equal 100% due to the rounding or insufficient data.

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NEW OUTBOARDS

(Continued from page 112)

brication and breakerless electronic ignition are additional factors. Gear ratios matched to the power supplied, and the new wide selection of propeller styles and pitches complete the rpm boost potential.

Better breathing and combustion add up to a bonus of 25 horses. Dual motor-cover air inlets help the engine inhale without gasping. Tuned air silencer and tuned-length intake manifold, plus tuned exhaust with megaphone and expansion chamber, let the air get in and exhaust out without restriction, but boosted by the scientifically tuned shapes. Pullover high-speed carburetor jetting, V-reed valves and straight-through induction, dual overlapped porting and increased compression ratio add to the total.

The largest power boost, 37 hp in the case of this size engine, has come from the increase in piston displacement. Improved head gaskets, forged pistons and pressure-regulated cooling all helped. But again, it was the application of computer technology that made possible the figuring of the stress analysis that allows the casing to house larger-volume cylinders. A bigger combustion chamber, longer piston travel, more power result.

Lowering friction is important. Lower it enough with improved gear lubricant, integral ignition and alternator, stainless-steel water-pump lining and pressure-back piston rings, and you come up with five more horsepower. Add power trim, adjustable engine height, hardened Teflon-coated propellers and through-hub exhaust, and you have extra performance features that are hard to measure in specific horsepower improvements, but deliver the power so that it is more usable and produces more speed. You have now more than doubled the output of an outboard, without adding size or weight.

Next year's choices

For 1980 boating, Chrysler will have 25 models from 4 to 140 hp, including 100- and 85-hp Chargers and a 75 Skier.

Evinrude and Johnson both go again from 2 to 235 horses, and are adding new electric-start 60s, a manual 55, a 7.5 and the recently introduced 4.5s that feature improved fuel efficiency and starting.

Mercury's additions to its 19-hp line include little 3.6-, 18- and 25-hp models, plus the new 225. Using the same 142.2-cu.-in. displacement as the 200, Merc enlarged the carburetor venturis, increased the reeds from 10 to 14, redesigned the air inlet silencer and intake manifold for increased capacity, changed port timing and introduced a new exhaust tuning.

Next spring will certainly see the makers of compact outboards adding to their lines, as well. Less size, weight and gas consumption per horsepower, for big and small outboard motors alike, is now the name of the game.

PM

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THE CHANNEL CHALLENGE

(Continued from page 111)

pounds for the 22-mile Channel excursion. This quantitative approach to helping athletes train precisely for specific tasks is one of the MacCready team's first practical spin-offs.

Another discovery was that, in power output, pedaling slowly-hard is the equivalent of pedaling quickly-easily. Regardless of personal choice in gearing, each individual has a maximum output governed less by muscle power than by lung and circulatory system capability.

"If you could get a day where you had four or five hours of just really calm, cool air, I think you could fly that long with suitable training," muses Allen. "It's to the point where human-powered flight is limited more by environment—by turbulence—than by the ability of the pilot to put out power."

So, has human-powered flight arrived for the common human? Well, besides detailed *Condor* construction plans already available from MacCready, he anticipates publishing an *Albatross* design summary. After so many changes, he doesn't even have its exact measurements at the moment. (Ron Moulton, an official observer, reports 94-foot 2-inch span, 5-foot 6-inch and 3-foot 4-inch root and tip chords, 33-foot length—propeller to bowsprit tip).

MacCready would like to see kits produced eventually, complete with carbon fiber tubing, and possibly based on the still untested, 72-foot span *Gossamer Penguin* (second backup vehicle in England). It is considered easier for amateurs to build and fly.

More immediately, MacCready intends to design a better, safer, lower-powered (3- to 4-hp) "micro-light," as powered hang gliders are being called (page 87, March '79).

Several team members are part of the Human Powered Vehicle Assn. and took part in its annual Speed Championships (page 90, Sept. '79). MacCready is HPVA president.

The ultimate benefit of the Channel project, says MacCready, "Doesn't have much to do with flight itself, but comes from the perspective you get in applying standard concepts toward a goal. The *Condor* isn't the 'ancestor,' but we had to go through it to get perspective on what can and can't be done." **PM**

Information for homebuilders: Paul MacCready is offering an information kit on manpowered aircraft for \$2; plans for *Gossamer Condor* can be ordered at \$75 and plans for *Albatross* and *Penguin* may become available in the future. Write MacCready at 145 Vista Ave., Pasadena, Calif. 91107.

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Never put wax on your car again... *GloSeal** is not anything like a simple wax or polish. It is actually a miracle polymer glass formulation serving as a powerful sealant and a beautiful exterior finish. When applied to your car's finish and chrome its **Electromolecular Action** literally fuses it to the surface, locking in a brilliant shine for years. *GloSeal** with *Polyglass* actually changes the molecular structure of your car's finish. It penetrates through the old wax and binds itself with the surface.

***GloSeal** with *Polyglass* is impenetrable,** non-porous and virtually impervious to damaging air pollutants, car-wash detergents, salt air and water, hot burning sun, cold winter winds, grease, wax, acids contained in eggs and shaving cream, ultraviolet rays and even fire damage. It also provides a brilliant, rich shine to your car's finish, keeping up the appearance and the value of your expensive investment.

Prevents oxidation from starting on new cars...and actually removes it from used models! *GloSeal** is literally a *Glass Shield* that becomes part of your car's finish. Your new car's paint is guaranteed not to oxidize... for up to 3 Years! Then *GloSeal** it again for years more of protection. On used cars, *GloSeal** will actually remove the surface oxidation, add gloss, and stop normal oxidation for 1 year before you need to reapply. It is similar to covering your car with an impenetrable coat of polyurethane.

Enamel spray paint can't even get through the clear glass shield... When this new professional automotive product is demonstrated to car dealers, the "spray paint test" is used. *GloSeal** is



***GloSeal** with *Polyglass*. Already on thousands of vehicles.**

applied to a car's hood following the instructions. Then enamel paint is sprayed directly on it, along with Magic Marker and other solvents. Then, to the observers' astonishment, all of these are wiped off the hood with a mere cloth. Nothing, not even dirt and dust can adhere to the surface!

Important:

*Many other "polymer" car care products are ordinary silicone-based formulations, similar to a synthetic wax, as evidenced by their wax-like feel. *GloSeal** with *Polyglass* is an entirely different product. It is far more advanced, glass-like, slicker, providing a better, "electromolecular" adhesion. The result is a richer, deeper gloss than you have ever seen before, plus months of extra "Glass enclosed" protection!*

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PM previews Hewlett-Packard HP-41C calculator



The HP-41C offers many new features, including plug-in memory expansion. It will also accept 16 preprogrammed cartridges.

At press time—too late for last month's story on new-generation calculators (page 98)—Hewlett-Packard announced a new programmable calculator, the HP-41C. They call this "personal calculating system," their most sophisticated one.

The HP-41C uses a liquid-crystal display (LCD), rather than lighted LEDs, setting it apart from other programmables. But the true differences are inside.

It will accept plug-in memory, as well as plug-in programs. Memory modules (\$45) can be added to the basic calculator (\$295) to raise its memory to 2000 lines of program. The Plug-in program cartridges, also \$45, can contain up to 4000 program steps each.

Each key on the calculator can be user-defined. If you want a key to mean the square of the previous entry divided by pi, you can so define it—or use an even more complex definition. Hewlett-Packard supplies keyboard overlays to relabel your personalized keyboard.

Accessories include an alphanumeric printer, magnetic-card reader and a wand you use to read printed programs (in bar code) without having to type.—Neil Shapiro

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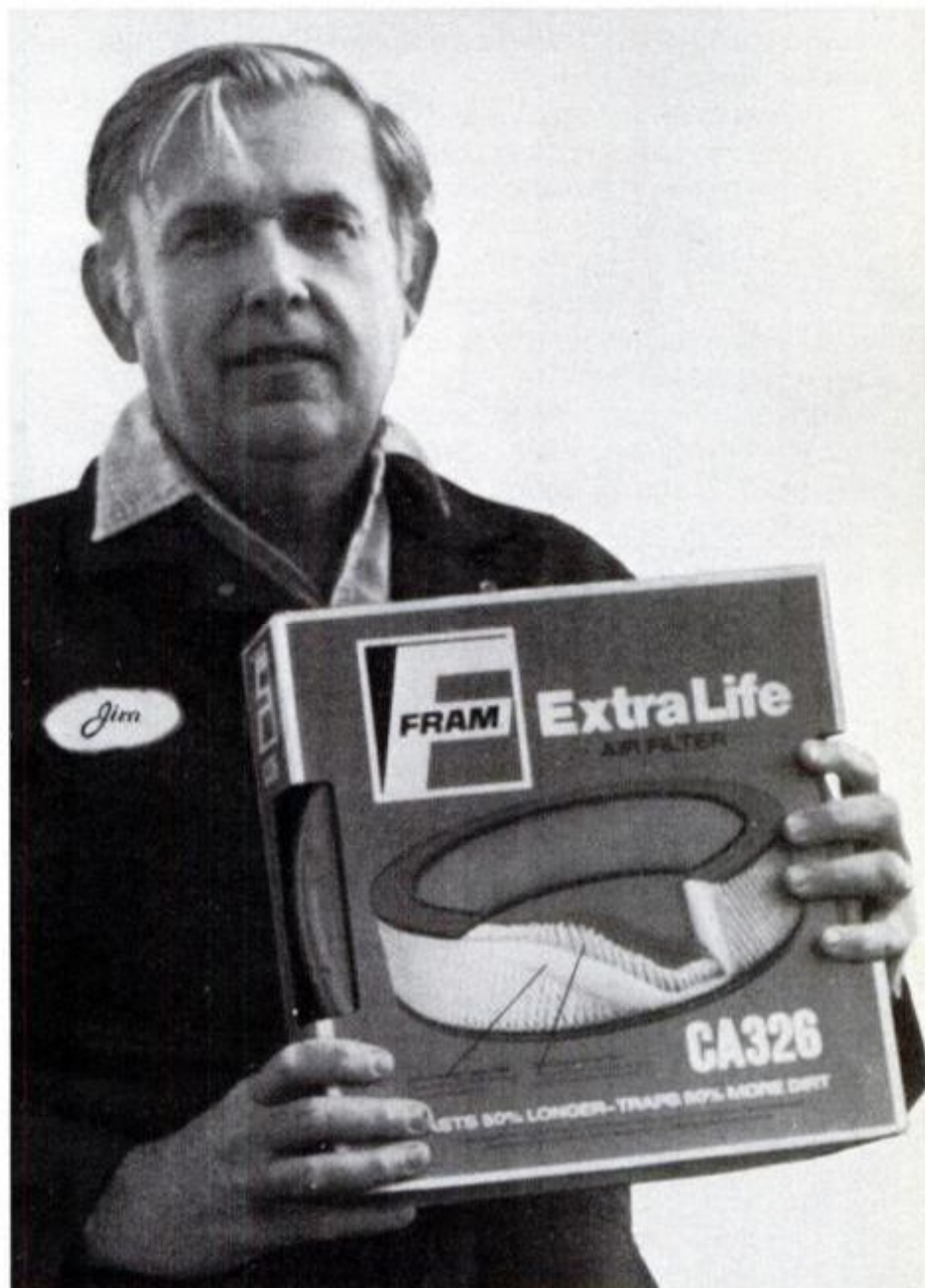
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*Tested against our conventional air filters in accordance with SAE procedures. Results may vary according to car's condition, filter change interval and where and how you drive.

REMINDER

Shotgun Barrel Recall

As your thoughts turn to hunting again, we'd like to remind you that Smith & Wesson issued a voluntary recall of the barrels of all existing 12 gauge Model 916T Takedown Pump Shotguns this past winter.

Owners of current Model 916T shotguns who did not take action after our first notices are again urged not to fire this gun with existing barrels. Under certain conditions, the original barrel of the 12 gauge Model 916T, shipped with the gun, could rupture.

A new design of interchangeable barrels has been developed to eliminate this specific problem. The new barrels will be identified by the letter "O" stamped on the top edge of the barrel near the breech end.

Individuals who have a Smith & Wesson or "Eastfield" brand 12 gauge Model 916T should send the barrel only to:

Smith & Wesson Barrel Exchange Program
2100 Roosevelt Ave.
Springfield, Massachusetts 01101

This shipment may properly be made by Parcel Post or U.P.S. as long as only the barrel is returned. Replacement will be made in approximately two weeks after receipt and at no cost to our customers.

This notice does not concern the Model 916 shotgun with fixed barrel.



Smith & Wesson

a BANGOR PUNTA Company

HINTS FROM READERS

Clothespin is saw handle



You can combine a springless wooden clothespin with a 1/2-in.-wide hacksaw blade to make this open-end sawing device. Cut tips off the clothespin legs. Cover one end of the blade with a double thickness of medium-grit sandpaper, grit side to metal. Insert covered blade end between the legs and turn .32-ga. wire around the wood to secure blade. Twist wire ends; bend into wood with pliers.—*W.E. Burton*

Handy accessory caddy



Here's a storage caddy you can make to hold brushes, router and small drill bits. Glue a 1 1/2-in.-wide piece of corrugated cardboard to a 3 1/2-in.-dia. wood disc. An awl into the side becomes the handle.—*Ken Patterson*

De-oiling file



Rub chalk into a file to remove oil or grease deposits. After several minutes, whisk it out vigorously with a stiff-bristled brush.—*Dayton Lee*

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William Wescott
Willoughby, Ohio 44094



Husband and wife have a going spare time shop

"I'm a construction foreman, and my wife is a nurse's aide. Our Foley shop fits in nicely with our regular jobs, and we earn extra money. Our sons help out too, so ours is a real family business."

"I'm still too young to retire, but when I do I'll have a very good business built up. Foley equipment helps us to do good work and brings customers back with more jobs on a regular basis ... we have a lot of repeat business the year around."

Victor Kosloski
Sturgis, Michigan 49091



Glad he chose Foley for his saw shop

"I worked as a carpenter all my life, but when a back injury forced me to quit I decided to go into sharpening full time. I'm very proud of my shop and glad my choice was Foley equipment ... it is superb. I made over \$48,000 last year, and this year it will go more than \$50,000."

Victor Johnson
Lincoln, Nebraska 68507

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

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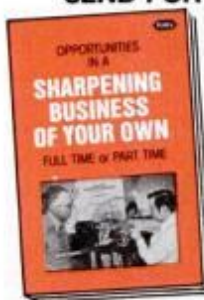
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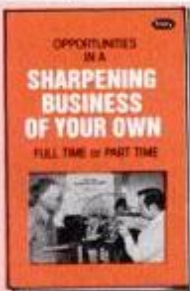
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DRIVING THE 1980 GENERAL MOTORS MODELS *(Continued from page 99)*

gets a rear-end revamp that updates the styling and helps its aerodynamic efficiency.

ALL-NEW SEVILLE

Cadillac Div. has redone its luxury Seville on the fully independent-suspension, front-drive chassis shared by Eldorado, Buick Riviera and Oldsmobile Toronado.

Cadillac did not have a drivable sample ready in time for this preview, but we can be certain that the Seville will handle and perform on a par with the excellent front-drive Eldorado, which received the downsize treatment a year ago.

Division general manager and GM vice-president Edward Kennard calls the Seville "the most significant new car of the decade." We're not so sure about that, but Seville for 1980 is, in Kennard's words, "not only the first U.S. car to be sold with a diesel engine as standard, it is a car with such advanced technology it will become a classic in its own right. It has a custom-built look. It combines European flavor and American flair. There is no other car like it."

The most striking visual feature, of course, is the classic Rolls-Royce-like rear end. There is really no rear deck; instead, the roofline slopes directly down to the rear bumper with an old-fashioned "bustle" trunk bulge.

Word is that this controversial styling touch was former GM design chief Bill Mitchell's final stroke before retiring two years ago. "Wait'll you see the '80 Seville," he said at the time.

We think it looks good from some angles (especially with the Elegante two-tone treatment) and awful from others, but we're betting they'll sell every one they can build, fuel crisis or not. Remember, the first Seville was controversial because of its squared-off, rear-roof profile. But now almost every new American sedan has adopted that look. This elegant new version gives Seville buyers something very different once again.

NEW ENGINE

Besides the standard Olds-built 5.7-liter diesel, the only other choice is a new Cadillac-designed and built 6.0-liter gas engine with sophisticated digital electronic fuel injection. Due to that state's more stringent emissions standards, California Seviles and other Cadillacs will have only the previously available 5.7-liter closed-loop, fuel-control, gas V8 engine.

Also standard on the Seville are four-wheel power disc brakes, electronic suspension leveling, electronic climate control, cruise control and a host of other luxury and convenience features.

Although the outside dimensions are similar to last year's car the new, front-drive Seville's weight (with the gas engine) is down some 300 fuel-saving pounds and interior roominess is enhanced in nearly every direction. One nice touch is a center console display area for radio, climate control, clock and other accessory controls. The special-edition Seville Elegante features standard leather-trimmed seats and a choice of three different two-tone paint combinations.

MORE EFFICIENT BIG CARS

The name of the game for the family-size GM cars this year is increased efficiency by means of better aerodynamics, less weight, lower rolling resistance, smaller standard engines and other engineering changes. Slimmed down drastically three years ago in Round One of GM's total redesign program, these popular entries are subtly restyled and improved in many ways for the 1980 model year.

Air drag was reduced by lowering their noses, rounding their fenders, squaring-off their roof shapes, raising their rear decks and adding tiny spoilers at the trailing edges. The resulting decrease in drag is significant (14 percent in the Buick LeSabre's case) and translates into improved fuel economy at highway speeds.

Rolling resistance was reduced largely by going to high-pressure radial tires, and weight was pared by substituting lighter materials wherever possible. The 100- to 200-pound weight reduction is especially impressive considering that the bodies and frames had to be structurally beefed here and there to maintain ride quality with the stiffer high-pressure tires. Overall fuel-economy improvement averages about 1 mpg per car, but would have been 2 to 3 mpg were it not for the economy lost to 1980's much tougher federal emissions standards.

CHEVY AND PONTIAC

The new exterior shapes of Chevy's Impala and Caprice series cars reduce their air drag to a coefficient of .450, which is impressive for such relatively large automobiles. A new Chevy-built 3.8-liter V6 engine replaces the 4.1-liter straight

(Please turn to page 238)

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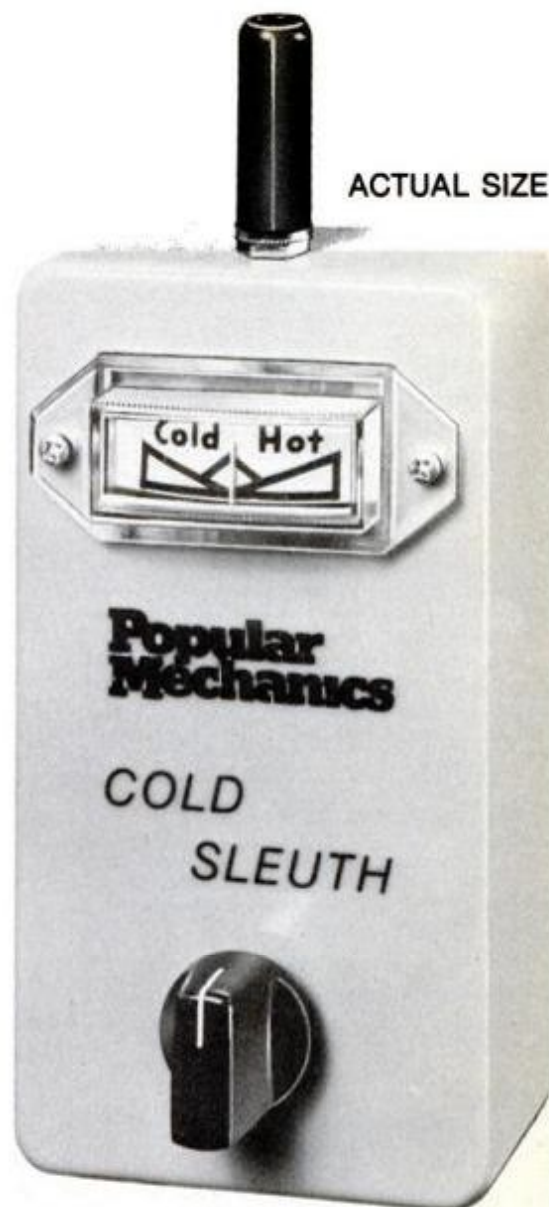
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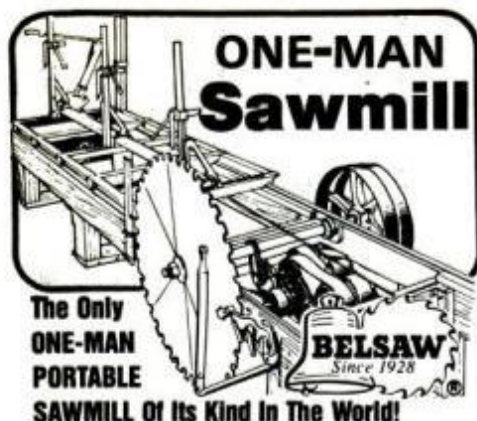
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IN THE
YELLOW PAGES
UNDER "SHOES"

Six as standard engine, and a fuel-saving lock-up torque converter is standard with automatic transmission, except in California.

Pontiac's 1980 Catalina and Bonneville models have a longer look due to extended front and reduced rear overhangs and the chopped rooflines. Luggage capacity is increased one cu.ft. to 21 as a result of the higher deck lid, new standard compact spare tire and other changes. A new Pontiac-built 4.3-liter V8 is standard in 49-state Bonneville Broughams and optional in other models, a 3.8-liter V6 replaces the standard 4.9-liter V8 in Bonneville coupes and sedans, and the 5.7-liter diesel V8 is available in some models. Certain versions also get the lock-up automatic transmission torque converter, and larger fuel tanks on all full-size Pontiacs increase driving range.

OLDS AND BUICK

Oldsmobile 88s and 98s are slightly shorter and weigh less than their '79 counterparts, and weight reductions from such things as smaller catalytic converters, a lighter-weight transmission with the 4.3-liter V8 engine, compact spare tire, tape-drive window regulators, aluminum intake manifolds and hoods on certain cars, and even plastic wheel covers on 98s add up to a weight saving of from 84 to 195 pounds per automobile.

Some station wagons also get a new, lightweight plastic tailgate assembly for a 12.6-pound saving, and some models feature the no-slip torque converter clutch. Inner and outer front fenders are bolted rather than welded together for easier serviceability, and the big Olds (like other 1980 full-size GM cars) boasts improved corrosion protection throughout.

Buick Div. has discontinued the Electra 225 coupe and sedan, leaving the more luxurious Limited and superluxury Park Avenue series Electras. A new 4.1-liter V6 is standard, and the 5.7-liter diesel is an optional choice. Two Buick exclusives in the Park Avenue are a slick new electronic touch-control airconditioning system and a six-speaker Concert Sound system with a 32-watt rms power booster.

The full-size Buick LeSabre also is redesigned for 1980 with a crisp new coupe roofline, lower curb weight and a long list of engineering changes in the interest of greater fuel efficiency. LeSabre Sport Coupe continues to offer Buick's 3.8-liter turbocharged V6 engine as standard

equipment, plus bucket seats, console and blacked-out exterior trim.

BIG CADILLACS

Rounding out the re-engineered big cars are Cadillac's Coupe and Sedan de Ville and Fleetwood Brougham luxury sedan. Like the other full-size entries, these have refined styling with "stiffer" rooflines, lower hoods and raised rear decks for increased aerodynamic efficiency. Standard engine (except in California) is Cadillac's new 6.0-liter V8, while the 5.7 diesel is available in all but limousine models.

Ride is improved in spite of the harder high-pressure tires, as are both noise insulation and corrosion protection. Coupe de Ville's boxier roof shape also lets rear passengers sit farther back, providing more than 2 inches extra legroom and better knee clearance. Interesting new options include an alarm system that disables the starter, and a built-in, but easily removable, garage-door-opener transmitter with controls for up to three doors.

As a group, these standard-size GM cars set a new industry standard in their class when they were introduced three years ago, and the latest changes make them even more desirable. They are exceptionally roomy, comfortable and quiet inside, ride like traditional American luxury cars, yet are surprisingly agile in the turns in the manner of expensive European sedans—especially with the optional handling suspensions offered by most divisions.

Recent fuel availability worries have lessened the appeal of such large automobiles, but those who still want, or need, large, family-size cars will find these latest models more fuel-thrifty than one might expect. Buick, for one, claims the longest highway driving range on a tank of gas of any gas-powered car in America... as much as 625 miles with the 3.8-liter LeSabre's 25-gal. tank, based on the EPA highway fuel-economy estimate of 25 mpg. Which division's car you prefer depends on your desires, budget and which brand, model or dealer you like best; but these are the best big cars yet from GM in every way and well worth considering.

CORVETTE UPDATED

"America's only sports car" gets new, lighter, soft front and rear bumper systems along with a styling update for 1980. Better aerodynamics (front and rear spoilers are now integral), lower-restriction exhaust

(Please turn to page 240)

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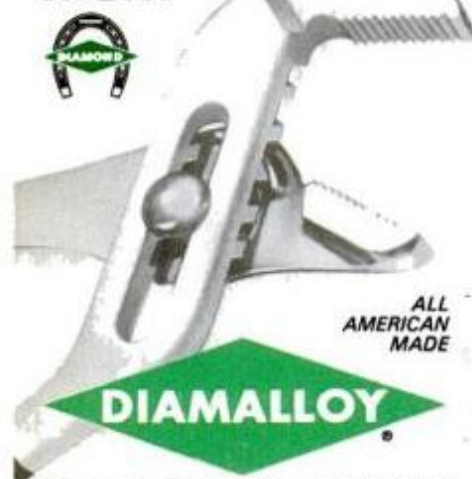
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DRIVING THE 1980 GENERAL MOTORS MODELS *(Continued from page 238)*

system, redesigned interior and instrumentation and a significant 240-pound weight reduction also distinguish the '80 models. The standard 5.7-liter V8 is rated at 190 horses with either automatic or four-speed manual transmission; and a higher-powered (L82) version of the same engine remains available. California Corvettes, unfortunately, are limited to a 180-hp, 5.0-liter V8 with automatic transmission.

The popular Camaro gets Chevy's new 3.8-liter V6 as standard and retains the 5.7-liter engine as an option, (with choice of automatic or four-speed manual transmission). Monte Carlo offers a turbocharged V6 in addition to the standard 3.8-liter V6, and optional 4.4-liter and 5.0-liter V8s. In the economy-car category, Monza loses its optional V8 and the station-wagon model, but Chevette gains a handsome, European-looking, rear-end restyle with wraparound taillamps, flush-mounted hatch glass and a small aerodynamic kickup on the trailing edge.

The fast-selling Chevette's braking performance also is improved, larger standard radial tires give better handling and longer tire wear, and there's a new, optional three-point passive belt system. Chevy's answer to the economy imports has improved every year, and this 1980 version is the best yet.

TURBO TRANS-AM

There's good news and bad news for Pontiac Firebird Trans-Am fans this year. Good is the new turbocharged 4.9-liter V8 available in Trans-Am and Formula. Bad is the demise of every engine larger than 4.9-liter and the four-speed manual transmission, victims of 1980 emissions standards and the corporate average fuel economy (CAFE) law.

The nonturbo 4.9 V8 is a bit anemic for a macho-image T-A, but the turbo version is fairly impressive once it's off the line. It's not a high-torque tire-burner like the old 400-plus cu.-in. engines, but it does beat last year's 403 automatic in 0-60 mph times and quarter-mile runs. Unfortunately, the turbo engine has not been certified for sale in California, even though Pontiac general manager (and GM vice-president) Bob Stempel says, "If ever there was a car for California, that's it!" Maybe next year, he says.

Other Pontiac models are little-changed for 1980. LeMans, Grand Le Mans and Grand Prix get minor styling revisions and the new 4.3-liter V8 as an option. The perfor-

mance-image Grand Am continues as a coupe model only, with a four-barrel electronically controlled 4.9-liter V8 as standard equipment.

Sunbird loses its wagon model and optional five-speed manual transmission. The optional 5.0-liter V8 and Formula version were dropped in mid-year 1979.

There is also no youth-image Phoenix model to compete with Chevy's Citation X-11, Olds' Omega SX and Buick's Skylark Sport Coupe.

NEW NOTCHBACK SEDANS

Many wondered about the salability of the Buick and Oldsmobile intermediate "aeroback" sedans when they were introduced two years ago; and indeed the odd fastback styling did not prove popular on four-door models. For 1980, then, GM admits its design mistake and replaces these cars with more fashionable notchback models. Looking like smaller versions of the old-style Seville, these cars offer excellent ride, handling and (in highline models) luxury appointments in attractive, reasonably fuel-efficient, mid-size packages.

Oldsmobile Cutlass four-doors have single rectangular headlamps flanking traditional Olds-style split grilles, while Supreme and Calais models use quad lamps and different grille variations. The lower-priced Salon coupe retains its fastback roofline and dual-headlamp treatment. There's a 4-4-2 package available for the top-line Cutlass Calais coupe that comes complete with gold-painted trim and aluminum wheels and standard four-barrel 5.7-liter V8.

Other Cutlass models make do with a standard 3.8 V6 or optional 4.3- or 5.0-liter V8, plus diesel version of the 4.3-liter engine. This little V8 diesel is a bit slow on the go but offers an impressive 24-mpg EPA fuel-economy rating for city travel.

The front-drive Toronado gets a better-looking grille design, weight reductions, a smaller (5.0-liter) standard V8 engine and ride and handling refinements for 1980. The Omega front-drive compact and Starfire sporty coupes are carried over with little change in their designs for 1980.

Buick's Century line also adds the new four-door notchback body and drops its aeroback sedan, and the Regal personal coupe gets a new frontal look with quad rectangular headlamps. Regal Sport Coupe and Century Turbo Coupe feature the

turbocharged 3.8-liter V6 as standard equipment. The Century Sport Wagon, with its black-out trim, sport wheels and all, is continued for those who want wagon utility along with sporty style and driving fun in a new, 1980 car.

New to the Century/Regal lineup is a limited-edition, Regal Somerset with dark blue and beige two-tone treatment inside and out, sport mirrors, wire wheel covers and accessory pockets on the front seat-backs, one of which contains a *color-coordinated umbrella!*

RIVIERA AND ELDORADO

Buick's front-drive Riviera has been massaged a bit for improved ride over last-year's already impressive version. New are aerodynamic outside rear-view mirrors fitting snugly to the body, and a Twilight Sentinel automatic headlamp control and delay system.

Cadillac's front-drive Eldorado gets minor design revisions plus the new, Cadillac-built 6.0-liter V8 engine with digital electronic fuel injection. California versions retain the 5.7-liter closed-loop fuel control V8, and the 5.7-liter diesel is optional nationwide. Inside are divided front seats with "loose, tufted pillows" in six shades of knit cloth or ten of leather.

SKYLARK AND SKYHAWK

Skyhawk, Buick's version of the superefficient front-drive GM X-cars introduced last April, and the subcompact Skyhawk sport coupe continue with only minor refinements for 1980.

MORE OF THE SAME FOR '81

With much lower emissions levels, new bumper and safety standards, and a 20-mpg CAFE requirement, automakers had to work extra hard just to meet the law for 1980. Smaller engines, lower drive ratios, lightweight materials, better aerodynamics, lockup automatic transmission torque converters, high-pressure tires, increased use of sophisticated electronic engine controls and, unfortunately, fewer power-train choices (especially in California) are just some of the more obvious effects of this efficiency vs. emissions and safety battle going on in Detroit.

Next year CAFE jumps two mpg to a 22-mpg average, and emissions standards are reduced even more. So the engineers whose ingenuity gets the cars to comply with these regulations will continue being the heroes of Detroit. **PM**

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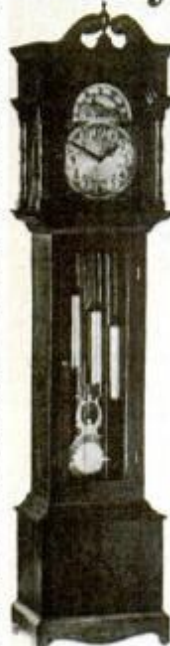
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1980 FORD, L-M CARS

(Continued from page 101)

transmission are standard, while Ford's 5.0-liter (302-cu.-in.) V8 and a brand new, fuel-saving, four-speed overdrive automatic are available options in both cars. Additional standard equipment includes halogen headlamps (hidden on T-Bird); analog clock; stalk-mounted controls for horn, dimmer and windshield wiper/washer; variable-ratio power rack-and-pinion steering; power front disc/rear drum brakes; stabilizer bars front and rear; fluidic windshield washer system and steel-belted radial tires.

New and interesting on the long list of options are: an electronic instrument cluster with digital speedometer and graphic fuel gauge, a diagnostic warning-light module, keyless entry system with computerlike pushbuttons on the driver's side outside door panel, automatic headlamp on/off and delay system, TR-type low-profile tires on cast-aluminum wheels, garage-door control, premium six-speaker sound system and electronic AM/FM stereo search radio, with or without 8-track or Dolby cassette tape player.

T-BIRDS SINCE 1955

For those too young to remember, the T-Bird was born in 1955 as a two-seater answer to Chevrolet's Corvette. Basically a cut-down Ford sedan with exciting styling and a 292-cu.-in. V8 engine, it was offered as hardtop and convertible and sold about 17,000 units in that maiden year. In '56 it got roof portholes, a "Continental" spare-tire kit and an optional 312 V8; the next year, it grew tailfins, in the style of the times. Sales remained at about 17,000 in '56, but fell to 15,000 for the '57 model year.

Sports car fans moaned and cried when the T-Bird got bigger in '58 to accept 352 and 430-cu.-in. engines and a second set of seats, but sales jumped to 48,500 in '58, 73,000 in '59 and 81,500 in '70. Thunderbird was by then well established as a four-seat sport-luxury coupe, and so it has remained ever since. Wheelbase was up to 113 inches from the original 102, and in 1967 it jumped again, to 115 for the two-door and 117 for a new four-door hardtop model. That year also marked the end of the T-Bird convertible.

Five years later the Bird grew to a gargantuan 120.4-inch wheelbase and became first cousin to Lincoln's Mark III luxury coupe, in two-door hardtop form only. But the Arab oil embargo in 1974 and growing concern for fuel economy caused

Ford to rethink the concept. For the '77 model year, the really big T-Bird was dropped and the name shifted to a special, restyled version of the intermediate Ford, formerly known as Elite. More than 322,000 of these smaller, more affordable Birds were sold that year, and their popularity remained high in 1978 and 1979.

COUGAR HISTORY

Meanwhile, Mercury's Cougar was carving its own solid reputation, first as a ponycar cousin to Ford's Mustang and later (beginning in 1974) as a mid-size specialty car, similar to the recent mid-size Thunderbird. But continuing fuel concerns and the government's corporate average fuel economy (CAFE) law dictated that both of these highly successful products would have to be redesigned and re-engineered into still smaller, more efficient packages.

During that first fuel crisis of 1974, Ford began serious work on an all-new, ultra-efficient, European-style family of cars code-named Fox. That project eventually evolved into the excellent Ford Fairmont and Mercury Zephyr, unveiled two years ago, and last year's exciting new Mustang and Capri sporty coupes. For 1980, the Fox threesome is completed with introduction of the best Thunderbird and Cougar XR-7 luxury-sport coupes ever built.

NEW CONTINENTALS

Lincoln-Mercury Div. also has totally redesigned its Continental and Mark series luxury cars into smaller, more efficient sizes. Mark VI for 1980 features standard electronic instrument cluster, stalk-mounted controls, power vent windows, fluidic windshield washer, concealed halogen headlamps, electronic fuel injection, four-speed overdrive automatic transmission and third-generation electronic engine control (EEC III) on both the 5.0-liter and the optional 5.8-liter (351-cu.-in.) V8 engines, plus a whole lot more. The new keyless entry system, premium sound, electronic stereo search radio with Dolby cassette tape player and auxiliary front lamps mounted on the headlamp covers are new options for 1980. And, for the first time, there is a four-door Mark VI for those who want something a step above the four-door Continental Town Car.

The Mark VI coupe sits on a 114.4-inch wheelbase, while the sedan shares Continental's new 117.4-inch-wheelbase chassis. Two-door and four-door Lincoln Continentals are similar to the Mark in design

(Please turn to page 244)

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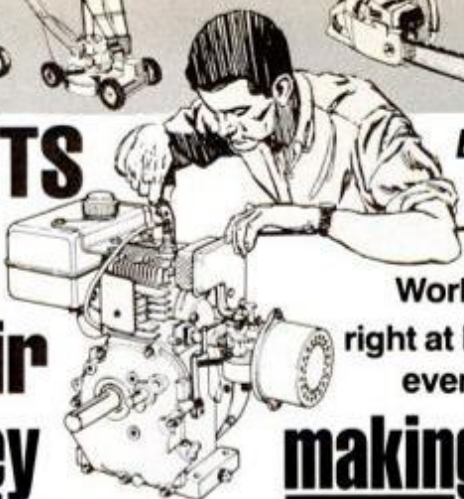
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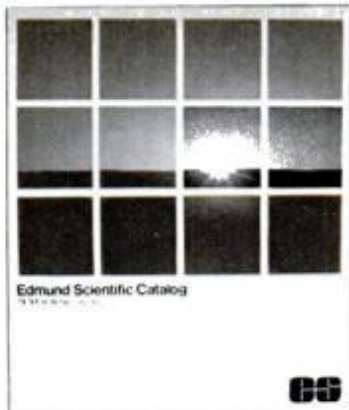
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1980 FORD, L-M CARS

(Continued from page 242)

and concept, except for the lack of such fillips as concealed headlamps, opera windows and the rear deck-simulated spare tire cover. Some of Mark VI's standard equipment is optional on lower-priced Lincolns.

Since Lincoln Continental and Mark VI buyers have been attracted traditionally to their massive size and appearance, L-M has taken great pains to make these smaller and lighter (some 900 pounds) new models look and feel almost exactly like the land yachts they replace. All of the traditional Lincoln luxury qualities are still there: pillow-soft ride, concert-hall quiet, superior passenger and cargo room, the whole shot. Most significant is that, while you have to look very hard to tell them from last year's models and you'd likely never notice the difference inside the cabins, these new Lincolns should be the most fuel-efficient big luxury cars in America, thanks to the fuel injection, electronic engine control and, especially, the new overdrive automatic transmission.

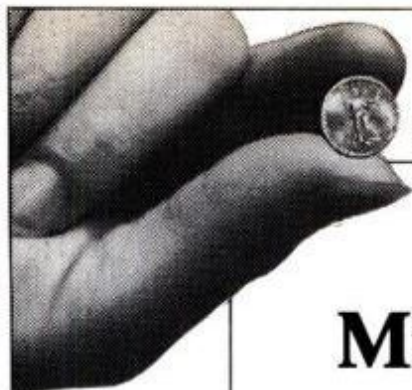
FAIRMONT AND ZEPHYR, MUSTANG AND CAPRI

Other Ford and Lincoln-Mercury models are little changed for 1980, but there are interesting new options and engineering improvements. Fairmont and Zephyr can now be equipped with the Ford 2.3-liter, turbocharged four-cylinder engine; Mustang and Capri will soon be available with automatic transmission attached to the same turbo motor. Mustang has a revised Cobra package similar to last year's Indy pace-car treatment, plus a simulated convertible top option. Mustang and T-Bird can be ordered with adjustable Recaro bucket seats in front. The 4.2-liter engine replaces last year's snappy 5.0-liter V8, and the old 3.3-liter (200-cu.-in.) straight Six supercedes the German-built V6 as Mustang and Capri options.

Also noteworthy is availability of the automatic overdrive transmission in Ford LTD and Mercury Marquis full-size cars.

Much tougher emissions standards and the 20-mpg fleet fuel economy requirement have made 1980 a very difficult year for the auto industry as a whole. Still, the more efficient T-Bird, Cougar XR-7 and Lincoln luxury cars, in combination with economy-enhancing changes to other models, should see Ford Motor Co. in a strong competitive position for the new decade's beginning, fuel crisis or not.

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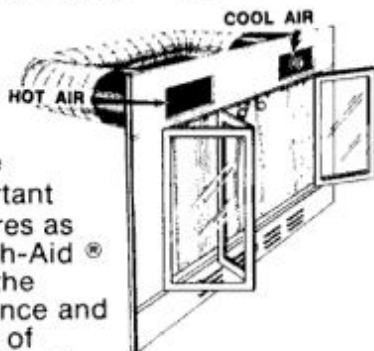
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1980 CHRYSLER CORP. CARS

(Continued from page 103)

with the Six, and although I understand the lockup clutches are perceptible under light throttle, I couldn't feel them.

The Cordoba/Mirada feels roomier inside, as indeed it is. The squared-off roof makes for better vision in all directions, including to the three-quarter rear.

Inside, the Cordoba gets an instrument background with wood texture, while the Mirada's is brushed aluminum. Buckets are standard in both cars, with a 60/40 bench and a console optional. The passenger's seat automatically moves forward on its tracks when you trip a lever. It then goes back to a preset position when you return the seatback to its upright stance.

The Mirada sports a grille design reminiscent of the coffin-nosed 1936-'37 Cord. The front bumper blends into this car's soft frontal system, and behind the Mirada's integrated front bumper lies an energy-absorbing inner bumper, made of lightweight urethane foam—a "bun," Dodge calls it.

Instead of incorporating the usual hydraulic dampers, the foam bun bonds to a high-strength steel reinforcement attached to the Mirada's unit body. The soft bumper covering doesn't scratch or distort, and the urethane foam resumes its normal shape after impact.

The 1980 Cordoba, meanwhile, keeps its more traditional front-end ensemble, with an upright grille and metal bumper. It, too, uses a soft fascia, even so.

The Cordoba's model lineup includes the base coupe, Cordoba Crown and Cordoba Corinthian Edition. The Mirada has two versions—base coupe and Mirada CMX.

The CMX, scheduled for production one month after normal Dodge introductions, comes with a bright roof halo, rear-quarter window louvers, forged aluminum wheels, wheel-lip moldings and glass-belted radial tires. The CMX's 10-spoke aluminum wheels look a lot like the 1932 Studebaker and Pierce-Arrow artillery wheels—very handsome.

Special suspension packages for the J-body include heavy-duty front stabilizer bar, a rear sway bar, recalibrated shocks and rear springs, road-feel power steering, P215/70R-15 steel-belted radials and 7×15-inch wheels.

The Cordoba/Mirada have several different roof treatments. One simulates a convertible top and has a sailcloth covering, "roof bows," canvas welting, no quarter windows,

and a smaller rear glass. There's also a T-top, a moon roof and the standard roof.

THE BIG CARS

Chrysler Corp. considers a good range of full-sized, six-passenger sedans as essential to the new-car market place as a wide variety of smaller cars.

Chrysler's large R-body spans 118.5 inches of wheelbase, carries six passengers in comfort, has a 21.3-cu.-ft. flat-floored trunk, and is marketed in four distinct car lines: Plymouth Gran Fury, Dodge St. Regis, Chrysler Newport and New Yorker—all four-door pillared sedans.

Engine choices start with the Slant Six, except in the New Yorker, whose standard engine is the 360 V8. All nameplates offer the 318 V8 optionally.

All but the Newport have up-option models, each with added equipment and features. The Gran Fury comes with wood-grain interior trim, soft headliner, carpeted door lowers and package shelf, plus seat-belt chimes.

The St. Regis Touring Edition boasts not only a long list of standard items like power steering, TorqueFlite, steel radials, tinted glass and chimes, but also offers leather/vinyl seats, aluminum wheels, special striping, power windows, wood-tone instrument trim and leather-wrapped steering wheel.

The New Yorker, with its distinctive opera windows and hidden headlamps, has the special Fifth Avenue edition in several decor treatments. The New Yorker's option list remains relatively short, because nearly everything available in or on any Chrysler product comes standard with this car.

New this year are flag-type right and left outside rear-view mirrors, the right one convex and driver-adjustable in some applications. Chrysler has also put the headlight dimmer and wiper switch into the turn-signal stalk. Windshield wiper arms are now made of a flat-black, glass-reinforced polyester that's more resistant to lifting, bending, streaking and glare.

The Open Road handling package will be available for all full-sized sedans. And all Chrysler Corp. cars share the optional five-year/50,000-mile service contract.

LeBARON/DIPLOMAT

The Chrysler LeBaron and Dodge Diplomat share the corporation's M-body, an offshoot of the F-bodied Volare/Aspen.

The LeBaron gets an all-new frontal treatment for 1980: an upright

grille with quad rectangular headlamps. Taillights have also been restyled. The Diplomat's grille changes are more subtle.

LeBaron and Diplomat sedans and wagons still span the 112.7-inch wheelbase, but new coupes in both lines drop down to a 108.7-inch span, with no loss of interior space. Sport/luxury versions of these coupes are the LeBaron LS and Diplomat S.

The LeBaron LS offers a chrome-and-stainless wire grille, two-tone paint, louvers in the front fenders, wire wheelcovers, twin sport mirrors, decklid trim, bucket seats and brushed-steel instrument panel with console.

Standard and optional features of the Diplomat S include a unique grille, vinyl top, opera windows, buckets, console and special interior trim.

The LeBaron wagon can now be ordered either with or without the wood grain exterior.

Halogen beams are available optionally with any four-lamp headlight system. The Slant Six and 318 V8 are both available for the M-car, and in California and the corporation's new Detonation Suppressor System is standard. The DSS senses spark knock and automatically retards ignition timing to reduce it.

VOLARE/ASPEN

These roomy, economical compacts continue with three body types for 1980: four-door sedans and wagons, plus new coupes on the shorter (108.7-inch) wheelbase.

Restyled grilles and bustles distinguish the '80 Aspen and Volare, with several dress-up packages available for either nameplate. Both offer Custom and Premier up-option interior/exterior packages. The Volare also lists Duster, Road Runner and Sport Wagon trim groups. The Road Runner has blacked-out moldings and includes the handling suspension. The Aspen's counterpart is called the Dodge R/T.

Aspen models, in fact, are similar to the Volare's and include the Special Edition, the Sunrise coupe and the Sport Wagon.

OMNI/HORIZON/024/TC3

Why change a good thing? Chrysler's U.S.-made, fwd subcompacts have been selling so well that the corporation decided not to make extensive alterations for 1980.

Sport models, though, have been added to the Omni 024 and Horizon TC3 coupes. The 024 gets a DeTomaso option package, and the TC3's counterpart is called the Turismo.

The DeTomaso 024 comes in red or

(Please turn to page 248)

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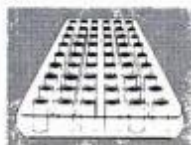
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1980 CHRYSLER CORP. CARS

(Continued from page 247)

yellow, with black lower body trim and identification, front air dam, deck-lid spoiler, wheel flares, black-out accents and special interior. A sport suspension is standard and includes Goodyear GT steel-belted radials on cast-aluminum wheels.

The TC3 Turismo offers similar goodies plus tach, fast-ratio power steering and reclining bucket seats.

IMPORTS AND TRUCKS

Chrysler Corp.'s liaison with Mitsubishi of Japan continues, and the

company will again bring in the highly successful Plymouth Arrow, Champ and Sapporo; also the Dodge Colt and Challenger. No great changes in any of these.

The Mitsubishi-built Dodge D-50 and Plymouth Arrow pickups receive paint and trim upgrading.

The Plymouth Trail Duster and Dodge Ramcharger get part-time four-wheel drive, instead of the full-time system used before. Voyager and Sportsman vans have better visibility and ventilation, with one-piece vented side windows. They also offer a wider choice of axle ratios and drive-line combinations. **PM**

1980 AMERICAN MOTORS CARS

(Continued from page 105)

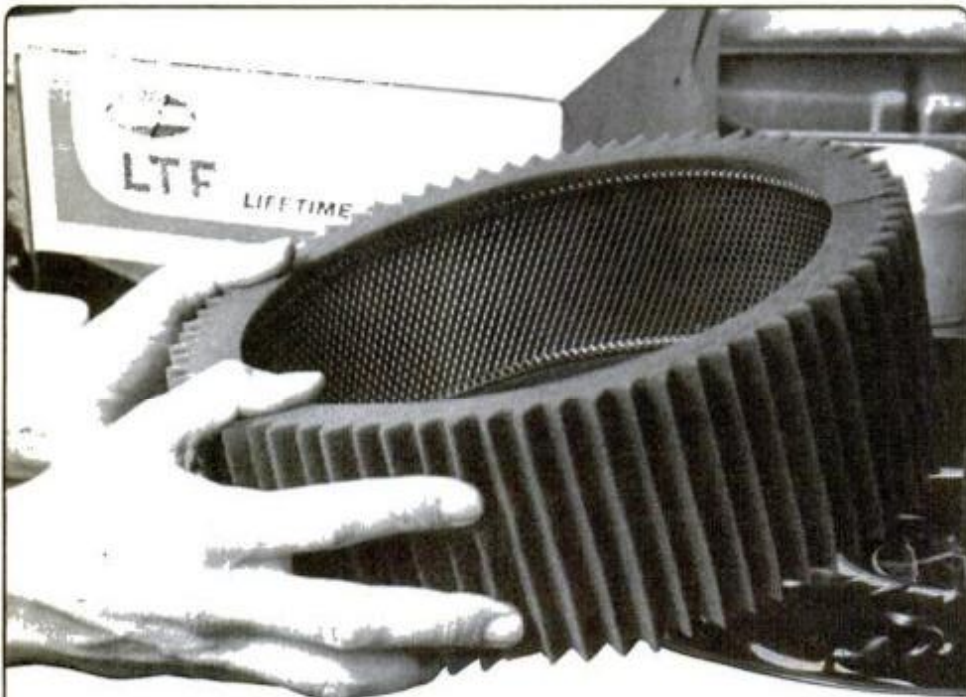
power amplifier, four high-fidelity speakers and fader control.

In addition to the new four-cylinder engine, Spirit gets premium reclining bucket seats as standard and a split, folding rear seatback in DL and Limited models. The plush Limited version also includes real leather trim, tilt steering wheel, power steering, power door locks and a power hatch release in the liftback. A sporty GT package features black-out trim, sport steering wheel, spoke-styled wheels, P195/75 radial tires, even a "deep-tone" exhaust system with the four-speed trans.

Concord has revised front and rear styling—a marked appearance improvement, especially with the large ribbed, wraparound taillamps in back. The DL and Limited two-door's louvered opera window seems a bit overdone, but we think it's much better than the previous, out-of-proportion treatment. New interior fabric and trim choices are offered on DL and Limited models, while the luxurious leather interior remains standard in Limited. In addition to the items already mentioned, new options include automatic load-leveling rear shock absorbers and a light-duty trailer-towing package, with hitch and wiring harness, for trailers to 2000 pounds.

The unique Pacer is carried over with little product change, except for slightly better fuel economy, partly due to its new, standard four-speed transmission. AMX, a mini-Trans-Am-style version of the subcompact Spirit, although no longer offering a V8 engine to match its racy looks, still has surprisingly quick performance with the 4.2-liter (258-cu.-in.) Six. It has a long list of goodies such as spoke wheels, DR70x14 white letter tires, fender flares, front and rear spoilers, sport steering wheel, blacked-out trim, GT suspension (with adjustable Gabriel Strider shocks), tachometer and deep-tone exhaust with the standard four-speed transmission. Optional on AMX is an upgraded interior package with reclining bucket seats, split rear seatback, day/night mirror, and underdash shelf.

Put all of this together with the 4wd Eagle in two-door, four-door and wagon body styles and a much-improved and expanded Jeep lineup—all sharing AMC's unique, new-design Quadra-Trac full-time 4wd system with its viscous-drive limited-slip center differential (see page 92, Sept. '79)—and you have the start of a fine year for AMC's drivable new cars, fuel crisis or not. **PM**



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In the past five years, electronic technology has turned the once staid watch industry into an exciting array of timepieces. Contemporary Marketing has followed this trend carefully, participating in modern watch growth by offering new alarms and chronographs as they were developed.

Now we have discovered—and are privileged to market—the most unique modern watch of all. It combines all the desired and asked-for features—available separately in other watches—into one timepiece! Take two minutes of your valuable time to read this message about a new watch that will be invaluable to you.

The **Windert Wrist Secretary** boasts the most exclusive combination of new timepiece features we have ever seen. In addition to two alarms, an hourly chime and a count down timer, the **Wrist Secretary** features a stopwatch and an extra-large display of hours, minutes and seconds or month, day and date. All attractively combined into a stylish, trim stainless steel back case—available in silvertone with matching stainless steel bracelet or goldtone with 5 micron gold case and bracelet.

If you are ready to trade up from your traditional watch or single alarm—or want to modernize your watch wardrobe, the **Windert Wrist Secretary** is the answer!

The secret of the **Wrist Secretary's** accuracy and versatility is a quartz crystal (that amazingly divides each second into 32,768 parts to maintain accuracy within 15 seconds a month!) plus a mini-computer chip (a miniature computer that controls, directs and stores in memory all of the functions this unique watch performs.)



Unique Graphic Display



The basic display, 35% larger than other multi-function watches, shows you hours, minutes and running seconds in easy-to-see numbers plus an

AM and PM indicator. You don't need your glasses to check the time. To see the month, day and date in the same big easy-to-read figures, just touch a button. No re-setting necessary, it automatically adjusts for months with less than 31 days.

There is total integration between the display and the five special functions. Each function (Alarm 1, Alarm 2, Chime, Timer, Chrono) is easily identified by the flashing, unique graphics on the display. When you press the Mode button to select individual functions, you know exactly what's happening.

Alarm 1 and Alarm 2 are both 24 hour alarms that offer the benefit of a dual alarm system within any 24 hour period. You can use Alarm 1 as a wake-up call at 7:00 AM and Alarm 2 as a reminder to take your medication before lunch. For the busy executive, the dual alarm system is a boon to keeping track of those important appointments. Each

alarm can be set at 10 minute intervals.

The unusual **Chime** alerts you to each passing hour on the hour. Provides a gentle reminder of each hourly segment throughout the day or night that can be activated or silenced as needed. It's a great conversation starter—or stopper—that keeps you on schedule during your busy day without being a "clock-watcher."

A new feature not available before is the **Count Down Timer**. Easy to set without taking the watch off your wrist, useful in a dozen ways each day—from timing a 3-minute egg to a 15-minute sales presentation to any event up to 11 hours, 59 minutes, 59 seconds. The chime signals each time your count down reaches zero.

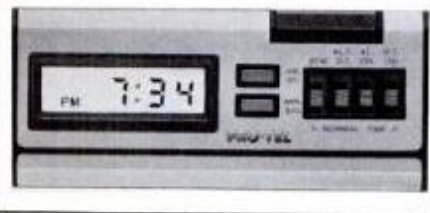
The 12 hour **Chronograph**, accurate to the second, times any event in business or sports. This useful stop watch rounds out the five special functions of the **Wrist Secretary** that make it the most sought-after multi-function watch available.

*Developed by Windert, the only watch to be honored with the most innovative consumer electronics product "OSCAR" out of 1000's of watches displayed at the 1979 International Summer Consumer Electronic Show.

And we saved the best news for last—the amazing low price! Comparable to the likes of a top-line Seiko in features, functions, accuracy and style, the **Wrist Secretary** (at 1/2 to 1/3 of the price) is only \$69.95 (Silvertone) and \$79.95 (Goldtone—5 micron gold). Add just \$3.50 for shipping and insurance per watch. Comes in attractive presentation box, ready for gift-giving. Available on 10-day FREE trial. Backed by Windert's One-Year Limited Warranty.

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SHOOT FOLIAGE FROM A DIFFERENT ANGLE (Continued from page 14)

day when the foliage is at its peak is not the time to experiment with unfamiliar films. Before shooting for keeps, try several different color films to see which one gives the results you like most. Shoot identical scenes and exposures to make the comparison useful.

It's also wise to bracket your test shots (that is, shoot additional frames over and under the "correct" meter reading in half-stop increments) if your camera permits it; sometimes such exposures produce more pleasing results. When you find a film you like, learn its characteristics and stick with it. The pictures in this article were taken with Kodachrome 64 slide film.

Your friend the sun

Most people follow the conventional wisdom of taking pictures with the sun behind them. That's okay for some shots, but it usually results in reduced contrast and a loss of detail—a plain photo. It's often better to work at a right angle to the sun, or to shoot directly into it.

When shooting into the sun, there are two ways to meter the scene accurately (assuming you don't have a hand-held meter). One rule of thumb suggests you measure the subject with the camera's meter and then add 1½ stops to the reading. Alternatively, you can turn your back on the subject and meter as though shooting with the sun behind you, then turn around, face the subject again and shoot. Either way, it's good to bracket just to make sure.

A word about bracketing: Don't go overboard. At first, you might want to take five pictures of a given scene: +1 stop, +½ stop, "correct" exposure, -½ stop and -1 stop. As you learn your film, you can reduce the number of shots. Depending on your preference, that might translate into shooting +½, correct and -½—or correct, -½, -1.

The photographs

Here's how the seven photos in this article were taken:

1. **These treetops** were shot with a 24-mm wide-angle lens. As with most of the other photos, a skylight filter was used for a slight warming effect (as well as lens protection). For shots like these, don't be afraid to lie on your back. When using filters with wide angle lenses, watch out for vignetting. The filter ring can obstruct incoming light rays near the edges of the image frame so that the corners of the picture are slightly darkened. Vignetting can be detected in advance by stopping

down and using the depth-of-field preview button if your SLR has one. Dark corners at f/16 or f/22 could signal somewhat less severe vignetting at f/8, for example.

2. **This ground photo** was taken in open shade with a 50-mm normal lens. The camera was on a tripod, to insure precise framing and eliminate camera shake.

3. **The light on the yellow leaves** was almost directly behind the photographer. That's all right, though, because the intense light and bright color made the leaves pop out. Shot was exposed for the leaves and then reduced a half-stop to darken the background. To snap leaves out from the background, a wide aperture on the 50-mm lens was used to reduce depth of field and throw the background out of focus. By the way, it's smart to use the depth of field preview button. It can help make sure that what you want to be in and out of focus shows up that way.

4. **The stump "arrangement" was not set up**, believe it or not. The photographer circled the stump until he felt he had the most interesting angle in relation to the direction of the light. Lens was 50-mm; note reduced depth of field.

5. **Here's a close-up of some sumac** taken with a 135-mm telephoto; no special close-focusing lens was needed. Shot in early morning, it is backlit. When shooting hand-held, be careful not to use too slow a shutter speed, especially with telephotos. A handy rule of thumb: shutter speed shouldn't be slower than the reciprocal of the lens length (i.e. for a 135-mm lens, minimum shutter speed would be 1/135 second).

6. **The compression effect of a telephoto** was utilized here to bring the moon closer. Again, a 135-mm was the lens. It is often advisable to use a lens hood with lenses 50-mm and longer to keep out stray light rays.

7. **Soybeans aren't trees**, but they make pretty colors in the fall. A 24-mm wide-angle lens was used here with a polarizing filter. To achieve maximum polarization, rotate outer ring of filter until meter reads lowest; then set exposure. Remove other filters when using polarizer.

To insure predictable color results, it pays to eliminate as many variables in film and processing as possible. Once you choose a film, find a processor you trust. Larger processors often give more consistent results because they use larger batches of chemicals. Whether you're shooting foliage or baby pictures, fewer variables mean fewer unwelcome surprises. **PM**

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tested by other labs, however, notably the Energy Test Lab in Portland, Me. The inspector was able to tell me if the unit I was considering had met with the approval of the review board in my home state (Connecticut).

Codes vary from state to state and even from city to city. A few city codes have not approved multifuel units, so check before you buy. Don't chance an illegal installation—it may lower the resale value of your home. And if you should have a fire, the insurance adjuster will be the first person to find out if you had a valid heating permit.

When it came to actual installation, I was pleased to find that Tekton corp., distributor of HS TARM boilers, encourages homeowners to participate. Depending on the dealer, you can assemble or trim out the unit yourself and save part of the installation cost (\$400 to \$1000 depending on where you live). I chose to work with a topnotch crew of professional installers and found this gave me invaluable knowledge of the unit.

In my opinion, connecting the electric controls, circulating pump and valves is best left to licensed professionals familiar with your unit—unless you are blessed with plenty of time, can acquire a good installation manual and have a background in plumbing and electrical work.

Differences and advantages

Since solid-fuel burning is inherently different from burning gas or oil, the heat distribution and safety systems we chose are more sophisticated than conventional systems. Our installation utilizes a mixing valve and a circulator which runs continuously—instead of a typical hydronic system that periodically circulates fairly high-temperature water. The four-way mixing valve adds more or less return water to the supply being pumped to the radiators and is controlled by the house thermostat. Aside from using heat more efficiently and eliminating costly short cycling of the oil burner, other advantages you will obtain through continuous circulation include:

■ Longer boiler life due to elimination of thermal shock to the boiler caused by surges of cold return water every time the circulator is started.

■ Longer circulator life, since most wear in circulators occurs during motor start-up.

■ A quieter house during the heating season.

■ A more comfortable house since the heat is more even.

Continuous circulation of water to radiators also acts as a safety feature for our wood-fired hot-water heating system. Since the wood fire is always generating heat (it can't be turned off like my old oil burner), the system will dispose of the heat efficiently. In a conventional system, there is a greater possibility of boiler overheat (when there is no circulation) and creosote formation (caused by the fire burning too slowly between sporadic calls for heat).

Other safety features on our unit include a high-temperature over-heat control which causes overheated boiler water to circulate to radiators—even if there is no call from the house thermostat.

Both the domestic hot-water coil and the boiler have pressure-relief valves piped down to near the floor or to a drain.

A backflow preventer was installed on the feed line to the boiler to prevent the contaminated water in the heat distribution loop from entering the domestic water supply.

In a power failure

Even with the electricity off, my multifuel boiler will keep our house warm. When an outage occurs, a special solenoid valve opens and allows hot boiler water to gravity-feed to the radiators, bypassing the check valve. The fire during such an outage would have to be fueled carefully and in moderation to prevent overheating the boiler. The automatic draft regulator will continue to control the fire even without electricity.

The answer: renewable fuels

The increasing frequency of oil and gas shortages will inevitably force us to depend on safe, renewable energy sources instead of non-renewable and species-endangering ones. During the transition, a smart homeowner will leave as many options as possible open—a multifuel boiler or furnace fills the bill. **PM**

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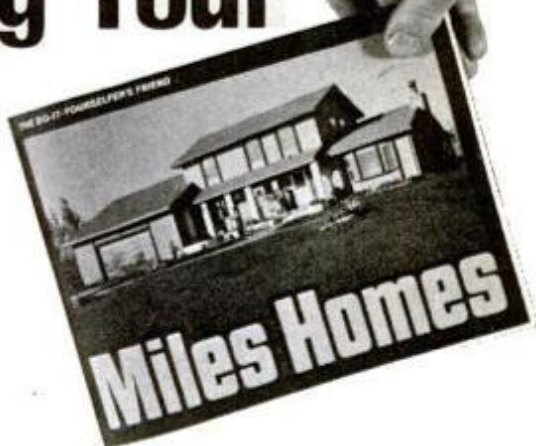
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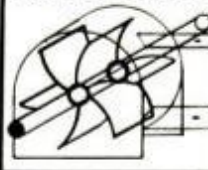
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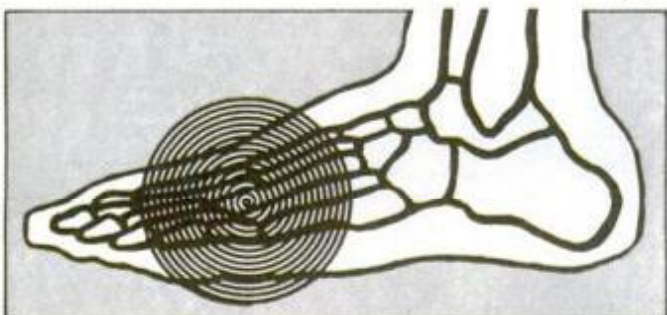
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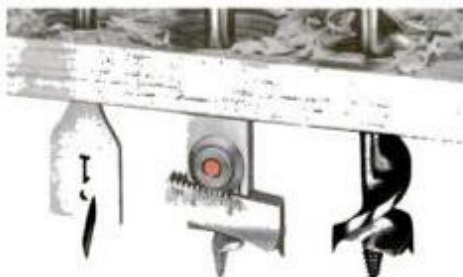


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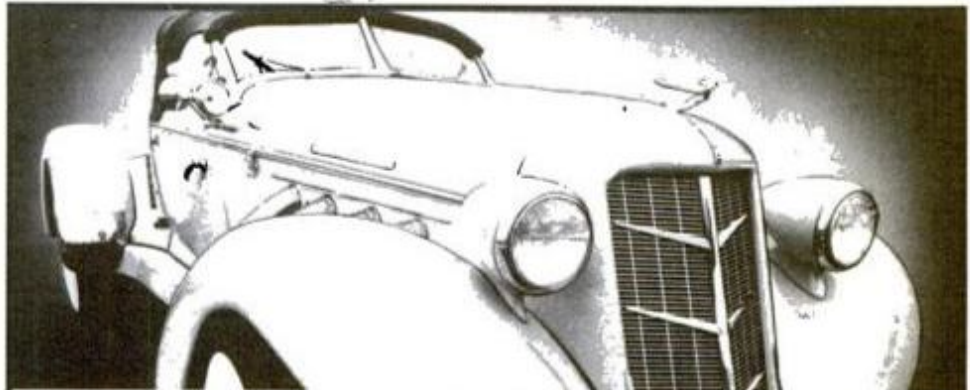
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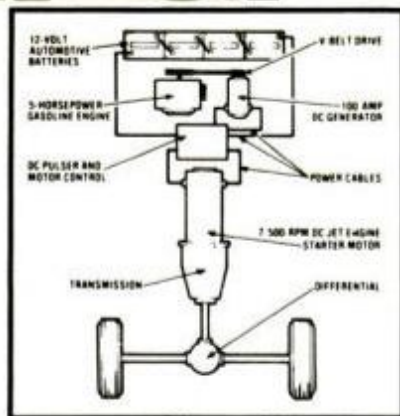
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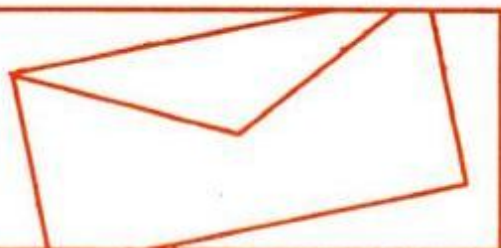


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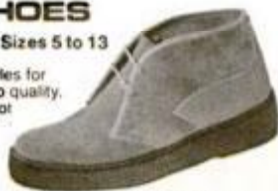
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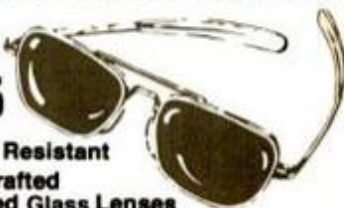
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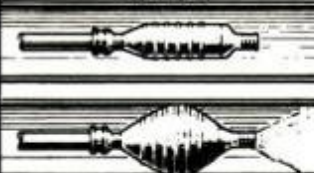
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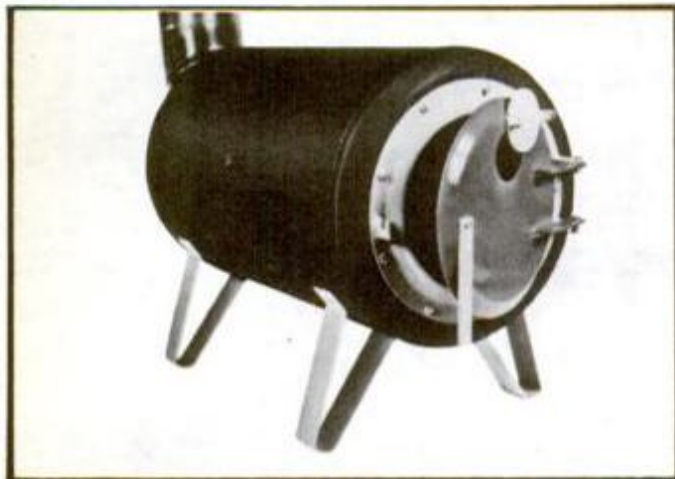
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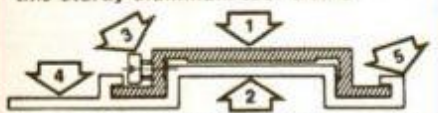
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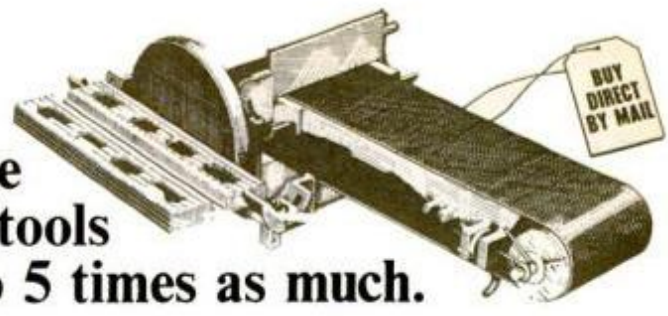
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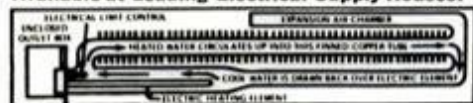
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YOU SAY YOU'RE FED UP WITH HAULING ICE?

Read about THE electronic breakthrough that has made the portable ice chest as obsolete as grandma's kitchen ice-box.

Does your family groan when it's time to empty all that yucky water out of the cooler? Are you getting tired of paying for food that goes bad? When somebody even mentions the word "ice" - do your back and shoulders ache a little?

YOU'VE COME TO THE RIGHT PAGE.

There's good news here: The Aerospace Program has spun off a portable refrigeration breakthrough!

Big Research Discovery

Space scientists at Cape Canaveral had to keep critical components in rockets and satellites cool. They needed something small and light...something that used very little power but was absolutely reliable...something that wouldn't konk out if it were tipped up, down, or sideways. The result? Solid state thermoelectric refrigeration modules that went to the Moon.

Enter Koolatron

Koolatron was quick to see the civilian-use possibilities of these modules for portable refrigeration. They worked until they developed Koolatron - a 12 volt portable electronic refrigerator that uses the same powerful solid state thermoelectric refrigeration modules used in rockets and satellites.

Saves Inconvenience

No more driving for miles or heading into shore for ice. Plug it in a lighter socket in your car, boat or van. Or run it off a 12 volt battery charger plugged into 110 volts.

Saves Energy

Koolatron uses very little juice - an average of only two amps when the temperature outside is 70 degrees Fahrenheit. That's less power than it takes to light a 30 watt bulb. Once contents are cold, you can turn it off at night to save power. Contents will stay cool for at least 6 to 12 hours. Your muscle-energy is conserved, too. It weighs only 15 pounds - and you'll never have to haul ice again!



Model F1A shown.

The new Koolatron keeps 40 lbs. of food at household refrigeration temperature but weighs only 15 lbs. Only 21" x 16" x 16" ext.

Saves Shopping Trips

Koolatron holds more - so you spend less time shopping. Although it measures no larger than most ice chests, its 36 quart capacity is not half-filled with ice and sloshing water. So there's more room for food - 40 pounds of it, or 40 large cans of soda pop!

Saves Food

This is dry cooling we're talking about. Not the damp kind that breeds mold and can turn perfectly good food bad overnight - exposing the whole family to needless risk. Koolatron keeps your food cold and dry. With food prices so high, it's a shame to let any more meat and milk or sandwiches spoil!

Saves Money

Ice is expensive these days. So is the gasoline you use in looking for it. Don't waste another dollar this way! Get yourself a new Koolatron 12 volt portable electronic refrigerator and LET IT PAY FOR ITSELF. That's right. The money thrown away on ice and gasoline and spoiled food - not to mention what your own time is worth - will MORE THAN PAY for your new Koolatron in a single year!

Proof: A recent survey of Koolatron owners revealed their average saving was \$156.03



SOUND FAMILIAR? ... "Mary, where do you want this 50 pounds of ice?" ... "Wait George, I'm not through draining the ice chest!" ... "Dad-dy - you're dripping more water where I've mopped the floor!" ... "Hey, Mom, these tuna salad sandwiches are soaking wet - and (phew!) they smell bad." ... "Mary, quick, I'm going to drop this @#!%\$& ice on my toes!" ... "George -!"

in just nine months. Some claimed they had saved over \$500.00 on ice, gasoline, spoiled foods, and the restaurant meals made necessary when the ice ran out.

No Toy

Koolatron is built to last. The rugged case is filled with the best insulation available - rigid urethane foam. Its heavy-duty handle can take loads of 150 pounds or more. Hinges and latches are made of non-rusting polypropylene. The exterior is a handsome harvest gold with a white, easy-to-keep-clean interior. Four non-slip rubber feet keep it from marring boat or camper surfaces.

No Hassle - Ever

Koolatron was designed by engineers who are also boatowners and campers. They know you want something simple that doesn't break down and is easy to service. Because of Koolatron's solid state construction your unit should never require any servicing unless physically damaged. If service is ever required, it is available through our service depots in Batavia, NY, or Barrie, Ont., Canada.

So Reliable It's Guaranteed For One Full Year

Your new Koolatron comes with a written one year guarantee plus complete instructions and helpful information. If you need additional help or advice anytime, you can call or write for a personal reply.

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Use your Koolatron for 21 days after you receive it. If for any reason you are not totally satisfied, return it for a prompt refund in full.

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For an additional \$10 you can order the Koolatron with an adjustable thermostat in place of the standard fixed temperature thermostat - order model F1A.

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