

Popular Mechanics

JUNE 1981 \$1.25

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**How to add handy
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in your back yard**

**PM ROAD-TESTS GM's
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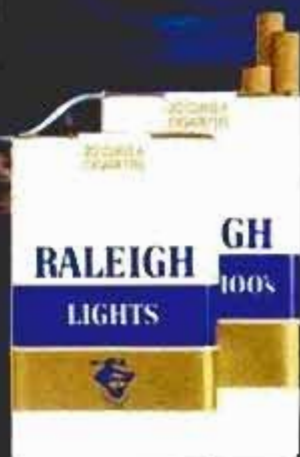
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information for this group, reaching over 5,200,000* adult males per issue. We know them well. Their interests and aspirations. And their buying patterns.

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Popular Mechanics is the magazine for the man who has the spirit and enthusiasm to translate his desires into reality.

The New Achiever is the man you'll want to talk to in the 1980's. And you can talk to him through Popular Mechanics.

*Simmons 1980

Popular Mechanics

The Magazine of the New Achiever.

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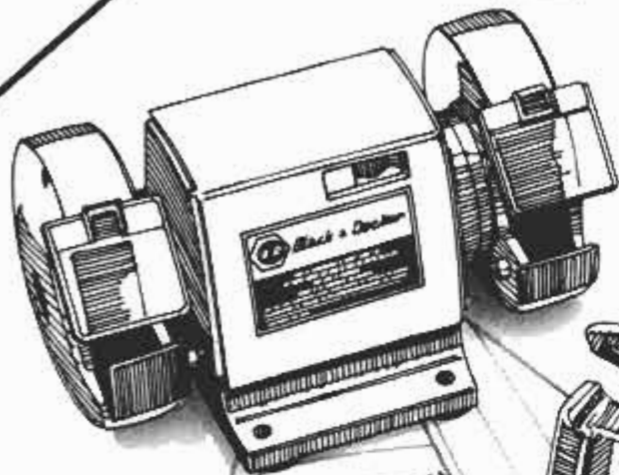
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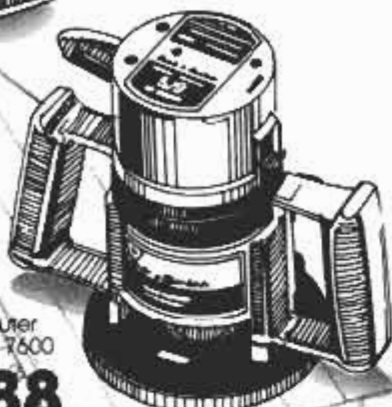
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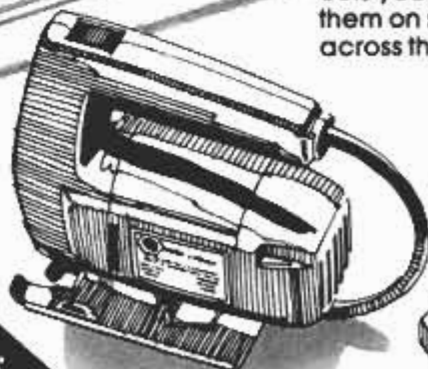


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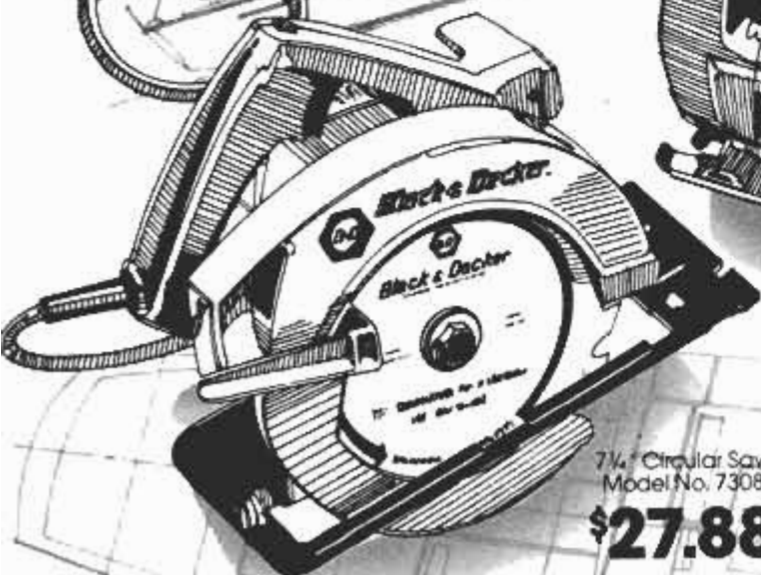


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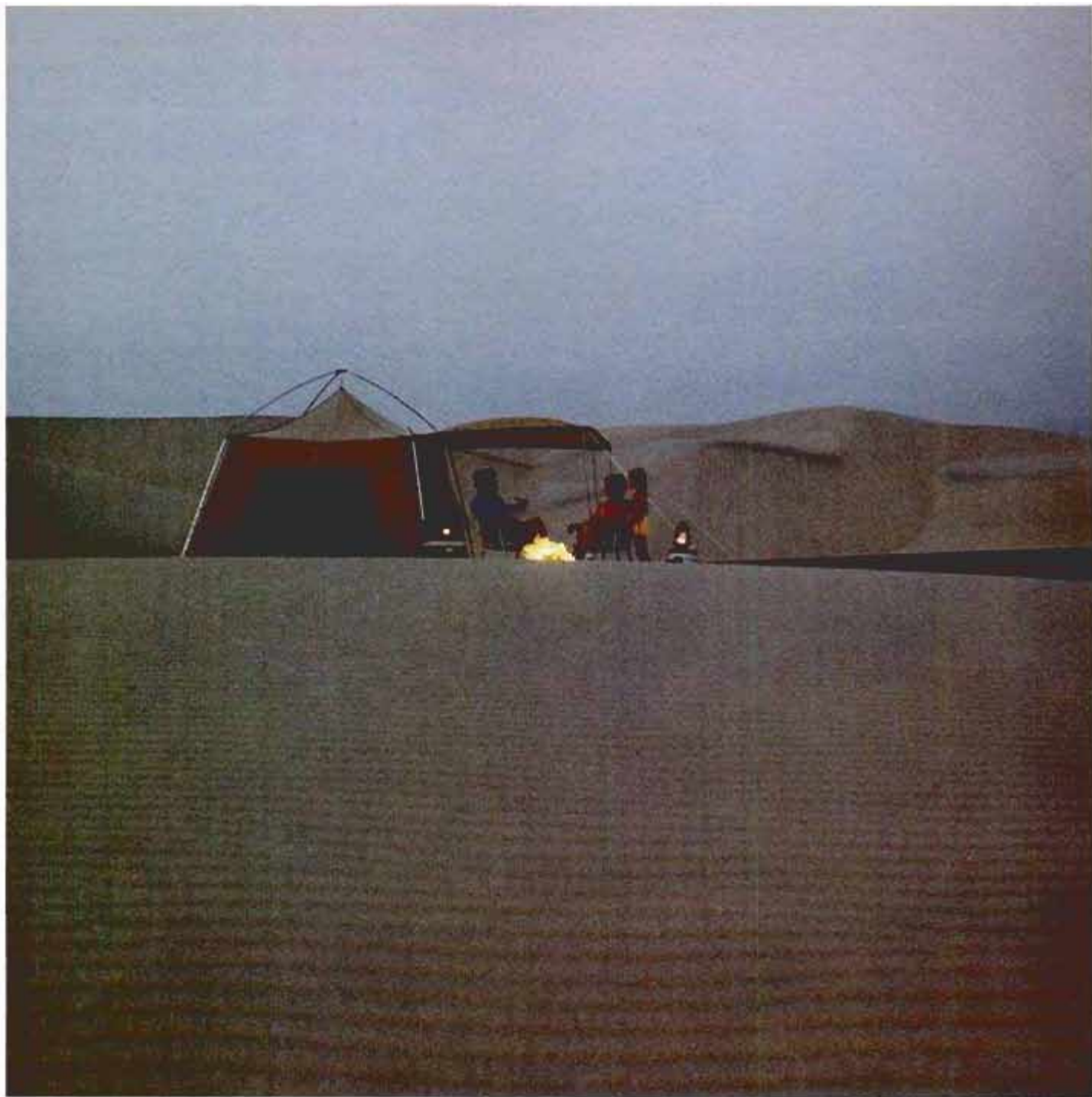
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5. Next Saturday, only 17 miles from where this picture was taken, the man in the picture has to mow his lawn.

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On the cover

Former racing driver Stirling Moss, a legend in his own time, is shown with a car that's trying to be one, the De Lorean sports car. Moss's exclusive report for PM on driving the long-awaited luxury sportster begins on page 65 in this issue.

—PM photo by Esler Crawford

Popular Mechanics®

JUNE 1981

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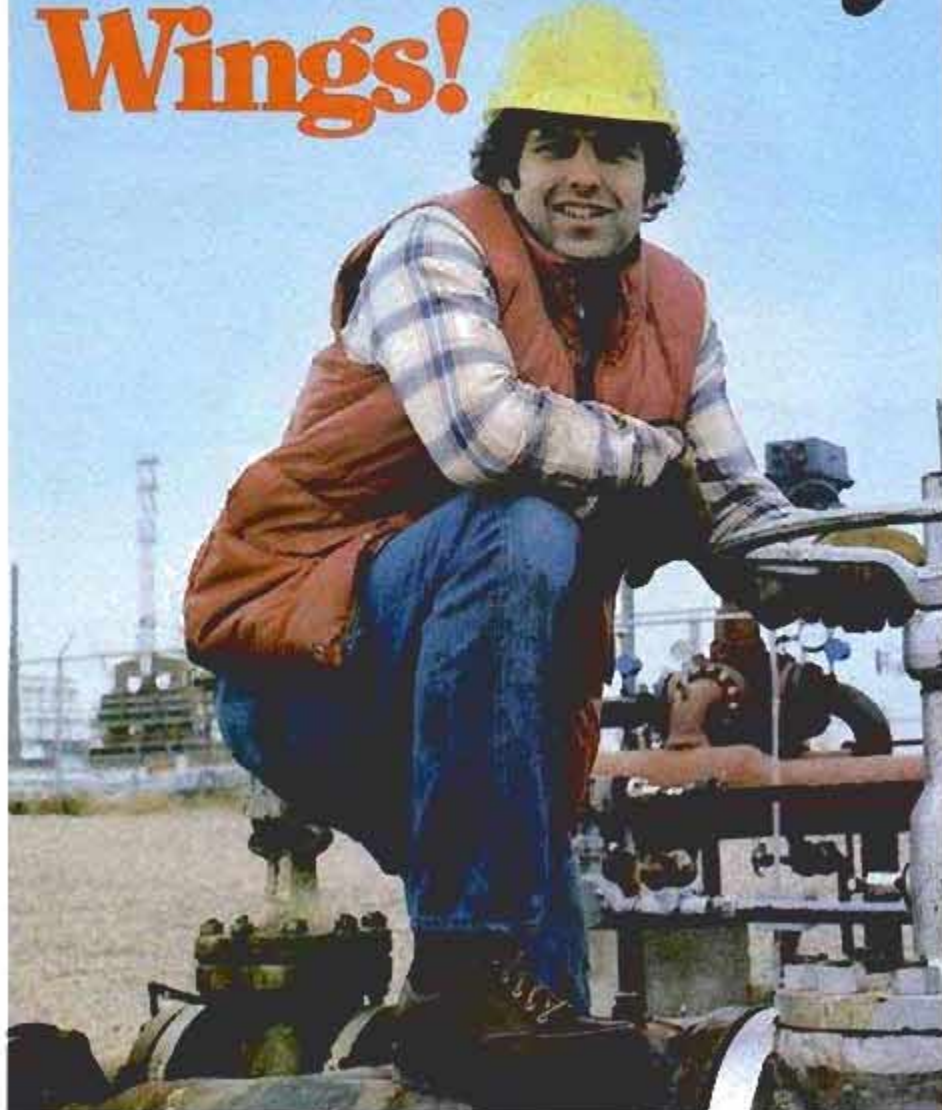
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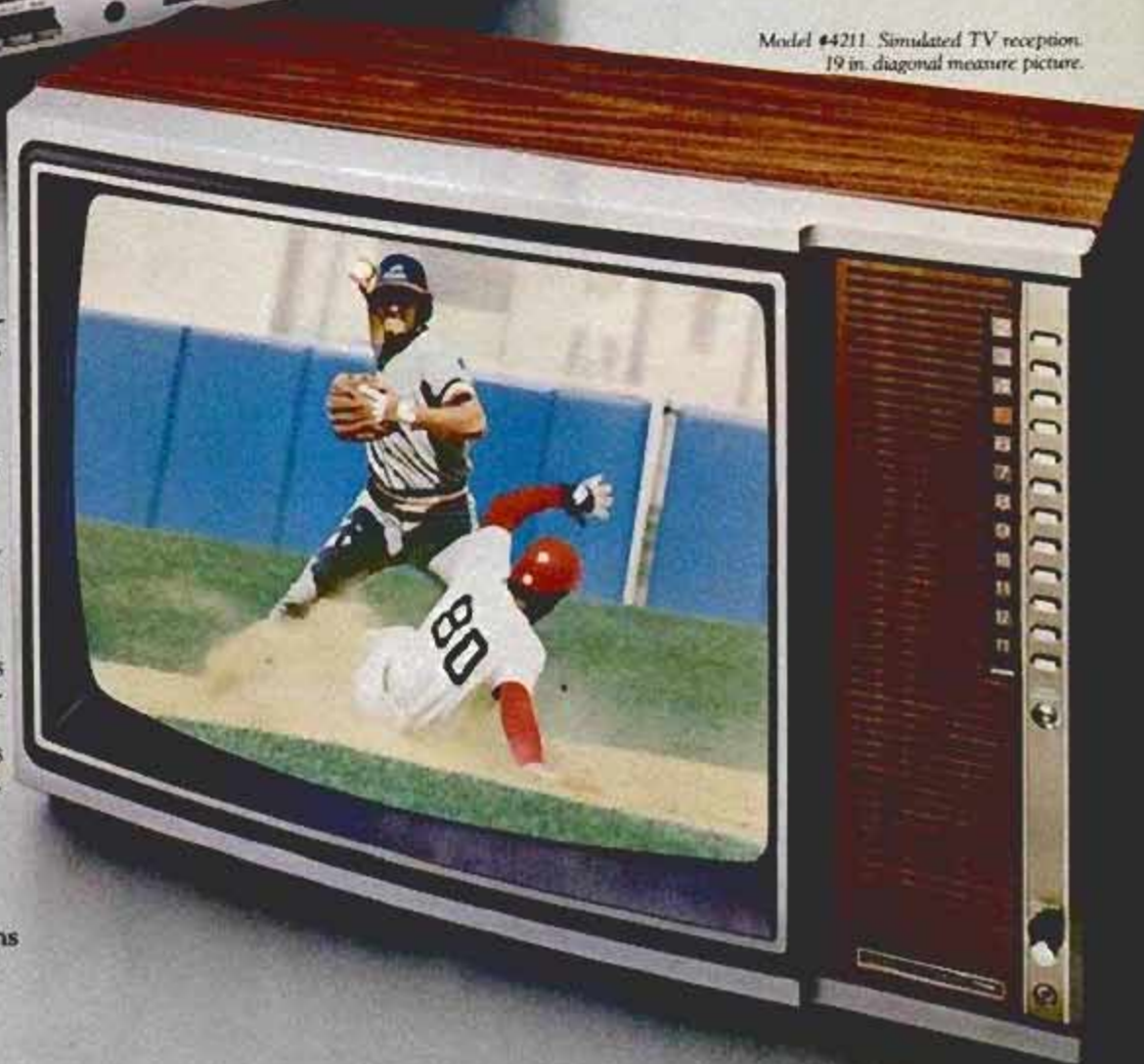
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LETTERS TO THE EDITOR

Tribute to a beautiful bird

Thank you for the article "Taps for the B-47" (*PM Briefs*, page 26, Jan. '81). It was a small, but fitting, tribute to a great airplane. Though never glorified in combat, the B-47 Stratojet was the bulwark of the Strategic Air Command in the days when Moscow was boasting about ICBMs and circling the earth with satellites. She was the last heavy bomber of her kind and stood for strength, deterrence and preservation of peace throughout the world.

The B-47 can take her place as one of the most beautiful bombers ever built. The sound of her six jet engines and thundering takeoffs may never again be heard, but her memory will never fade away.

FRANK B. AUSTIN,
S. SGT., USAF
FORT CAMPBELL, KY.

New light on a daring rescue

We at Whittaker Corp.'s Survival Systems Div. read with interest your excellent article *The Ocean Express Disaster—A Hard Lesson at Sea* (page 86, Dec. '80). On a couple of points, the article incorrectly described the circumstances aboard the survival capsules.

The capsule hatches measure 28 by 34 inches and accommodate even a large man without "squeezing" through.

Rather than simply "flipping over" by itself, capsule No. 3 was actually pulled over because the towline was attached at the top, instead of at the waterline. Neither the Coast Guard nor the National Transportation Safety Board established that the capsizing was due to any defect in the capsule's design or function.

J. LAIBSON
VICE PRESIDENT, ENGINEERING
WHITTAKER CORP.
LA MESA, CALIF.

A windy debate

Come on, PM! Wind can't possibly help run Julius Tamosiunas's car (*Tech Front Lines*, page 148, Feb. '81). The wind-powered generator increases drag on the car, burning more gasoline than it produces in electricity. PM does a great job of reporting on technical subjects, but let's see more skepticism.

WILLIAM M. WOODHULL
ONTARIO, N.Y.

We are as skeptical of something-for-nothing schemes as anyone. But drag is only part of the question. Tamosiunas claims that his wind turbine, however inefficient it may be, still generates electricity more cheaply than he can buy it from a utility. Also, his car has regenerative braking, which returns part of the energy lost in drag. We're not saying the system is all that's claimed; we merely reported what appeared to be an interesting—if debatable—concept.

Old-fashioned, but fun

I am enclosing a picture (below) of the Funny-Face Man bank I made from your plans (*Old-Fashioned*



Funny-Face bank made by PM reader Lenz.

Banks You Can Make, page 94, Jan. '81). I enjoyed building it and am also in the process of making the Baboon Bank.

ROBERT LENZ
ALLIANCE, OHIO

Glad you liked it. For the benefit of others, we should point out that two dimensions in the art require slight alteration. In the Funny-Face Man, the distance between the pivot points should be 4 1/4 inches, not 6 1/2 inches. In Kirk's Cat, the height given as 10 1/8 inches should be 10 1/4 inches.

Million-dollar questions

It was with great interest that I read your article *PM's Million-Dollar Car Test* (page 112, March '81). However, it left a burning question

about the DeTomaso Pantera. The only Pantera I ever heard of was built by Ford around 1971-73. If the car shown was an old model, where did you get it? If it's a new model, what about it? I won't sleep until I have the answer.

KENNETH W. SELKING
DECATUR, IND.

You're right that the original Pantera went out of production, but it's back and roaring. A California firm (Panteramerica, 2210 Wilshire Blvd., Santa Monica, Calif. 90403) is importing the cars once again for the American market. Hope you can get some sleep now.

I have some criticisms of your million-dollar car test. When you spend a fortune on a high-performance sports car, you don't expect practicality, driving ease and comfort, yet that's what you implied. It's like comparing \$200 tennis rackets to see which is the better fly swatter!

Also, I don't think you should have held price against the cars, considering the enormous protective tariffs that the government puts on foreign cars.

TOM FORTE
EDISON, N.J.

PM Auto Editor Tony Assenza replies: We disagree. When you pay \$100,000 or so, you have a right to expect absolute perfection in comfort and driving ease—not, for instance, a painfully uncomfortable sitting position, as was the case with some of the high-priced cars we tested. We don't see any point in buying a car for \$90,000 when you can achieve comparable performance from one costing half that. And there are no special tariffs on performance cars; they're the same for a Maserati as for a Toyota.

New face for an old clock

A new brass bezel is now available for PM's Butler clock, as featured in *A Lincoln Legacy: Two Mantel Clocks You Can Build* (page 130, Feb. '81). Unlike the single-ring bezel suggested in the article, the new one is an authentic, two-piece reproduction that exactly duplicates the bezel used on the original clock. It's \$14 postpaid from C & R Clock Shop, 11906 Q Drive North, Battle Creek, Mich. 49017. **PM**

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PM ELECTRONICS MONITOR

Rotten "Woodpecker"

For a long time now, ham-radio operators and shortwave listeners have been bedeviled by a vile popping, clicking, hissing interference called the "Woodpecker." It is more or less an open secret that this sporadic, but strong, interference comes from Russian low-level radar operating in the ham-band frequencies.

The Woodpecker directly violates a number of international treaties and agreements that the USSR is party to. Worse, it interrupts international communications on an almost hourly basis. (United States defensive radar does not operate in the ham-band frequencies.)

A few ingenious hams have come up with a way to harry, if not destroy, the Woodpecker.

Radar works on an echo principle. Radio waves are sent out and then received again. If the waves have bounced off an object—an airplane, say—their echo is subtly different.

Ham radio operators have begun taping the sound of the Russian interference. Then they turn their beam antennas directly at Russia, up their own power to the legal limit of 1,000 watts—and play the Woodpecker's racket back directly to them.

About five seconds of this raucous counterinterference totally scrambles the Woodpecker's echo and makes it almost useless as a radar device.

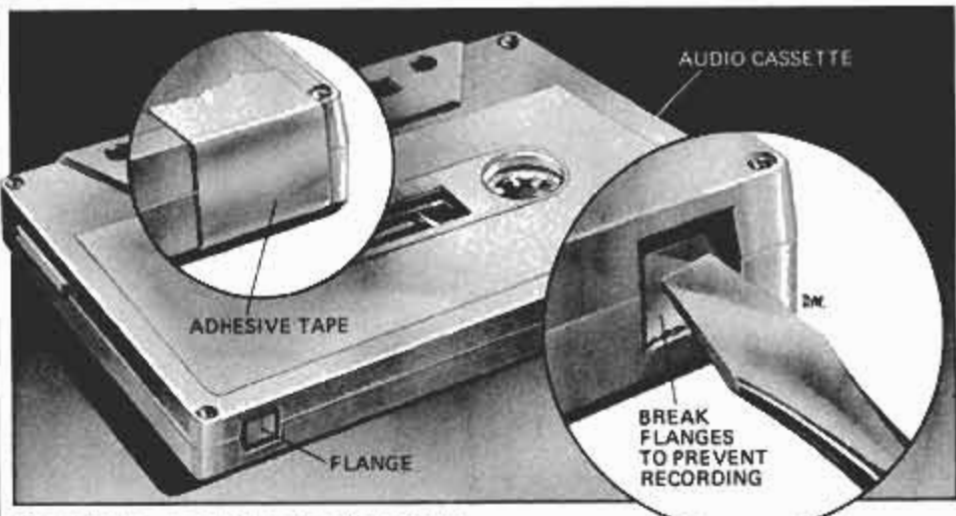
We've actually heard the Woodpecker shut down after a taste of its own malodorous medicine. Unfortunately, it usually starts up again at a slightly higher or lower frequency. Not even the most dedicated Woodpecker plucker can spend all his time defeathering this persistent and meddling bird.

A letter in a recent ham journal attempts to drum up support for a plan wherein all operators pause in their contacts one day and, with one mighty, outraged voice, play back the Woodpecker whistle. Surely, even Russia might take such a hint.

We will be poised by our tape recorder awaiting only the word as to when this international blast-in will take place.

All about telephones

Ever since we told readers how to remove a phone dial and change the number (*PM Electronics Monitor*, page 32, Mar. '81), we have been receiving requests for more phone



Use those record-protection tabs

The other day, a friend sadly narrated a truly terrible tale of electronic marital woe. Seems his wife, faultless otherwise, had recorded the audio portion of a soap opera over my poor friend's favorite rock album, thereby erasing the music.

Well, now their marriage may be on the

rocks, but it's still not too late to save your own.

On the back of every audio cassette, there are two flanges. When you break them off, you can't record on the cassette. If you should ever want to record, put adhesive tape over the now-empty notches.

information. We are planning a few more phone hints—but until then, we have turned up two very interesting books.

How to Buy, Install and Maintain Your Own Telephone Equipment, by Joseph La Carrubba and Louis Zimmer, is a potpourri of entertainment for telephone tinkerers. Its 48 pages detail everything from how the system works to how to route the wires through your wall.

One of the handiest features in the book explains how to make a "test set adapter" to help you install, repair and troubleshoot your own telephone.

Now that many people own their own phones, a book like this should come in very handy. After all, Ma Bell repairs only her own phones. If you bought one from someone else, you're on your own if you need repairs.

The book is available from the Almar Press, 4105 Marietta Drive, Binghamton, N.Y. 13903; \$4 covers the cost of the book, as well as postage.

The book *More Telephone Accessories You Can Build* by Jules H. Gilder will interest the true electronics tinkerer. Circuits are included to do everything from conference calling to setting up a complete telephone exchange in your own home. You can even build a hold system that plays electronic tones to the caller. The book is published by Hayden Books and sells for \$7.25.

Killing Klingons

In previous columns, we've mentioned the plethora of *Star Trek*-oriented games available for home computers. Well, the craze hasn't died. A new program for the Apple II computer, called *The Warp Factor*, features a huge number of options.

You can run an entire starfleet, ship by ship, and the computer will run the nasties against you. While typing in orders, you watch graphic and textual displays that are much more comprehensive than anything this viewer has ever seen Captain Kirk use on the *Star Trek* TV show. There are shields, phasers, photon torpedoes—even scenarios involving one-man fighter ships in stellar dogfights.

This spectacular space simulation is available from Strategic Simulations Inc., Dept. PM, 465 Fairchild Drive, Suite 108, Mountain View, Calif. 94043. Cost is \$59.95 and includes floppy disc, instructions and playing aids. **PM**



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The answer to the \$20,000 question can be found on the labels of any Johnnie Walker Red bottle. The answer to the \$5,000 bonus question is on the special greeting card gift boxes you'll find

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Greeting Card Gift Boxes.



at most liquor stores that sell Johnnie Walker Red. So make your toll-free call to Johnnie Walker Red. And clip out the entry form from this ad or get one from your local participating restaurant or liquor store.

It could add up to \$25,000 for you.

"Call Johnnie Walker Red Contest" — Official Rules

1. To enter, fill in official entry form on a 3" x 5" plain piece of paper. Clearly print your name, address and the answer to the official contest question. The question can be obtained by dialing the Johnnie Walker Red national toll-free number: 1-800-223-0353. New York State residents dial toll-free 1-800-522-5630. Dial any time, day or night, seven days a week, from April 20th to June 30th, 1981, or if you wish to have the question mailed to you, write Johnnie Walker Red Contest Question, P.O. Box 85, Pound Ridge, N.Y. 10576. Please print your name, address, city, state and zip code. The information needed to answer

the question may be found by looking at the labels on any bottle of Johnnie Walker Red Label Scotch Whisky. Labels may also be obtained by requesting same from: Labels, P.O. Box 34, Pound Ridge, N.Y. 10576. Please print your name, address, city, state and zip code. To qualify for the Bonus Prize, print the year in which the Johnnie Walker Red Greeting Card Gift Box was copyrighted. You'll find that year on the box, or send to Johnnie Walker Red Bonus, P.O. Box 4, Pound Ridge, N.Y. 10576 for Bonus Greeting Copy from which you may deduce the answer. 2. Enter as often as you wish, but each entry must be mailed in a separate envelope no larger than 4-1/8" x 9-1/2". Mail to Johnnie Walker Red Contest, P.O. Box 8017, New Canaan, Connecticut 06842. Entries must be postmarked by July 3, 1981. 3. Winner will be determined in a random drawing, from among all correctly answered and eligible entries, conducted by V.I.P. Service, Inc., an independent judging organization whose decision is final, and will be notified by mail. 4. Grand Prize: \$20,000 in cash. Bonus Prize: \$5,000 in cash. Winner will be required to sign an affidavit of eligibility and release granting to Somerset Importers, Ltd. the right to use winner's name and photos in its publicity. 5. Bonus Prize will be awarded if Grand Prize winner correctly answers Bonus question. Both prizes (total value \$25,000) will be awarded if Bonus question is answered correctly. If not, \$20,000 will be awarded. Odds of winning

will be determined by the number of correctly answered entries received. Local, state and federal taxes, if any, are the responsibility of the winner. 6. Contest open to residents of the United States. Employees and their families of Somerset Importers, Ltd., Wanson Simon, Inc. and its operating companies, their advertising agencies, liquor wholesalers and retailers, and V.I.P. Service, Inc. are not eligible. Contest void in Ohio, Pennsylvania, Texas, Utah and wherever prohibited or restricted by law. All federal, state and local laws and regulations apply. 7. ENTRANTS MUST BE OF LEGAL DRINKING AGE UNDER THE LAWS OF THEIR HOME STATE. 8. To learn winner's name, send a stamped self-addressed envelope to: Johnnie Walker Red Winner's Name, P.O. Box 202, Pound Ridge, N.Y. 10576. Please do not send entries to this box number. 9. Entry forms mechanically reproduced not acceptable. NO PURCHASE REQUIRED.

Official Entry Form "Call Johnnie Walker Red Contest"

First Prize \$20,000
Bonus Prize \$5,000

To enter the "Call Johnnie Walker Red Contest" you must answer the contest question. To obtain the contest question dial toll-free 1-800-223-0353 (New York State residents dial toll-free 1-800-522-5630). Then look at the labels on any bottle of Johnnie Walker Red Label Scotch and print your answer below.

ANSWER _____

BONUS ANSWER _____

Mail your completed entry form to: "Call Johnnie Walker Red Contest"
P.O. Box 8017, New Canaan, Connecticut 06842

I certify that I am of legal drinking age under the laws of my home state.

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

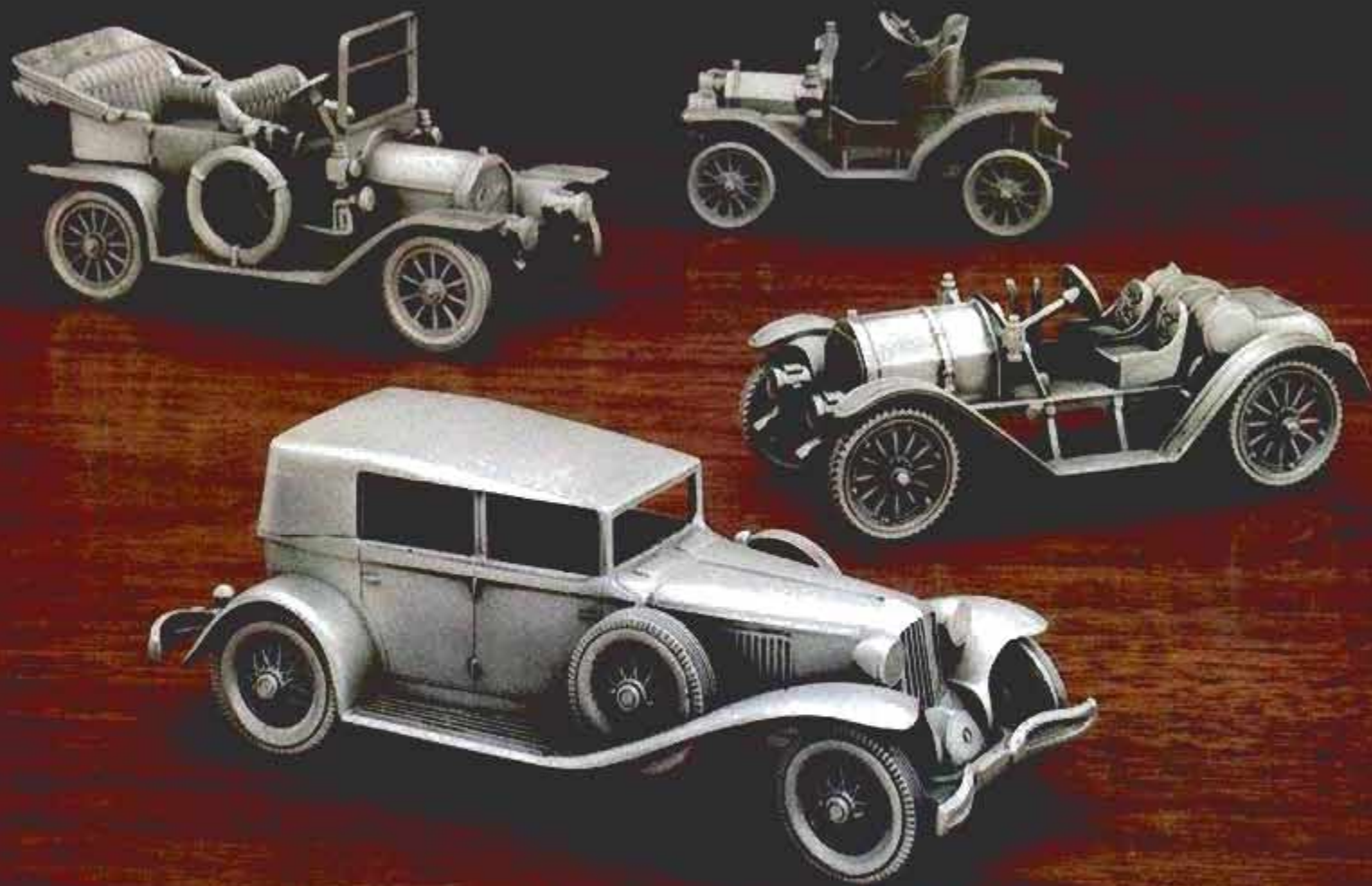
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Announcing...

America's Historic Motorcars

A collection of authentic
hand-crafted pewter scale replicas
of twelve legendary American automobiles.

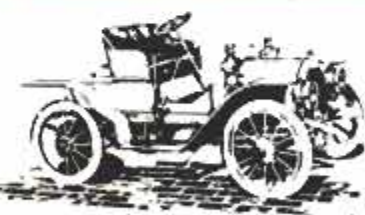


Replica in foreground shown actual size.



1937 Packard Coupe Roadster

Replica above shown actual size.



To the generations of Americans who grew up admiring them, our country's legendary automobiles represented much more than mere transportation. They were magnificent expressions of values we Americans have traditionally honored. They symbolized pride in craftsmanship, brilliant engineering, beautiful design, and a spirit of freedom and adventure that mirrored our national temperament.

To own one of these mechanical marvels was the cherished dream of millions. Just having one parked in the driveway was a source of incomparable pride. But more importantly, these classic cars gave wheels to our longings. They gave us the freedom, whenever the spirit moved us, to answer the call of the open road with speed, power and luxury at our command.

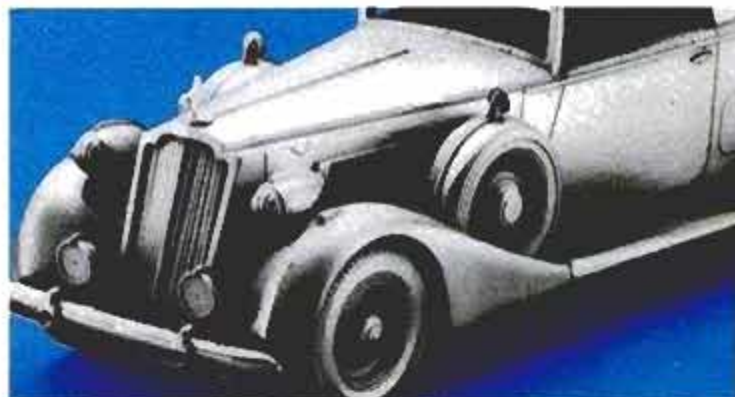
And now, twelve of America's most influential and renowned motorcars will drive out of the pages of history to capture our imaginations once more. This time they will be fashioned not from steel, leather and glass, but from intricately hand-crafted pewter! Each will be flawlessly reproduced down to the tiniest detail... lovingly hand-



finished...and individually hand-polished to a gleaming luster. It will be a collection to treasure for all time!

America's Legendary Automobiles

Throughout the world, these cars were the royalty of the roadway, the crowning achievements of our "Yankee ingenuity" and industrial leadership. Automobiles like the 1909 Cadillac "30" Tourer...the 1929 Cord L29...the 1913 Mercer Type 35J Raceabout...the 1937 Packard Coupe Roadster. In all, it will be a dazzling "honor roll" from the Golden Age of American automotive genius!



Authentic and Astonishing Detail

Each replica will be authentic in scale to the automobile's original size and range from approximately 3" to 6" in length. Each will be individually cast in fine pewter, and then the distinctive beauty of the pewter will be enhanced by a lustrous antique finish, individually polished by hand.

You'll immediately notice that the features of each of America's Historic Motorcars have been captured with astonishing realism. From the tire treads to the decorative hood ornaments...from the spindly wheel spokes to the intricate radiator grills — wherever your eyes turn, they will uncover incredible lifelike detail!

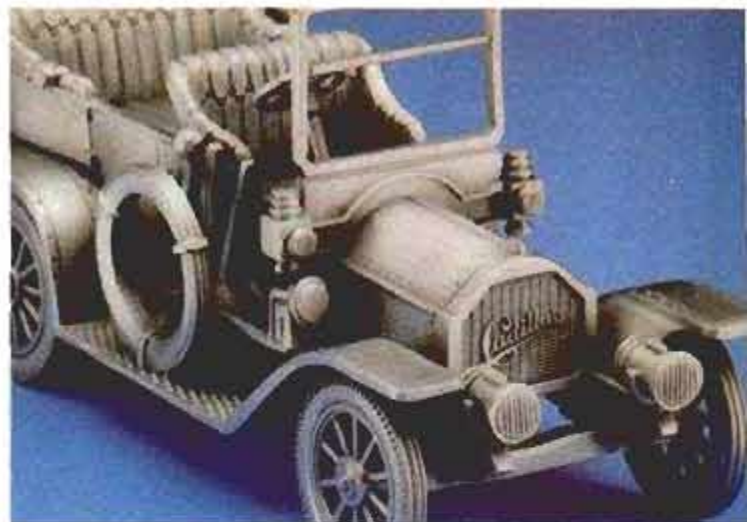
Accompanying each replica will be a fascinating historical folder. This charming "auto-biog-

(Continued on bottom of next page)

Copyright © 1992 by The Pewter Foundry, Inc.

Cadillac

The 1909 Cadillac "30" Tourer, 1909 was the year in which Cadillac was acquired by the newly formed General Motors Corporation. This car, named for the courageous French explorer and founder of the city of Detroit, had already blazed new automotive frontiers by becoming the first American automobile with interchangeable parts. Now, in 1909, it had been chosen to become the innovator and luxury car of the G.M. line. This "30" Tourer was quite deluxe for its day, with such advanced features as doors, optional top, and seating capacity spacious enough to accommodate five people.



(Continued from previous page)

Replica above shown actual size.

raphy" illustrates and explains the car's development, unique personality, and importance in automotive history. It tells you many interesting facts you probably never knew about each car. Reading the folder will add immeasurably to your enjoyment of the collection, for you'll be able to savor the mystique and romance of each motorcar.

Exceptional Value

The original issue price of each of America's Historic Motorcars is a remarkable value at only \$43.50, payable in two convenient monthly installments of \$21.75 each. Considering that comparable pewter replicas, when available at all, are sold at significantly higher prices, you can understand why this is a rare collecting opportunity.

Convenient Acquisition Plan

America's Historic Motorcars will be available

only by advance reservation. None will be sold separately and none will be available in stores. To reserve your collection, you need send no money now. The twelve replicas will be issues at the rate of one every two months.

If you should receive any replica you are not completely satisfied with, you may return it upon receipt for replacement or refund. And, you may cancel your subscription at any time.

Please Respond Promptly

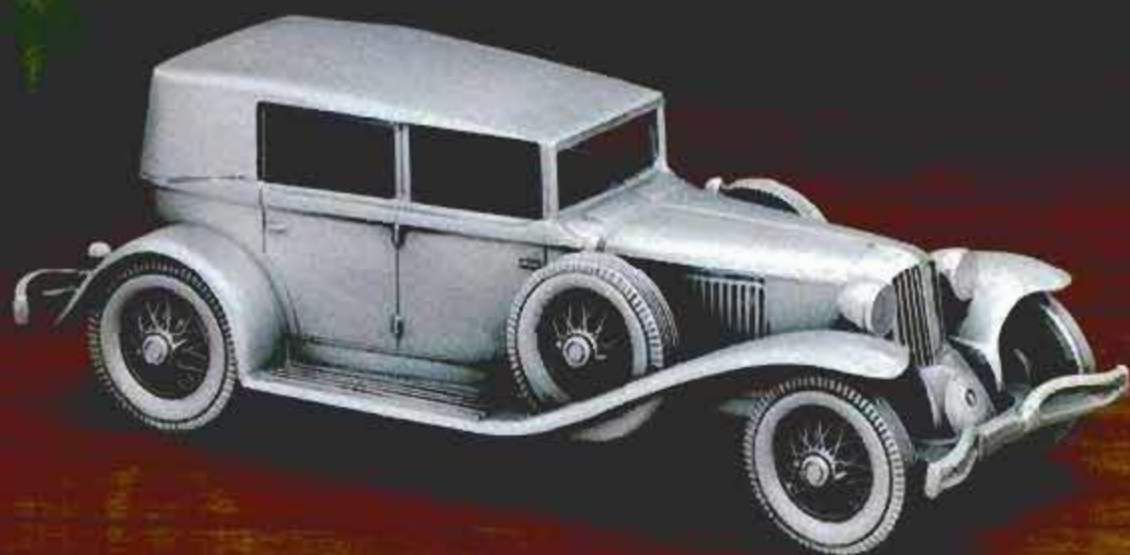
The opportunity is now open to own this unique collection. For production planning purposes, the attached reservation application should be returned no later than June 30, 1981.

Displayed in your home or office, these stunning pewter replicas will attract the same kind of attention as the full-sized cars they model. If you have ever fantasized about owning a legendary American motorcar, you'll never have a better

(Continued on bottom of next page)

Cord

The 1929 Cord L29 Cabriolet. Sleek, low and long were the lines of this first Cord automobile. Unveiled at the 1929 New York Auto Show, the L29 pioneered the long, low look that was to become popular worldwide. The substantial vertical bars of its slightly V-shaped front grill contributed an air of importance to the otherwise flashy body design. Powered by a Lycoming straight-8 engine, the L29 was the first frontwheel drive American car to gain public acceptance. The L29 was available in both closed and open models, and its design won over many former buyers of true sports cars.



(Continued from previous page)

Replica above shown actual size.

opportunity than this to realize your dream in an affordable yet very meaningful way. Return your reservation today!



America's Historic Motorcars

L76

The Danbury Mint
47 Richards Avenue
Norwalk, Conn. 06856

Please return by
June 30, 1981.

Limit: One Collection per Subscriber

Please accept my reservation application to America's Historic Motorcars. I understand this is a collection of authentic hand-crafted pewter scale replicas of twelve legendary American automobiles. The collection will be issued at the rate of one replica every two months.

I need send no money now. I will pay for each replica as billed in two convenient monthly installments of \$21.75 each. Any replica I am not completely satisfied with may be returned upon receipt for replacement or refund, and this subscription agreement may be cancelled by either party at any time.

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Mike Todd, School Principal and Do-It-Yourselfer

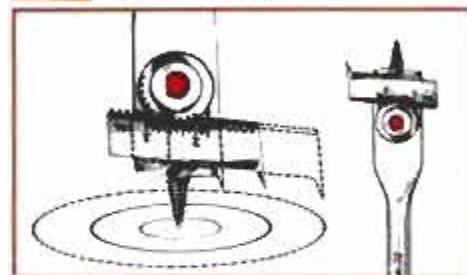
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Set of 6 Speedbor "88" bits with metal hang-up rack. Sizes ¼", ½", ¾", 1", 1½", 2".

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Irwin Micro-Dial bores 35 hole sizes
Just dial the size hole you want up to 3 full inches. Taper square shank fits all hand braces. Machine-sharpened spur and cutters deliver clean, accurate boring action. No. 22 model (illustrated) combines 35 standard sizes in one precision-engineered wood bit, ½" to 3". No. 21 lets you dial 19 standard sizes, ⅜" to 1¾".

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NOTES FROM THE EDITOR

John A. Jiblet

It's been a long time since the introduction of a new car has generated such prolonged public interest as that accompanying the all-new De Lorean Sports Car. From the time former GM executive John Z. De Lorean announced he planned to build a car, there has been a steady stream of news stories, speculation, publicity photos and interviews.

Well, the car is really here, folks. Stirling Moss, famed driver, and Tony Assenza, PM Auto Editor, both know it for sure. They drove it, and

their report begins on page 65. Not only did we send Stirling and Tony to Dunmurry for the test; we also dispatched Art Director Ira Herrick.

We're pretty sure Ira will not be ready to return to Northern Ireland soon. In the course of passing through one military police checkpoint, he was asked to spell his name. No sooner was I-R-A out of his mouth, than he was popped out of the car and frisked. Then, as he tells it, he spent days waiting for rainy weather to clear, living in a hotel that looked like a prison camp surrounded by a barbed-wire fence.

Ira's last ride on Irish soil was as Stirling Moss's passenger when both were racing for a shuttle flight to England. When pressed, Ira recalls a high-speed 180° hand-brake turn in the middle of a country road, a wild off-the-road shortcut... and then he becomes incoherent. It was music to his ears, he concludes, to hear again: "Back to the drawing board, Ira."

Editing a magazine isn't just typing and proofreading. You have to get out there where things are tough to get the story. Here are Bill McKeown and I risking all in Biscayne Bay to get a story (page 78). It really looks tough, doesn't it? **FM**



Auto Editor Assenza gets inside word on world's newest sports car from John Z. De Lorean himself.



Three back-seat drivers make sure I keep their boat away from the rocks and shoals.

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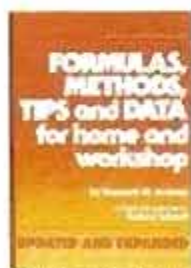
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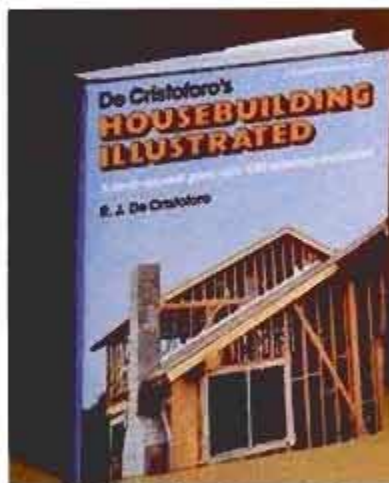
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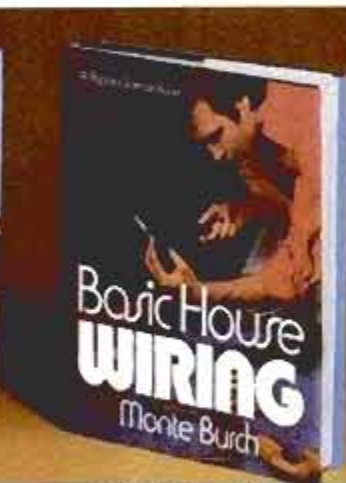
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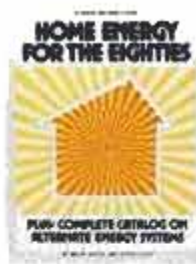
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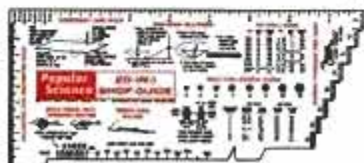
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MICHELIN

ALL OUTDOORS

How old? How valuable?

Everyone seems to have an aged outboard motor in his basement, an antique shotgun in a closet, a great-uncle's fly rod in the attic—or knows someone who has. Every so often, when you move or clean the gear, admiration turns to avarice as you wonder if, like so many things, it has become a valuable collector's item over the years.

The difference between jewels and junk, of course, often depends on the condition of the items and whether there's a market for them. To answer many recent letters, here are some suggestions.

The first outboard motor may have been created about 1866, and examples of rigs made between then and 1950 are avidly collected by members of the Antique Outboard Motor Club, headquartered at the Shipyard Museum of Clayton, N.Y. Locating parts, motors, instruction sheets, even buyers of your gear, is possible through the club's publications and newsletters. To join, send \$12 to the membership chairman, W. D. Verner, Ingram Barge Co., 4304 Harding Rd., Nashville, Tenn. 37205.

And that old pistol, rifle or shotgun? Inflation and demand keep pushing these prices up, too. A good idea of a bottom line is found in *Gun Trader's Guide*, \$9.95 postpaid from Stoeger Industries, 55 Ruta Court, South Hackensack, N.J. 07606. Prices are given for used guns in excellent condition, and a formula tells how to estimate for less than perfect models. Later this summer, a new edition of *Gun Collector's Digest* will be available from DBI Books, 1 Northfield Plaza, Northfield, Ill. 60093, for \$8.95.

For fishermen, the good news is that information on aged tackle and a marketplace to buy and sell it is available in the newsletter of *The Antique Angler*, Box K, Stockton, N.J. 08559, for only \$5 a year.

Choice boating

You might not guess what kind of boats are most popular and where they are used, but industry associations have come up with some figures for last year. Fastest growing in popularity—in fact, the only ones to show an increase—are the blow-up boats, the doughnuts, dinghies, sport boats and white-water rafts that are grouped under the name of *inflatables*. About 27 percent more

dollars were spent on them than ever before. Free-fuel sailboats held their own, but powercraft sales dropped during a year of very depressed waterfront business.

There are now more outboard boats around (6,850,000) than all other kinds combined, and the state with the most is Florida, followed by Minnesota and Texas. Among cities, the most outboard motors were sold last year in Minneapolis-St. Paul. Then came Chicago and Detroit; the largest numbers are owned in Florida, Michigan and Texas. The estimated 10 million pleasure boats used by 60 million people in 1980 seem well divided between fresh water and salt.

Loading for super savings

Cost cutting up to 90 percent? It's possible when you hand-reload your own shells and cartridges. Home reloading can reduce shooting expenses from one-half to one-tenth of



While saving ammo money, a reloader can wear these shooting-jacket patches.

what you pay in stores. Better still, the hobby is simple, safe fun and may produce a better product than you can buy. Most bench-rest shooters who try for the ultimate in accuracy load their own ammo, and so do many hunters and skeet and trap shooters where the practice costs can balloon.

Little .22-caliber cartridges can't be reloaded, but rifle and handgun centerfire cartridges and shotgun shells are reusable a number of times when you save the casings—the most valuable part—instead of

throwing them away. Digging bullet lead out of the range backstop and recasting it further reduces costs.

Basic steps are to remove the old primer, resize the case to its original dimensions, insert a new primer, recharge with powder, seat a new bullet or add wad, shot and recrimp a shotshell. Very simple tools are available for small reloading jobs, or you can invest in more elaborate equipment. Getting started is easy. First you send \$2 to the National Reloading Manufacturers Assn., Suite 300, 1221 Southwest Yamhill, Portland, Ore. 97205, and request its *Discover Reloading* and *Source Guide/Check List* booklets. These give information on where to order the necessary instruction manuals, tools and free catalogs. The NRMA also has how-to-build plans for a reloading bench for \$2, a reloader patch for your shooting jacket for \$1, and a collection of 12 additional patches for \$4.95. Know another sport where you can save so much so quickly?

Old look—new look

For depth of vision, a shooter often learns to line up sights with both eyes open and to shift focus from barrel to the distant target. A recent suggestion for outdoorsmen with vision problems is to use one of the new soft contact lenses as a monocle, or use one for distant vision in one eye and a close magnifier in the other. Obviously, you'd need the advice of your ophthalmologist, but the new softer, longer-wearing contacts might provide better vision and eye protection at the same time.

Dog-house data

For traveling with your dog, *Touring with Towser*, \$1.25 from Gaines Dog Food, Box 1007, Kankakee, Ill. 60901, is a new directory listing nearly 4,000 U.S. hotels and motels that welcome both you and your pet.





Johnson mid-range outboards...power that breezes past the pumps.

What makes our mid-range outboards (from 50 to 75 hp) the perfect companion for most boaters? Simply put, they give you all the power you'll probably ever need to water ski, fish, or cruise. But, even more important, they deliver their power on far less fuel than you'd believe possible.

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Loop charging is an engineering

term that means the cylinders are charged with fuel and burned gases exhausted in a continuous looping-like flow, from intake ports, to the top of the combustion chamber, to exhaust ports. So every ounce of fuel is used...most effectively.

We introduced the first multi-cylinder, loop-charged outboard to America better than 12 years ago...and competitors have been trying to catch up ever since. But

we didn't rest on our innovation. We've been improving them ever since. Improving their power to weight ratio to make them even more efficient...giving you more power for greater acceleration and faster planing. Adding features to make them even better...like

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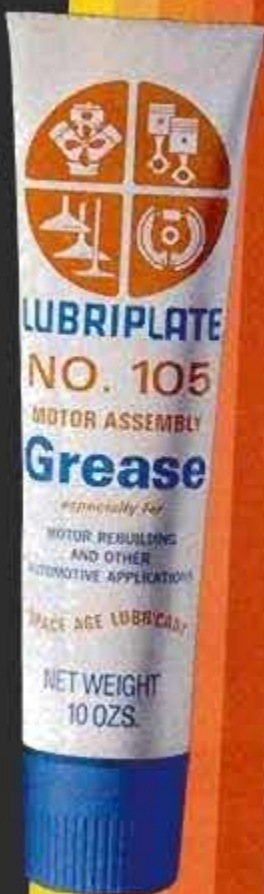
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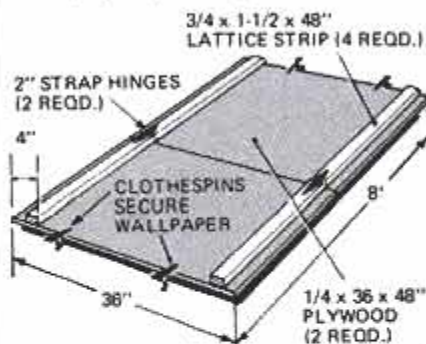
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HINTS FROM READERS

Wallpaper pasting board



You can make this folding board for pasting wallpaper of 1/4-in. plywood, lattice strips and two strap hinges. To prevent the wallpaper from rolling while applying paste, fasten the top of the paper to the board with clothespins.

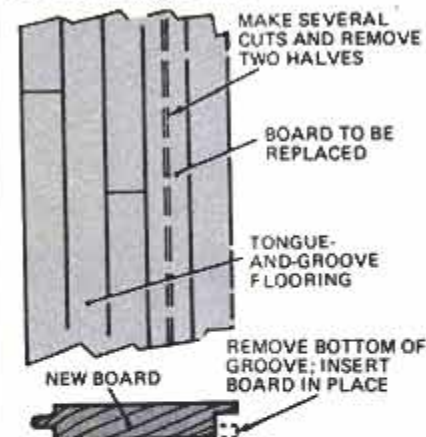
—L.S. Streufert

Motor-oil cleanup

Use dry cement to clean spilled oil and car drippings off a concrete floor. As soon as possible after the oil has been spilled, pour the dry cement over the oil spill and leave it several hours. Then you should sweep up all the cement with a stiff brush. You'll find that most of the oil will also be gone.

—Larry Wood

Out of the groove



Here's a simple way to remove tongue-and-groove lumber from a floor or a paneled wall without ruining adjacent boards. With an electric saw, make several cuts down the center of the board to produce a kerf that's wide enough to allow removal of the two parts. On the replacement board, rip off the bottom lip of the groove. Then tap the board into place.

—Howard E. Moody

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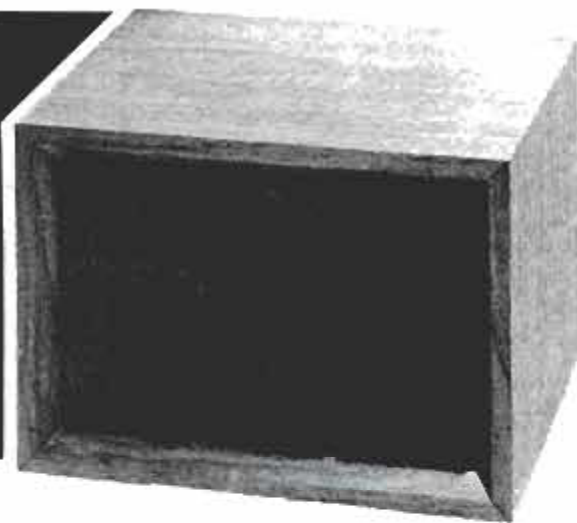
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HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

URNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected. (It can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.

The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc., terminals for connecting optional outside siren and back-up battery (battery not included); entry delay time control and sensitivity control.



The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 1/4" x 9 1/4" x 8") and weighs less than 6 1/2 pounds.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

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The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

WARRANTY

One year, 100% parts and labor when returned to factory post-paid. A five year extended warranty is available for a charge of \$25.00.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from main alarm, they are available with 50 feet of wire for \$29.95. (Connecting terminals are provided on the back of the alarm).

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This is your opportunity to purchase an alarm system directly from the factory for only \$239.95. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days of receipt for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of \$239.95 plus \$4.95 postage, handling and insurance. If you want the optional outside siren, add \$29.95. Optional outdoor 7" x 10" metal warning sign (stake not included) add \$9.95. (California residents add 6% sales tax.)

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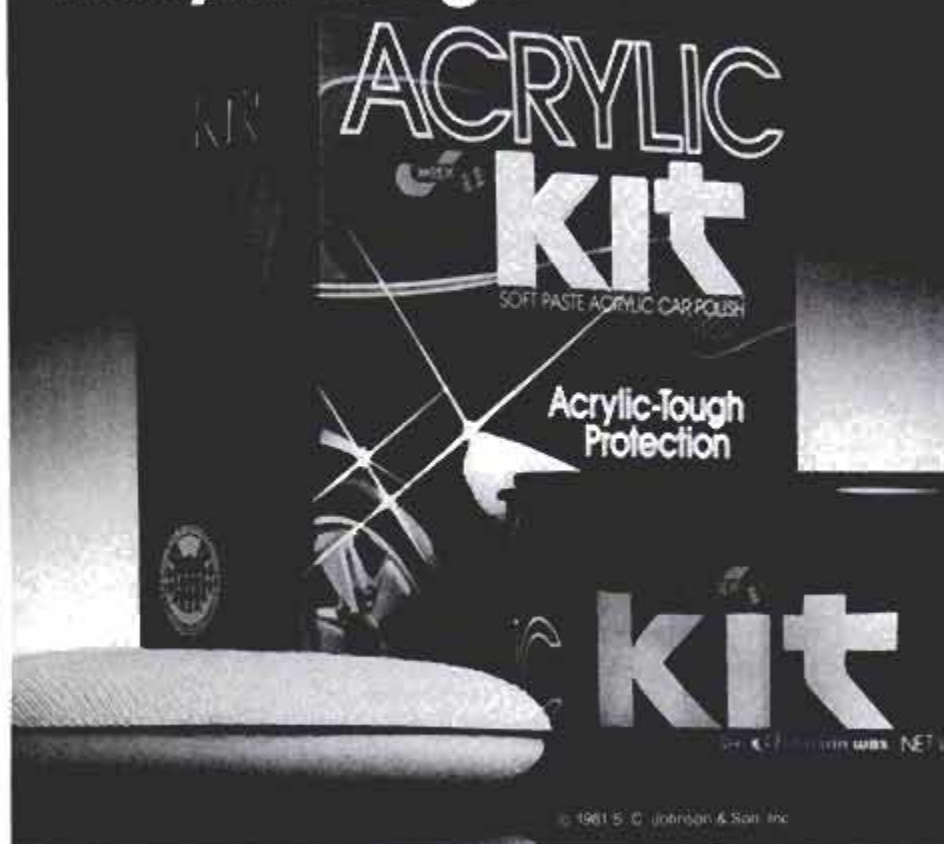
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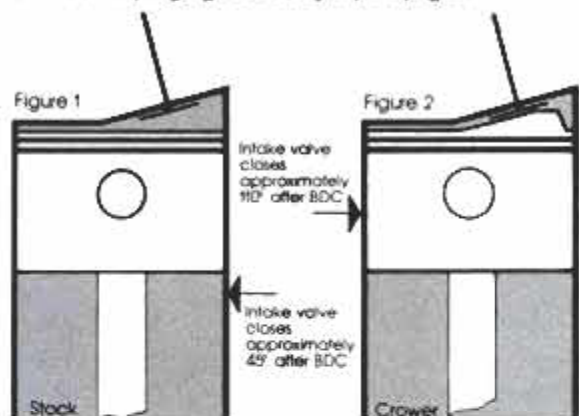
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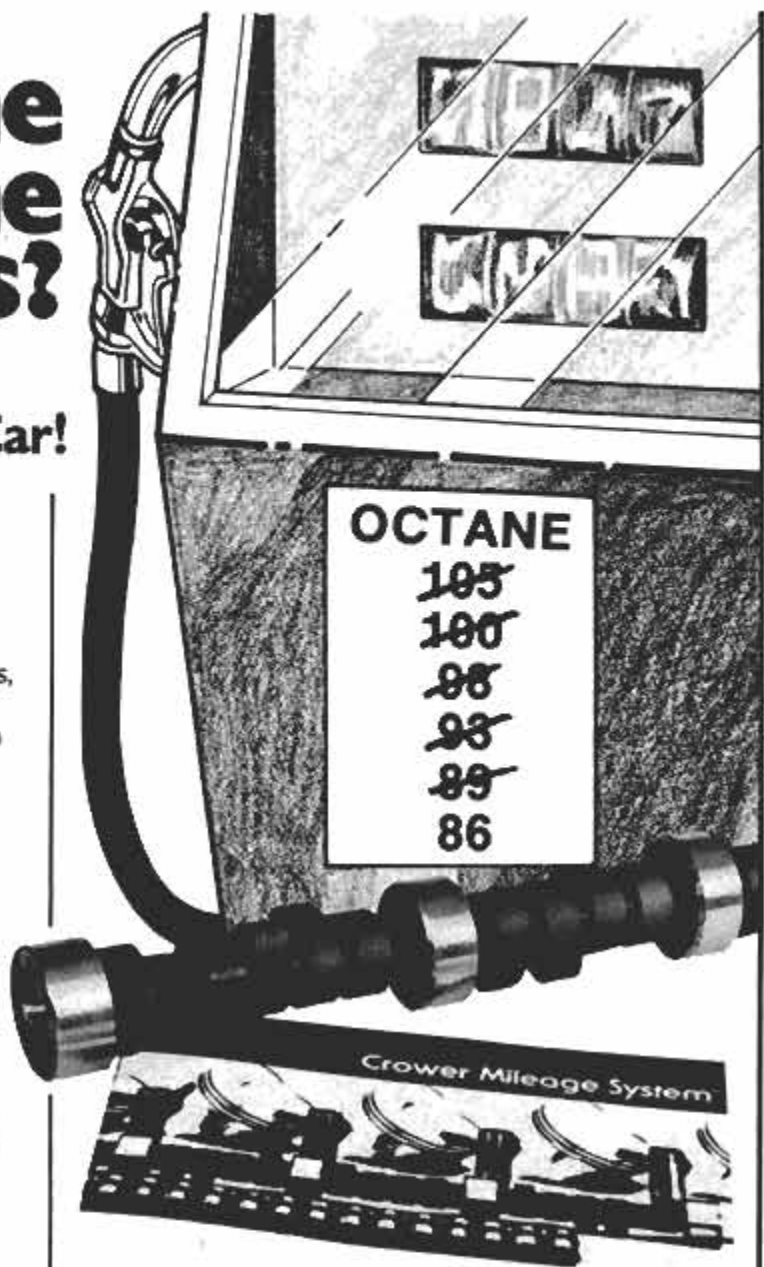
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CAPSULE REPORTS ON NEW AUTO PRODUCTS

Motorcycle tire-repair kit

If you ride a motorcycle, this thought has probably crossed your mind from time to time: What happens if I get a flat?

With the help of your bike's onboard toolkit, the Stop & Go kit has everything you'll need to fix a roadside puncture, short of a blow-out. It includes two forged-steel tire levers (9½ inches long) for breaking the tire bead from the rim, an Enginair tire pump with a 42-inch filler hose and sparkplug hole adapters in 18-, 14-, 12- and 10-mm sizes. The



Emergency tire-repair kit has everything.

pump converts engine compression into inflation pressure. The kit also includes patches, adhesive, reamers and plugs. Prices are \$24.95 for tube-type tires, \$27.95 for tubeless and \$29.95 for the deluxe kit, which lets you fix both types. Stop & Go International's address is Box 544, Wheeling, Ill., 60090. Or visit your motorcycle dealer.—*Joel Breault*

Rear end dragging?

Rear suspension bottoming out? New shocks might not be the answer. Weak, sagging rear leaf springs won't be helped unless you buy expensive air shocks.

Less costly and often just as good: leaf helper springs. I bought a set for my vintage Firebird for \$21.75 and installed them in about 20 minutes. These springs are adjustable for load weight and spring height. I set mine for maximum lift. The springs I used are made by Superior Industries International Inc., which



Leaf helpers give sagging springs a boost.

maintains a toll-free customer hot line at (800) 423-2999. California residents call (213) 781-4973 in Van Nuys.—*M.L.*

Chrome cleaner

I've always dreaded cleaning rust from my motorcycle's spoked wheels. However, the Blue Magic Co.'s MagMagic chemical chrome cleaner is easy to use and does an excellent job.

This product comes in plastic bottle with a pump applicator. Spray rust-covered chrome with MagMagic, wait two minutes and rinse thoroughly with water. For stubborn rust, use a medium-bristle scrub brush. This cleaner is potent;



Strong chrome cleaner dissolves rust fast.

take extreme care when you're spraying it.

An 8-ounce bottle of MagMagic is \$4.50 at most automotive stores, or write Blue Magic Co., Box 3145, Long Beach, Calif. 90803.—*Joel Breault*

Battery-terminal cleaner

Everybody has to do some battery maintenance sooner or later. This job is easily dealt with, thanks to Lisle Corp.'s battery service tool.

The tool is designed for maintaining the clamp-on type of battery-

cable ends. It features a 1¼-inch-long retractable, tapered, stainless-steel coil for scraping corrosion from the inside diameter of each terminal. A thumb wheel locks the coil in



Battery-cleaning tool removes corrosion.

place, then the entire tool housing is turned in a clockwise motion. At the other end of the plastic housing is a battery-post scraper with an adjustment for different sizes.

The terminal cleaner retails for \$5.25 and is available at most parts houses, or you can contact Lisle at 802 Main St., Clarinda, Iowa 51632.—*Joel Breault*

No teeth to chew with

Worm-drive hose clamps aren't new, but this Red Head hose clamp takes the science of holding your car's plumbing together a step further.

Most hose clamps have the band perforated all the way through. As you've no doubt noticed, this perfor-



New hose clamp doesn't chew into rubber.

ation eats into the very rubber you're trying to keep in one piece. The Red Head clamp isn't completely perforated and allows more contact area between the screw and the band. This permits you to tighten it more firmly and reduces screw slippage. Prices vary according to size. Contact Awab, 777 Livernois, Ferndale, Mich. 48220.—*T.A.*

SPACE TRAVEL

You don't have to look to the future to get the kind of roominess, comfort and high fuel efficiency your family needs. Just look to the 1981 Zephyr. Zephyr gives you more combined passenger and trunk space than such "X" cars as

Skylark and Omega (based on EPA Interior Volume Index). And long distance mileage? Zephyr is rated at an impressive **23** *EPA EST. MPG, 34 EST. HWY. Along the way, you'll enjoy the comfort and style you've come to expect from Lincoln-Mercury. The 1981 Zephyr. Suddenly, the future of your family's travel never looked brighter.



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A cowboy in a white hat and western attire is riding a brown horse that is bucking. He is carrying a large, oversized bottle of Lord Calvert Canadian Whisky. The bottle's label features a Union Jack and the text 'LORD CALVERT CANADIAN' and 'Canadian Whisky. A blend of choice materials'. The background is dark with horizontal light streaks, suggesting motion.

Lord of the Canadians

SCIENCE WORLDWIDE

Firing up for Jupiter

The two-inch-diameter projectile you see in the photo at right has just gone through a searing, split-second test flight in preparation for a 1985 mission to Jupiter.

The blunt-nosed projectile is a model of a nose cone built to withstand the heat of entry into the Jovian atmosphere at speeds of about 115,000 mph. After heat shields are jettisoned, the probe will send data 400 million miles back to Earth.

In the National Aeronautics and Space Administration test of the heat shield material, the model hit a speed of 11,000 mph. Temperatures on its surface rose to 6,000° F.

Reading ancient bones

Using a scanning electron microscope, researchers at Johns Hopkins and Harvard Universities have come up with some new suggestions on how distant ancestors of humans lived 1.8 million years ago.

Pat Shipman at Hopkins and Richard Potts at Harvard have been studying animal fossils for tooth scratches, gnawing marks, punctures, cuts and charring from fires. Using the scope, the two were able to differentiate between tooth scratches (grooves with smooth bottoms) and slicing marks made with stone tools (V-shaped grooves, not smooth at the bottom). One of their findings:



A scanning electron microscope enables Shipman to explore scratches in bones to reveal lifestyles of 1.8 million years ago.



NASA fired heat shield model down 1,000-foot-long range to prepare for the 1985 shot.

Our distant ancestors were apparently bright enough to pick over animal bones and carcasses with tools to remove tendons and other tissues that they could use for tying things together. "They were interested in more than food," Shipman says.

The investigators' bone readings also suggest that hominids—prehuman creatures—competed with carnivorous mammals for the same food, and frequently scavenged from each other.

Risks of a man's role

As women claim a larger share of wages by going to work, they'll become poorer in terms of physical health, according to a professor of health administration.

Prof. Nancy Milio of the University of North Carolina reports that a woman's life expectancy now exceeds that of a man by eight years. But by the end of the century, the gap is likely to close, as women suffer more heart, respiratory and other diseases that have long afflicted men more than women. In the future, women will die from liver cirrhosis at a rate almost equal to the rate for men, Dr. Milio says. And they won't enjoy the drop in digestive-disease rates expected for men.

To some extent, changes in health depend on job conditions. At work, women often face the same health risks as men, including heavy workloads, rotating shifts, noise and toxic chemicals. As many as one in five working women currently hold hazardous jobs, Dr. Milio reports. But the strain on a woman continues

after she leaves the office or factory. At home, working women spend more time in unpaid work than their spouses, if one is present. On average, they have six fewer hours per week for recreation than most men have.

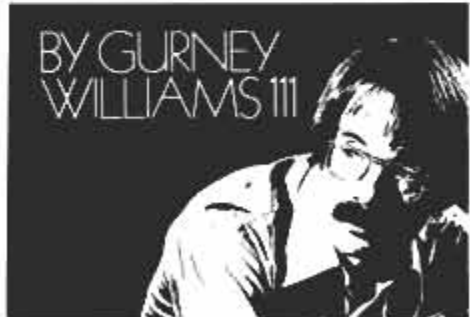
Bugging the cricket

A Notre Dame biology professor has put tiny "wire taps" on the auditory nerves of crickets to help him understand messages in their chirping.

Biologist Harold Esch can now recognize cricket mating songs, different for each species, as well as the hissing noises signaling battles between the insects. Using a computer, he's reproduced chirping so accurately that female crickets have come bounding down corridors toward his lab, looking for a mate.

By inserting thin electrodes near crickets' ears, Esch has been able to isolate four distinct sets of neurons, stringy nerve cells which relay sounds to the brain in the form of electrical pulses.

Esch hopes that his exploration of cricket nerves will reveal more about how the nervous system controls an organism's behavior. **FM**



Walt Garrison
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PHOTO HINTS

Safety strap



A disaster can result if a snap on your camera bag's strap opens by accident. A securer snap, called a minicarabiner, is available at mountaineering supply stores. —Bob Berger

Keep 'em clean



Corrosive gases can escape from NiCd batteries and dirty their contact points. When you charge NiCds, clean and dry them and sandpaper ends lightly for good contacts. —Robert Hertzberg

Easy mixings



A translucent plastic, 2-gallon bucket is a handy darkroom aid for mixing stock solutions of chemicals. Use masking tape and India ink to mark the 2-, 3- and 4-quart levels.—A. Weber

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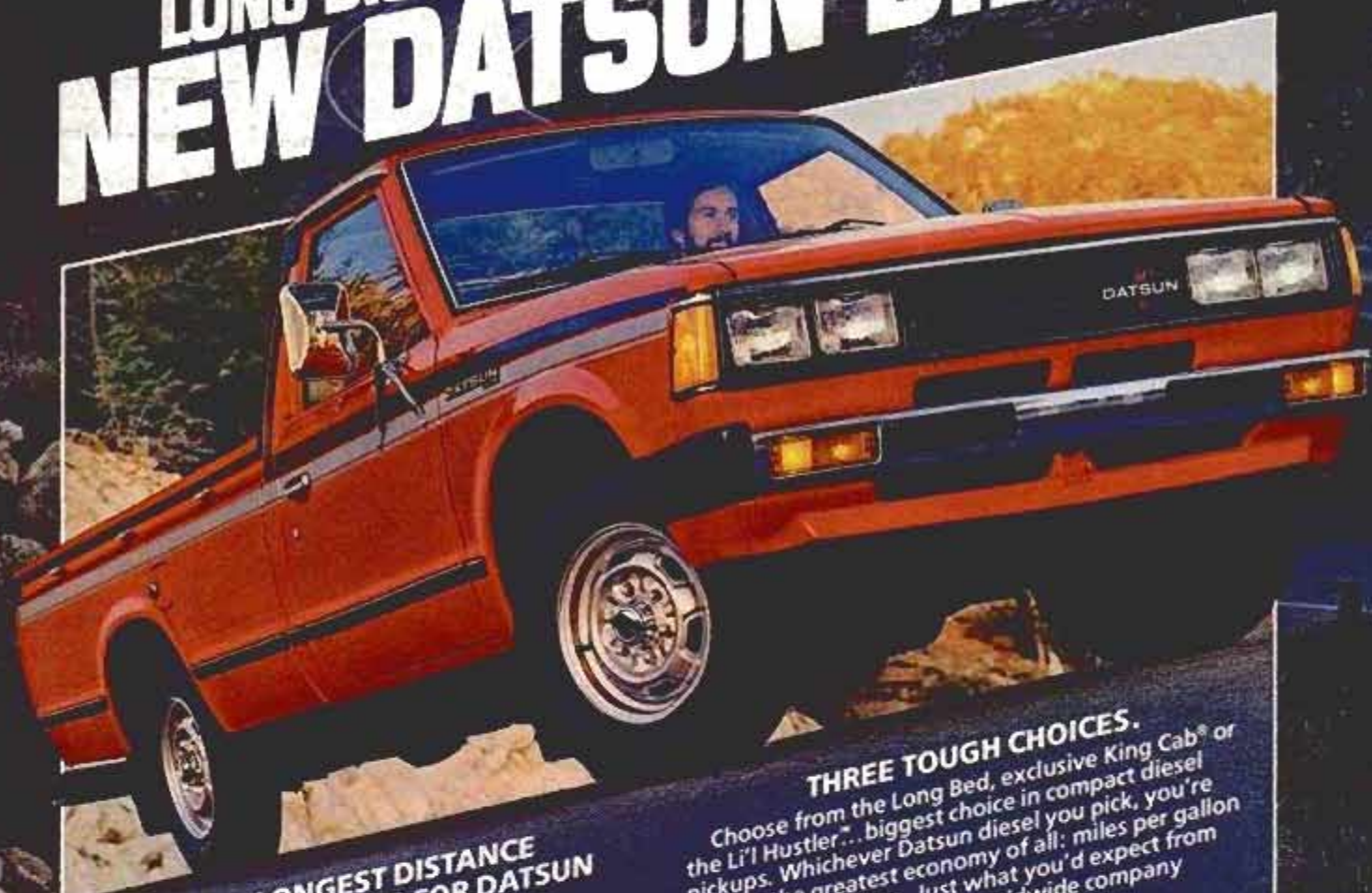


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WE ARE DRIVEN

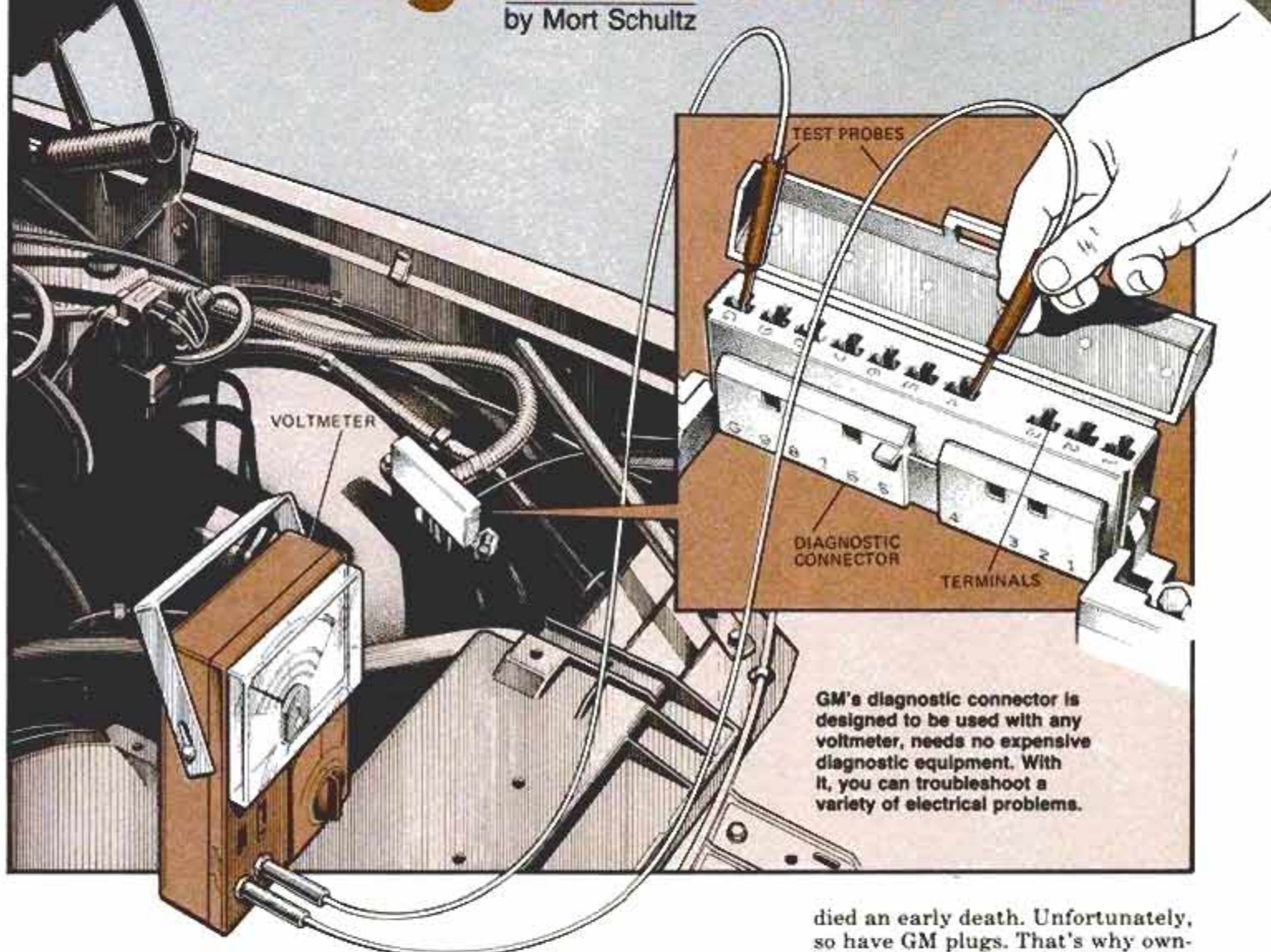


DATSUN

TRUCKS

Troubleshooting with GM's Diagnostic Connector

by Mort Schultz



GM's diagnostic connector is designed to be used with any voltmeter, needs no expensive diagnostic equipment. With it, you can troubleshoot a variety of electrical problems.

If you own one of General Motors' 21,068,446 cars made in model years 1977 through 1980, you may be part of an elite group. All Chevettes (including '76 models) and most full-sized models (except Cadillac) are equipped with a diagnostic connector. Your GM connector, if you have it, is a bright orange electric-system plug mounted on the left-front fender housing. GM likes to call it the "GM Connection."

Some 2.5 million Chrysler models also have a diagnostic plug. But, unlike GM's, it's not a tool to be used by the Saturday mechanic—not unless you own the Chrysler Electronic Engine Performance Analyzer

(EEPA), which is doubtful: This console costs about \$10,000.

The Chrysler plug first appeared on all 1978 Omnis and Horizons and then on all Chrysler Corp. cars and trucks in '79 and '80. According to Ray Bollman, an advanced serviceability specialist assigned to Chrysler's Service and Parts Div., "The plug is not intended as a test source using common-type shop equipment. To probe the plug indiscriminately may do damage to the alternator, starter and neutral-start switch circuits."

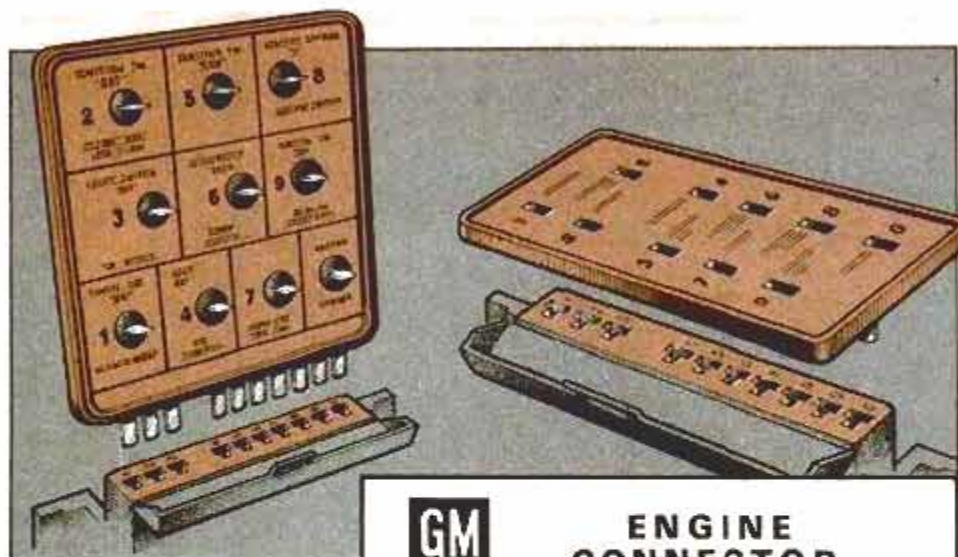
Ford never produced cars with diagnostic plugs. VW had plugs on models several years ago, but they

died an early death. Unfortunately, so have GM plugs. That's why owners of 1977-80 GM cars are an elite group.

The main reason for the demise of this splendid idea is that few mechanics know what to do with it. Many don't even know it exists. Those who do, think you have to hook it up to an exotic, expensive tester.

I recently spent a day in Detroit "troubleshooting" my '79 Bonneville's electrical system by inserting paper clips in the diagnostic plug to serve as connecting terminals for a voltmeter. Paper clips are okay, but an adapter made for the purpose is better. The adapter plugs into the GM Connection. You then attach your voltmeter to the adapter terminals.

If your voltmeter has probes, rath-



Two adapters are available for the GM Connector. One of them (above) is made by AC-Delco and Fox Valley. The other (above right) is made by Snap-On Tools. If you are not using an adapter, you can refer to the diagram (right) for identification of the terminals.



er than alligator clips, you can insert the probes right into the diagnostic plug. You don't need an adapter or paper clips—just a way to identify plug terminals.

I know of three companies that market adapters for the GM Connection: AC-Delco (part No. ST600), Fox Valley (M121) and Snap-on Tools (MT34). (The AC-Delco adapter is made by Fox Valley.) The price of the adapter is less than \$10, and you can get one from auto parts and accessories stores or a GM dealer.

Printing on the adapter identifies circuits. If you prefer to use paper clips instead of the adapter, or have probes on your voltmeter, cut out the diagram above and glue it to a piece of cardboard to give it body. Then hold it against the holes of the diagnostic plug, to identify circuits.

One thing the adapters provide that the paper-clip method doesn't is a way to troubleshoot an airconditioning system. GM models with the cycling clutch orifice tube (CCOT) refrigeration system have two diagnostic plugs—one to test an electrical system and another for airconditioning circuits. The latter connector, if you have one, is on the cowl at the right rear of the engine compartment.

Airconditioning diagnosis is too lengthy for this article. But in case you're wondering what all those terms on diagnostic-plug adapters are, designations printed in red identify electrical circuits; those printed in black identify airconditioning circuits.

Whether you buy an adapter or use the diagram, you'll want to know what each printed abbreviation refers to, so plug in the adapter or hold the diagram alongside the holes. Note that there are three holes (or terminals), a space and then seven more holes (or terminals). In other words, the lineup is terminals 1, 2, 3—space—terminals 4, 5, 6, 7, 8, 9 and G. The G terminal is the ground connection.

Here, in order, are the designations of these checkpoints:

- 1—Starter-solenoid BAT terminal.
- 2—Ignition-switch BAT terminal.
- 3—Headlight-switch fusible-link terminal.
- 4—Distributor BAT terminal.
- 5—Ignition-switch IGN terminal.
- 6—Distributor TACH terminal.
- 7—Blank (no function).
- 8—Starter-solenoid s terminal.
- 9—Ignition-switch SOL terminal.

Use your diagnostic plug for troubleshooting when one of the following problems crops up:

- Engine cranks sluggishly or doesn't crank, but the starter solenoid clicks or chatters.
- Engine doesn't crank and starter solenoid doesn't make any noise.
- Engine cranks okay, but doesn't start.

- Engine misses or idles rough.
- Battery keeps running down.
- Battery uses excessive water.

The rest of this article outlines how to troubleshoot using the GM Connection. Each step is numbered. In going from one problem to the next, numbers continue consecutively—each problem doesn't begin over again with No. 1. I frequently refer to other steps and this numbering system is easy to follow. After each step, check to see if the problem has been solved.

Sluggish or no cranking—starter solenoid makes noise

1. Check battery cables for loose and corroded terminals. Replace the battery if it is physically damaged.

2. Check the "eye" of a Freedom battery. If the car has no Freedom (sealed) battery, use a hydrometer to test electrolyte specific gravity. Do one of the following:

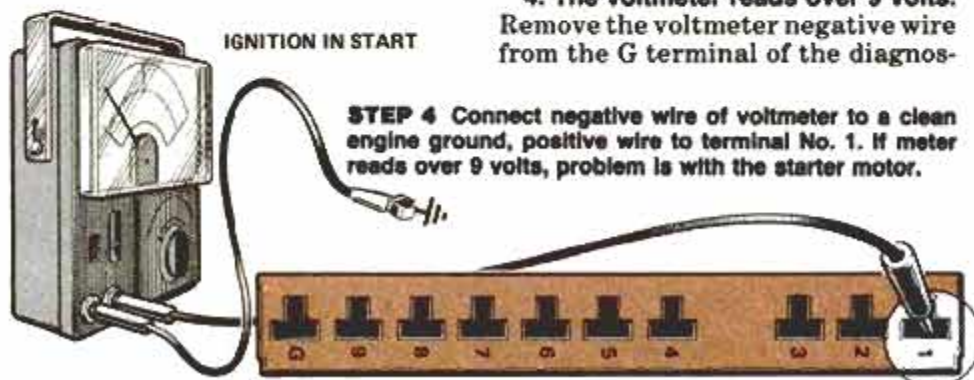
- If the eye of the Freedom battery is light, replace the battery.

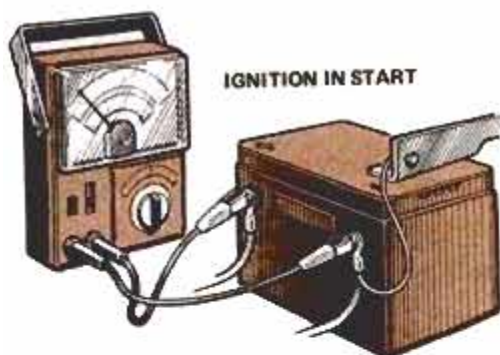
- If the eye of the Freedom battery is dark or electrolyte specific gravity of a conventional battery is below 1.230, charge the battery. Then check for a loose alternator drive belt. If the battery keeps discharging over a period of time, test alternator output. If that's okay, assess the way you're driving. An engine that's run only for short distances may not allow the battery to recharge.

- If the Freedom battery eye is green or electrolyte specific gravity of a conventional battery is above 1.230, the battery is okay. Look elsewhere for the trouble

3. Connect the negative wire of your voltmeter to the G terminal of the diagnostic plug. Connect the positive wire of the meter to terminal No. 1 of the plug. Move the ignition switch to START and look for condition described in Steps 4 and 5.

4. The voltmeter reads over 9 volts. Remove the voltmeter negative wire from the G terminal of the diagnos-





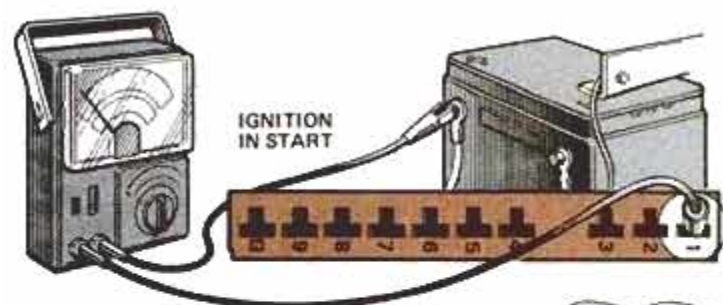
STEP 5 Connect voltmeter to the battery terminals as shown to test the condition of the battery. Load test if necessary.

tic plug and press the end of this wire against a clean metal spot on the engine. Move the ignition switch to START.

If the voltmeter still records more than 9 volts, test the starter motor. There's a problem with it. But if the meter reads less than 9 volts, clean and tighten the battery ground cable connection on the engine.

5. In doing the test described in Step 3, if the voltmeter reads less than 9 volts, check battery output. Connect the voltmeter negative wire to the battery negative terminal and the voltmeter positive wire to the battery positive terminal. Move the ignition switch to START and look to see which one of the following occurs:

- Voltmeter records less than 9.6 volts. Have the battery tested under load conditions. If it's okay, the starter motor is faulty. If the battery fails the load test, replace it.
- Voltmeter records more than 9.6 volts. Do Step 6.



6. Connect negative wire of the meter to terminal No. 1 of the diagnostic plug and the positive wire of the meter to the battery's positive terminal. Move the ignition switch to START. One of two things will happen:

- The meter reads over 0.7 volts. A corroded or loose battery positive cable exists at the starter solenoid or the fusible link serving the starter system has blown.
- The meter reads under 0.7 volts. A corroded or loose ground cable exists at the battery.

Important: In making repairs, don't overlook the possibility that

component wiring can break. When this happens, resistance impedes the functioning of the particular component. For example, if the voltmeter shows a faulty ground cable connection, but cleaning and tightening the connection doesn't resolve the problem, replace the cable on a hunch. Stranger things than a bad cable have been known to affect engine performance.

No cranking—starter solenoid doesn't make noise

Do Steps 1 and 2. Then proceed to the following:

7. Connect the negative wire of the voltmeter to the diagnostic-plug G terminal and positive wire to terminal No. 8 of the plug. Move ignition switch to START and check for the following possibilities:

- Voltmeter records over 7 volts. The starter solenoid is faulty.
- Voltmeter shows less than 7 volts. Proceed to Step 8.

8. Move the positive wire of the voltmeter from terminal No. 8 of the diagnostic plug to terminal No. 1. Move the ignition switch to START. One of two things will happen:

- The voltmeter reads over 9 volts. Proceed to Step 9.
- The voltmeter reads less than 9 volts. Test for a problem with the starter motor, battery or battery cables as in Steps 4, 5 and 6.

9. With the voltmeter negative wire connected to the G terminal of the diagnostic plug, connect the voltmeter positive wire to terminal No. 9 of the diagnostic plug. Move the ignition

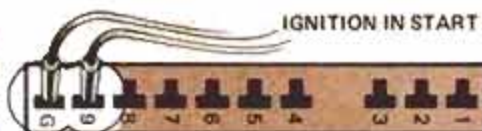
STEP 6 If the meter reading should be less than .7 volt, a bad ground cable exists. If it's over .7 volt, a bad positive cable or a blown fusible link is responsible for problem.



STEP 7 If voltmeter reads over 7 volts, the starter solenoid is bad. If it's under 7 volts, proceed to Step 8.



STEPS 3, 8, 15, 17 These four tests use same terminal plugs but, depending on reading, check different functions.



STEP 9 If meter reads over 7 volts, the purple bulkhead connector is loose or corroded. Under 7 volts, see Step 10.



STEP 10 If the reading is over 7 volts, ignition switch is faulty. Under 7 volts, the red bulkhead connector is bad.

switch to START. One of the following will occur:

- The voltmeter reads over 7 volts. The bulkhead connector terminal to which the purple wire is attached is loose or corroded. (The purple wire connects the ignition switch to the starter solenoid.) Or the car has a faulty starter safety switch (neutral-start switch). This switch prevents starting the engine in any transmission setting except PARK or NEUTRAL. If the switch cannot be adjusted, replace it.
- The voltmeter reads less than 7 volts. Proceed to Step 10.

10. With the meter's negative wire connected to the plug's G terminal, attach the positive wire to terminal No. 2 of the plug. Look for the following:

- A meter reading over 7 volts. The ignition switch is faulty.
- A meter reading less than 7 volts. The bulkhead terminal to which the red wire is connected is loose or corroded. (The red wire connects the battery lead to ignition switch.)

Engine misses, idles rough or cranks, but doesn't start

11. Connect a test light between terminals No. 4 and 6 of the diagnostic plug and let the engine run at curb idling speed as you observe the way the test light glows. (If the engine can't be started, you will have to examine sparkplugs, sparkplug cables, and distributor cap and rotor by conventional means.)

The test light will indicate one of three possibilities, as follows:

- If one flash is brighter than the others, the cause of misfire or rough idle is an electrical problem. See Steps 12 to 14.
- If one flash is dimmer than the others, the cause of trouble is a secondary circuit malfunction. Check sparkplugs, sparkplug cables, distributor cap and rotor.
- If flashes of light are of the same intensity, the cause of misfire or rough idle probably lies in the fuel

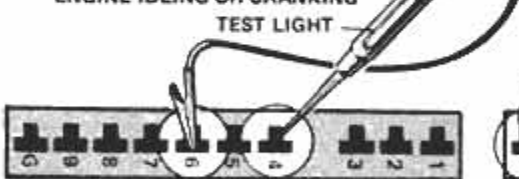
system, or with a loss of vacuum from a vacuum hose or vacuum-operated component.

12. Attach the voltmeter negative wire to the G terminal of the diagnostic plug and the voltmeter positive wire to terminal No. 6 of the diagnostic plug. Let the engine idle, or crank it if it doesn't start. Look for the following:

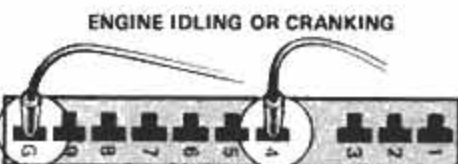
- A voltmeter reading over 9.6 volts with the engine idling or over 7 volts with engine cranking. There's a malfunction with the High Energy Ignition (HEI) system.

- A meter reading less than 9.6 volts with the engine idling or less than 7 volts with it cranking. Go to Step 13.

13. Leave the voltmeter negative wire connected to the diagnostic plug G terminal and the voltmeter positive wire connected to the diagnostic plug terminal No. 4.



STEP 11 This test checks for misfire caused by electrical problems, secondary circuit malfunction or a vacuum leak.



STEP 13 This test checks the diagnostic connector itself for trouble, or a malfunction in the HEI distributor.

14. Connect the voltmeter positive wire to terminal No. 5 of the diagnostic plug and the negative wire to the plug's G terminal. Look for the following:

- The meter records over 9.6 volts (engine idling) or over 7 volts (cranking). The wire from terminal No. 6 to the HEI distributor may be grounded, so check this before doing extensive troubleshooting of the HEI distributor. More than likely, though, the trouble will be with the HEI distributor.

- The voltmeter records less than 9.6 volts (engine idling) or less than 7 volts (engine cranking). Go to Step 14.

14. Connect the voltmeter positive wire to terminal No. 5 of the diagnostic plug and the negative wire to the plug's G terminal. Look for the following:

- Over 9.6 volts while idling or over 7 volts cranking. Examine bulkhead connector terminals for corrosion or loose connections.

- Less than 9.6 volts idling or less than 7 volts while cranking. Replace the ignition switch.

Frequent battery discharging

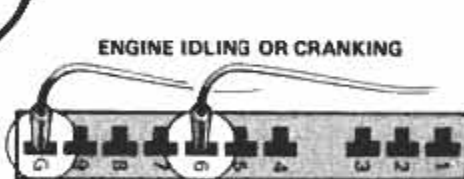
15. Adjust or replace the drive belt, if necessary, and see that the battery is fully charged. Run the engine at 1500 rpm for one minute. Then turn on headlights (high beam), radio, heater/airconditioner blower motor (high speed) and rear-window defogger blower. Leave the engine running.

Connect the meter's negative wire to the diagnostic-plug G terminal and positive wire to terminal No. 1 of the plug. Here's what will happen:

- A recording of less than 12.5 volts. The alternator has a malfunction.

- A recording of more than 12.5 volts. Go to Step 16.

16. Turn off the engine and all accessories. Be sure car doors are shut. Disconnect an under-the-



STEP 12 If the voltmeter reading is over 7 volts with engine cranking (not running) there is an HEI malfunction.



STEP 14 Idling voltage less than 9.6 volts or cranking voltage less than 7 volts indicates a faulty ignition switch.

hood light, if there is one. All electrical components must be off, because you are going to test for a short that is draining the battery. Keep the ignition switch off.

Disconnect the battery negative cable and attach a 12-volt test light between cable terminal and battery negative post. If the test light glows, a short exists that is draining the battery.

Some likely causes are a shorted glove-compartment or trunk light, or else a misadjusted brake-light switch.

If the light doesn't glow, frequent starting of the engine followed by short drives are probably putting a drain on the battery, causing it to discharge.

Battery uses too much water

17. Connect the voltmeter negative wire to the diagnostic-plug G terminal and connect the positive wire to plug terminal No. 1. Run the engine at 1500 rpm. Be sure all lights and accessories are turned off. One of the following will occur:

- The meter reads over 15.5 volts.

This indicates that there is a voltage-regulator problem inside the alternator.

- The reading is below 15.5 volts. Extended driving in hot weather may be causing battery water to evaporate.

Mysterious terminal No. 3

The only terminal of the diagnostic plug we haven't mentioned yet is No. 3. Use it to test headlamp-circuit voltage.

Terminal No. 3 can help determine whether complete headlight failure has been caused by a burned-out fusible link, simultaneous lamp burn-out or headlight switch malfunction.

Connect a test light between the G terminal and terminal No. 3 of the diagnostic plug. Turn on headlights. If the test light does not light, check the headlight wire to the battery for an open fusible link. If the test light works, look for a bad switch or burned-out bulbs.

Additional benefits of the diagnostic plug

Other than for troubleshooting, there are several benefits in having a GM diagnostic plug. Here are a few of them:

- Convenient hookup for a tachometer. Instead of having to connect the tach to the HEI distributor, the Saturday mechanic can attach it to terminal No. 6.

- Burglar protection. Connect a jumper wire between the No. 6 and G terminals. Close the plug cover. This grounds the ignition system. The engine will crank, but sparkplugs won't fire.

Unless the would-be burglar is also familiar with the GM Connection, he'll have to look elsewhere for easy pickings. This is like a built-in kill switch.

- Making an engine compression test when no one is around to help and you have no remote switch. Turn off the ignition switch and place the transmission in PARK. Connect a jumper wire between the 1 and 8 terminals. The engine will crank without starting.

- Jumping a failed ignition switch. If this switch fails, use the diagnostic plug to get it to a shop for switch replacement, instead of having the car towed.

First, connect a jumper wire between terminal Nos. 2 and 5. Use another wire to jump the 2 and 9 terminals momentarily. When the engine starts, remove the 2-9 jumper. The engine will keep running. Now, turn the ignition switch on to unlock the steering-wheel lock and drive the car.



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Portable boat dock you can build



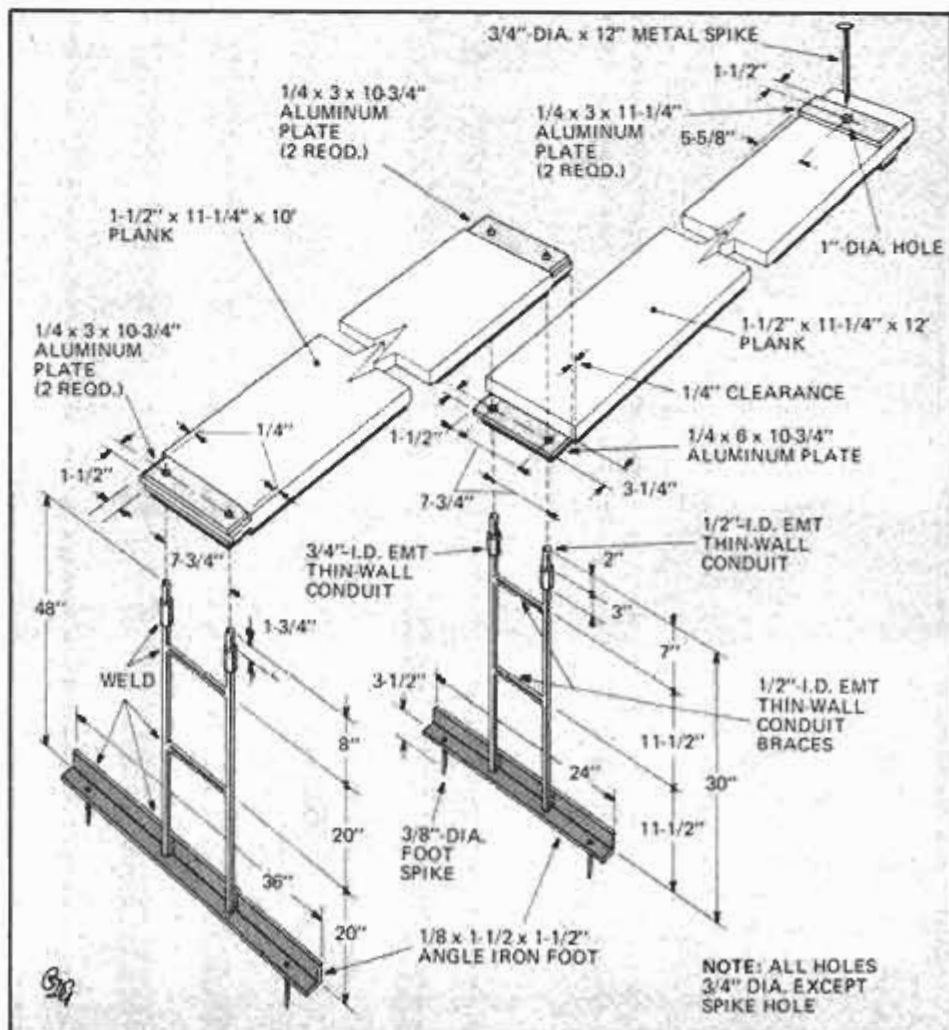
Dock is in position alongside the boat. Bumpers are used between boat and dock.

This portable boat dock keeps your feet dry while it lets you avoid beaching your boat. This will be most appreciated by any passenger unwilling to jump in and wade ashore or scramble over the foredeck. The dock will also save wear and tear on the boat's hull. Instead of beaching (running the hull onto shore over sand, pebbles, rocks or stumps), the boat may be left afloat several feet from shore.

The dock is easy to construct. If you are not a welder, welding charges at a local machine shop should be minimal. When you call for an estimate, remember that EMT stands for electrical metal tubing. The spike can be made from any 12-in. metal rod such as the steel rods (bars) used to reinforce concrete.

Begin by cutting the rabbets for the let-in aluminum plates in the planks. Pine may be used, but redwood is lighter. Note that the two plates through which the spike passes are surface-mounted. Mount

(Please turn to page 38E)



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BOAT DOCK YOU CAN BUILD

(Continued from page 38B)



The last step in setting up the dock is driving a metal stake firmly into the shore.



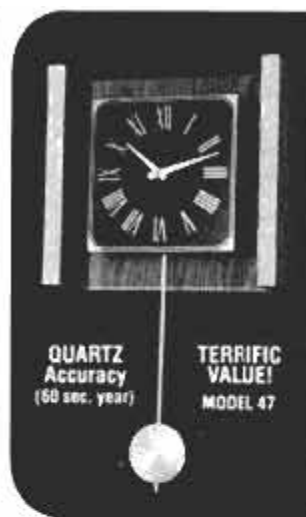
If you've been planning to try your hand at welding, start with this simple project.

all plates with countersunk No. 9 flathead wood screws, staggered with respect to the opposing plate. Then drill the 1-in.-dia. spike hole and 3/4-in.-dia. holes for the vertical supports.

If you plan to use a finish on the planks, do this before mounting the plates. Use a nonskid paint or sprinkle sand lightly on the wet finish.

If it's calm when you reach your site, you can position the dock overboard without getting out of the boat. But one chivalrous crew member should wade in to make sure the dock feet are properly secured on the bottom. Hammer the spike in place before using the dock.

The planks can accommodate two people at a time without undue bouncing, which would cause the shore spike and foot spikes to loosen. But be careful on windy days. A strong wind could blow a boat into the dock with enough force to tip the dock over. Then the upturned angle-iron feet could damage the hull of the boat.—James H. Brennecke



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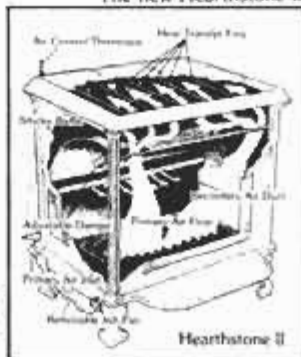


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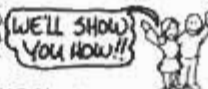


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AT LAST - A RECHARGEABLE BATTERY
SYSTEM YOU CAN TRULY AFFORD
NEVER BUY BATTERIES AGAIN EVER



SUPER VALUE
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rechargeable
battery system

LOOK WHAT \$24.95 WILL BUY

Starter set includes (1) 9 volt battery, (6) high capacity "AA" cells,
(6) "C" size adapters (6) "D" size adapters

INVENTORY? You no longer have to maintain an expensive inventory
of "C" and "D" cells. All you need is a supply of "AA" cells and our
revolutionary new BATTERY ADAPTERS.

SAVINGS! Now you can benefit by the cost advantages of total
household rechargeability. A comparable purchase of Nickel Cad-
mium Batteries, without adapters, would cost more than \$60.00.

QUALITY? These batteries are not seconds or closeouts. These hi-
capacity "AA" Nickel Cadmium Batteries are guaranteed to be
recognizable, top quality, brand-name manufacturers.

CREDIBILITY? It is important to understand that on a SINGLE
CHARGE, when immediately drained an average 500 MA, one hi-
capacity "AA" NI-CAD Battery has the power to LAST LONGER than
the smaller size carbon batteries (when drained at same rates). Will
recharge 1000 times (for less than \$0.05 worth of electricity).

IMAGINE! After the purchase of your starter set you may occasion-
ally want to add a few additional pieces to your system. However, by
then you and your entire household will soon be free of buying
throwaway carbon or alkaline batteries. Forever.

THE FUTURE IS HERE! Every year there will be more new battery
operated products for our entertainment and convenience - be
prepared for the increased demand - have enough rechargeable bat-
teries and adapters on hand to remain free of the expensive habit of
throwaway batteries.

INFLATION? Can you anticipate the cost of throwaway batteries
1,2,3 years from now? You know the cost of rechargeables
today they will never be less!

PARENTS! No disappointed children due to dead batteries in toys.
Excellent stable voltage for electronic games.

FRUGAL! Even if your household budget limits you to a very small
inventory of rechargeable "AA" and corresponding adapters, you can
still avoid purchases of throwaway's because they can be easily
transferred from one device to the other as needed.



OPTIONAL CHARGER

Wall plug-in charger with module.
Charges 2 "AA" or 4 "AA" or 1 9V
battery overnight. ONLY \$5.95

ACTION! Send in your order before your next purchase of expensive
throwaways. Start saving your hard earned money, Act Now, order
below.

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Yes, send me the following with 15 day no risk return.

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Starter Set as shown \$24.95 EA _____
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Additional "AA" @ \$1.99 EA _____
9 Volt @ \$7.95 EA _____
Module Charger @ \$5.95 _____
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Add \$1.50 for delivery and handling. N.Y. State residents add 7% sales tax

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BUILDING YOUR OWN . . . GARDEN CART?

(Popular Mechanics, July 1980, page 110)



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NEW NOW for home and shop

A A handsome Bachelor's Chest kit is now available by mail from the furniture division of Emperor Clock Co., Dept. FS, Emperor Industrial Park, Fairhope, Ala. 36532. The unfinished chest is offered in 3/4-in. solid cherry (shown) for \$299.50 and 3/4-in. solid black walnut for \$399.50. The chests are 18 3/4 x 29 1/4 x 33-in. wide and feature fluted quarter columns, ogee bracket feet and dovetail-constructed drawers. The kit comes ready to assemble with precut, presanded pieces and all the necessary hardware, screws and instructions. Factory-assembled and finished chests are also offered at \$599.50 for the cherry and \$699.50 for the black walnut. Shipping is collect.

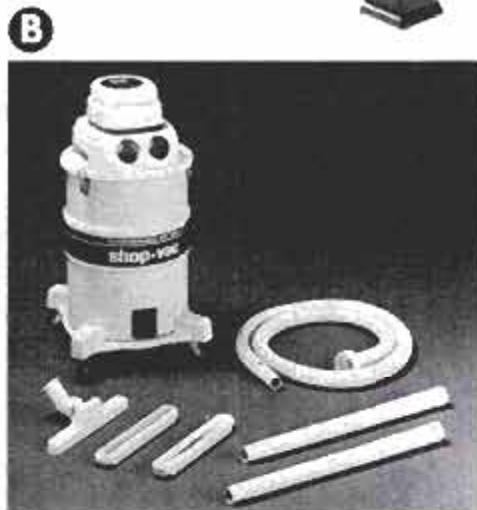
B The Model 800-02 Shop-Vac is a heavy-duty, wet-dry unit with a 10-gal., rust-resistant, epoxy-coated steel drum. It boasts a 1 1/4-hp motor and a positive locking system on the hose extension wands, and master nozzle that eliminates slippage. An automatic float shut-off stops the wet pickup when the drum is full. Mounted on a four-wheel dolly, the unit comes with a 6-ft. hose, two wands, and three 10-inch heads: the master nozzle, a squeegee shoe and a rug shoe. A 6-gal. and a 16-gal. drum are also available in the same series. The 800-02 shown here is \$96.95 at home centers and department stores. It's from Shop-Vac Corp., 2323 Reach Rd., Williamsport, Pa. 17701.

C Porta-Bench is a handy folding workbench that lets you take the bench to the job instead of the job to the bench. The top is made of particleboard and the top back is perforated hardboard. The legs and supports are 22-gauge rolled steel with a bright orange baked-enamel finish. Black plastic pads are supplied for the leg bottoms. The unit is 18 x 33 1/2 x 36 in. when standing and is only 4 1/2-in. deep when folded. It weighs 24 pounds and sells for \$42.95 postpaid. Order by mail from Harvest Gifts, Dept. BP3, 6226 Acadia Ave., Agoura, Calif. 91301. Allow four weeks for delivery.

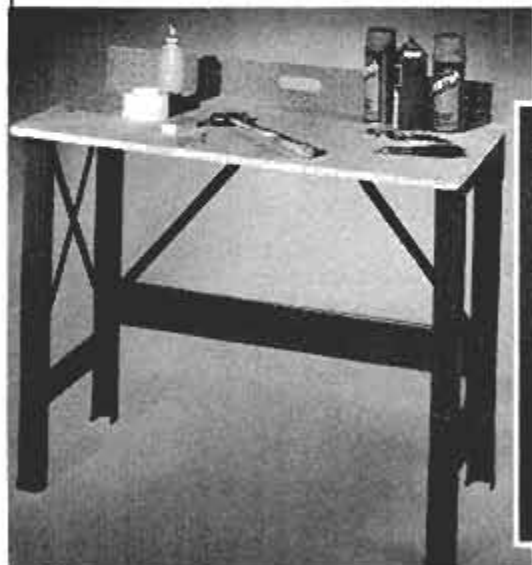
D The Lawnflite Power Edger Model 595 is a heavy-duty edger. It has a stamped-steel chassis and a 9-in. tempered-steel blade driven by a 2-hp. constant-speed Briggs and Stratton engine. It rides on two 7-in. wheels in the back and a single 6-in. wheel in front. The blade-engagement lever is located on the edger's 3/4-in. tubular-steel handle and the blade depth can be adjusted at both the handle and the edger head. The product weighs about 60 pounds and sells for \$178.95 at home and garden centers and department stores. It's from MTD Products Inc., Box 36900, Cleveland, Ohio 44136.



A



B



C



D

STP Gas Treatment does it all. Here's why it outsells them all.

At today's prices, drivers are demanding more and more from their gasoline. And more and more from their gas additives.

STP Gas Treatment delivers what drivers ask for. It's the Driver's Edge. It provides protection for your fuel system. Removes water that can cause problems. Inhibits rust. Cleans your carburetor. And keeps it clean to save you gas.

STP does it all. That's why it outsells them all.

Removes water— fights gas-line freeze.

Water gets into your gas tank through condensation and, sometimes, by contamination at the pump. This water can cause poor engine performance and, in cold weather, gas-line freeze.

But the special-action formula of STP Gas Treatment used regularly works to protect your fuel system. It surrounds water droplets and helps carry them through your engine. And the less water in your fuel system, the less chance of a problem.

Inhibits rust.

Even a little rust can cause serious fuel system problems. It can clog your fuel filter, or block your carburetor jet. This can mean hard starting, plus stalling and sputtering.

But STP Gas Treatment has a special rust and corrosion inhibitor designed to prevent these problems. Both these steel bars were soaked in gasoline plus water. But the bar on the right—the one without the rust—was protected by STP Gas Treatment. No wonder it's the Driver's Edge.



UNTREATED TREATED

Cleans carburetors and keeps them clean.

Normal engine heat and oxidation cause gum and varnish to build up. These deposits can clog openings, reduce tolerances and harm engine efficiency.

STP Gas Treatment cleans your carburetor. And works two ways to prevent these harmful deposits from accumulating again. First, it coats

metal surfaces which works to prevent gum and varnish molecules from getting a toehold. And second, it surrounds these molecules with a stick-proof coating so they can pass harmlessly through the fuel system.



UNTREATED TREATED

The carburetor sleeve on the left shows fouling and deposit accumulation. The one on the right—the one that still looks like new—was protected by STP Gas Treatment. Which would you want in your engine?

Saves gas.

A dirty carburetor lessens your engine's operating efficiency, reduces mileage, wastes gas.



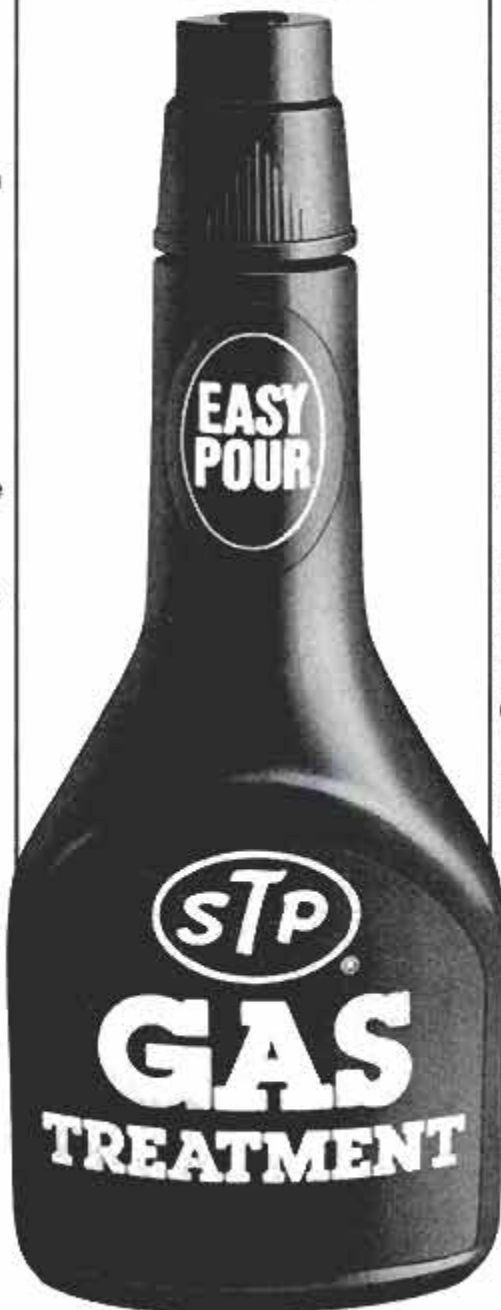
But STP Gas Treatment cleans carburetors. Intake valves and manifolds, too. And, used regularly, **keeps** them clean. Net results: improved engine efficiency and important gas savings.

Get the Driver's Edge.

If you demand more from your gas—and more than many gas additives even promise—join the millions of smart drivers who demand STP Gas Treatment. Keep it on the job—every mile, every fill, every season. Because STP Gas Treatment **delivers. Satisfaction guaranteed or your money back.**

STP Gas Treatment **does it all.** Removes water, fights gas-line freeze, cleans carburetors, saves gas. That's why it **outsells them all.**

The driver's edge.



APPLIANCE CLINIC

QUESTIONS ANSWERED

His refrigerator runneth over

We have a Frigidaire refrigerator model No. FPDS 14-T that sometimes leaks around the bottom of the door. We have checked the inside drain, and that is not the problem. I installed a new door gasket. That helped for a while, but now we're back to a puddle on the floor every morning. Could you please help?—C.P. Sanders, Humboldt, Tenn.

Many refrigerator leaks trace to one simple cause: failure to pitch the refrigerator correctly. A refrigerator should have a slight pitch or tilt to the rear. To check for pitch, see if your refrigerator door closes automatically after you open it. If it just hangs there or fails to latch tightly, the refrigerator is probably perfectly level. By pitching it slightly, you can be sure that the water collected inside will flow toward the internal drain—and not against the door.

To correct the pitch, adjust the front levelers with a wrench.

Take a notch in your belt

I suspect the drive belt is loose on our Sears Kenmore automatic washer, model No. 110.6804650. The wash cycle starts with a loud, rubbing noise. Also, when pressed, the belt moves inward about 1/4 in. However, it appears the belt cannot be replaced easily without removing the entire gearbox. Is this true?—J.T. Lambert, San Jose, Calif.

First, "eyeball" your belt carefully while pulling or turning the unit over slowly. Check for frayed sections or loose pieces of the belt that could be slapping the housing as the belt turns. Because these machines are very compact, the belts must run in tight quarters. Any flaws in the belt will produce the rubbing noise.

Second, tighten your belt until you have 1/2 in. deflection at a point midway between the pulleys. Bolts through slotted holes in the motor base are provided for this adjustment.

Third, your machine's dry clutches may be going bad and making the rubbing noise. To replace the clutch or the belt, call a serviceman. But consider the cost of this move against the machine's value: It might be time to buy a new one.

Do-it-yourself help

A good friend has a lawnmower with a Briggs & Stratton engine that

emits heavy black smoke. No amount of carburetor adjustment helps. I cleaned the plug and points and adjusted the engine to factory specs. Now, we can get the engine to run only if we pull the plug wire off about 1/4 in. so there is a spark gap. If we put the wire on the plug, the engine stops. What could be the problem? Here in Japan, we're a long way from a repair shop.—Earl A. Taylor, Sendai, Japan

The black smoke indicates a very rich air-fuel mixture; it may be caused by an improperly adjusted carburetor, overchoking the engine, a clogged air filter or contaminated fuel. As far as ignition is concerned, we suggest replacing the points and condenser. Be sure to set the points at .020-in. air gap. Next, remove the cylinder head and clean the carbon from the piston head and valves. Make sure the valves are seating



B & S repair manual is available by mail.

properly. Reassemble the engine; it should work.

Briggs & Stratton Corp. offers an excellent do-it-yourself repair and instruction manual. The address of your nearest representative is Yanase & Co. Ltd., Trading Div., 6-38 Shibaura Itchome, Minato-ku, Tokyo. For those in the United States who would like the manual, the address is Briggs & Stratton Corp., Box 702, Milwaukee, Wis. 53201. The manual is \$5.95 postpaid. Ask for Repair & Instruction Book No. 4.

Confused dryer

I have a Penncrest electric dryer model No. 2200 that has a heating problem. With the door closed and the timer set for operation, the dryer revolves, but the element doesn't heat. When the door is opened, the dryer doesn't revolve, but the heating element comes on. I was told that the door on-off switch may be the problem.—J. Van Dyke, Ossian, Ind.

The door switch doesn't appear to be your problem. This switch controls the dryer's motor operation. We suspect a sagging or grounded dryer heating element. Your dryer has two of these heating elements, which are located behind the drum assembly. One of the elements may be contacting the metal heater housing, energizing part of the element across 120 volts. This would cause the element to heat up when the drum has stopped turning and the door is opened.

We recommend that an authorized service technician make the repairs. The price of labor and replacing the heating element should be approximately \$60.

Tub trouble

I have a Frigidaire Jet Action washer, model WC DARN, about 4 years old. Recently, I noticed some holes starting to rust and enlarge along the top of the enameled tub. How do I replace this tub?—J. Gizovski, West Mifflin, Pa.

Take a putty knife and wrap its blade with masking tape. Then slip this into the seam along the top edge of your machine and flip the top open. (The masking tape will prevent damage to the porcelain.) Remove the exposed wide rubber gasket. Take out the agitator, then loosen and remove the locknut beneath it. Remove the support flange which holds the agitator in place and you will see a series of bolt heads around the inside center base of the tub. Remove these bolts and pull out the tub. To replace the tub, reverse the above procedure. If the old ones are still sound and pliable, you don't need a new gasket or hose. **PM**

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

ONLY QUAKER STATE GUARANTEES NEW CAR ENGINE LUBRICATION FOR A LIFETIME. IN WRITING!

Introducing Quaker State's Lifetime Engine Lubrication Protection Program.

Now Quaker State, the motor oil refined from Pennsylvania Grade Crude Oil, announces the most daring Protection Program available in the oil industry. It's the Lifetime Engine Lubrication Protection Program, the only program to cover your new car's engine for as long as you own it.

This exclusive program is brand new. So take a few minutes to read the following. Once you do, you'll see just how much this program can mean to you. We're sure you'll want to take advantage of it... and keep your new car staying on the road with Quaker State.

Q. Just what is Quaker State guaranteeing?

A. We're not only guaranteeing the quality of our motor oil, but we're guaranteeing that Quaker State will protect so well, if your engine is ever damaged because our oil fails to protect it, we'll pay for repairs or replacement of any or all of these parts: Pistons & rings, crankshaft & bearings, timing chain, rocker arms and pivots, rods and rod bearings, wrist pins & bushings, camshafts & bearings, valve stems & guides (grinding & adjustments excluded), oil pump, push rods, valve lifters, cylinder heads, cylinder lining or bore, distributor drive gear and timing gears or sprockets.

Q. What do I have to do to get this protection plan?

A. When you buy a new car, light truck or van from a participating dealer, you'll get the protection plan. To keep it in effect, all you have to do is follow these 4 steps:

1. Have all services performed by your new car dealer or other auto service center.
2. Have the oil changed according to manufacturer's recommendations, or at least every 6 months or 6,000 miles, whichever comes first.
3. Have oil filter and air cleaner replaced, and emission control system maintained, according to manufacturer's recommendations.
4. Keep all service records. These must indicate that only Quaker State Motor Oil was used with date and mileage indicated.

That's it. Now when the manufacturer's warranty ends, your Quaker State limited warranty protection begins... and continues for as long as you own the vehicle!

Q. What won't the guarantee cover?

A. It won't cover defects in manufacture, vehicles used in competition such as racing, damage caused by negligence, collision or abuse, improper installation, or engine parts not lubricated by motor oil.

Q. Suppose something goes wrong and I'm covered. What do I have to do, and how long will it take for me to collect?

A. All you have to do is notify Quaker State of a claim, by writing or calling collect. (Address and phone number are on the warranty.) Our claim representative will contact you within 24 hours. Provide the claim representative with a copy of your warranty, copies of your service records, and a statement of damage and repair cost from the dealer or any repair shop you choose. If everything is in order, the claim representative will approve the claim and make the payment.

Q. If I don't have a brand new car, can I still get the Protection Program?

A. If your car has under 6,000 miles, you can switch to Quaker State and qualify for the Protection Program at a participating new car dealer's service department. But if your car has more than 6,000 miles, it can't qualify.

Q. If I buy a new car now, and keep it for 100,000 miles or more, will this Quaker State Protection Program be good for that long?

A. Yes. Lifetime really means for as long as you own your new car—even if you keep it for a lifetime. After all, thousands of people are already driving over the 100,000 mile mark using Quaker State without this protection program. Now, you can do it with Quaker State and have this *extra* protection for as long as you own your new car.

Q. Why is Quaker State the only motor oil with a written Lifetime Engine Lubrication Protection Program?

A. We've been making quality motor oil since 1910. In all that time, millions of people have depended on our ability to help them stay on the road. All that "on-the-road testing," plus our own laboratory tests through the years, are all the proof we need. Quaker State has the confidence in its product to put our promise of quality in writing.



STAYIN' ON THE ROAD WITH QUAKER STATE

DETROIT LISTENING POST

Detroit minicars for '84

Although minicars have been common in Europe and Japan for years, there has never been a market for them here. But Detroit is betting that within a few years there will be substantial U.S. demand for tiny two- and four-seat cars powered by small-displacement three- and four-cylinder engines that deliver 40 to 50 mpg.

GM is developing a very small front-wheel-drive (fwd) hatchback, the S-car, which is scheduled for introduction in Europe in 1983. It will make its U.S. debut a year later. Smaller than the current rear-drive Chevette, the S-car will come in both two- and four-passenger versions with standard three- and optional four-cylinder engines in the 1.5 to 2.0-liter range. City mileage will exceed 40 mpg.

Another GM program involves a still-smaller commuter car with a tiny, motorcycle-type engine. A production possibility for the late 1980s, this one could deliver as much as 80 mpg.

Ford, meanwhile, is going the shortcut route by negotiating an agreement with its Japanese partner, Toyo Kogyo (maker of Mazda cars and trucks), to import a TK-built fwd mini beginning in 1984. It's a four-seater that's smaller than the European Ford Fiesta. Powered by a new TK three-cylinder engine, it should achieve city fuel economy in the 40 to 50-mpg range.

Chrysler is planning a similar time- and moneysaving end run with Peugeot of France. The two companies will jointly develop a small fwd Omni/Horizon replacement that will be introduced in '84 or '85.

VW plans to have its next-generation Rabbit (one version possibly powered by a 50-plus-mpg turbocharged three-cylinder diesel) in production by late '83 or early '84.

Sports-car news

And speaking of small cars, the two-seat, mid-engine, fiberglass-bodied, Pontiac P-car "commuter" may be ready for production earlier than originally expected. If development continues to go well, the commuter may make an appearance a year from now.

Both Ford and Chrysler have sports-car competition in the works,

but Chrysler may get there first (by mid-1983) with a fwd K-based two-seater with Porsche (924/928) styling and a hopped-up, fuel-injected, turbocharged version of the new 2.2-liter four-cylinder engine.

Thousands of electrics

GM may not hit its current target of 1985 for a marketable electric car, but vice president and technical staff group executive Alex Mair remains optimistic. He says that his company will be selling 200,000 electric vehicles a year by the end of the decade.

A realistic production startup target for GM EVs is likely late 1986. The Japanese, who are rumored to be well under way with their electrics, may be first with quantity-built EVs.

GM V8s deep-sixed

Pontiac has become the latest GM division to scuttle production of V8 engines in favor of more fuel-efficient powerplants. In Pontiac's case, the 4.9-liter V8 (the division's last) goes out the door to make room for the 2.5-liter Four, which will be standard in both the new, fwd, mid-size A-cars and the smaller Camaro/Firebirds which are expected late this year.

Buick was first to completely drop V8 production (to maximize V6 capacity) about a year ago, and Oldsmobile may be next. The famous Olds V8 diesel may go too, sources say, when a new diesel V6 is ready in 1982. And that V6 oil-burner option, intended for transverse mounting in those fwd '82 A-cars and '83 "full-size" B-cars, is rumored to give 30 mpg city and 40 mpg in highway driving.

Plastic body panels?

Sheet-metal body panels may be on their way out. If supplier PPG Industries gets its way, the metal panels will be replaced by plastic ones.

PPG's "Phase Alpha" thermoset resin system, which allows construction of large panels such as hoods and decklids in strong, lightweight plastic, is now being tested by Detroit's automakers.

Another source says that GM's S-car mini is likely to have a hood, decklid, roof, and perhaps even doors and fenders of sheet-molded

compound (SMC) plastic when it makes its debut in '84.

New performance catalogs

The fourth edition of *Chevrolet Power*, the Chevy performance bible, is a combination catalog and how-to manual. It contains sections devoted to small-block and large-block V8s, the twin-cam Cosworth Vega four-cylinder, and 90° V6 engine. It's available over the dealer's counter for \$6.95.

Holley's *1981 Performance and RV Parts Catalog* contains specifications and recommended applications for Holley performance and efficiency products. The catalog features a special section on the new Z-series high-torque, high-fuel-efficiency intake manifolds and a list of new 1981 products. Send for part No. 73000-11, \$1.50 (check or money order), to Catalog Sales, Holley Replacement Parts Div., 11955 East Nine Mile Rd., Warren, Mich. 48090.

AMC exports hit snag

The anticipated export of AMC 4x4 vehicles to France has run into some problems. The French Government has slapped a heavy tax on large-displacement engines. This would virtually eliminate the large Cherokee and Wagoneer models from the French marketplace. The CJ line, however, will not be affected by this tax.

Both diesel and gasoline versions of the CJs are being built especially for the French market, with styling and tuning input provided by a team of Renault engineers.

Eventually, AMC hopes to tap the potentially huge demand for off-road vehicles in Africa, where Renault has a powerful dealer network. **PM**



WHEN YOU'VE GOTTA RELY ON YOUR CAR, RELY ON HARDWORKIN' AC-DELCO PARTS.

AC-Delco. They're the hot-firin', cold-crankin', road-handlin', dirt-fightin', hardworkin' replacement parts for your car.

For more than 50 years, hardworkin' people have relied on AC-Delco parts. In their cars. Trucks. Boats. Motorcycles. It's

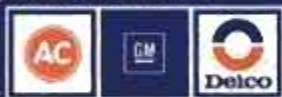
the one name they look to for just about everything — for just about anything that moves.

There's hot-firing AC Fire Ring Spark Plugs. If your spark plugs are misfiring, a tune-up and a fresh set of ACs can help improve mileage. Big Delco Shocks. Tough AC Filters to help trap dirt.

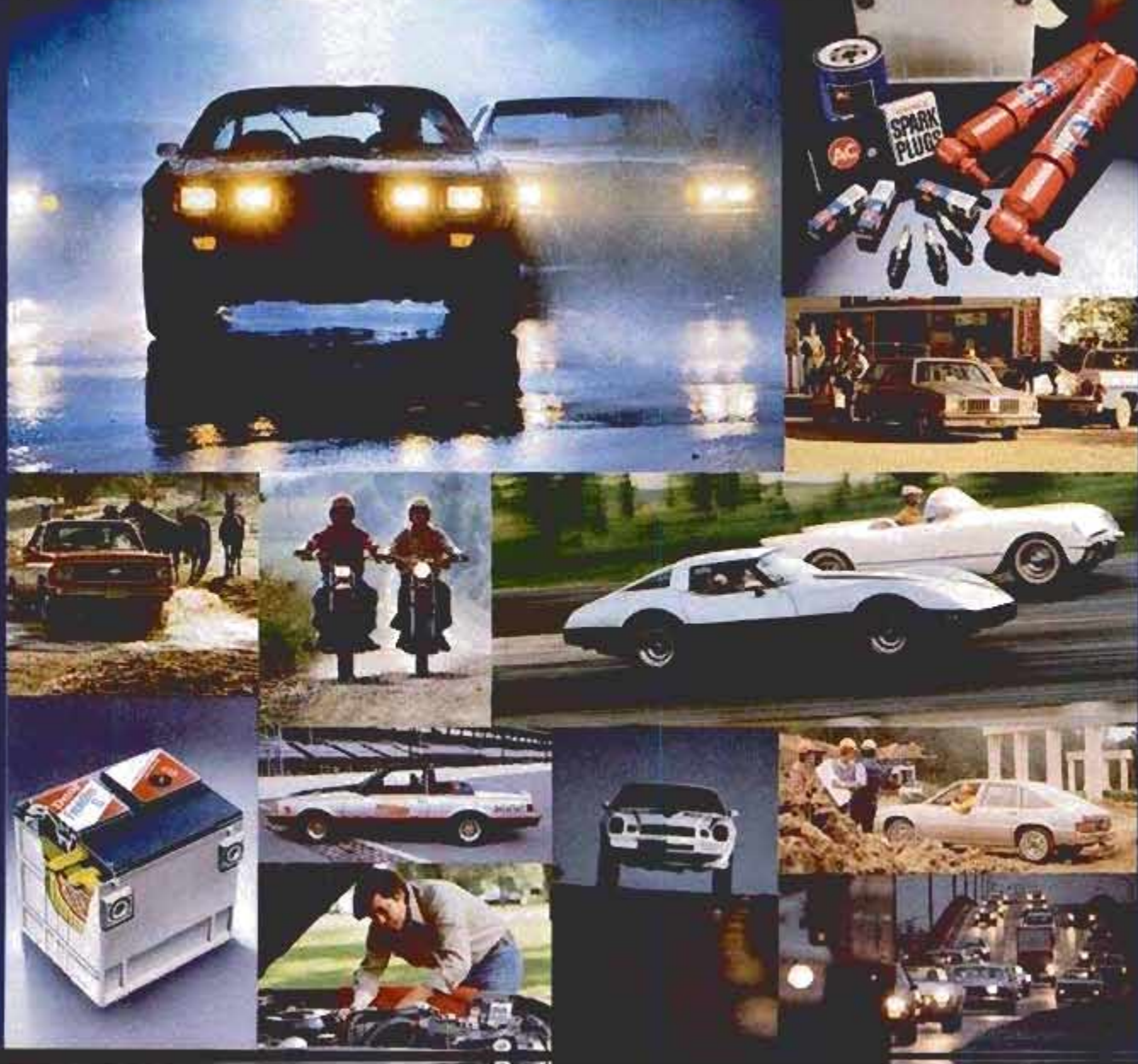
And maintenance-free Delco Freedom II Batteries. For quick, powerful starts in any

kind of weather. Even in the gruelin' heat of summer that's really tough on batteries. If your car's battery is showing signs of failure, get ready now for the summer driving months ahead. Ask for Delco Freedom II starting power.

When your car's got work to do, go with the brand that's built its reputation on hardworkin' reliability: AC-Delco.



AC-DELCO WORKIN'



HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Brush-on insulation?

My house is constructed of maintenance-free red tile blocks that are exposed on the outside and covered with 1/2-in. plaster inside, applied directly on the surface. There is no insulation in these walls and, due to a tight budget, I can't add insulated siding to correct the problem. Is there any brushable or sprayable clear liquid I could apply to the outside to form a weather barrier and thus reduce the heat transfer?—Mark Tatlock, Seymour, Ind.

Sorry, no. If there were, it would be fantastic!

Three-pronged question revived

We have received several letters regarding the "Three-pronged question" (*Homeowners' Clinic*, page 30, Jan '81). It is correct that an appliance can be operated between the black (hot) and the green grounding wire. However, this is only incidental to the problem at hand.

The reason the National Electrical Code requires that all receptacles be of the grounding type is to ensure the grounding of the appliance housing. In the two-wire-plus-ground setup, the green wire in the appliance cord is connected directly to the housing so that, when a fault occurs, the current will pass harmlessly back to ground instead of being conducted through the housing and possibly to you.

Sweating it

I am considering putting a vapor barrier on both sides of the outside walls of a new house I am constructing. Will sweating occur between the two layers?—Larry Dever, Huntsville, Tex.

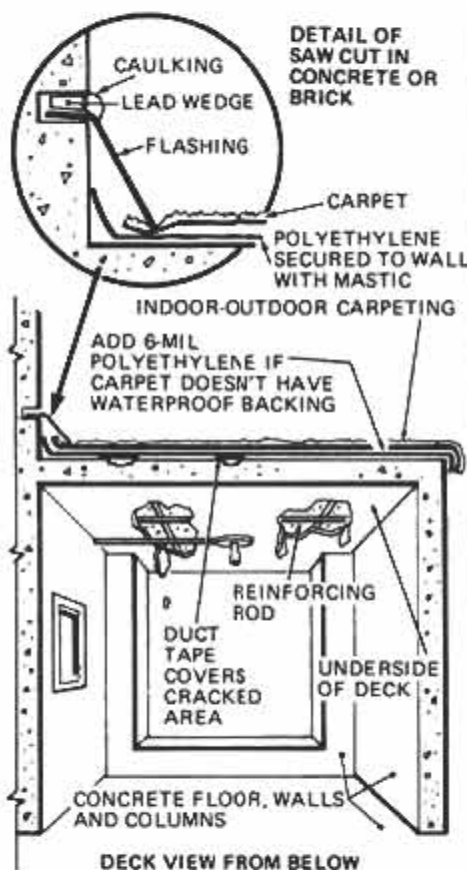
The vapor barrier must be installed on only the warm side of an exterior wall. Otherwise, any moisture that gets inside the wall will be trapped there and wood rotting will certainly follow. (See "Mildew and peeling paint," *Homeowners' Clinic*, page 52, Oct. '80.)

Deck's crumbling

The underside of my concrete front porch deck has deteriorated to the point where the steel reinforcing rods are showing. This is due to rain and snow seeping through the slab from cracks on top. Over the past 20 years, I've had all sorts of suggestions, including pouring another 4 in. of concrete on the top.

Patching cement never stays on, so I covered the cracks with aluminum duct tape and contact-cemented indoor-outdoor carpeting over the deck. It looks good and neighbors have copied the idea, but I'd still like to solve the real problem if it can be done inexpensively. What say you, oh seer of the Homeowners' Clinic?—Nick Gaudio, Chicago.

Nick, I haven't used my crystal ball since Mrs. O'Leary's cow broke it in your big fire. I think your solution was pretty reasonable, but I



If carpet doesn't have a waterproof backing, install 6-mil polyethylene; adhere it with roofing mastic. Then apply flashing.

would add the following stipulations for others, which you might check.

1. Not all indoor-outdoor carpeting has a completely waterproof backing. If yours doesn't, add 6-mil-thick polyethylene between the deck and the carpet.

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.

2. As long as the deck is pitched a minimum of 1/4 in. per foot away from the house, and properly flashed, you should be okay.

3. Flashing is very important because any water that gets under the carpet after it's installed will be extremely hard to detect.

4. With the kind of deterioration shown in the drawings you sent, I would consult a structural engineer to verify strength of slab and security of its house connection.

5. If the engineer gives you the green light, I suggest you use Euco Poly-Patch, a combination of cements, silica sands, bonding additives and plasticising agents (about \$13.50 per 50-pound bag). This may be mixed with water or, for superior bonding, with Flex-Con (about \$9.50 per gallon).

If you use the latter, follow the directions on the bag and container, but keep in mind that you'll need about 1/2 gallon of Flex-Con per 50-pound bag of dry mix. Any large holes between 2 and 3 in. deep should be brought up to finish in several applications. If your local building-supply house doesn't carry these products, write to Euclid Chemical Co., 19218 Redwood Rd., Cleveland, Ohio 44110, for the nearest supplier.

LAWN CARE TIPS

Low rainfall and enforced water restrictions in some parts of the country necessitate changes in normal lawn care. Here are some suggestions on spring lawn care for water-restricted areas from O.M. Scott & Sons:

■ **Mowing.** Raise the height of the cut. This is a key step, as taller grass will shade the soil, reduce evaporation, protect root system.

■ **Watering.** If any watering is allowed, try to save it so you can use your regular sprinkler, rather than watering frequently but lightly. However, avoid wasteful runoffs.

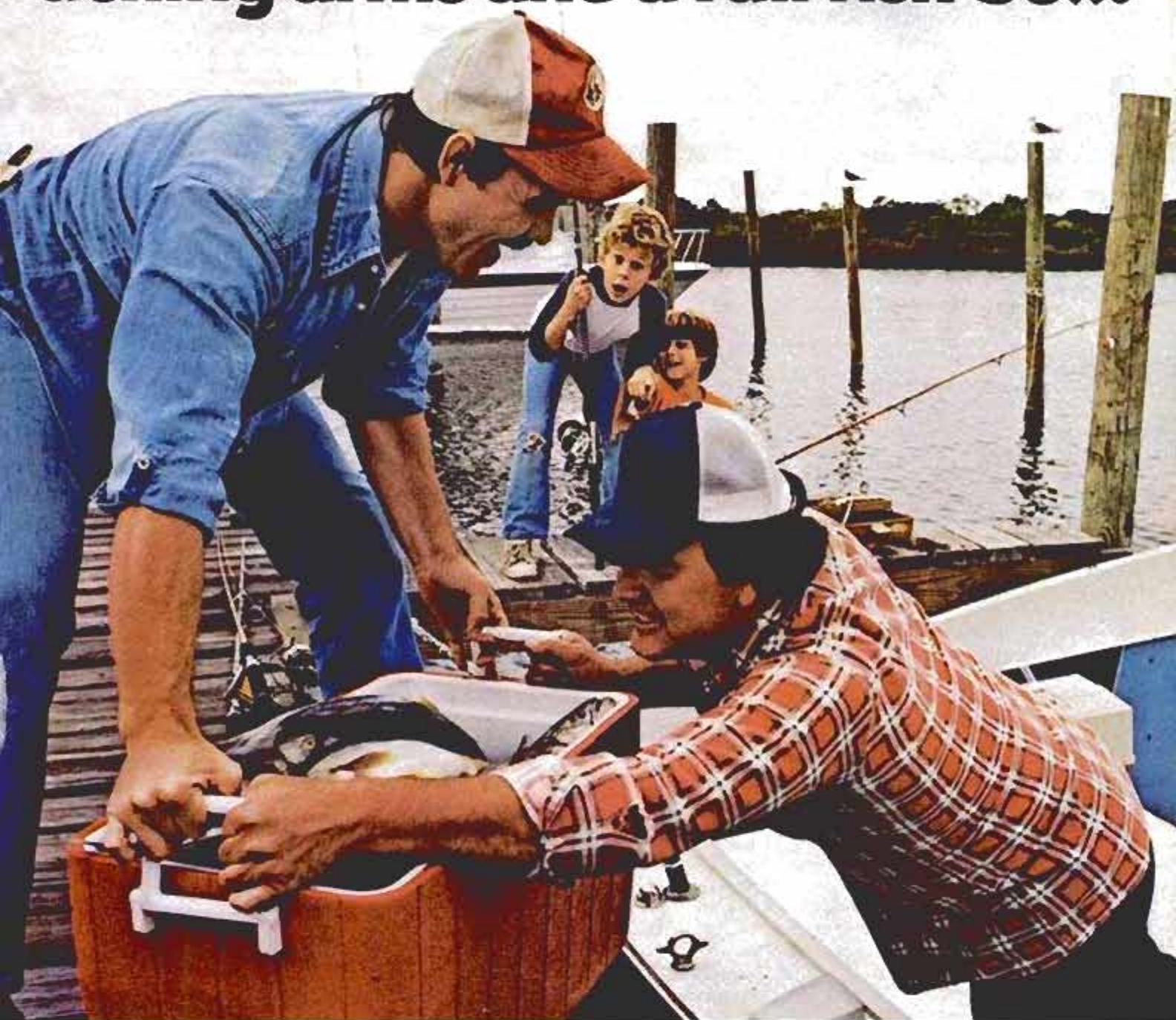
■ **Fertilizing.** Proceed as in any other year. However, use fertilizer that doesn't have to be watered in after application.

■ **Seeding.** With restricted watering, it's probably too late to start a new lawn, but you can sow seed on thin spots.



BY JOHN GAYLOR

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CAR CLINIC

SOLUTIONS
FOR MECHANICAL
HEADACHES

BY
MORT SCHULTZ



Repeating myself

In the March '81 Car Clinic, you told Len Perone that he can mix radial tires with other tires. This is contrary to every bit of safety advice about tires I've ever read. Please correct your statement before some of your readers have accidents.—Charles Warner, Covington, Va.

I've gotten several letters similar to yours, and all I can say, as politely as possible, is: *Read the question and answer more carefully.*

The question was, "Can I use steel-belted radials and fiberglass- or fabric-belted radials on the same car?"

The answer was, "It's okay. Mixing radials with different belting materials won't affect a car's handling."

Nothing was said about mixing radials and bias-ply tires on the same car, which should never be done. But it's okay to use fabric- and steel-belted radials on the same car. Got it?

On the right track

I noticed fuel leaking from several connectors soon after repairs were made (by a Cadillac-Oldsmobile dealer) to the electronic fuel-injection (EFI) system of my 1978 Coupe DeVille. Attempts at tightening connectors and sealing leaks have failed, and I've been advised to have the entire fuel rail replaced. This is expensive. Is there no other way of sealing connecting points? Please rush your answer. We're not driving the car for fear of fire.—Edward Gordon, Madison, Wis.

I'm wondering if your Cadillac mechanic is aware that once he loosens fuel-rail-assembly connectors, he has to install special conical gaskets when reassembling these fittings. Gaskets aren't used by Cadillac when EFI systems are installed on engines at the factory, but they are necessary when repairs are made that involve taking apart the fuel-rail assembly. A gasket (part No. 1608786) should be installed in each connector that's loosened to

make repairs. Furthermore, if another repair has to be done in the future, old gaskets must be replaced with new ones.

A quake in Quakertown

My 1980 Plymouth Volare (225-cu.-in. engine and automatic transmission) has had an engine vibration, almost like a miss, since I took delivery of the car last November. The people at the dealership have done everything they can think of, including a complete tune-up and checking engine mounting pads. They have been more than cooperative, and I have no quarrel with them. We're all looking for help. Can you give it to us?—Walter Sullivan, Quakertown, Pa.

Maybe I can. It depends on whether the dealer overlooked the possibility that vibration is being caused by a loose alternator mounting bracket. A member of Chrysler's service department in Detroit tells me that many 1980 models equipped with 225-cu.-in. engines went to showrooms with inadequately torqued brackets.

To determine if your car is one of these, remove the alternator drive belt. Start the engine. If there is no more vibration, tighten the three parts of the alternator mounting bracket to specification.

Torque the bolts on the two parts of the bracket assembly on which

the alternator rests to 30 foot-pounds. These parts are attached to the underside of the alternator and to the engine. Torque the bolts of the horizontal bar attached to the top of the alternator and to the engine to 200 inch-pounds.

Readers get a say

Every time the mail deliverer stops at my desk with a bundle of letters that ask questions, I also get several letters from readers who have additional information or corrections to what I've said in past columns. Many of these readers are professionals and much of what they have to say is worthwhile. So, every so often, I like to devote part of a column to their comments, with thanks. Here are two:

1. "In regard to the Feb. '81 Car Clinic item on GM X-body cars with shifting problems, the input gear and not the bearing was changed in production," Louis Ray writes. He's shop foreman at Southern Chevrolet Co. in Alexandria, La. "It wasn't your fault, Mort. The bulletin has a misprint."

The bulletin Lou refers to is No. 80-I-37. The correct information is that the input gear (not the input gear bearing) in the manual trans-axle of the X-body car was changed in production as of Nov. 16, 1979. If you have a car built before this date, and it has a shifting problem, have your dealer replace the old input gear with the new one. The part number of the new gear, which dealers should have in stock, is 14020899.

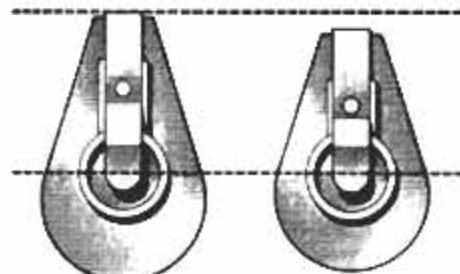
2. "As a professional mechanic certified by the National Institute of Automotive Service Excellence, I find your column contains answers to several common, as well as not-so-common, problems many mechanics often overlook or simply don't realize exist." So writes Jerry Stuckey, shop foreman at Air Base

(Please turn to page 48)

Rotary club

Whether your distributor has electronic ignition or breaker-point ignition, it can probably be fitted with a number of rotors, each a different size. However, only one size will work, and that's the correct size. An incorrect rotor will not meet sparkplug voltage requirements and, as a result, engine performance and fuel economy will suffer.

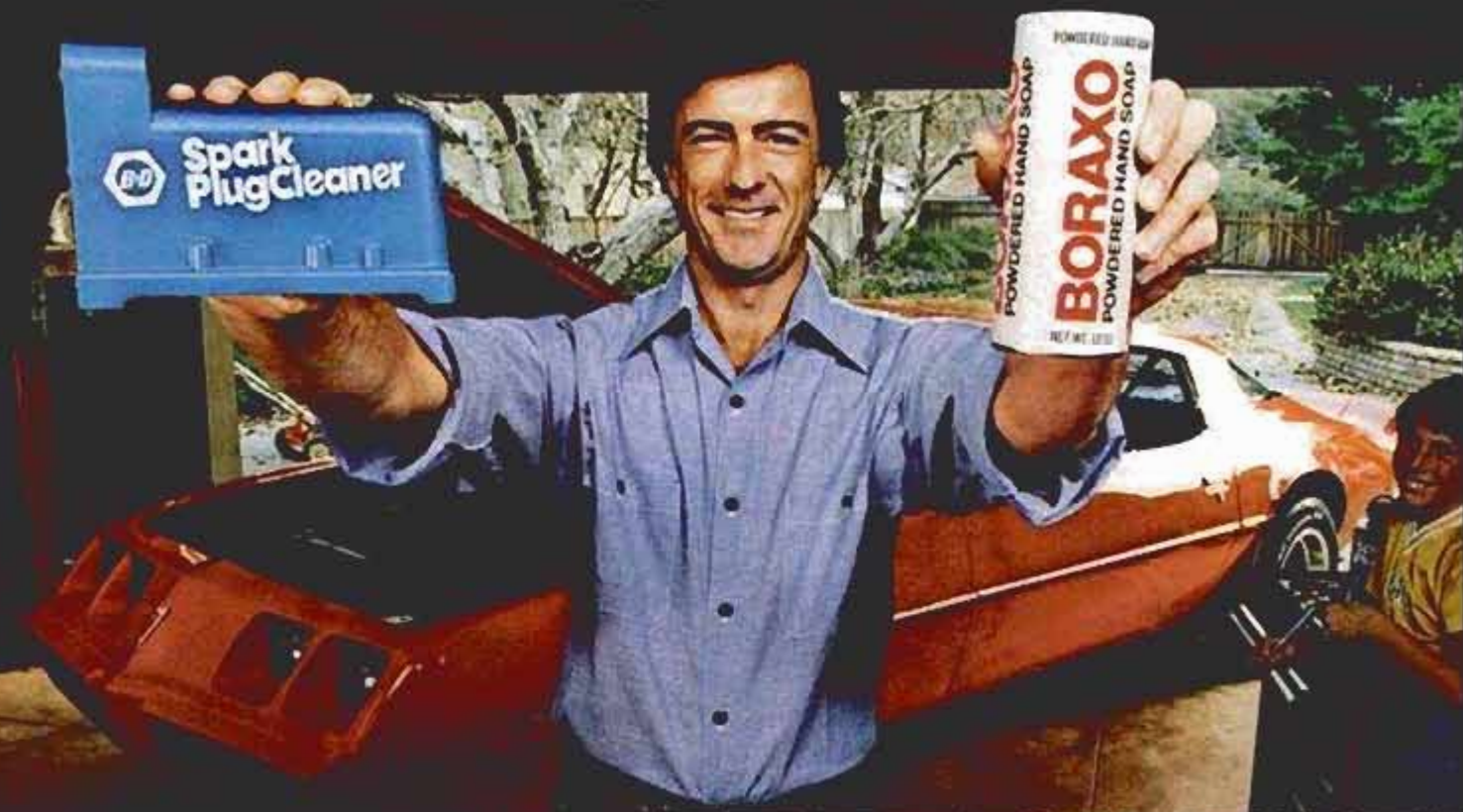
When you're replacing a rotor, match the new part number to the old part number. They must be the same. If one of the part numbers isn't available, line up the old and new rotors. They must be identical in size. Don't take the word of an auto parts clerk that the rotor you're buying is the right one for your ignition system.



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(Allow 6 weeks for rebate.) Offer expires Dec. 31, 1981. Postmark no later than Jan. 31, 1982.

CAR CLINIC

(Continued from page 46)

Auto Repair in Montgomery, Ala.

However, Jerry takes exception to what A.R. Spahn had to say about the tendency of GM High Energy Ignition rotors to develop dielectric puncture (*Car Clinic*, Mar. '81). A.R. suggested switching to a new rotor before severe damage is done to the rotor shaft. Jerry says that A.R.'s solution will not cure the problem, but just delay it.

"The main cause of dielectric puncture is too much resistance of sparkplug cables," Jerry claims. "This extensive resistance inhibits the flow of energy through the cables. When dealing with 35,000 volts, the easiest path for the energy is through the rotor to the rotor shaft. I recommend checking sparkplug-cable resistance and replacing cables that aren't within manufacturer specification. It is sometimes necessary to perform this check with the engine under load instead of at idle. And this check should be part of every tune-up to prevent trouble."

Finally, writes Jerry, "Keep up the good work and many thanks for all your helpful hints I've had occasion to use."

Pinioning it down

The car in question is a 1971 Datsun 510. The problem, which has been with me for two years, is with the starter motor. It makes a terrible grinding noise every so often. If I let it stop turning and try again, things usually work normally. However, the trouble seems to be getting worse, because now the starter occasionally makes this noise two or three times in a row. What's wrong?—Edward Caldicott, Huntington, N.Y.

Probably a worn starter pinion gear that's not engaging the flywheel ring gear. But, if not, maybe it's a worn flywheel ring gear that's not allowing the pinion gear to engage. Or maybe both. In time, you will have to replace the pinion gear and/or ring gear.

Capping a gusher

There's oil coming from the 1600-cc Silent Shaft engine of my 1978 Dodge Colt, and I don't know why. The right side of the engine gets coated. I clean it off, and a couple of days later the same thing happens. My mechanic is baffled.

How can oil "leak" through a solid engine block? Of course, rocker-arm and oil-pan covers have been checked. The oil is not coming from either, so

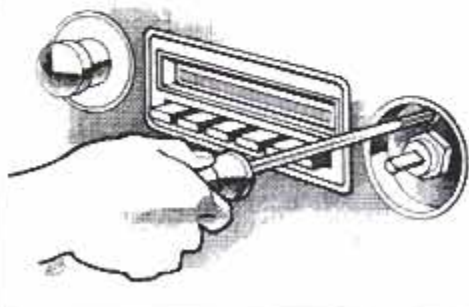
Trim up and tune down



If you have a radio antenna built into your car's windshield, there is probably a small screw just above the tuning shaft of the radio. It's an antenna trimmer-adjustment screw, and its purpose is to enable you to get the best possible AM reception.

If you're having trouble pulling in an AM station, or if a usually strong AM station is fading in and out, turn the volume control all the way up and tune to a weak AM station at about 1400 kc.

Pull off the tuner-control knob and turn the trimmer-adjustment screw until maximum volume is attained. Peak volume is normally reached when the screw is set about one-quarter turn from the full clockwise position.



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from where?—Bill Lewis, Waltham, Mass.

From a spot you'd never find unless you knew it was there. I'm talking about a little breather-type hole in the engine, just to the rear of the front case. The hole is directly above the right front Silent Shaft bearing and forms a natural exit point for oil that the shaft churns up.

Tell your mechanic that Chrysler Corp. has issued a little aluminum ball (part No. MDO34007). If it's pressed into the hole, the oil squirt will stop. However, he shouldn't press it down too far, because then the ball will interfere with the front case bolt. Push the ball into the hole until its center is about 1 mm below the surface of the engine. If it's positioned properly, the top of the ball will protrude above the surface of the engine. This also applies if you have 1978-80 Colts and Arrows with the same trouble.

Encore

I recently installed a new carburetor on my 1976 Ford Torino with 351-cu.-in. engine. Since it was installed, I've had a hesitation-on-acceleration problem that I haven't been able to remedy. I seem to remember reading of a solution in Car Clinic a while

back. Can you repeat it for me, please?—Bill Stack, Burbank, Ill.

Sure, Bill. Reposition the accelerator-pump operating rod, located on the throttle-actuated bell crank, to the No. 3 position. This increases the accelerator-pump travel. Also, reset the automatic-choke index from the two notches RICH to the three notches RICH position. Eliminate the electric choke by disconnecting the wire from the choke cap.

Wild horse

Since I bought my 1979 Ford Bronco, it's been hard starting. Once started, it bucks and snorts until the engine warms up. I'm told I have to live with this. Please say it's not true.—Fred Sill, Colorado Springs, Colo.

Okay, Fred—it isn't true. Broncos (and F100 pickups) with the problem can be broken by disconnecting the wire that feeds current to the electric choke. Fold the wire back and secure it to the wiring harness with electrical tape.

GOT A PROBLEM WITH YOUR CAR?

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

SERVICE TIPS

■ VW has introduced a binding arbitration plan for VW, Porsche and Audi owners who can't solve their differences with dealer service departments.

The plan operates under the auspices of the Council of Better Business Bureaus. If you and dealer service are at loggerheads, write to the customer assistance department in your area (look in the owner's manual). If matters can't be resolved and you go to binding arbitration, you will be given a list of residents in your area. From this list, you and the dealer have to select an arbitrator who will make a ruling to which both parties in the dispute are bound.

■ You can get rid of those annoying singing or humming sounds you're hearing from the engine compartment of your 1981 Omni, Horizon, Aries or Reliant. Have your dealer refer to service bulletin 24-02-81 (1/9/81). The heart of the repair, which will reduce the high coolant flow rate that's giving you those soprano noises, is a new flow-control valve (part No. 3848004) that must be installed in the heater return hose.

■ More and more cars are using radiators with plastic tanks (Rabbit, Scirocco, Dasher, Mercedes, Renault, Escort and Lynx are some).

One of the major reasons for damage incurred by these tanks is the overtightening of hose connections. Too much pressure will split the inlet, so be careful.

PM taste-tests future food



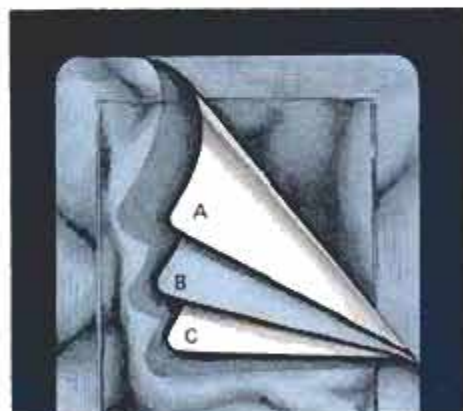
If it can deliver flavor, the retortable pouch may replace bulky cans, as well as energy-extravagant frozen foods.

We have tasted the future and it is, well, not bad. That's the essential conclusion we drew from a brief but intensive PM gobble-in, held to evaluate meals prepared and packaged in food technology's most talked-about innovation—the flexible retortable pouch.

The food items we tried are not yet available in much of the country, but are being tested in selected areas by some heavy hitters in the food business: Kraft Foods, ITT Continental and a Canadian subsidiary of United Biscuit called Magic Pantry.

The meals were packed in Flex-Can pouches supplied by Reynolds Metals Co., one of the few companies to have its pouch approved by the U.S. Food and Drug Administration. Under less stringent rules, this packaging is already far more widespread in Japan, for instance.

As energy awareness sweeps over all facets of life, great changes are being wrought, and food processing



Pouch has three layers: inert polypropylene (A) contacts and seals off food; aluminum foil (B) bars light and oxygen; polyester (C) is tough, accepts printing.

PM testers (from left): executive editor Robin Nelson, editor John Linkletter, asst. home/shop editor Penny Spangler, science editor Gurney Williams, outdoors editor Bill McKeown, art director Ira Herrick.



Retortable food pouches store like books, heat easily on campstove.

and packaging are bound to be affected. Anyone can deduce that distribution and marketing of precooked frozen foods, for example, require lots of energy—from the manufacturer's cooking, then freezing, to the grocer's freezer storage case (a major part of his overhead) to the consumer's refrigerator storage and eventual reheating.

Yet alternative means of packing precooked foods—like cans or jars—don't usually deliver the fresh-cooked flavor that frozen foods approximate. This is often due to what one Reynolds executive describes as "the middle-pea problem."

When a can of peas, for example, is heat-processed on a canning line,

enough heat must be applied to the can to thoroughly cook the "middle pea" in the can. Therefore, any number of perimeter peas will be overcooked—and, coincidentally, more energy will have been expended than necessary.

Store food indefinitely

Enter the retortable pouch, so called because raw food is placed in it, then cooked after sealing in a steam-pressure vessel or retort. The resultant package can be processed quickly at the cooking temperature desired (due to the flat profile), and may be stored indefinitely without refrigeration.

The weight saved is another energy factor when transportation is considered. The typical steel-can material required for an equal amount of processed food will outweigh the requisite pouches almost by a factor of 10.

After more than a decade of developmental wrestling with such problems as the migration of sealants into the foods, a basic three-ply pouch using inert polypropylene as the only material contacting food is being tried for more applications. The Department of Defense recently contracted with Reynolds to switch all Army C-Rations into pouches.

At PM, we thought it was time for a preview of what our convenience foods will taste like in the totally energy-budgeted future. In a trial of 15 different meals selected from among those now being tested, the editors dug into everything from chicken à la king and Salisbury steak to sweet-sour pork.

In more than 90 percent of the trials, individuals rated pouch-packed meals over similar (by recollection) canned meals.

In more than 50 percent of our taste tests, pouch food was rated equal to or better than similar frozen convenience meals. Appearance and texture were listed as problems in a small minority of cases. (Chicken à la king was rated down for appearance so often we wrote that off as the nature of the beast.)

The overall response: surprisingly good for nonfrozen, precooked, packaged meals. A specialty item, smoked salmon (Gold Seal Specialty Seafoods, Anacortes, Wash.) got outright raves. The Bravest Attempt award went to the stuffed cabbage (Magic Pantry), the flavor of which was judged as good by about half the panel and "bland" by the others.

For convenience and outdoor applications such as camping and boating, the future of pouch foods is already here.—Robin Nelson

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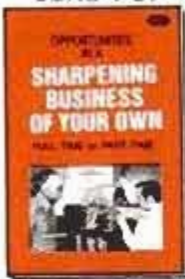
If you need only \$200 or \$400 extra income each month, a sharpening business is ideal for spare time. The additional dollars can be SPENT for more of the good things of life. Or they can be SAVED in a rainy-day fund that the family can bank on.

More sharpening businesses are needed every year

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

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HINTS FROM READERS

Tin-can stilts



Measure and cut rope so it's taut when user's arms are extended downward.

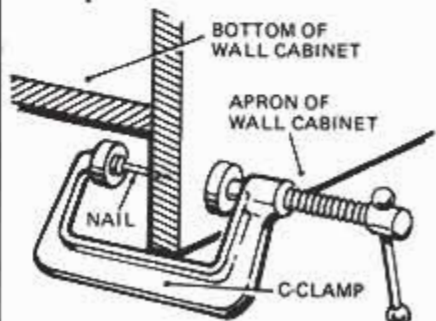


Draw the rope through both holes in the bottom of the can and knot the ends.

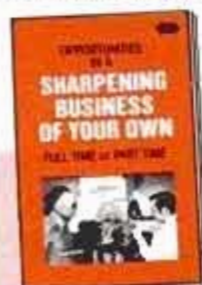
To make tin-can stilts, punch two holes directly across from each other along the bottom perimeter of two inverted 2-lb. coffee cans. Draw a rope, approximately 40 in. long, through the holes in each can and knot both ends.

—Alan W. Farrant

Clamp drives nail



I used a C-clamp to force a nail gently into the back side of the bottom rail of a kitchen cabinet so I could hang my car keys. This won't disturb contents of the cabinet.—Walter Fehiberg



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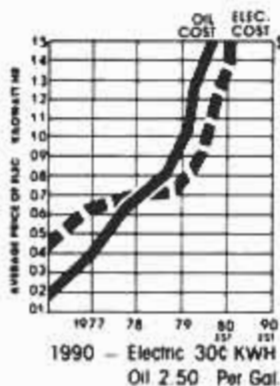
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PM's Whatsit

No question that this is a unique piece of outdoor furniture, but what's sitting behind the grillework should tell some of you, at least, a lot more about it. We'll show the rest on the next page.

Vacuum chamber restores documents

When the turn-of-the-century courthouse in Spalding County, Ga., burned recently, firefighters did their best to save valuable books, mortgage papers and other important legal and historical documents. Unfortunately, most were heavily water damaged, but local officials knew exactly what to do. As had happened in a previous fire, the soaked papers were taken to the high-altitude chamber at Lockheed-Georgia Co. in Marietta. With the chamber evacuated to the equivalent of 60,000 feet of altitude, the temperature was raised to about 140° F., at which point all the water soon vaporized and was passed off as harmless steam, leaving the court records in their original condition.

The Lockheed chamber is normally used to test new aircraft parts and systems at simulated high altitudes.



Notes from underground

Of the many recent schemes and plans we've seen for earth-covered construction of one kind or another, the U-Dome (from Master Press, Box 432, Dayton, Ore. 97114) looks like one of the best ways to get your feet wet. It's basically a dome, 12 feet in diameter by about 9 feet high at the apex, uniformly bermed over with 2 feet of earth and therefore capable of providing insulated storage—as stable as 55° year-around, depending on location—for dry goods (root cellar) or wet, as in wine. It can even serve as an underground sauna, and one Oregonian built a larger underground dome which is a working goat-farm dairy facility.

Recycled half-inch water pipe is bent into shape for the frame, set into a foundation of ready-mix concrete reinforced by old wire fencing. Complete plans and suggested applications, inside and outside, are \$12.95 from Master Press.

Shape of things to come?

As a prototype for a shallow-diving submersible in which he plans to circumnavigate the Florida coast, Larry Miller of St. Petersburg built this wedge-shaped, radio-controlled, near-surface cruiser. He equipped the 7-foot vessel with a periscope through which photos are taken with a remotely controlled Olympus OM-10 camera. Builder Miller says the radical lines of the prototype have proven out hydrodynamically for what he has in mind. He's starting to work on the 21-foot version in which he will cruise along, "taking pictures and having fun."



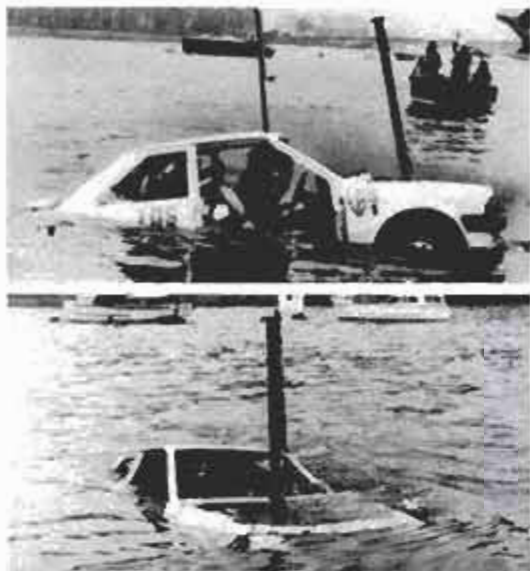


Whatsit revealed

Dave Carbas of Newport Beach, Calif., had his VW Beetle rebodied in Zacatecas, Mexico, by a local wrought-iron artist. We know what your first question is, and the answer is about \$7,000. For that, Dave got back a Beetle that weighs just about the same as the original body, and its balance is intact. He'd even like to drive it more often, when weather permits. Except, he says, "It stops traffic."

Dry humor

The British makers of a new demosturizing lubricant spray called LPS 1 hit on the perfect demonstration of its alleged protective capabilities. After spraying a Ford Escort's engine and electrical contacts liberally, and fitting it with breathing and exhaust extensions, they hired a frogman to drive it into the Thames River and out again. Could be the answer to the downtown parking problem.



Roundtrip Atlantic hop will challenge air racers

There could be a lot more than pure sport at stake when French organizers send off some 100 assorted civil aircraft on a *transat en double*—Paris to New York AND return—race June 6, in connection with the annual Paris Air Show. Among the several competing divisions will be single-engine piston planes (don't forget the Mae West) and biz-jets. No wing-and-a-prayer microlights, though, since seven days is the outside limit for all competitors to finish up back in France (with optional fuel stops). All entries

will be required to land and remain 24 hours at the Bridgeport, Conn., municipal airport.

Even utilizing all the pit stops on the old World War II ferry flyway (Gander, Reykjavik, et al), some of the lighter aircraft at low altitudes will be extended to their endurance limits as they buck headwinds on the westbound leg. But the publicity sure to await winners, particularly in the smaller classes, might be worth the proverbial million to a manufacturer or other vested interest.

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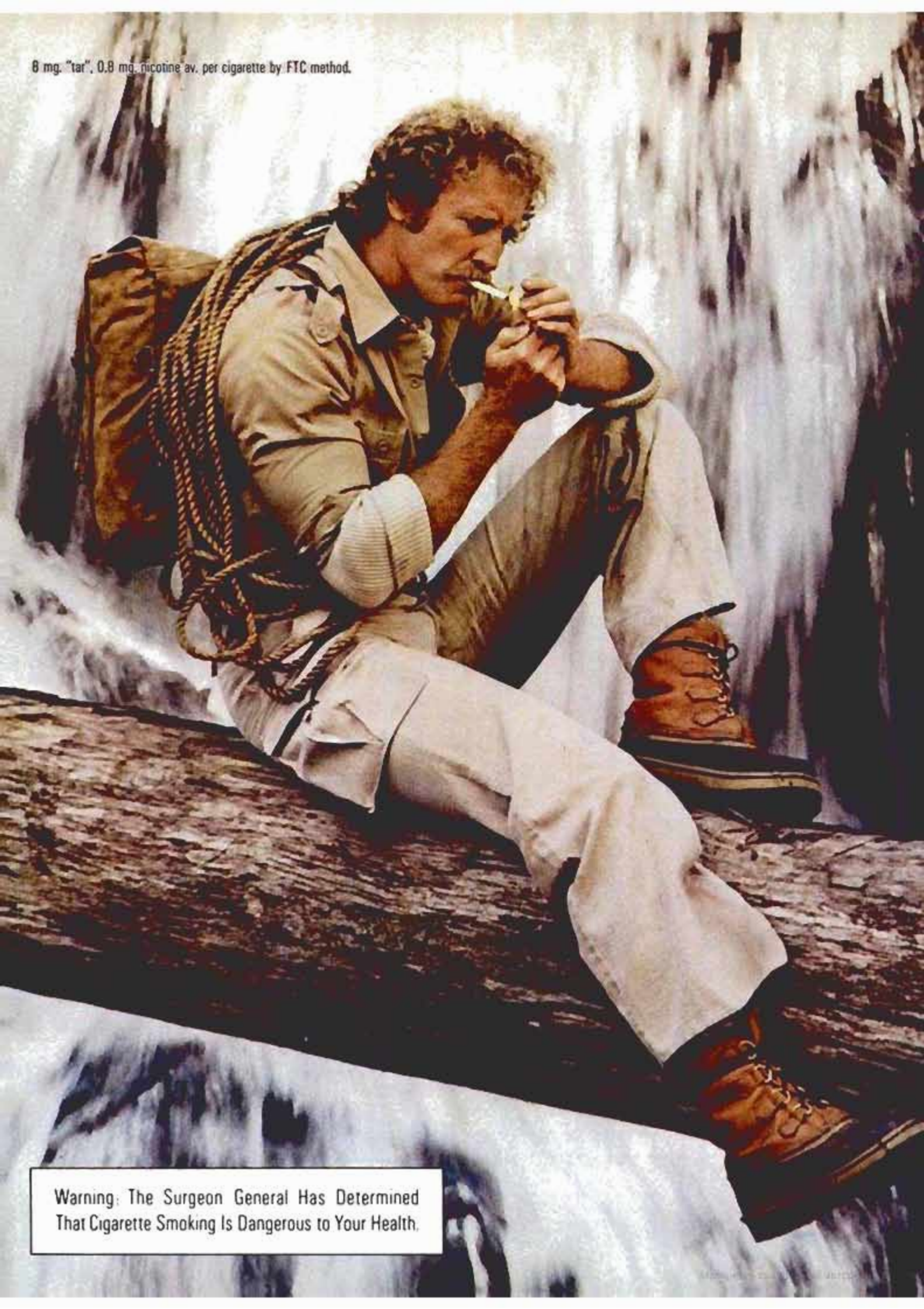
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Stirling Moss road tests the De Lorean sports car



Before the first production models of the long-awaited De Lorean sports car were readied for export, PM sent British race-car driver Stirling Moss to John Z. De Lorean's plant in Northern Ireland to drive the gull-wing two-seater. Shortly after, Auto Editor Tony Assenza visited the Dunmurry facility for a firsthand look at the plant, the car and the former GM executive who wants to put an all-new sports car on American roads. Here's their report.

Moss: The De Lorean is certainly a striking-looking car—long, low and extremely sleek. Like the old Mercedes 300SL of the '50s, it has gull-wing doors, a design it shares only with the Lamborghini Countach. They make access and exit easier, but once you're sitting in the low and very comfortable seats, you



With Moss at the wheel, unique new car flashes by on De Lorean Motor Co. (DMC) test track. Cast in the exotic-car mold, the De Lorean features a fiberglass underbody to which a stainless steel skin is laminated. Styling is by famed designer Giorgetto Giugiaro; car is assembled in Northern Ireland.

find you need the arms of an ape to reach up to close the doors behind you.

The controls are nicely arranged for driving quickly, with the gearshift lever falling easily to hand for grabbing gears. It's a five-speed unit, with

fifth being an overdrive. I found fifth quite useful for cruising at moderate highway speeds, but it needs to be downshifted to a lower gear for acceleration. The engine doesn't produce enough torque to overcome the gear

ratio. Getting into reverse isn't as much of a chore as it is on so many other so-called sports cars.

There are electric windows, though they only open a few inches. I suppose the only time you might need them is



Short, 94.8-inch wheelbase and a low center of gravity give the car excellent handling characteristics and fast transient response.



One-piece, wishbone chassis is the major frame member. The engine resides in the rear, with the gas tank and radiator at the front.

to ask someone the way or pay a toll, since the car is fully airconditioned, with vents in the doors as well as the center of the dash.

Assenza: The car's styling was done by the now-legendary Italian studio,

Ital Design, headed by Giorgetto Giugiaro. His design credits encompass a variety of vehicles, including the Mangusta, VW Rabbit, Audi 4000, Alfasud and even the nonexotic, but thoroughly practical, little Fiat Panda.

At first sight, the De Lorean reminds you of the Lancia Monte Carlo due to the cut of the roofline and sloping rear panels. But that's as deep as the resemblance to any other car goes. It has a

(Please turn to page 154)



Interior provides a first-class sports-car environment. Engine is a 2.85-liter V6, giving 130 hp. Power is from a Renault five-speed manual gearbox or three-speed optional automatic. Front suspension is independent, with upper and lower A-arms and coil-over shocks.

How lab sleuths use science to fight crime

It's no longer "Elementary, Watson." Today's forensic scientists go after criminals with lasers, computers and high-powered electron microscopes.

by Dick Dempewolff

Morning papers in New York City carried the familiar story. Two men with ski masks over their eyes had walked into the midtown branch of a major bank. One with a pistol, wearing the kind of cheap, green plastic gloves that you buy in the hardware store to paint your kitchen cabinets, slipped the note under the teller's cage.

It was over in seconds. The two were out of the bank and into a waiting car with a hefty bag of booty.

As the stolen car burned rubber cornering through side streets, the hit man tore off his gloves and tossed them to the floor. At a rendezvous point, the pair abandoned the getaway car, climbed into another waiting vehicle and drove off calmly through urban traffic.

Based on past history in such cases, the well planned and coolly executed heist should have had every chance of landing in the "unsolved" bin, while the thieves blew their wad and glutted themselves in some sunny haven like Las Vegas or Acapulco. Those plastic gloves were not incidental to successful completion of the "job." Plastic materials have static charge characteristics

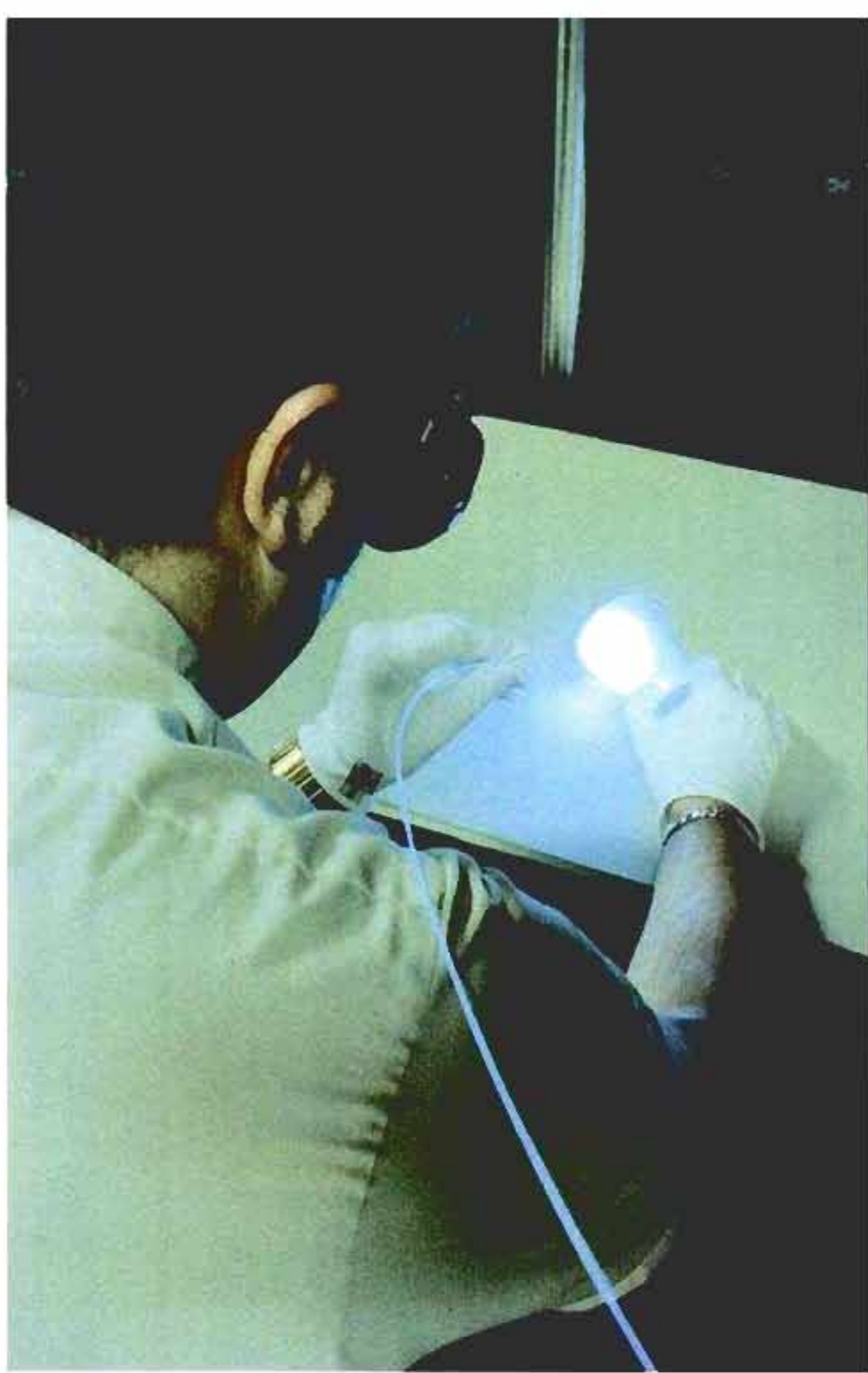
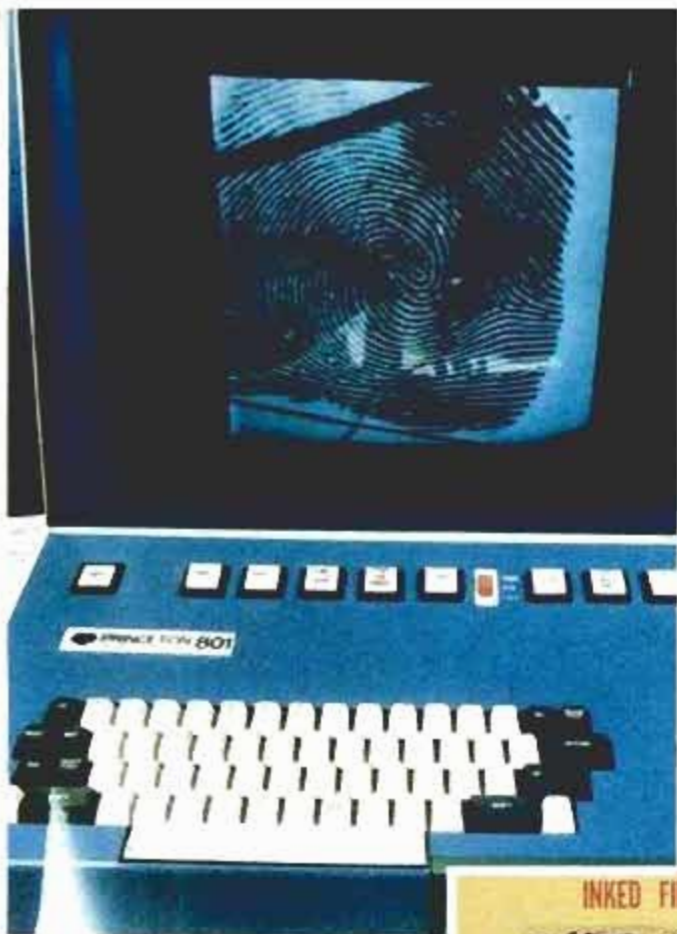


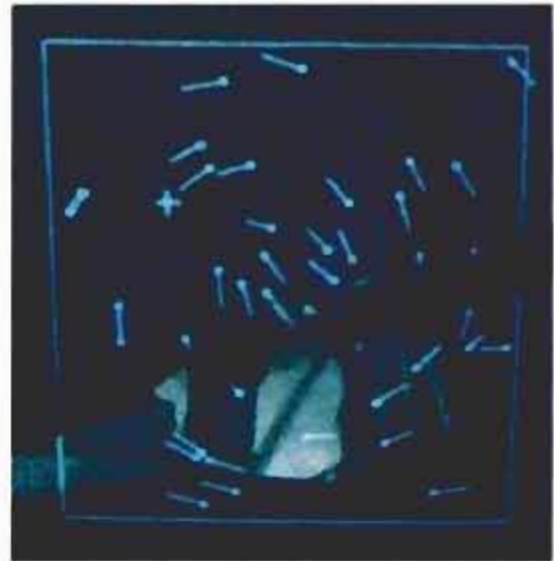
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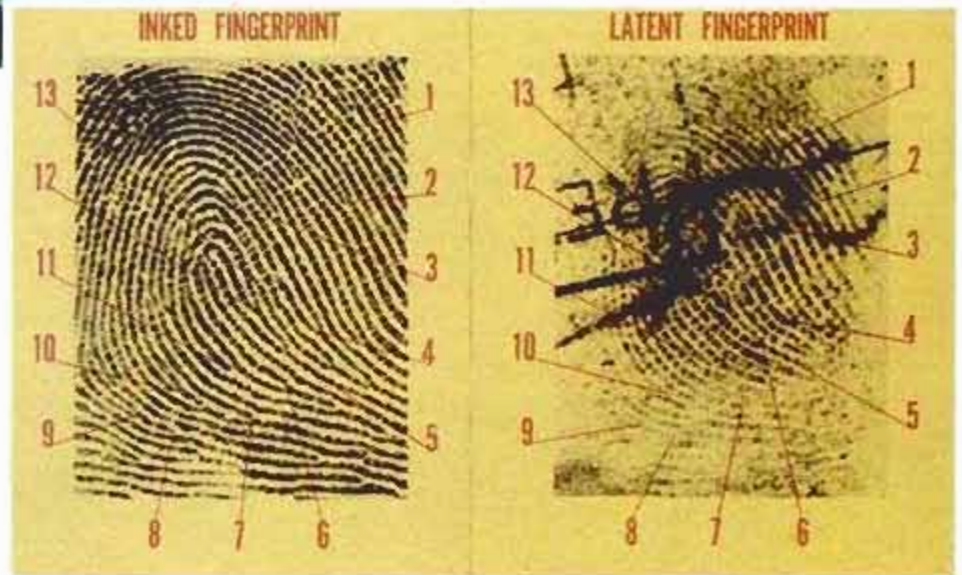
Eerie blue beam of an argon laser directed through fiber optics (above) reveals prints (left) on cup. Laser often works where dusting for prints fails.



FBI computer (terminal above) enhances fingerprint, using same principles astronomers call on to sharpen weak images from cameras in space.



Computer analyzes print for important features, then displays distinctive portions as circles and lines.



Using print's unique features (numbered above on print), computer finds a match (above left). Result: dramatic display for use in the courtroom.



Despite computer wizardry, humans still check analysis with close side-by-side look at print from evidence and from fingerprint files.

that ordinarily prevent dusting powders or chemicals from bringing out any latent fingerprints.

This time, however, the plastic gimmick didn't work. The culprits were identified—and trapped—by the eerie, pencil-thin beam of an argon laser—one of an arsenal of formidable new tools in the forensic science laboratory of the Federal Bureau of Investigation in Washington, D.C.

Investigation of that bank robbery resulted in the prompt discovery of the abandoned stolen car. The gloves and other items of possible evidence were turned over to FBI laboratory scientists for analysis. Routine dusting had, as expected, turned up nothing. But under the laser light, fingerprints inside and outside of the gloves luminesced as though spotlighted. The best specimen was photographed and subjected to a new computer. It quickly enhanced the view of the specimen—the way photographs of objects in outer space are enhanced—then compared it with millions of other fingerprints in the FBI's vast fingerprint library. It found a perfect match.

With the hit man identified, an alert went out and the suspects were intercepted and arrested. According to the laser lab experts, without that bluish beam of coherent light—which apparently causes various proteins or amino acids in human

skin exudation to luminesce—there was no way fingerprints could have been found on those gloves. It not only provided prints but, with the help of new computer wizardry, put the finger on the criminals who pulled the job. And it was done in a few hours. Under former manual methods, even if latent fingerprints could have been made visible, the search and confirmation of a match might have taken weeks.

That case typifies the nuclear-age sophistication now being used in the ongoing battle against crime. Today, the real sleuths in a mystery are more apt to wear a lab smock than a shoulder-holstered automatic. The criminals they pursue may be trapped by space-age tools such as mass spectrometers, neutron-activation devices and liquid or gas chromatographs. Between them, these sophisticated devices can identify the parts of pinpoint-size particles of virtually any known material found at a crime scene—as well as on a suspect's clothing, body or belongings.

Efficient, high-powered comparative microscopes can nail a killer with proof that the shell case found at the scene was fired by the pin of the gun found in his pocket. Rapists are being trapped by electrophoresis—a system employing electricity to sort unique components of blood, saliva and semen. Stolen art is being identified, and often recovered,

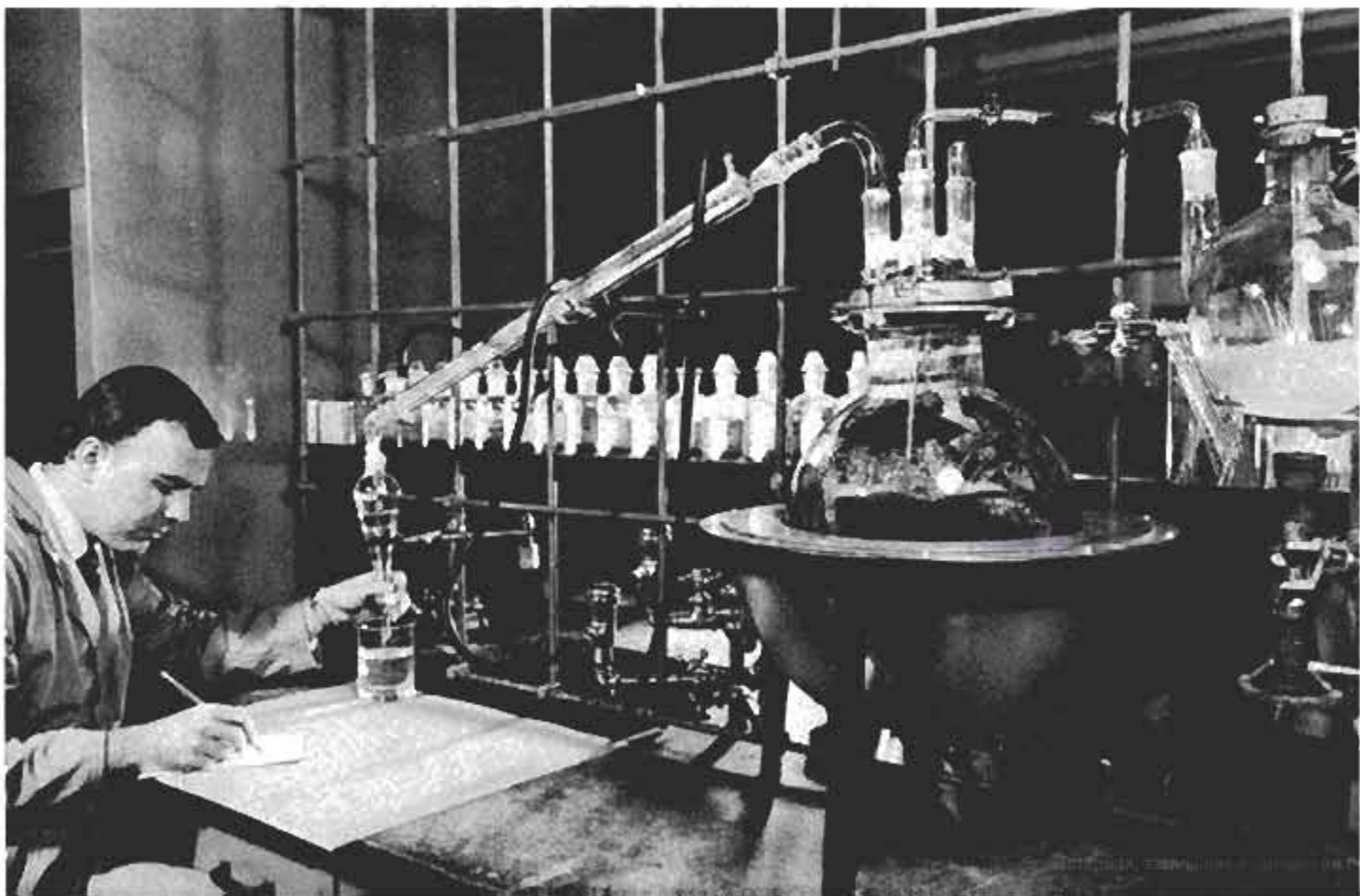


FBI metallurgists use acid to restore filed-off serial numbers on guns used in crimes; numbers are then recorded on film.

thanks to a computerized identification system with a memory bank of nearly every stolen masterpiece anywhere.

Investigators just punch in descriptions of retrieved paintings, and the computer searches the bank and displays artwork matching the description for easy identification. Electronic gear is cornering kidnapers with "pictures" of their own telephone voices, and tricky electrostatic devices are reconstructing notes they may have written before the ransom note came off the pad.

To identify accelerating agents in a suspected arson case, investigator boils burned residue, distilling it into component parts.



"Fifteen years ago," says Inspector William Doran, Deputy Assistant Director of the FBI's Laboratory Div., "a spot of blood might tell us if it came from an animal or a human being and, if the latter, what type blood he had. Now, from a tiny scrap of bloodstained cloth found at a murder scene, our scientists may be able to provide investigators with a suspect's race, lifestyle, where he was prior to the crime, and even the color of the sweater he was wearing—all from the microparticles they are able to shake from the bit of fabric."

Besides filling a vacuum produced by restrictions placed on policing agencies by the courts, today's lab sleuths often are able to provide jurors with unbiased scientific evidence that's hard to beat. It can, in fact, be so pragmatically conclusive that a subject will plead guilty rather than chance a jury's verdict.

There was the case, for instance, of a high school girl found dead in her car, her own .22-cal. revolver on the seat beside her. It looked like suicide. Local police sent the girl's clothing to the FBI for routine analysis. A boyfriend, who admitted they had quarreled, claimed innocence and there was nothing concrete to dispute him.

Telltale blouse

Then scientists in the Firearms-Toolmark lab turned up a curious fact. Careful analysis of the area around the bullet entry hole in the girl's blouse, under high-powered microscopy, failed to reveal the presence of gunpowder residue that would have been there in a self-inflicted gunshot. When the examiner exhibited his lab evidence before the grand jury, indicating that the fatal shot had to have been fired from no less than three feet away,

the boy confessed he'd done it, and pleaded "guilty of manslaughter." He was sent up for 18 to 20 years.

The FBI laboratories are unique in that they provide—in one place—forensic specialists in a wide spectrum of disciplines. While most cases handled fall within their own investigative jurisdiction, the facilities and experts are available to local law-enforcement agencies with no other access to competent forensic assistance. As a result, bits of evidence from myriad criminal cases all over the country pour into the J. Edgar Hoover Building on Pennsylvania Avenue daily.

Packages contain garments, blankets, sheets with blood, paint, semen or other stains for analysis; items for fingerprint examination; castings of shoe prints, bite marks, tire treads; bullet slugs or casings and other evidence or "clues" picked up at crime scenes.

Fingerprint ID is a far cry from yesterday's hand matching of an incoming print against prints on file in a building as big as a city block. Today, a computer named AFRS (an acronym for Automatic Fingerprint Reader Systems) can take an incoming print and put it together with a matching one in a matter of minutes. Eventually, AFRS is expected to read all 25,000 incoming prints a day, and match them against the FBI's criminal file of some 22 million that will be tucked away in digital code in a room no bigger than an average home. And new tools, like that laser, will be finding

latent fingerprints where no one ever before dreamed they could be developed.

Snooping with lasers

Actually, no one is sure just how the laser does what it does. It keeps turning up new surprises.

Not long ago, evidence in a burglary case included a bicentennial coin and script collection card. The coins were still embedded in their slots, but there was an open area where a bicentennial dollar bill had been removed. The item had been dusted and chemically treated for possible fingerprints without any success, so it was turned over to the laser lab for one last try. Even there, no latent prints were developed. But something else was.

There, where the paper certificate had been mounted, was a perfect reproduction of the bill—so clear beneath the coherent light beam that technicians could easily read the serial number. How come? No one knows. Apparently, some component in the ink residue luminesces under laser light.

The great value in many new forensic tools is the fact that they now can find revealing clues in quantities of material a human eye can't even see.

How many clues on a pinhead?

In the Elemental Analysis Unit, where many of the most advanced devices are used, technicians are accustomed to working with sam-

(Please turn to page 157)

High-powered microscope reveals check was printed after signing: more evidence in a case of alleged forgery.



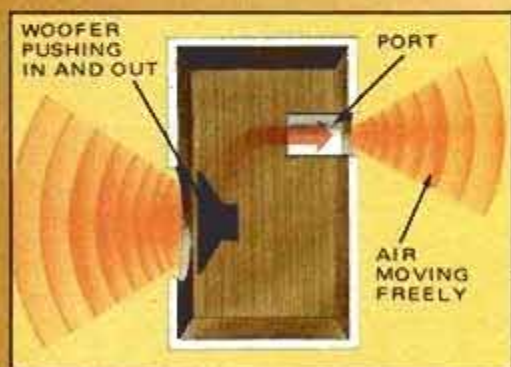
Sheets, blankets and garments found at crime scenes, or worn by suspects, are scraped for particles that may spell murder.



Now: Small \$200 speakers that can take 100 watts of power

Now that we've tested these new, inexpensive speaker systems, we're believers—they really do sound as good as some of their big-buck brothers.

by Christopher Greenleaf



Cizek Sound Window

Cizek Sound Windows go where other speakers cannot, as they are only three inches deep. ADC MS-650 has non-parallel sides; this forces all the sound waves to travel unequal distances (drawing, right). This prevents sound waves from reinforcing themselves, causing the distortion

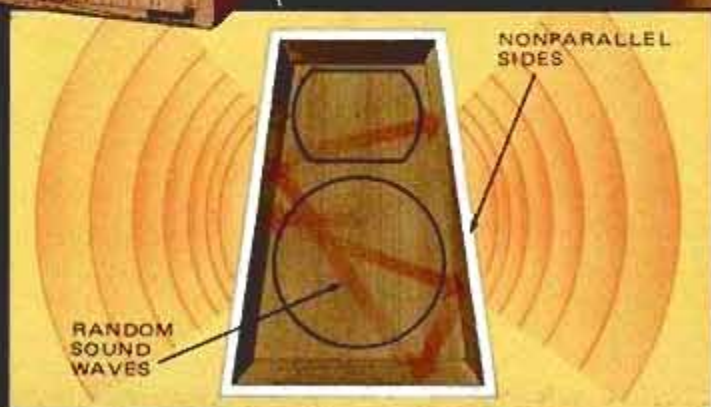
known as resonance. Both the Ohm N2 subwoofer and Ohm M mini are vented enclosures. The vent, also known as a port, allows air to flow freely in and out of the enclosure (see drawing above). With venting, the speaker can make sound both by pushing and pulling air—so speaker sounds larger.

Ohm N2

Ohm M



ADC MS-650



Prices aren't going up everywhere. In the world of audio, a speaker is considered one of the most critical components in a stereo setup. And here's good news—we found 18 excellent speakers that range in price from \$155 to \$390 a pair. That's manufacturer's suggested retail, which means that by shopping around you can take home most of those we tested for around \$200 or less a pair.

These speakers put today's audio technology to work to achieve great sound at reasonable prices. Some use sealed acoustic suspension; others are

vented; some use passive radiator woofers. The largest is smaller than the typical bookshelf speaker: it's 26x11 $\frac{3}{4}$ x9 $\frac{3}{4}$ inches. The smallest is 7x4 $\frac{1}{2}$ x4 $\frac{1}{2}$ inches.

About the only thing these speakers have in common is that they all sound great—and they are all affordable.

We've defined minispeakers to be any whose greatest dimension is 16 inches or under. We consider others to be bookshelf types.

Time and again, the minis amazed us with full-size sound.

(Please turn to page 152)

Design Acoustics LDM

Yamaha NS-10M

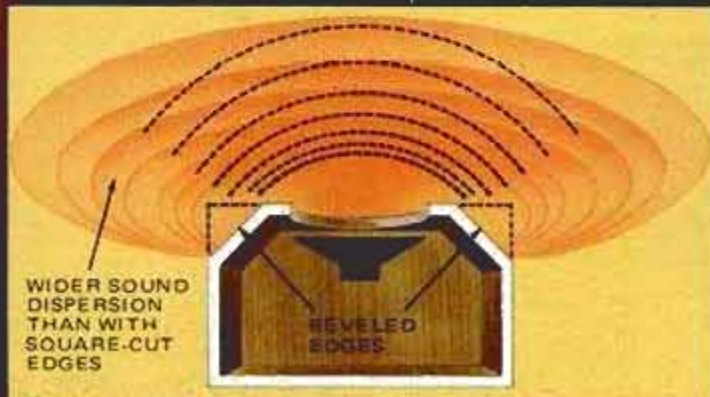


Polk Mini Monitor

Allison Six



PM photo: David Pruitt



The Yamaha NS-10M had best bass of any mini we heard. Design Acoustics LDM uses enclosure with beveled edges. Sound waves transit off enclosure better than from square-cut edges and cone of sound is widened (drawing, left). Polk Mini Monitor uses a woofer fluid-coupled to a flat, passive

radiator. Allison Six uses an adjacent wall to reinforce lower midrange and bass (drawing, above). Speaker should be on shelf and not floor. These eight speakers and the 10 others mentioned in the text can be used with the finest of today's amplifiers. Their sound is well-imaged.

PM tests six 4x4s with

Subaru wagon



With 9.2 inches of ground clearance, the Ford Bronco lived up to its rugged name in the deep stuff. It also provided a snug, first-class interior—the best of the lot.

Chevy LUV



AMC SX/4



Four-wheel-drive vehicles used to exact many penalties for their ability to take you anywhere. The ride was bumpy, gas mileage rarely got out of single figures, reliability was suspect, and you needed crampons to clamber into the high cockpit.

No more. Four-wheel drive has become socially acceptable. Subaru's inexpensive and economical 4wd wagon is just about the "state car" of Vermont, and the AMC Eagle—with its sophisticated viscous-drive system—is

The Subaru and Chevy LUV were the easiest to shift in and out of four-wheel-drive, and they were quite good in medium-deep snow. With better tires and more ground clearance, the SX/4 could have gone almost anywhere that the bigger guys go.

split personalities



Ford Bronco

the first 4x4 in which you truly can't tell whether all four wheels are being driven—until you clear the first mudhole. Then there are the Japanese minipickups, pint-size haulers that own half the U.S. truck market this year. They're all available with four-wheel drive and are selling like hot cakes.

In order to find out whether these new little 4x4s honestly compete with old-style, full-size utility vehicles and pickups from Ford, GM and Chrysler, we chose

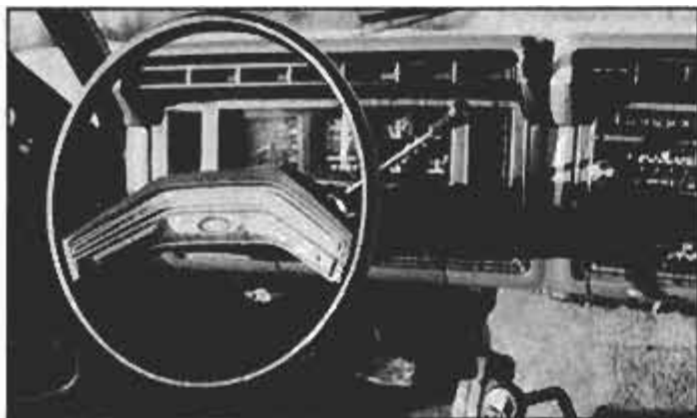
GMC's Suburban can almost be called a 4x4 bus. It can seat eight persons in perfect comfort and accommodate all their luggage. The Dodge pickup was the best snow scrambler. It handled surprisingly well and has an exceptionally roomy cab.



GMC Suburban



Dodge W160



Ford Bronco: plush, elegant cockpit made for cruising or bruising.



Subaru wagon: utilitarian but very inviting and well assembled.



Chevy LUV: no-frills look in a pickup that works for a living.



AMC SX/4: snug command center with rugged, sporty touches.

4x4 PRICES, SPECIFICATIONS, PM TEST RESULTS

	Subaru GL 4wd Wagon	AMC Eagle SX/4 DL	Ford Bronco Ranger XLT	Dodge W150 Ram Custom SE 4wd	GMC Suburban Sierra Grande 2500	Chevrolet LUV Milkado 4x4
Base price	\$7,129	\$7,119	\$9,084	\$8,060	\$10,065	\$7,865
Price as tested	\$7,900	\$10,809	\$14,449	\$12,006	\$12,981	\$10,103
SPECIFICATIONS						
Wheelbase	96.3 in.	97.2 in.	104.7 in.	115.0 in.	129.5 in.	104.3 in.
Track: front/rear	53.0/53.9 in.	54.2/55.2 in.	65.1/64.4 in.	65.7/64.0 in.	67.6/65.9 in.	52.3/52.7 in.
Length	168.3 in.	166.6 in.	177.6 in.	190.2 in.	218.7 in.	173.8 in.
Width	63.8 in.	73.0 in.	77.2 in.	79.5 in.	79.6 in.	63.0 in.
Height	56.9 in.	55.2 in.	73.2 in.	76.2 in.	75.4 in.	60.8 in.
Ground clearance	Adjustable, 8.1 to 9.1 in.	7.72 in.	9.2 in.	9.62 in.	8.8 in. front, 7/8 in. rear	7.8 in.
Curb weight	2,300 lbs.	3,100 lbs.	4,300 lbs.	5,060 lbs.	4,950 lbs.	2,600 lbs.
Fuel-tank capacity	12 gal.	22 gal.	25 gal.	21 gal.	25 gal.	13 gal.
Engine	1.8-liter flat-Four, pushrod-operated overhead valves	4.2-liter in-line Six, pushrod-operated overhead valves	5.0-liter V8, pushrod-operated overhead valves	5.2-liter V8, pushrod-operated overhead valves	5.7-liter V8, pushrod-operated overhead valves	1.8-liter in-line Four, single overhead camshaft
Transmission	4-speed manual transaxle	3-speed automatic	3-speed automatic	3-speed automatic	3-speed automatic	4-speed manual
Four-wheel drive system	Part-time, automatic hubs	Full-time, viscous drive	Part-time, manual locking hubs	Part-time, automatic hubs	Part-time, automatic hubs	Part-time, automatic hubs
Suspension, front/rear	Independent MacPherson struts, coil springs, antiroll bar/independent, coil springs, semitrailing arms	Independent, upper and lower control arms, coil springs/leaf springs	Independent, swing axle, coil springs/rigid axle, leaf springs	Rigid axle, leaf springs/rigid axle, leaf springs	Rigid axle, leaf springs/rigid axle, leaf springs	Independent, upper and lower control arms, coil springs/rigid axle, leaf springs
EPA fuel rating	25 mpg	17 mpg	12 mpg	12 mpg	13 mpg	22 mpg
PM TEST RESULTS						
Fuel economy	21.4 mpg	11.7 mpg	10.4 mpg	10.6 mpg	13 mpg	18 mpg
Acceleration, 1/4 mi.	13.2 seconds	12.5 seconds	12.1 seconds	12.5 seconds	12.4 seconds	12.9 seconds



Dodge pickup: tough, spartan, very roomy.



GMC Suburban: businesslike, comfortable.

six machines representing nearly every size and type of civilian four-wheel-drive vehicle you can buy. Then we assembled a group of determined off-roaders—including Auto Editor Tony Assenza, Detroit Editor Gary Witzenburg and auto writer Rich Taylor—and headed for upstate New York during a late-winter blizzard.

Each driver drove each vehicle on a loop including icy rural roads, peagraveled dirt and a stretch of dry highway. Then we spent a day attacking a snow-covered mountain with drifts so deep the Subaru was left sliding on its belly, wheels spinning helplessly in soft powder. We laid out a 1/8-mile drag strip on a private road for some comparative acceleration figures, and finished up with a no-holds-barred, simultaneous, six-truck assault on a nearly vertical slope.

Our results are conclusive. The little Subaru, Eagle and LUV could climb most of the places the big trucks go, except in deep snow. They could carry enough payload to make them just as useful 90 percent of the time; they were just about as quick on the dragstrip—and the LUV and

Produced by the PM Auto Dept.

Text: Rich Taylor
PM photos: George Ancona

Subaru sucked up half as much gasoline to do the same job. Not to mention that the little vehicles cost thousands less. No wonder half the total U.S. truck market belongs to the Japanese.

Still, the torquy, highly sprung, fat-tired American trucks could plow through impossible terrain where minis couldn't go, where that last degree of traction and ground clearance counted for everything. The giant Suburban could easily carry eight persons compared to the Subaru's four—and do it so fully loaded that per-passenger mileage was nearly as good.

And while our acceleration test showed the V8 trucks only marginally quicker by the clock, all three felt more muscular, with an effortless mid-range surge of power that only a lazy V8 can give.

Amazingly, not one of the six vehicles gave us a moment's pause despite our ham-handed off-road

(Please turn to page 158)

AMC's SNOWBIRD SUPREME—THE EAGLE WAGON



Part-time 4wd and a manual gearbox boost the Eagle's gasoline mileage and versatility.

When I first encountered American Motors' Eagle almost two years ago—driving it up and down slick, mud-soaked hills at AMC's Wisconsin Proving Ground—I was struck by its soundness of design and the originality of its concept.

Seemingly, all the Eagle needed to approach perfection at the time was better fuel economy via less weight, smaller engine, manual transmission (it was available only with automatic) and part-

time 4wd. So for '81, the standard six-cylinder engine lost 90 pounds of extra fat and was joined by a 2.5-liter four-cylinder, courtesy of GM's Pontiac Div., as base equipment. The lineup was augmented by a pair of smaller, lighter Spirit-based Eagles called Kamback and SX/4, and a manual four-speed transmission became standard. All of this boosted the base Eagle's EPA city rating to a creditable 22 mpg. Then last winter came a slick Select-Drive option

that allows switching from 4wd to 2wd and back at the flick of a lever. It doesn't affect this year's EPA numbers, but it's a real boost to real-world economy in the 2wd mode.

After driving a lovely sport-model Eagle wagon through some of Detroit's worst winter weather, I'm more enthusiastic than ever. It was a six-cylinder with four-speed and the new dash-mounted Select-Drive, and it literally ran rings around everything else I encountered on the very slippery roads.

It's no different to drive than any other car, and switching in and out of 4wd is a snap (pull a safety catch down and slide the lever across), because it's all electric and hydraulic. There are no cumbersome levers sticking out of the floor, no transfer-case gears to wrestle into mesh.

The Eagle's big Six had ample power and torque, the clutch and gearbox operated as slick as wet soap, and the Eagle felt strong and secure and handled like a sports car in conditions that planted some real sports cars in the ditch.

It's still not a real fuel-economy bargain (17-18 mpg around town, 20 highway), but well worth the extra gas for its unique combination of comfort, style, luxury, all-weather invincibility and payload capacity.—G.W.

Sea Drive: OMC's new sterndrive outboard

It looks like a kicker, acts like an I/O, and it purred through our tests with bonus performance and economy.

by Bill McKeown BOATING EDITOR



Skimming the shoals of Miami's Biscayne Bay, we found a single 2.6 Sea Drive on a 22-foot Grady-White gave fast, quiet performance.

It looks like an outboard. But its innovative mounting on a solid transom, its automatic oil-injection system, sound- and water-proofing and its economical performance make the Sea Drive a seaworthy invention. Installation (below) keeps its light weight well astern. In later tests, its hinged mount (right) located above the powerhead allowed for tilt-up clear of the water.



When Ole Evinrude urged boatmen to "throw away the oars" early in the 1900s, it was because he'd found a better way to move rowboats: his outboard motor. When Jim Wynne created a practical combination of inboard and outboard power in the 1950s, his I/O sterndrive became a success, filling the need for an inside-the-boat engine and steerable tip-up drive outside.

Then last fall Outboard Marine Corp. announced it had new answers for old problems of inboards, sterndrives and outboards in smaller hulls (see *All Outdoors*, page 46, Dec. '80). All three used up cockpit space with engine boxes covering inboards or motor wells for outboards to tilt into. Why not a powerplant with the light weight, steering flexibility and hinged lower unit of the outboard or sterndrive, plus the high transom and sealed-in water resistance of the inboard—all mounted completely behind the boat for best balance?

Sea Drive is the name OMC has given its answer, and PM has just tested a first prototype. Fastened on the transom and pushing a boat along, it looks at a distance like a large, sleekly shrouded outboard motor. Up close, however, the differences are obvious. Here is an engine that can still tip up when it strikes a log, but doesn't tilt into the boat. Instead of hinging under the powerhead, the Sea Drive mounts on a bolt-on bracket that pivots up at a point just above the top of the cowling. Electric trim adjusts the unit's

angle for thin-water trolling or for powering quickly up on plane. Full tilt, we found, could lift the propeller and skeg tip of the lower unit completely out of the water for ease of servicing and protection from barnacles and saltwater corrosion.

Under the hood, the motor also looks like an outboard, but when buttoned up and cranked up, its differences become apparent. Though it's still a two-cycle engine, there's no cloud of smoke on start-up or while idling. Gasoline and oil are not premixed. Instead, a new device called an Economixer uses a microchip computer and oil-injection system with separate oil tank to provide a mix of about 150 to 1 gas to oil at idle, 75 to 1 for three-quarters throttle and 50 to 1 at full bore. It saves over 37 percent in oil and provides no smoke, no worry and better performance. The OMC Parts & Accessories Div. will also be supplying the

Economixer for V4 and V6 Johnson and Evinrude outboards.

Remarkably low noise level is another benefit of the new system. This was borne out by dB meter readings at both the transom and helm positions of our Grady-White 22-foot Bahama 222. Talking at a conversation level was easy, and the sturdy, well-made hull had no tendency to kettledrum vibrations from the shock-mounted Sea Drive. Air intake for carburetion is through a flexible hose into the cockpit. The engine is so sealed that, after backing down to take solid water over the unit, we found no moisture on the engine when the cowl was removed. Exhaust is out through the propeller hub.

Our test unit had a 2.6-liter displacement, rated at 205 hp and weighing 467 pounds. It pushed our Grady-White to speeds in the mid-40s—5 to 6 mph faster than a sterndrive setup with similar horsepower. A 10-percent saving in fuel is expected over outboards with production units, and a 34-percent gain in range has been measured over inboards. So far, 2.6-liter and 2.5-liter Sea Drives (with 155 hp for the smaller) are available, and a 1.6-liter unit is planned for early '82.

Boats like the G-W Bahama family fishing cruiser and in sizes from 17 to 35 feet, with transoms of 44 inches or more, are considered ideal for Sea Drive single or twin installations. Already, 12 different boat makers are offering Sea Drive power. **PM**

PM photos. Jerry Imber



Twins outperformed inboards on a big Bertram and didn't drown out under waves.

There's no mystery why people chose the SX/4. An Ohio housewife volunteered: "I wanted four-wheel drive plus economy. And I like the SX/4's sporty look. The five-year rustproofing warranty also helped sell me."

What does she think of the car now that she's had a chance to live with it? "Great car! I like the way it handles, particularly on icy and wet roads. I also appreciate the



Next to 4wd, the SX/4's sporty styling—its high-water look and the urethane fender flares—attracted a lot of attention.

way it rides. I like the car being high off the ground; it allows excellent visibility."

A Wisconsin accountant echoed: "SX/4's handling feels super. Traction is fantastic on ice, snow and off-road. Sound engineering, and the car is well put together."

A Minnesota dentist put it this way:



"Sure beats a Jeep. The SX/4 can do nearly anything a Jeep can do, but it offers a smoother ride, better gas mileage, is quieter, and has excellent comfort. I didn't buy this car for the rear-seat space; I like it short. Also, the SX/4 is warm even at 30 below and the windows don't get all fogged up."

Most of the SX/4 owners we surveyed live in America's snowbelt where the traction advantages of a 4wd vehicle are obvious. And our questionnaires went out in the wintertime, which turns out to be the SX/4's best season.

"Handling is wonderful on icy surfaces," a Colorado policeman told us, "and also in fairly deep snow. The ground clearance of the SX/4 lets it step over and through drifts that stop other vehicles. Our

area also has a lot of steep, curvy roads. When it's icy on these roads, no 2wd automobile would ever venture onto them."

Four-wheel drive topped the list of SX/4 selling points, but fully a third of the owners we surveyed mentioned "high-off-the-road styling" as the car's second most important attraction.

"It looks sporty; looks good," commented a West Virginia bookkeeper, "and being high off the ground, it doesn't drag or bottom-out on bad roads."

"The car looks rugged and powerful," confided an Ohio truck driver. "Since it stands up tall, with those plastic fender flares and 15-inch tires, the SX/4 looks like it means business, which it does. People notice the car and ask me what it is and what it'll do. I like that."



Most owners opted for the Four with four-speed. Buyers of Sixes griped about mpg.

BY MICHAEL LAMM WEST COAST EDITOR

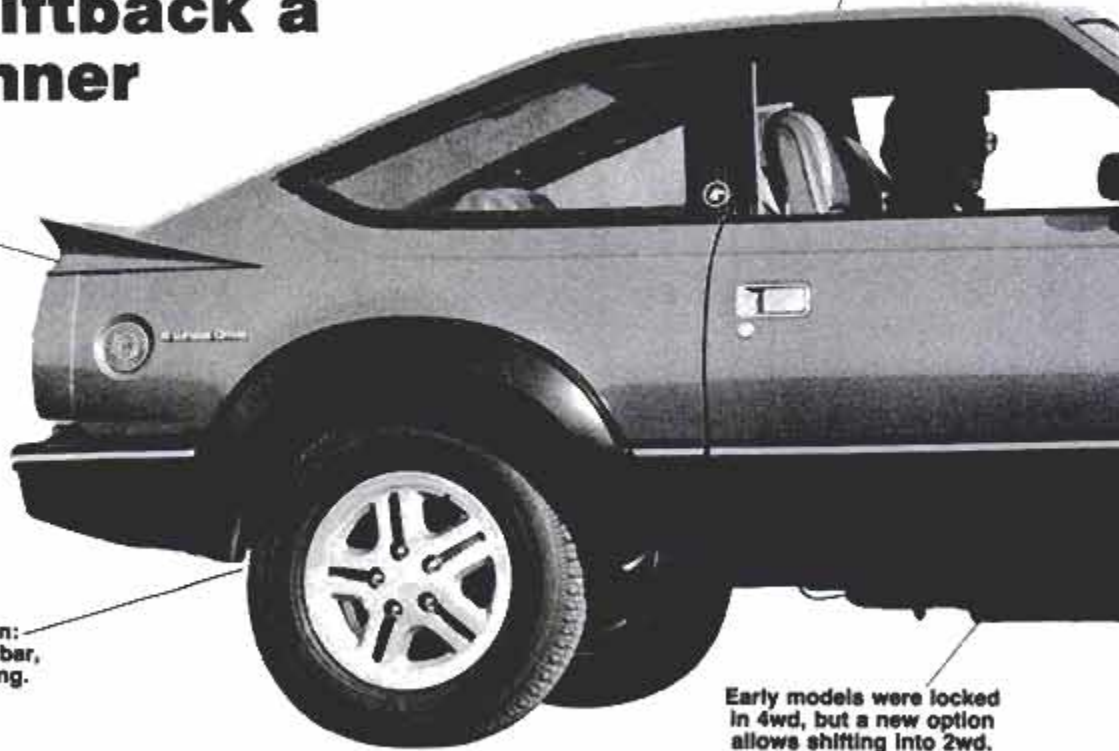
Four-wheel drive, sporty looks make the AMC compact liftback a winter winner

Plenty of headroom for front passengers, but the sloping roof makes rear riders duck.

Liftgate spoiler comes with GT package. GT features tach, blacked-out grille and trim.

The GT Rally package option: adjustable shocks, rear sway bar, special springs, faster steering.

Early models were locked in 4wd, but a new option allows shifting into 2wd.



The SX/4's high-water styling brought smiles to many an owner, yet it caused a few frowns, too. Some buyers would have appreciated a few inches of height ending up in the rear seat. An Illinois greens-keeper, for example, grumbled that, "Anyone over 5 feet tall will feel cramped in the back seat."

"True," added a Texas mail carrier, "but I knew when I bought the car that I'd rarely put anyone in the rear compartment." Yet the lack of legroom, headroom and trunk space was a consistent complaint.

One upstate New York farmer was especially unhappy about the lack of trunk room. "With the spare tire back there (in the hatchback), there's barely any room for anything else. When I need to load something, I usually take the spare out and leave it home for the trip."

Another gripe centered on fuel mileage, particularly from owners of SX/4s with six-cylinder engines and automatic transmissions. Those with Fours and sticks seemed happy with their reported 19.3/24.2 mpg city/highway—even though those figures fall short of EPA averages (as always).

Several SX/4 owners suggested that some sort of mechanism to shift from 4wd to 2wd would aid gas mileage by reducing power-train friction losses. Our survey, conducted in late 1980 and early '81, preceded AMC's announcement of just such



Attractive, functional dashboard received good marks. Select Drive is recent option.

a device. Select Drive became available as a \$149 option for all AMC 4wd passenger cars built after Jan. 15, 1981. Select Drive allows 4wd AMC cars to be shifted from 4wd to 2wd and back again via a switch on the dashboard.

According to the manufacturer, it works like this: By stopping the car and moving the switch to 2wd, the driver activates a vacuum disconnect built into the front-axle assembly. At the same time, a mechanical shifter in the Select Drive transfer case slides a splined clutch forward to cut off power to the front-drive chain sprocket.

Unfortunately, retrofitting Select Drive to earlier vehicles would entail much work and expense. It's a shame, because 14.3 percent of our respondents indepen-

(Please turn to page 166)

What drives the SX/4?

AMC's recent successes with 4wd—its Jeeps and Eagles—made it reasonable to pass four-wheel drive down to the corporation's smaller offerings.

Thus, for '81 we have the AMC SX/4 liftback, based on the 2wd Spirit, and the 4wd Kammback, derived from the venerable Gremlin. Actually, all AMC passenger cars trace a common heritage to the 1970 Hornet. Many body and mechanical components interchange among current Concord, Eagles, Spirits, SX/4s and Kammbacks.

AMC's 4wd system is built by the New Process Gear Div. of Chrysler Corp., under license from FF Developments Ltd. of Great Britain. Unlike most 4wds, the SX/4's system uses a viscous silicone fluid coupling between the rear and front axles, with no mechanical lockup.

Early AMC 4wds couldn't be taken out of 4wd, but Select Drive, which allows either 2wd or 4wd operation, has been a \$149 option since mid-January '81.

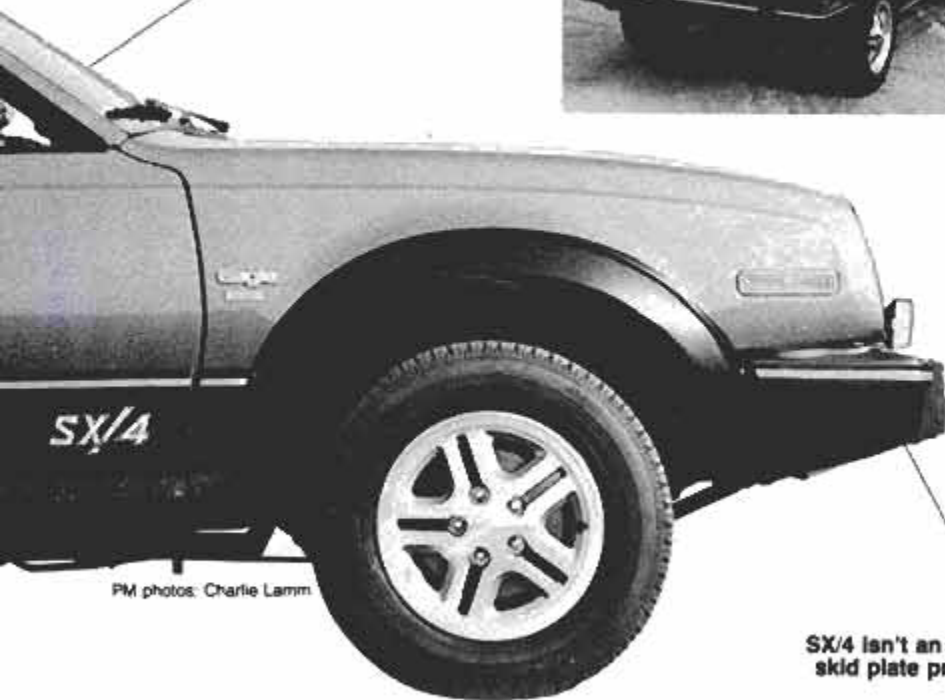
Pontiac's "Iron Duke" 151-cu.-in. Four is the Spirit/SX/4's base engine, with the 258-cu.-in. Six optional. The Six is now 90 pounds lighter, thanks to thinner block castings and the use of aluminum accessories. A manual four-speed comes standard, with a three-speed automatic also available.

The SX/4 with the sport package includes fog lamps mounted on the front bumper, Goodyear Arriva steel-belted radials and halogen headlamps.

Among the other options available are pop-up sun roof, some towing packages and a heavy-duty suspension package.

A NATIONWIDE SURVEY BASED ON 1,225,443 OWNER-DRIVEN MILES

SX/4's high stance and large windows give fine visibility.



Rear passengers cope with wheel-well intrusion, tight legroom and relatively low roof produced by fast-sloping hatchback.

SX/4 isn't an off-roader, but skid plate protects oilpan.

PM photos: Charlie Lamm

FIRSTHAND REPORT:

DRIVING GM'S J-CARS

These 1982 front-wheel drives are the General's latest counterattack in the subcompact wars.

by Michael Lamm WEST COAST EDITOR



Pontiac J-2000 four-door sedan has the traditional chiseled nose which, in the hatchback version, helps give it the lowest coefficient of drag (Cd) of any J-car.



Chevy Cavalier wagon has 64.8 cu. ft. of cargo room. Wheelbase on all J-cars is a trim 101.2 inches.

With the introduction of its J-cars, General Motors has struck at the very heart of Japanese competition—the hotly contested subcompact class. Pontiac General Manager W.E. Hogle predicts that subcompacts will account for a full 45 percent of domestic sales by 1982. GM wants to take the lion's share of the market.

Three GM divisions will release J-cars initially. Chevrolet calls its version the Cavalier; Pontiac has the J-2000 and Cadillac's becomes the Cimarron.

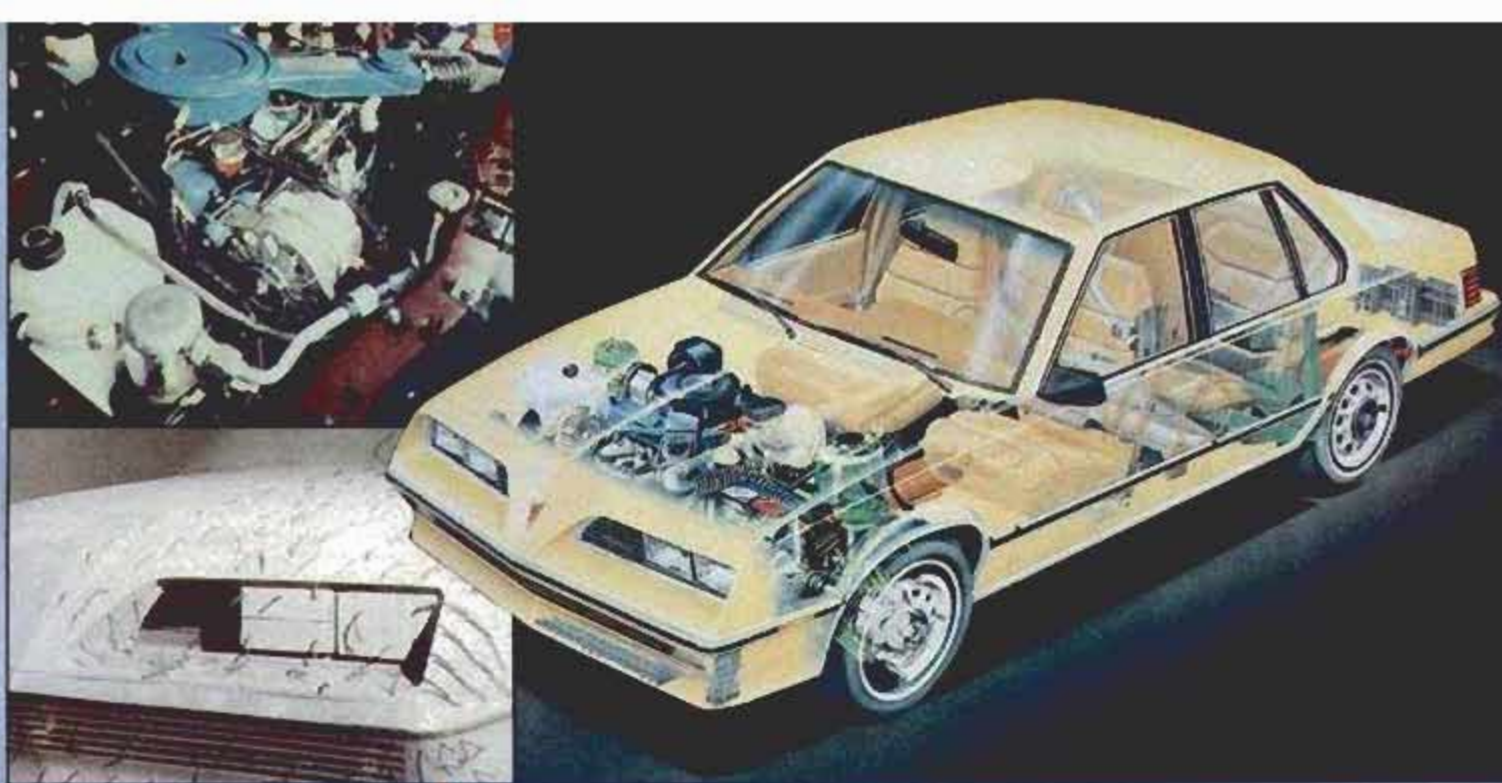
We got a chance to drive the Pontiac and Chevy versions but, as is usual Cadillac practice, that division had no "driving" cars available at its preview—only

(Please turn to page 167)



Cavalier hatchback's ride quality, interior room and noise insulation at speed are very good; it handles well, too. Dash (above right) has full instrumentation.





The 1.8-liter pushrod Four (top) is as light as Chevette's 1.6-liter and puts out more power. Extensive wind-tunnel tests (above) produced a .398 Cd on Pontiac's J-2000 hatchback.

ENGINEERING THE J-CARS

GM's searching for quality with robots, lasers and gamma ray detectors.

by Gary Witzenburg DETROIT EDITOR

On paper, the GM J-cars are deceptively conventional: 1.8-liter, overhead valve (pushrod), four-cylinder engine; four-speed manual or three-speed automatic transmission; transverse front engine, front drive; MacPherson-strut front suspension, semi-independent, coil-spring rear suspension; rack-and-pinion steering; front disc, rear drum brakes.

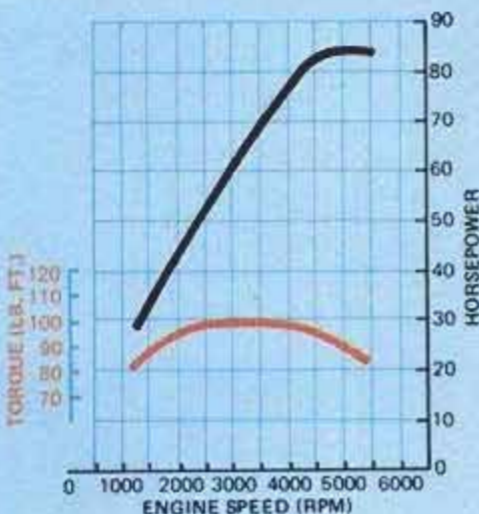
Styling, though very handsome, is largely unoriginal. Rooflines are part BMW, part Honda Accord, part German Opel. The Pontiac's front looks like a Firebird, the Chevy's rear like a Triumph TR-7. The Cadillac's face seems straight off an Impala, its tail adopted from a Ford Fairmont.

What, then, makes these cars so significant? Their wide coverage of the market, from family sedan and wagon to sexy hatchback coupe to luxury small sedan? Excellent space efficiency and smooth, quiet ride? Generous standard equipment lists? Value-oriented engineering and a very

real commitment to quality? All of this, and more.

The J is GM's first car series created from the very beginning in the shadow of stiff foreign competition, and the quality program started long before the assembly line.

Every joint, for instance, is designed not just to fit together properly, but also to give a smooth, seamless appearance once



assembled. Door frames for the four-door models are one-piece stampings, as are the inner and outer door panels, to eliminate joints and weld marks. A small army of robots performs some 450 spot welds per body, while laser scanners check key dimensions and gamma ray detectors ensure that no pieces have been left out or misassembled in doors and other components. The elimination of lead-soldered seams, an almost

clinical, dust-free environment, and even the design of body contours and corners help give a lustrous, high-quality paint finish.

The underpinnings

Underneath, the front suspension is classic MacPherson struts, similar to those on GM's X-car. Rack-and-pinion steering (connected directly to the column with no universal joint) is high-mounted, with its tie

rods running to steering arms halfway up the struts. Rear suspension is an interesting "double-crank, trailing twist axle" design, with trailing arms attached to a cross beam that doubles as a stabilizer bar. This allows more trunk space between the wheels.

The cone-shaped, variable-rate springs give ample wheel travel (each coil fits inside the next)

(Please turn to page 169)

CADILLAC CIMARRON: GM GOES AFTER BMW

America's status symbol has been downsized.

by Paul Weissler



Cimarron is the smallest Caddy ever, but still features luxury interiors. Suspension differs from other J-cars: Smaller air gap in trailing arm bushing (below left) reduces oversteer.

Is the world ready for a front-drive, four-cylinder Cadillac with a standard manual gearbox? We're not so sure, but the folks that make America's ultimate status symbol, seem to think so. Still, an automatic transmission is optional.

An equally important question is: Are potential customers willing to pay Cadillac prices for a car that is essentially a Chevrolet?

In the past, there has always been a good bit of corporate sharing among Caddy and the other GM divisions. Nevertheless, Cadillacs were stamped with that unmistakable mystique—the presence, the size, the advanced engineering that

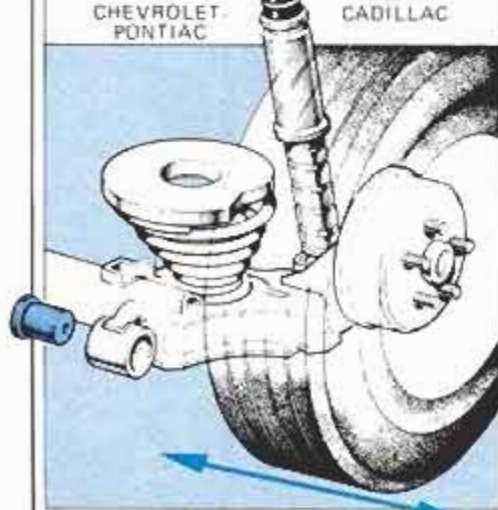
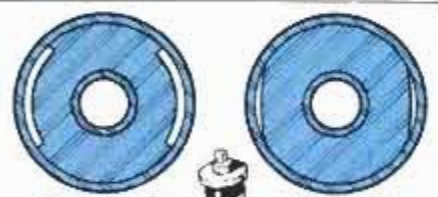
made the extra price seem justified.

But in the case of the Cimarron, there is almost no mechanical difference. And the differences that do exist are subtle and might not be noticed in a side-by-side comparison of the Caddy and other J-cars.

The difference in this Cadillac is the ride-and-handling package. The standard steering gear has a fast 14:1 ratio, quicker than the 16:1 ratio on the other Js, and matched only in Chevy-Pontiac J option packages.

To provide better roll stiffness for flat handling, the Cimarron front

(Please turn to page 161)





With the rear wheels chirping and the front end up in the air, the Z-car now has 180 horses available, thanks to the turbo.

FIRSTHAND REPORT

by Michael Lamm
WEST COAST EDITOR



What a difference a turbo can make! It doesn't always, but in the case of the Datsun 280-ZX, the turbo turns a pussycat into a tiger.

Datsun let me compare a normal, fuel-injected 280-ZX with the new turbocharged version. Both had automatic transmissions—the only way you can buy the turbo presently. The comparison took place at Golden State International Raceway (nee Sears Point) in northern California.

Rotating parts for the Z's Garrett-AiResearch turbocharger are made in the United States, with the housing manufactured in Japan. The turbo delivers 90 percent of its 7.3-pounds-per-square-inch boost at 2,200 rpm, and the pressure curve remains nearly flat up to top revs.

In straight-line acceleration, the resulting thrust feels very strong and increases as rpm rise. I felt no

flat spots as the big ohc Six lunged willingly to 5,600 rpm. The Z really goes now. It's been made infinitely more fun to drive.

Datsun has added steering and suspension mods to this package, too, so the turbo Z's handling shows as much improvement as its acceleration. Front stabilizer bar thickness has been increased from 0.985 to 1.024 inch. And the power steering is now a relatively quick (17.8:1-ratio) rack-and-pinion type that gives plenty of road feel, yet doesn't take a lot of muscle to use. (The standard Z uses a recirculating-ball power steering system.)

The turbo's standard tires are the sticky and resilient Bridgestone P205/60R-15s on special alloy wheels unique to the turbo Z.

You now have enough horses underfoot to broadside the car through turns very fast: power on, tail out, front wheels grabbing for more pavement. In this situation, the 280-ZX oversteers, but it's very forgiving and easily controlled via throttle and steering wheel.

Horsepower for the nonturbo Z-car went up 10 percent this year, to 145 at 5,600 rpm. The turbo raises that to 180. Torque now peaks at 203 foot-pounds at 2,800 rpm, compared to 156 previously.

What Datsun's done to this engine is simple enough, but the turbo doesn't represent mere bolt-on power. The engineers have installed a hotter cam, different pistons, and sturdier connecting rods. Compression ratio is down from 8.5:1 to 7.4:1. Ignition timing and fuel metering are controlled by a newly designed computer made specifically for the

turbo. In addition, the automatic transmission got considerable beefing, with a specific torque converter, heftier input and output shafts, and more clutch plate surface—all this in addition to the suspension and steering changes.

We had no timing equipment at the raceway, but Datsun's tests show the following acceleration figures: 0 to 60 mph in 7.1 seconds, 0 to 100 in 20.9, and the standing quarter miles in 15.4 seconds at 89.0 mph. And that's how the car felt, too—very strong and impressive. In fact, it comes awfully close to the performance of the Duntov turbocharged Corvette and .3 sec. faster than the Ferrari 308 GTSi (see *PM's Million-Dollar Car Test*, page 112, Mar. '81).

And despite all that added power, the Datsun 280-ZX turbo still gets very respectable fuel mileage: 20 city, 24 highway, for a combined EPA average of 22 mpg overall. **PM**



Suspension has been beefed up considerably on the turbo so its cornering ability matches its straight-line acceleration.



10 big cameras you can hide in your hand

New miniaturization techniques give you big-camera features: SLR or rangefinder, 35 mm or 110, manual or fully automated

by Bob Berger

PM photos by the author

Spring has brought us a bumper crop of easy-to-tote cameras—perfect for the traveler, snapshotter and anyone who has ever groaned, “Oh, I wish I had a camera with me—that would be a great shot.”

Most compact cameras are small enough to nestle in your palm. But modest size and weight are not their only virtues. Some boast features that would be hard to find in larger, more costly cameras. To help you

choose the compact that's best for your picture taking, here's how the cameras compare.

Pentax Auto 110

The tiniest of our compacts, the Pentax, at a mere 6.1 ounces and less than 4 inches long, is almost toylike in appearance. But this little gem is no Cracker Jack prize. It's a high-precision, single-lens reflex, and offers a unique feature for a compact—interchangeable lenses.

The lenses are featherweights. The wide-angle weighs about one ounce, the telephoto less than two ounces. A film winder is an option, as is a set of closeup lenses. Film loading is a cinch—the Pentax takes 110 cartridges.

If you'd like to retire your two-ton gadget bag, ponder purchasing a Pentax; it can live quite happily in a shirt pocket. And, even with wide-

angle and telephoto, the whole outfit remains pocketable. The Pentax list price is about \$250. Telephoto and wide-angle list for about \$80 each.

Minolta 110 Zoom Mark II

A lot of photographers like the Minolta, and what they like best is its 25-67-mm zoom lens. In its macro mode, the lens focuses down to 7.7 inches. The shutter, like that on the Pentax, is electronic, but instead of the Pentax fully automated exposure, the Minolta requires that the lens aperture be set manually. The built-in meter then automatically selects the appropriate shutter speed.

A fine feature on the Minolta is a switch just above the eyepiece that adjusts the viewfinder to suit your vision. The Minolta holds a 110 cartridge firmly in place with a four-point pressure system for maximum



Our array of 10 tiny cameras includes three 110 models—Minolta, Chinon 110 and Pentax—and seven 35-mm minis. List prices for the models we compared range from \$75 to \$342.

sharpness. Included in its \$342 list price are a detachable grip and lens hood.

Chinon 110

A simple camera, the Chinon 110 is strictly for snapshotting, but has such amenities as built-in power winder and built-in flash. The fixed-focus lens is designed to keep things sharp from 3.3 feet to infinity. Its shutter is mechanical, with two speeds. Suggested retail price is \$74.95.

Olympus XA

Like others in the Olympus lineup, the XA is a design tour de force. Though the XA doesn't fold, and the lens doesn't collapse, the camera is thin enough for a pocket. Working this bit of magic necessitated a unique internal-focusing lens design—the lens is actually shorter

than its focal length, by some 4 mm.

Other XA innovations include rangefinder windows and a sliding cover. The latter is an integral part of the camera that switches off the electronics when closed—and effectively protects the lens and viewfinder.

That's right—despite its 4-inch length and a weight of only 7.9 ounces, the XA has a coupled rangefinder. And the electromagnetic shutter release is marvelous. The XA uses 35-mm film, as do the remainder of the cameras in our story. List price, including electronic flash, is \$233.

Minox GL

The lightest 35-mm of the group, the Minox has a folding front cover to guard the lens and viewfinder against dust and fingerprints. When it's closed, the cover also shuts off

the electronics and locks the shutter. The electronic shutter, just as on the Olympus, automatically sets the proper speed for any aperture selected. When you're shooting candidly, the whisper-quiet Minox shutter is a big help. List price: \$330.

Chinon Bellami

Though a bit heavier than some of its rivals, the Bellami, at 8.8 ounces, is a trim little package. Actuating the film-advance lever opens two dust-cover doors that seal the lens. After you set the desired ASA rating, the Bellami's automatic exposure system does the rest of the work. Suggested retail is \$185.

Ricoh FF-1s

Another of the folding-front models, similar in appearance to the Minox, the Ricoh weighs in at just

(Please turn to page 164)

Our survey of 1981 Chrysler Imperial owners turns up three major specifics:

■ They love their cars' styling. Appearance ranked as the No. 1 reason for purchase, and it's also the Imperial's best-liked feature.

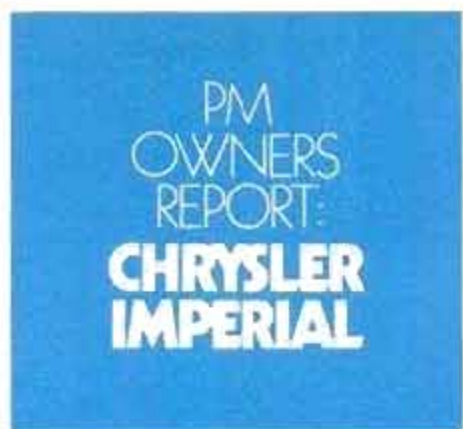
■ A record number of owners—43.2 percent—have absolutely no complaint with the automobile. That's the *highest* figure we've ever logged, and a real tribute to Chrysler.



The bold front end is one part of the overall styling which sold owners on the Imperial.

■ On the negative side, however, a small number of owners ran into problems with the Imperial's new electronic, throttle-bodied, fuel-injection carburetor and the computer that regulates it.

Apparently, MoPar engineers hadn't worked all the bugs out of the system



before early owners took delivery. Also, a dead or disconnected battery meant the system had to be recalibrated. We're told that more recent EFI computerized carburetors work fine.

Here's a cross-section, then, of comments from Imperial owners on all aspects of their cars:

A Florida pilot told us, "Craftsmanship is excellent, and what I especially appreciate in the car are the styling, comfort level, electronic digital instrument displays and good fuel mileage. I'm getting 17 to 24 mpg. The one thing I don't like is lack of power."

An Iowa manufacturing vice-president added, "Styling sold me this Imperial, but I also felt Chrysler had to put more quality into it, and they have. It's a supercomfort-

able car, with excellent road handling and good fuel mileage. I did try gasohol, but it dissolved the pump impeller in the fuel-injection system. The dealer repaired it immediately, and I'm very satisfied with Chrysler's warranty and service."

From a Texas housewife and mother: "It's a beautiful car, but I bought it primarily because I figured that an American company in trouble had to prove it could build a better product—in this case, the best car ever put on the market. I'd need two pages to tell you everything I like about my Imperial. Just to give you one example, take the warranty. My kids ran the battery down showing off the electronics to their pals. My dealer sent a man 50 miles to jump-start the engine. What more can I ask for? It's a handsome, quality car."



No-option, fully-loaded interior comes with a computerized, all-digital gauge package.

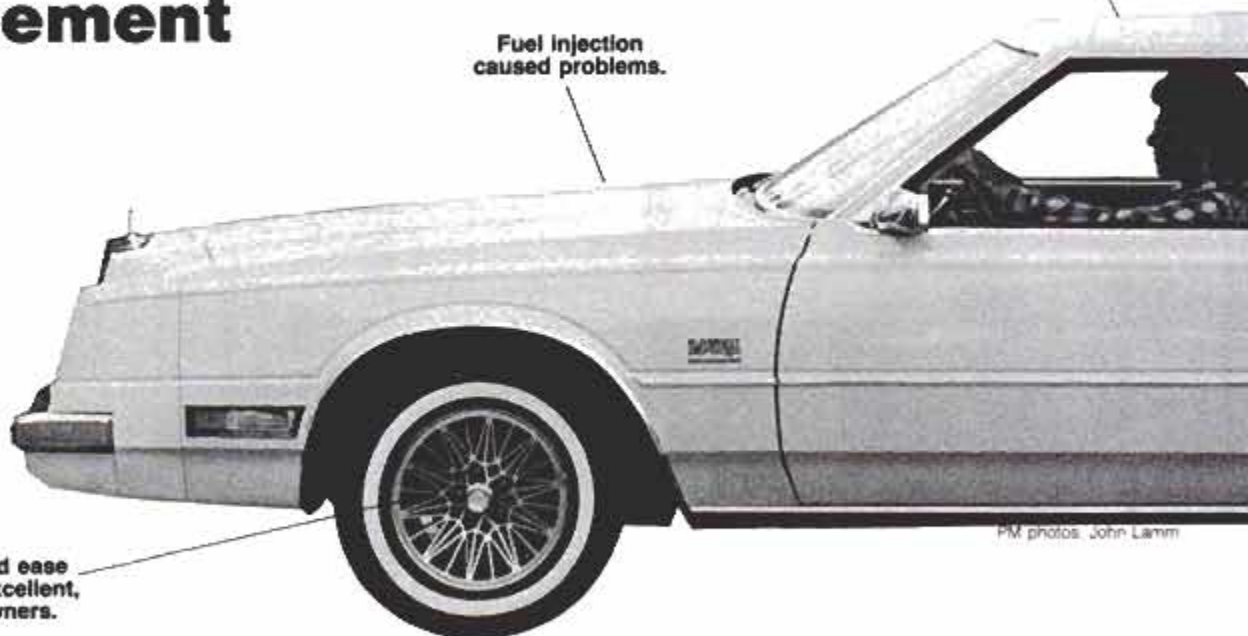
BY MICHAEL LAMM WEST COAST EDITOR

Owners praise its impeccable styling, but the fuel injection needs improvement

With sunroof option, headroom is limited.

Fuel injection caused problems.

Road-holding and ease of handling are excellent, according to owners.



PM photos: John Lamm

A California attorney: "One morning the car wouldn't start. The electronic ignition failed totally. The service manager personally came out 25 miles, started the car, returned with me to the dealership, and in 45 minutes replaced the ignition system. Then, too, they dismantled the entire dashboard to find and correct a squeak. Height and seat comfort exceed any car I've ever ridden in. Not much legroom in back, but I knew that when I bought the car. I initially felt, and still feel, that the Imperial's styling and luxury are unexcelled. Also, I was attracted to the car because it's unique compared with, say, an Eldorado."

The president of a Wisconsin jewelry-store chain: "I wanted a true luxury car with fuel injection—a car in which you don't see yourself coming and going. Imperial has that great look. I've owned Caddies, Mercedes, and even a Rolls, but the Imperial's workmanship beats all. I think it's the finest American car made. I wish they'd make a four-door, and with the sunroof, the car needs more headroom, but the absence of problems—not even a squeak in 5,200 miles—makes me sure I'll buy another."

An Ohio dentist: "What attracted me at first was the Imperial's lines—very sleek. But most of all, in driving the car I was taken with the solidness and quiet ride; it's like riding in a vacuum. I'm 6-foot-2 and could use a little more space. The

seats should lower a bit further. This is the most luxurious interior I've ever been in, with a wonderful sound system, tight-fitting doors, and as a person who's been disappointed in Cadillacs, I believe it might be the best built of all American cars."

A photographic-paper-mill foreman in New York: "Haven't been back to the dealer for anything. Car looks very good,



Throttle-body fuel injection delivers good mileage, but it is prone to some failures.

but I'd like rain gutters over the doors, plus more trunk space and a bigger gas tank. Even so, fuel mileage is 50 percent better than my 1979 New Yorker trade-in. The Imperial's quiet ride and ease of handling make it a joy in every situation."

An Illinois corporate vice-president: "The fuel injector malfunctioned, and the engine would cut out at intervals ranging

(Please turn to page 168)

Chrysler's total luxury car

Three important points make the 1981 Imperial like no other American car: 1, its styling; 2, the fact that you can buy it only one way—fully equipped; and 3, its maintenance/service warranty.

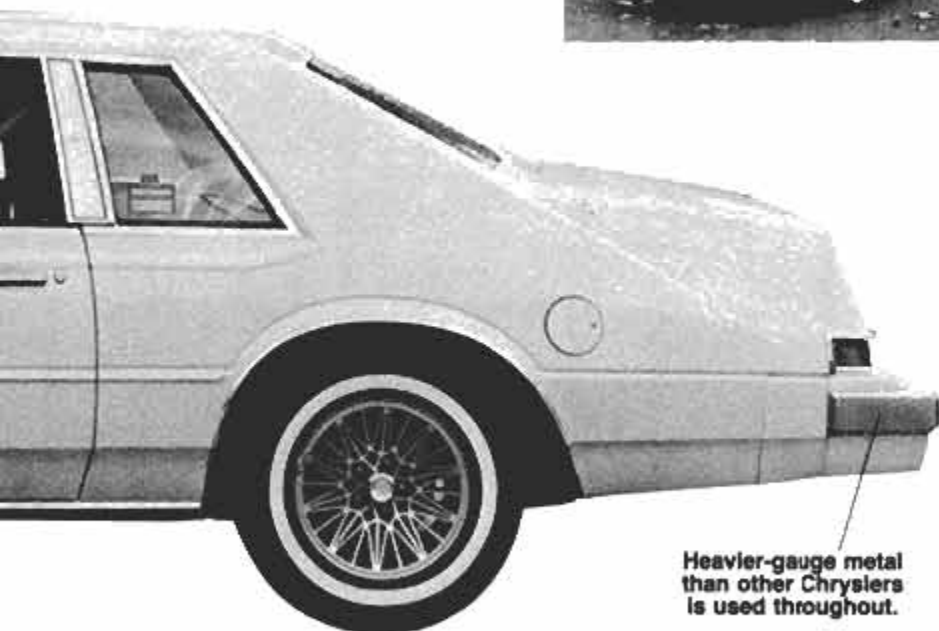
For the first two years or 30,000 miles, Chrysler promises to take total care of all new Imperials, from major repairs down to oil changes, wiper-blade replacement, filters, fan-belts, wheel alignment and sparkplugs.

As for buying the Imperial fully equipped, you do get one option—a sunroof—but that's all. Every power accessory, including a six-way driver's seat and four-way passenger's seat; leather upholstery, with your choice of 34 interior/exterior combinations—all those and more come standard.

Not every Chrysler dealer sells Imperials. Those who do had to put up \$25,000 for the privilege. The factory, though, does its part, too. Example: all Imperial assemblers must have 25 years' experience. All mechanical components are handpicked, be it an engine block, piston, or electrical connector. Imperials are built on special lines in Canada, uncluttered with lesser cars. All Imperials undergo simulated and real road tests, use heavier-gauge sheet metal than normal Chrysler products and get two handrubbed finish coats of paint.

Less ethereally, all Imperials share basic body platforms, floorpans, suspension, and mechanical components with Miradas and Cordobas. The only available engine is the 318-cu.-in. V8 with throttle-body electronic fuel-injection carburetor.

A NATIONWIDE SURVEY BASED ON 784,809 OWNER-DRIVEN MILES



Heavier-gauge metal than other Chryslers is used throughout.



Many owners noted lack of rear-seat headroom and legroom. Quality of craftsmanship, however, got consistent praise.



Even when rated for bigger motors, a light aluminum skiff like this one from Mirro Craft can be set up to get up on plane with a mill the size of a Johnson Sea-Horse 9.9-hp outboard.



Fisher Marine's 16-foot aluminum Water Strider III-V, weighing 510 pounds, is rated to 60 hp, but with its Controlled-Vee hull, planes with 25-hp Mercury at economical two-thirds throttle.

Mini-motors for economy boating

Smaller is better for powering new budget-beating compact craft.

by Bill McKeown BOATING EDITOR



Little outboards are big favorites this year. They cost less, weigh less, burn less gas and need less boat to carry them. They also produce less speed, which isn't all bad. Going slower means more time getting there, but may save banging the boat across a bumpy chop and give

you a smoother ride in addition. There are also many more models from which to choose. For outboard motors under 50 horses, there's a choice of more than 100 models from over a dozen makers. Include electric mills and the builders top two dozen. This year, only one manufac-

turer is making an outboard of 300 hp, and only three make motors over 200 hp.

Shop the chain stores and you may find motors with private-brand-labels. These, like the better-known makes, are usually dependable since they come from the same makers.



Even a double-ender canoe can use a thwart bracket to side-mount a 2-hp Evinrude for fishing, as on this Alumacraft.



New design improvements, like Zodiac's inflatable keel, give vee shape to bottom and provide smoother ride while handling bigger, faster motors.



When the wind dies down, a transom bracket that hinges down and mounts a long-shaft outboard with top controls can power a sailboat home.



For yacht harbor dinghies, a smaller motor is safer on hulls with low freeboard and helps young skippers slow down to the tame, no-wake speeds that are required.



Light weight of inflatables helps make them fast with minimal motors like Evinrude 4.5. Low center of gravity and high flotation make them safer for family boating.



No longer ranked with the large engines, this 50-hp Mercury can pull several water skiers, tops 40 mph, but cuts fuel consumption almost in half at cruise throttle.



Motor from Suzuki, which has taken over the Spirit line, powers a Fisher Scow 16-V, a 325-pound skiff rated for up to 40 hp.



Using the remote steering recommended for safer control of big motors, Metzeler 12-foot inflatable mounts a 25-hp Yamaha.

Proper pick of motor weight and power will match outboard to compact craft.



Single-cylinder Mariner with water cooling gives a 2-hp push to small rigs like Bass Hunter.

but are just dressed in different engine cowls.

Which motor to pick? Fortunately, small craft carry plaques which list the maximum power recommended for safe operation. Today's boatmen, however, are finding that a light, modern hull of, say 12 feet, and rated for up to 40 hp, may be able to plane or even tow a water skier with a mill of 25 horses or less.

Even a 30- or 40-foot cruiser can be eased along with a 2-hp minimotor rigged astern in an emergency, or towed by a dinghy with similar power. Many offshore outboard boatmen who used to mount two big engines now also replace the twins with one

mammoth plus a mini stowed away until there's a special need—perhaps for trolling, problems with the big one, or a depleted fuel supply that the large motor would gobble up too fast getting home.

Some inland impoundments make engine choice an almost automatic 9.9 hp when there are local rules allowing only engines under 10 hp. Yet many craft will also perform well on 2, 4, 6, 7.5 hp or one of the other new small categories that many makers now offer. It's often worthwhile to rent several different sizes and test them, experimenting with mounting at various transom heights to get the most speed, with-

out going so high that the propeller breaks out and cavitates on every turn.

Among the smaller kickers available this year, there's one with a new name: The Explorer, from a division of Eska Co., is an American-made motor. Models are offered in 3.5, 5, 7.5, 9.9 and 15 hp. Mariner, a brand that's earned a reputation for dependable workhorse performance, has added a single-cylinder, 4-horse to bring its total to 18 models; 10 are between 2 and 50 hp.

For 1981, American Honda has the only four-cycle outboards, in 7.5 and 9.9 hp. Lightweight 13- and 21-pound Aqua Bugs are 1.2 and 3 hp. Chrysler-



Square-end canoes, like this 19-foot aluminum Grumman, paddle like conventional models or power easily with Merc's little 3.5.



Explorer is a new outboard line from Eska, with motors of 3.5, 5, 7.5 and 15 hp, as well as the 9.9-hp model shown above.



Small inflatables like this Zodiac can now handle powerful motors like the Chrysler 30. Zodiac 19-footer takes up to 115 hp.



Among imported models is the Flat Nautica Whitehead, made in 8 and 14 hp, with adjustable shafts in lengths up to 34 inches.



Side-mount outboard bracket can be slid forward for best motor-handling position and balance under power for solo canoeing.

er claims weight reductions and fuel economy for its 3.5- and 50-hp Econo-mate models. Included among eight motors in between are extra-long-shaft 7.5- and 9.9-hp models for sailboat use. Cruise n' Carry is a 1.4-hp that weighs 12 pounds.

Evinrude and Johnson have added 25-, 40- and 55-hp Workhorse motors for heavy-duty and commercial use, in addition to nine smaller models starting at 2 hp. Mercury's minis begin at 3.6 hp, while the Merc list includes 30 models up to 50 hp, including short- and long-shaft lower units, plus manual and electric start. Montgomery Ward and Sears both offer six models, with Sears'

Gamefishers from 1.2 to 15 hp, and Ward's Sea Kings from 3.5 to 15.

Micro-minis include the 2-hp Aquascooter that can operate underwater; the 17-pound, 1.7-hp Mighty Mite II; the Porta-Mini 2.5-hp; and the TAS 1.2-hp and 2.5-hp at 11 and 18 pounds respectively. Slightly larger are the British Sea-gulls, in eight models from 2 to 5½ hp, plus a new through-hull "in-board" for sailboats.

More imports from Japan are appearing on the market. Datsun marine dealers are handling Nissan outboards in 7.5, 9, 9.9, 15 and 30 hp. Suzuki, taking over the Spirit line, has nine horsepower ranges from 2

to 50, plus others up to 85. Tohatsu imports 10 from 3.5 to 35 hp. And 6- and 16-hp Carniti diesel outboards come in from Italy.

Most of the larger manufacturers now provide electric start on some of their bigger minis. A few have extra-long shafts, beefed-up reverse performance and controls on top for better adaptation to sailboats as auxiliary power. Larger inflatables come with fixed transoms where motors can be clamped on, and double-ended conventional canoes can be fitted with side brackets.

So which new one do you choose? The old rule is still: Buy from an established dealer you can trust. **FW**

This dollhouse is a toy box, too!



Simple is the word for this dollhouse design. Left side (above) is for play; right side (below) becomes the toy box.

You'll have almost as much fun building this house as your youngsters will have playing with it.

by Rosario Capotosto and Harry Wicks

PM photos: color, George Ancona; black-and-white, Rosario Capotosto

Build this charming dollhouse and you're certain to become the hero father of your block. Its bright, cheerful design will blend well in any little girl's room; the two

roomy floors and the spacious toy box are sure to make this a child's favorite toy.

Adapted from dollhouse plans offered by Georgia-Pacific Corp., the



house is built with conventional building techniques and standard workshop tools. You need neither exotic tools nor any super-sophisticated carpentry knowledge to duplicate the house on these pages. Our goal, when we built the prototype shown, was to simplify construction as much as possible, thus making the house quicker and easier to build.

The windows, door and stairway are integral parts of the hinged

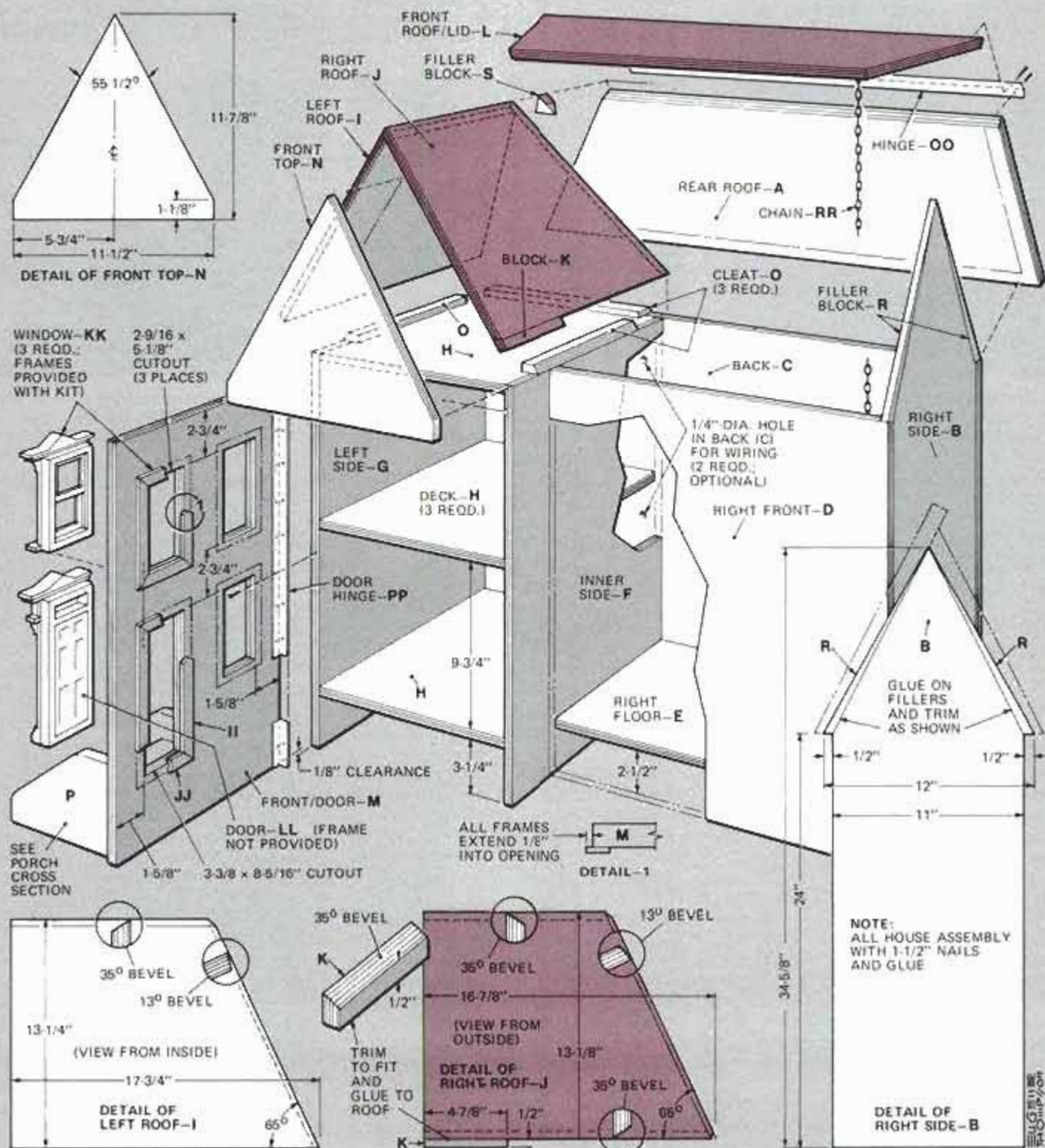
front panel, which swings aside readily for access to the dollhouse behind it.

Roof-panel safety feature

The hinged roof panel over the toy box is simply lifted for access to the storage space below. There is an important design note regarding the toy box roof that you should consider. We debated whether or not to install permanent hardware to hold the roof in the open position and

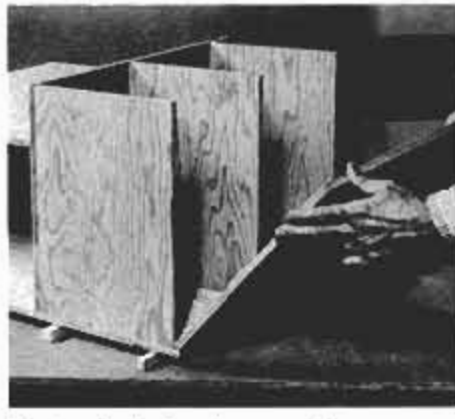
decided against it, fearing that there is too great a chance of one child releasing the roof while another youngster is leaning into the box.

Similarly, if there is no hinge protection at all, there is a real risk of hinge damage caused by an exuberant child opening the rooftop too enthusiastically. We opted for a length of chain that prevents opening the roof beyond hinge capacity. *But be aware that the chain does not*





Use compound such as ZAR Wood Patch to fill voids and blemishes before assembly.



Start nails during dry assembly to ensure good lineup later. Note that shoulders (O) on the end panel have not yet been added.



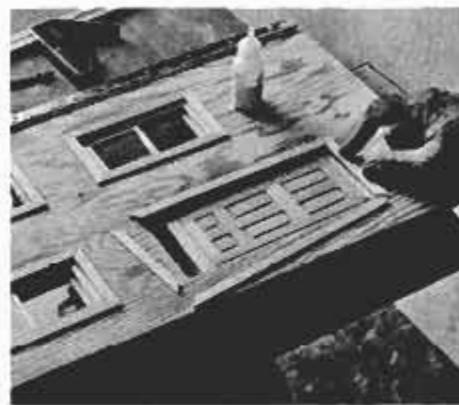
The basic box, ready for the roof to be installed, as it's shown in the drawings.



Strip (K) is added to extend overhang after through bevel cut is made on bottom of roof panel. Piece is then glued and nailed.



Bore holes in the corners, then use your sabre saw to cut out the window openings.



Mitered framing strips are installed for windows and door backup support. Frame is not supplied with door; it must be made.

serve as a permanent stop in the open position.

You'll need $1\frac{1}{2}$ sheets of $\frac{1}{2} \times 48 \times 96$ -in. fir plywood to build the house. Lay out the parts as shown in the cutting diagrams. Don't forget to allow for saw-kerf waste between the pieces. Since three roof panels require compound angle cuts, you should allow an extra inch or so for those parts to permit resawing after all square cuts have been made.

Use a smooth-cutting plywood blade to cut out the parts. Work with a straightedge guide and portable circular saw or, if you can, use a table saw. If necessary, the cutting can be done with a sabre saw and straightedge.

Note that the pointed right-end panel (B) features two pointed fillers (R). You'll find it much simpler to do the cutting if you make straight through cuts along the parallel sides, then add $\frac{1}{2} \times 1$ in. strips of solid pine to each edge of the top slants. Use glue and masking tape to hold them in place, then mark and cut the panel to the required angle.

Fill all voids and surface blemishes, usually on the C or D side, then sand all parts before assembly. If you mark all of the glue-joint lines

and bore undersize pilot holes for the nails, you will ensure a neat, accurate assembly. Use carpenter's glue and 4d ($1\frac{1}{2}$ in.) finishing nails to join all pieces.

The best order of assembly is as follows: Attach the back to the right end, then add the bottom of the storage compartment. Next, add the front (D), then the partition (F). The room ceiling and the floors go on next, followed by the left endpiece. Finally, add the triangular attic front.

The back roof panel (A) requires a 30° bevel cut along its top edge and a compound angle cut along the end abutting the house roof. To make this cut on the table saw, tilt the blade to 13° and set the miter gauge to 25° .

If desired, a beveled cleat (O on the back wall) can be nailed and glued in position on the inside of the roof panel to simplify and strengthen the assembly. This cleat *should not* extend beyond the attic area. Glue and nail the piece in place.

Cut both attic roof panels to size, beveled and mitered as shown. Once again, attach cleats (O). Note that the bottom edge of the right attic roof panel has a beveled setback. It's easier to achieve this notch by mak-

ing a through bevel cut, then adding a short strip (K) to form the overhang. Also, when the panel is attached, it will project slightly above the peak. After the glue has dried, use a belt sander to true up the joint.

Mark and cut the lid/roof panel to fit and attach it with a $1\frac{1}{16}$ -in.-wide continuous hinge. Attach a length of chain and two screw eyes to limit the lid's travel.

Handsome windows

The windows and door are store-bought ready-mades. We used Victorian-style units that are remarkably well detailed: The double-hung windows actually open and close, as does the door. The elegant reproductions are from Houseworks Ltd.; see the materials list for how-to-order information.

Lay out the openings for the windows and door, then bore a small blade-entry hole in each corner; use a sabre saw with a fine-tooth blade to make the cutouts.

The windows come with mitered frame members for use in trimming the back side. Rear frame strips are not supplied with the door, but can be easily made with $\frac{1}{4} \times \frac{1}{2}$ -in. pine stock.

Build the stairway as a unit and attach it directly to the front panel of the house. Allow clearance at the bottom so it won't bind against a floor or table as it swings.

The stylized trees and shrubs are cut from $\frac{1}{4} \times 36 \times 48$ -in. fir plywood.

Apply a coat of primer sealer—such as Bin or Enamelac—to all surfaces, but leave small, bare patches of wood where trees and shrubs will be glued. Don't paint the backs of the trees and shrubs.

Trees, windows and front door are attached with glue and $\frac{3}{4}$ -in. brads after all painting is done.

The dollhouse shown here was painted with latex interior semi-gloss enamel. To obtain varicolored trees and shrubs, we poured some green paint into a separate container and darkened it with burnt umber pigment from a tube. **PM**

MATERIALS LIST—DOLLHOUSE

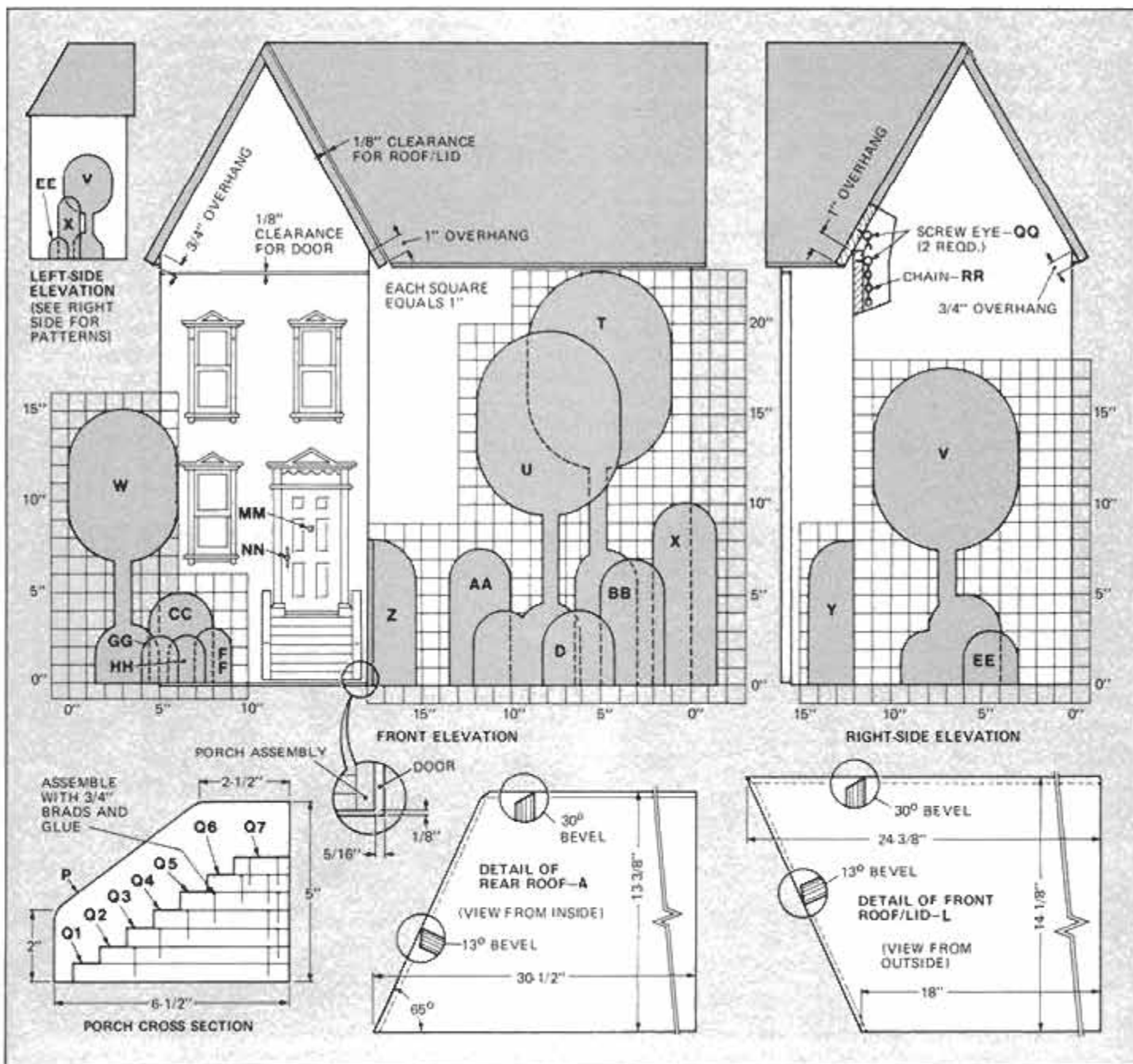
Key	No.	Size and description (use)
(All parts below are of $\frac{1}{2}$" plywood)		
A	1	$13\frac{3}{8} \times 30\frac{1}{2}$ (roof, rear)
B	1	$11 \times 34\frac{1}{8}$ (side, right)
C	1	$24 \times 29\frac{1}{8}$ (back)
D	1	$13\frac{1}{8} \times 24$ (front, right)
E	1	$11 \times 17\frac{1}{8}$ (floor, right)
F	1	15×24 (side, inner)
G	1	15×24 (side, left)
H	3	$10\frac{1}{2} \times 15$ (decks)
I	1	$13\frac{1}{4} \times 17\frac{3}{4}$ (roof, left)
J	1	$13\frac{1}{8} \times 16\frac{7}{8}$ (roof, right)
K	1	$1 \times 47\frac{1}{2}$ (block, right roof; trim to size)
L	1	$14\frac{1}{8} \times 24\frac{3}{8}$ (roof/lid, front)
M	1	$11\frac{1}{2} \times 22\frac{3}{8}$ (front door)
N	1	$11\frac{1}{2} \times 11\frac{1}{8}$ (front/top)
O	3	1×10 (cleats; trim to fit)
P	2	$5 \times 6\frac{1}{2}$ (porch side)
(All parts below are of $\frac{1}{2}$" pine)		
Q-1	1	$1\frac{1}{2} \times 4\frac{1}{2}$ (porch step)
Q-2	1	$2\frac{1}{4} \times 4\frac{1}{2}$ (porch step)
Q-3	1	$3 \times 4\frac{1}{2}$ (porch step)
Q-4	1	$3\frac{3}{4} \times 4\frac{1}{2}$ (porch step)
Q-5	1	$4\frac{1}{2} \times 4\frac{1}{2}$ (porch step)
Q-6	1	$4\frac{1}{2} \times 5\frac{1}{4}$ (porch step)
Q-7	1	$4\frac{1}{2} \times 6$ (porch step)
R	2	1×15 (filler, right side; trim as shown)
S	1	2×2 (filler block; trim to fit)
(All parts below are of $\frac{1}{4}$" plywood)		
T	1	8×22
U	1	8×18

Key	No.	Size and description (use)
V	3	8×17
W	1	5×16
X	2	$3\frac{1}{2} \times 10$
Y	1	$2\frac{1}{2} \times 7\frac{1}{2}$
Z	1	$2\frac{1}{4} \times 7\frac{1}{2}$
AA	1	$2\frac{1}{4} \times 7$
BB	1	$3\frac{7}{8} \times 7$
CC	1	$3\frac{1}{2} \times 5$
DD	1	$3\frac{3}{4} \times 4$
EE	2	$2\frac{1}{4} \times 3$
FF	1	2×3
GG	1	$1\frac{3}{4} \times 2\frac{1}{2}$
HH	1	$2\frac{1}{4} \times 2\frac{1}{4}$
II	1	$\frac{1}{8} \times \frac{1}{2} \times 8\frac{1}{8}$ pine
JJ	1	$\frac{1}{8} \times \frac{1}{2} \times 4\frac{1}{8}$ pine
KK	3	Windows (Houseworks No. 5002)
LL	1	Door (Houseworks No. 6013)
MM	1	Door knocker (Houseworks No. M07)
NN	1	Doorknob (Houseworks No. 1105)
OO	1	$1\frac{1}{8} \times 24$ roof hinge, continuous
PP	1	$1\frac{1}{8} \times 22\frac{1}{2}$ door hinge, continuous
QQ	2	Screw eyes
RR	1	25" chain

Misc.: $\frac{3}{4}$ " nails, $1\frac{1}{2}$ " nails, glue, pigmented shellac sealer, paint, sandpaper.

Dollhouse accessories: Houseworks Ltd., 2388 Pleasantdale Rd. N.E., Atlanta, Ga. 30340. Send \$1 for a product catalog. Request the list of retail outlets.

Dollhouse furnishings in color photo were supplied by Tiny Doll House, 231 East 53rd St., New York, N.Y. 10022. Send \$3 to the company if you desire its catalog.



TECH FRONT LINES

Engine never idles as steel flywheel spins out savings

Dr. Andy Frank's gas-saving Pinto, shown on these pages, may be the model for a whole new breed of cars that travel by spinning their wheels.

The Ford's six-cylinder engine no longer supplies power directly to the car's wheels. Instead, the powerplant is used *only* to pump up a 200-pound steel flywheel to its maximum speed of 8,000 rpm. When this job is done, the engine shuts down, idle and all. That leaves just the whir of the spinning flywheel, the unit that delivers energy directly to the car's wheels. The advantage of such a hybrid: a 50-percent improvement in fuel consumption.

This Pinto hybrid is a proof-of-concept project that Frank and some associates at the University of Wisconsin built with Department of Energy (DOE) dollars. Frank, a mechanical engineer,

gagged at the fact that the engines in today's cars might use 100 hp or more to move a car a few feet through stop-and-go traffic when 10 hp would have sufficed.

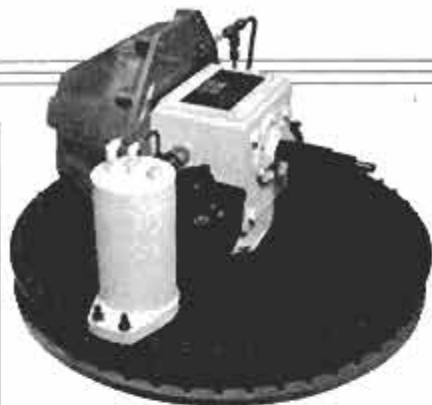
"It's like using \$100 bills to make a dime telephone call," Frank says. "In the hybrid car, the flywheel doles out only as much horsepower as needed for a given job—from a dime's worth for creeping through traffic to a dollar's worth for a burst of acceleration."

This hybrid innovation is an example of what engineers call "load spreading." In this case, the flywheel supplies a uniform amount of energy on demand while the engine runs intermittently at top efficiency. When the

AUTOMOTIVE

flywheel's spin drops below 4,000 rpm, the highly tuned engine roars back to life at preset rpm, pumping up the flywheel until it reaches 8,000 rpm. Then, once more, the engine shuts down, silent and—for a while—unnecessary. A fully charged flywheel can accelerate the Pinto to 50 mph and maintain this speed on a level roadway for some four miles before the engine cuts in again.

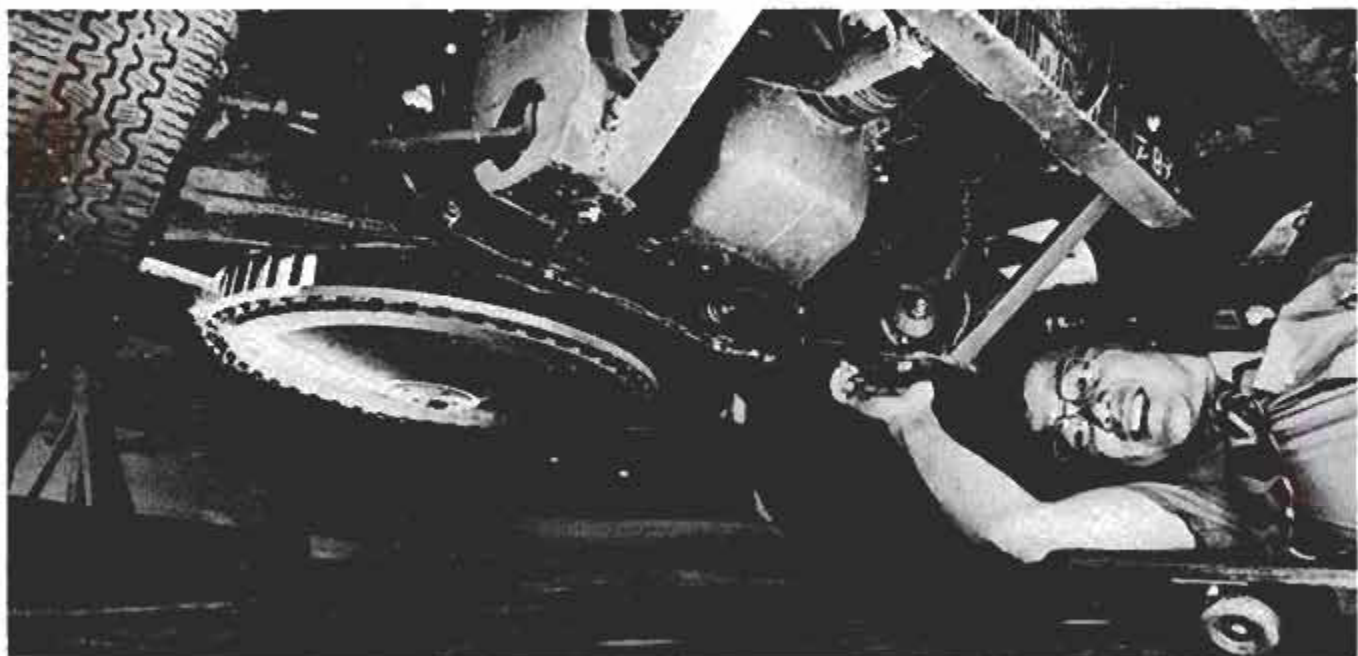
Two other factors in this Pinto



A 200-lb. flywheel banks energy.

hybrid contribute to its 50-percent drop in fuel consumption. First, the car has a regenerative-braking system. Braking energy, rather than being dissipated as heat, is used to pump up the flywheel. Second, the engine's shutdown in between charging times eliminates engine idling time, which can gulp up 30 percent of every gas gallon during traffic jams.

The heart of this hybrid car's performance is a continuously variable transmission: the mechanical equipment that orchestrates the complex play between engine, flywheel and brakes. This variable transmission feeds a corrected torque to the car's wheels even as the flywheel's rpm drop. It senses when the flywheel needs recharging and taps some of its remaining energy to start up the engine. Then it feeds power to the flywheel until it's fully charged, and cuts out the engine again. (A standard car battery



Ford Pinto's engine revs up flywheel mounted beneath car, then cuts off. Flywheel also gets a boost from braking.



Transmission separates the seats.

and starter motor are used for initial starts.) The transmission also links the wheels to the flywheel during regenerative braking.

Right now, Frank is working on an advanced version of the hybrid flywheel car, a project funded by DOE and some unnamed corporations in Detroit. The continuously variable transmission in the Pinto was made from off-the-shelf parts. A major improvement Frank envisions is a custom-built transmission and flywheel assembly, matched to each other and to the GMX Citation he's currently modifying.

Omnivorous engine

A Salt Lake City research firm, Combined Energy Corp., has announced the development of a retrofit kit which will allow most gasoline engines to burn diesel, kerosene, alcohol or any combination thereof.

The company claims the kit can be installed by two mechanics in about four hours at a cost of \$1,000.

The system is controlled by a sophisticated computer which analyzes the engine's power needs. The computer makes the necessary carburetion and firing adjustments at a rate of 1,000 adjustments per second, to keep the engine running at its most efficient level.

Other features of the system include synthesized voice signals to warn the driver of malfunctions such as fouled sparkplugs, overheating, low oil levels and poor battery condition.

The most astonishing claim is that this system will improve mileage by 100 percent. Sounds too good to be true. We'll keep you posted as we learn more.

MARINE

Agile bell, robot sub

Two thousand feet beneath the Mediterranean, an agile, tethered diving bell hefts a heavy pipeline support jack into position with its two manipulator "arms."

The 10-foot-high craft, which resembles a lunar-landing module without legs, is attached to a mother vessel above. But it can maneuver freely to a depth of 3,000 feet by using its 5-hp electric thrusters. Its crew of two, working in a shirt-sleeve, one-atmosphere environment, operates the manipulators to set pipeline saddles, clamps, and mats to anchor the structure.

The OMB is one of the newest of a fresh fleet of tiny, hard-working undersea vessels.

They may be small (the OMB hull is just 76 inches in diameter), but their missions are anything but modest. Right now, for instance, the OMB is helping to construct the world's deepest (1,500 to 2,400 feet) pipeline between Italy and Tunisia. Without the little bell, made by Perry Oceanographics of Florida, pipeline builders would never meet their 1983 construction deadline. The bell rings in at \$700,000—a bargain for heavy undersea construction.

There are cheaper alternatives

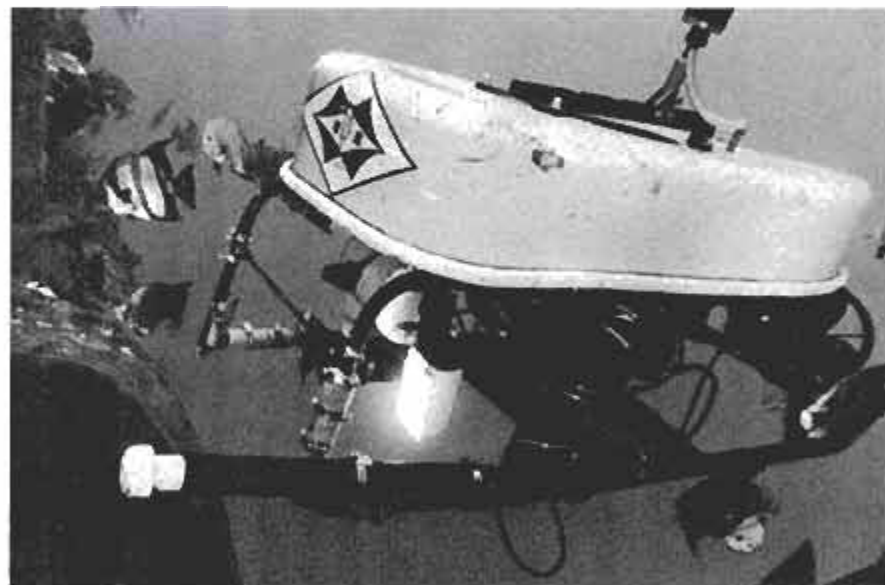
for other jobs. Fastest selling of all undersea vehicles today are unmanned submersibles, such as Perry's Recon IIIB. This five-foot-long, \$450,000 robot sub replaces divers for many risky tasks. The latest models feature small manipulators and "eyes"—on-board TV cameras.

An operator on the surface pilots the tethered sub while observing a TV monitor. Recon IIIB can also provide color or black-and-white video, carry a 35-mm still camera and maintain station—hover—in a three-knot current.

Today, there are 10 times as many unmanned subs in service as there were just five years ago. But a Perry spokesman emphasized that divers will never be totally replaced by robots. And in some cases, divers and Recon IIIBs work side by side: The robot provides light and real-time video monitoring, and acts as a "gofer" for undersea tools.



Bell does heavy undersea work.



Robot sub handles risky jobs, sends TV pictures, and carts tools for divers.

MEDICINE

Nuts-and-bolts sight

A tiny nut-and-bolt device, made from a material that you know best as sapphires and rubies, has already restored sight to 15 blind Americans, and it offers hope to many others. A 25-year-old Florida woman, dependent on a seeing-eye dog despite previous eye operations; a 69-year-old St. Louis grandmother, blind for 20 years; a 39-year-old Elmira, N.Y., businessman—each has had sight returned to them by a new telescopic lens. It was implanted by Dr. Frank Polack, former professor of ophthalmology at the University of Florida.

The device offers hope for people with damaged corneas—but only for those whose retina and optic nerve are healthy.

In the normal eye, the cornea (a half-inch, dome-shaped, transparent covering) and the lens beneath it (the size and shape of a round vitamin pill) transmit and focus light rays on the retina at



A 69-year-old woman sees for the first time in 20 years after receiving telescopic lens (parts at right) to replace her damaged cornea.



the back of the eyeball. When these structures are so damaged that adequate light can no longer enter the eye, blindness results, even though the retina and optic nerve are healthy and normal.

Some years ago, plastic implants (methyl methacrylate) were tried when corneal transplants couldn't be performed. But these usually became infected and were often pushed out by the body's reactions. To help these people, Dr. Polack turned to a mineral called corundum, a neighbor of the diamond in hardness. Its finer varieties are gemstones such as sapphires and rubies. In its industrial forms, corundum is used as bearings in watches and motors and even as an abrasive.

A circular "nut" of this material is stitched in place over a prepared opening in the center of the eyeball. The bolt—roughly the diameter of a ballpoint-pen button, and a third of an inch long—is made from a single optical crystal. It works like a fixed-focus camera, channeling light rays on the retina to provide telescopic or tunnel vision.

"This is really an artificial cornea, to be used when corneal transplant, the method of choice, cannot be done," Dr. Polack says.

"It is a method of last resort. The material is hard and is expected to hold up for many years"—although no one knows yet what its life expectancy will be.

But it does restore sight: The 25-year-old woman can see well enough to work in a hospital X-ray laboratory; the grandmother can watch her 13 grandchildren and great-grandchild grow; the businessman can play ball with his daughter.

Bionic blood

Japanese doctors have safely transfused artificial blood into some 200 patients, according to a California firm which hopes to supply the milky-white fluid here.

Dr. Thomas C. Drees, president of Alpha Therapeutics in South Pasadena, says some Americans' lives have been saved with transfusions of Fluosol. That's a chemical substance, related to Teflon, with impressive ability to soak up and transport oxygen like real blood. But wide use in the United States depends on results from clinical trials that are now under way. The synthetic stuff has one key advantage over the real thing: a shelf life of three years, compared with just three weeks for whole human blood.



Robert Jarvik displays the Jarvik Seven artificial heart, designed at the University of Utah for human use. Air-driven device would need Food and Drug Administration approval as safe and effective before it could be implanted widely.

AVIATION

Lear's light pusher

"Don't take a nibble; take the big bite," Bill Lear, a legendary dreamer who delivered on his dreams, used to say. Lear took many big bites, inventing and often manufacturing impressive technology. His creations range from the first automatic direction finder to the eight-track stereo and, of course, the famous Lear Jet, the centerpiece of a generation of executive aircraft.

Even though Bill Lear died in 1978, his Reno-based corporation recently launched a new plane—the Lear Fan 2100—aimed at taking a big bite out of aviation fuel bills. The pusher-prop aircraft, with an economy cruise speed of 350 mph, uses 40 gallons per hour. That's 8.75 mpg, more than twice the range per gallon of Lear's jets.

The eight-person aircraft, ca-

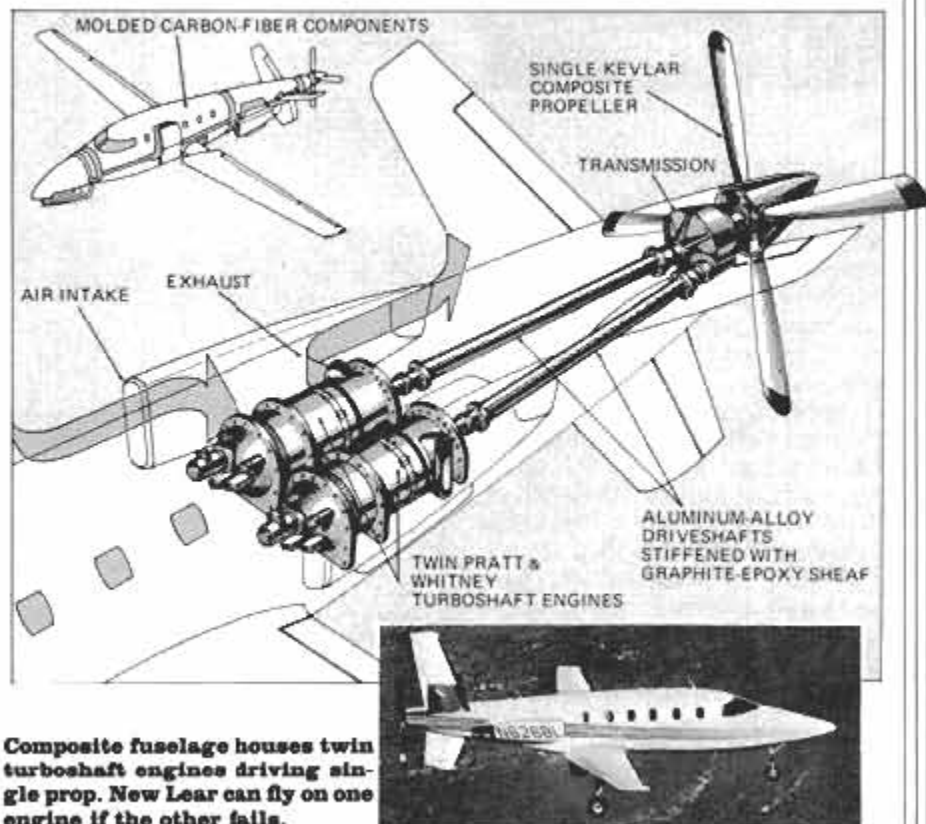
Chopper detector

The unobtrusive sensor below snags downwash sounds from helicopter rotor blades to provide early warning of terrorist attacks originating from the air.

A prototype of the saucer-shaped sensor, developed by Sandia National Laboratories, recently proved itself by detecting a whisper-quiet Hughes 500C chopper that was simulating an attack. If trials continue to go well, the device—whose innards are classified—will sprout up as an antiterrorist sentinel at many government facilities.



Novel sensor warns of air attacks.



Composite fuselage houses twin turboshaft engines driving single prop. New Lear can fly on one engine if the other fails.

pable of speeds of 400 mph, is built largely of a carbon-fiber composite, Thornel. Most of the airplane—including the fuselage, wings, frame, tail fin and control surfaces—is made of the strong, superlight material. Total weight of the plane, when empty, is only 4,000 pounds. In fact, the fuel weight (1,700 pounds) is more than the weight of the carbon fiber used in fabrication (1,400 pounds).

Two engines, one prop

The plane will cruise up to 41,000 feet, powered by two Pratt and Whitney 650-hp turboshaft engines. The engines are installed in the fuselage just behind the cabin-pressure bulkhead, thus eliminating drag produced by conventional wing- or fuselage-mounted powerplants.

The engines drive a single, rear-mounted pusher prop via a helicopter-type transmission. The aluminum-alloy shafts, which have a graphite epoxy outer sheaf for stiffness, link the engines and transmission. These shafts have been used in helicopters and other commercial and military aircraft for 25 years. Overriding clutches in the transmission permit shutdown of one engine without compromising

the other engine's performance. In case of coupling failure, anti-flair bearings prevent the shafts from whipping and damaging the tail cone.

The \$1.6 million plane won't be rolling off assembly lines until late this year, but even then, you might have to wait a while to pick one up. The company reports that 175 were ordered even before the first test flight.

The wild glue yonder

Look, up in the sky. It's an Air Force plane. And holding it together: It's superglue!

That, at least, is the dream of William Shelton, manager of an Air Force program designed to test the feasibility of replacing rivets and welds with sophisticated stickum, cutting aircraft weight by 15 percent. The test program, conducted at Wright-Patterson Air Force Base in Ohio, has been so successful that a new glue, FM-73, is being used to repair wings on cargo planes.

The glue comes in thin amber sheets which are sandwiched between parts. After baking for 90 minutes at 280° F., the "sandwich" is tough as rivets: Shelton says it would take about 3½ tons per sq. in. to tear it apart.

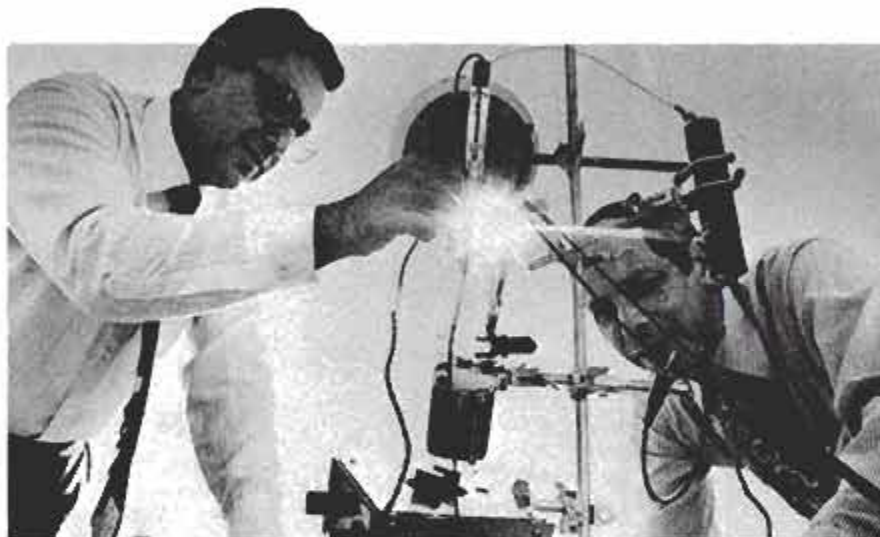
ENERGY

Fish farm follow-up

Despite the cold, the John Todd family ate fresh, home-grown lettuce regularly last winter. They also watched catfish grow and kept their gas burner off for all but 15 to 20 minutes a day on the frostiest days.

Providing the warmth to their traditional New England house was a greenhouse addition (*Solar Heat and a Fish Farm—All in One Dramatic Addition*, page 82, Dec. '80). It was designed to collect heat in greenhouse fish tanks and circulate it for storage in a well-insulated basement. The Todds say it met most of their expectations.

Their report was not entirely glowing. Trees shadowed sun more than John Todd had calculated and the Todds had second thoughts about their wood stove. They used it as little as possible,



A new liquid solar cell from Bell Labs that produces electricity from sunlight has overcomes corrosion problems plaguing such cells. Key is an

indium phosphide crystal bathed in blue-green solution. Sunlight hits crystal, brings electrons to its surface, protecting it from oxidation.

since they were concerned that smoke was polluting neighborhood air. And the basement didn't reach the tropical temperatures they had expected.

Still, the house remained

warm, lettuce flourished and fish-tank water never dropped below 48° F., warm enough to support the catfish which John Todd expects to begin harvesting about the time you read this.

INVENTIONS

Unchaining bikes

An Illinois man has invented a device to send power from pedals to wheels without a chain.

Harold H. Kantner, president of Transcience Associates Inc. of Evanston, won Patent 4,249,750 for a "fluid-power converter." The invention transmits power to

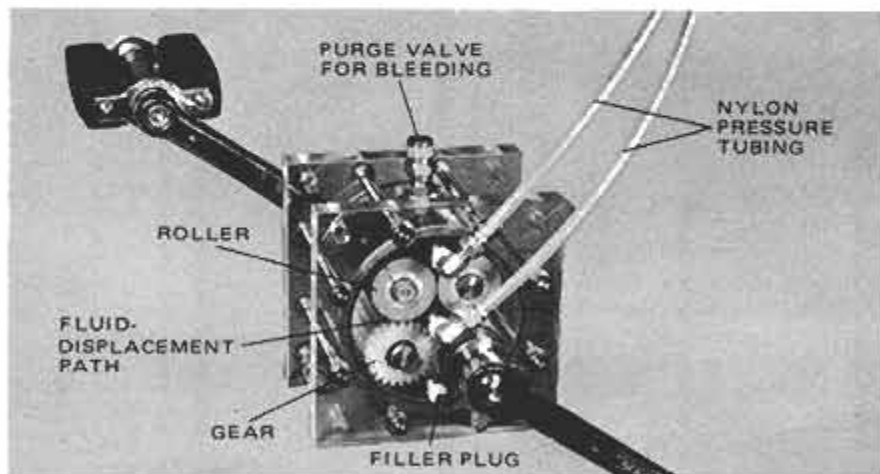
wheels through sealed pipes carrying fluid, probably oil. The system could propel mopeds, wheelchairs, golf carts, or bicycles.

Life form patented

A landmark patent, the first issued for a microorganism since the Supreme Court decided that forms of life created in the laboratory were patentable, was granted to technical staff members of the Bristol-Myers Co. in Syracuse, N.Y. The invention is a

biologically pure culture of a microorganism named *Streptosporangium*. The company has used it as one means of making a cancer-fighting agent. Production of the organism involves no genetic engineering—manipulation of the organism's genes. It requires fermentation of a strain of the organism found in soil.

The Supreme Court decision involved a 1972 patent application filed by Ananda M. Chakrabarty, a General Electric Co. microbiologist. His application was still pending when Bristol-Myers received Patent 4,248,970.



Tubes carrying oil, pumped by pedaling, transmit power to bike wheels.

Pedestrian power

A Floridian has invented equipment for generating electricity from pedestrian and vehicular traffic. Roy L. Lundgren of Ft. Lauderdale was granted Patent 4,250,395 for the system.

Walkers and drivers travel over lines of tread plates. The plates dip momentarily under the weight of the people or cars passing over them and move rocker arms. These are mounted by one-way clutches on a shaft that drives an electric generator.

ELECTRONICS

Undersea TV

The undersea world is about to go on the air—rather, on the water. Researchers Henning Harmuth and Jerry Dieks have been conducting experiments for Catholic University on transmitting moving images underwater using sound waves.

This new equipment promises to have many applications, from oil-rig operation to hunting for sunken treasure. Objects up to 100 meters away are visible on a TV-style monitor even through muddy, blackened waters.

On Harmuth's 25-sq.-ft. prototype unit, there's an array of 256 hydrophones and a sound projector. You only see half as many hydrophones in our photo (below at right), because some are dual-devices.

The sound projector transmits ultrasound waves which echo back to the array. On the array, the hydrophones receive these acoustic signals and convert them to electrical impulses which can be read as points on a TV



If you've ever heard a professional or amateur singer suddenly break down in mid-song with a harsh, rasping gasp, you'll be glad to know that technology has triumphed. The Humid Mike from Voice-Saver contains a humidifier to moisten a performer's parched throat.

Far-out phonemes

"Oh my, it talks!" That was the reaction of one office worker who unwittingly walked in on a demonstration of a new speech-synthesizer for the Apple II computer. Even after we explained that it was only parroting words, the computer raised suspicions. After all—if a computer is capable of speech, how far can it be from taking over the world?

Fortunately (or perhaps unfortunately), the answer is still: "very far."

The speech is laboriously programmed into the computer's memory to take advantage of \$275 worth of hardware obtained from Street Electronics corp. This equipment plugs into any Apple computer.

The Street Synthesizer can combine vocal building-blocks of short sounds called *phonemes*, into words that emanate from the Apple computer's speaker.

screen. Already, the equipment can produce 25 frames per second of TV images—more than enough to show movement.

At first, this "acoustic-imaging" gear will appear on submarines. Signals from the system will be much harder to detect than existing sonar noises. And the TV and animated-movement capabilities should be much easier to interpret.

Shrinking the gear

Harmuth hopes that the military uses will bring down the cost of the technology and so lead to a myriad of civilian applications. He points out that while the equipment is large and bulky now, so was commercial diving gear 40 years ago. The electronics, he says, can be reduced in size in the same way that large computers became handheld calculators.

Besides underwater applications, there may be some medical applications in this device's future.

Theoretically, it should be possible to use this technique in an acoustic microscope, revealing real-time movement of speci-

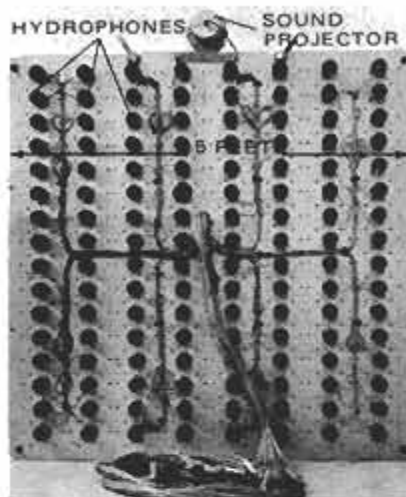
The synthesizer comes with a pre-programmed vocabulary that will come in handy for a variety of general applications. But special words require special programming.

Programming, or editing, a word is a lengthy and involved process. And until you get the hang of it, it's a frustrating one, as well. But in time, we were able to elicit a synthetic greeting of "Welcome to Popular Mechanics."

That seemingly simple task took us many hours. And it raised our respect for such computer games as Milton (from Milton-Bradley) which jabbars a steady stream of wisecracks in ersatz speech while telling numbered players how they are doing ("Whoop-dee-doo, No. 2").

The final output of the synthesizer is intelligible, but we noted a strange accent. Our results sounded something like a Martian who had just learned a Scottish brogue.

mens. The sound waves would travel through flesh and the echo would produce an image of the body's interior. But Harmuth says it would be much harder to get a high-resolution picture



Undersea gear "sees" by transmitting sound and sensing echoes.

from an acoustic microscope than from his undersea device.

Ultimately, salvage operations may have the most to gain from acoustic imaging. Treasure seekers will be able to scout the ocean floor for sunken ships. Harmuth's underwater "eye" will make such expeditions less blind.

Editor: Gurney Williams III

Contributors: James R. Berry, Jack Carroll, Arthur Freese, Tom Johnson, Stacy V. Jones, Neil Shapiro, Almee Thurlo

WORKSHOP MINICOURSE

Wallboard is the home materials product that makes just about every do-it-yourselfer an expert wall finisher. Because of its great resistance to cracks due to a house settling (unlike plaster), the product is the first-choice wallcovering for many.

Called wallboard, drywall and plasterboard, one trade name for the product is Sheetrock. The material consists of fire-resistant gypsum sandwiched between two layers of tough paper. It is sold in $\frac{3}{8}$ -, $\frac{1}{2}$ - and $\frac{5}{8}$ -in. thicknesses. Sheets 4 ft. wide come in 8-, 10-, 12-, 14- and 16-ft. lengths.

Drywall panels are installed using ringed or annular nails.

Plasterboard comes with long edges tapered so joint compound and tape can be applied to create a smooth, continuous wall surface.



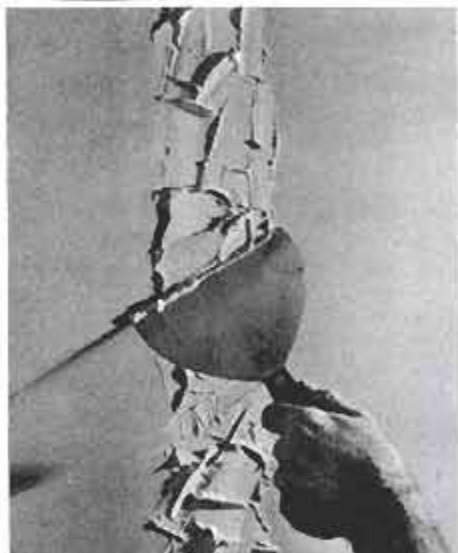
Next day, apply second coat of compound, wider than the first, and draw it smooth using a 10-in.-wide trowel. A third thin coat is applied in the same way as the second, but feathered about 18 in. wide.



If your taping knife has a metal cap on the end of its handle, use it as a hammer to bury the nailhead in the wallboard. If not, sink the nail with your hammer; immediately clean the tool after you're done using it.

You need certain tools for installation, such as a ruler, metal straight-edge (a 4-ft. T-square works great), utility knife (buy the kind that uses replaceable razor blades because the material dulls cutting edges fast), a 16-oz. hammer and a keyhole saw.

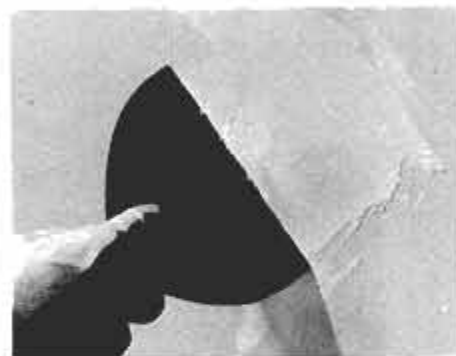
You will want additional tools for finishing, including a taping knife, corner-finishing tool and a hawk—



Start by applying a generous coat of joint compound to the straight joint. Work one joint at a time, or compound will stiffen.



All nails in plasterboard should be dimpled (as shown) to receive compound. The hammerhead should not break the paper.



Then apply one coat of joint compound.

for carrying the compound from can to wall. Or, you can fashion a homemade version, using $\frac{1}{2}$ -in. plywood and a sturdy dowel-handle attached with screws.

Always check the walls to make certain that all nails are dimpled. Correct any that aren't and you're ready to start the compounding step.

More next month.

PM



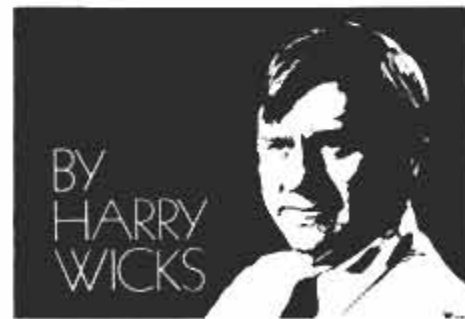
Tear a strip of paper to desired length and embed it in the compound. Make a pass with your taping knife to smooth the joint; return all excess compound to the can.



If you fail to dimple a nail, you are sure to find it when you apply the nail-hiding compound. A protruding nail will look like this when you apply compound.



Properly dimpled and compounded, nail looks like this after one coat of compound. After three coats, it is invisible.



'81 OUTDOOR LIVING GUIDE

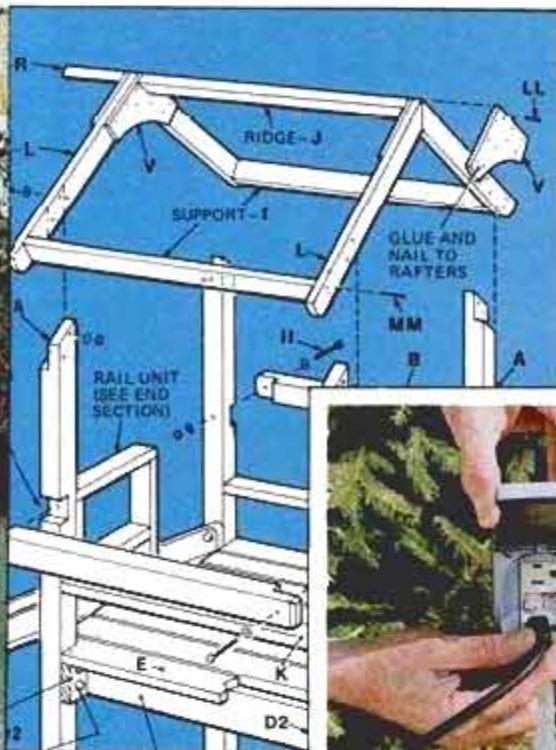
With your own creative ideas and these Popular Mechanics projects, you can turn your home into a vacation paradise. This is the summer to rediscover your own back yard, and realize that staying at home and playing at home can be a whole lot of fun.



Plywood picnic table... build it in your workshop.



Kid's back-yard play structure... be an instant hero.

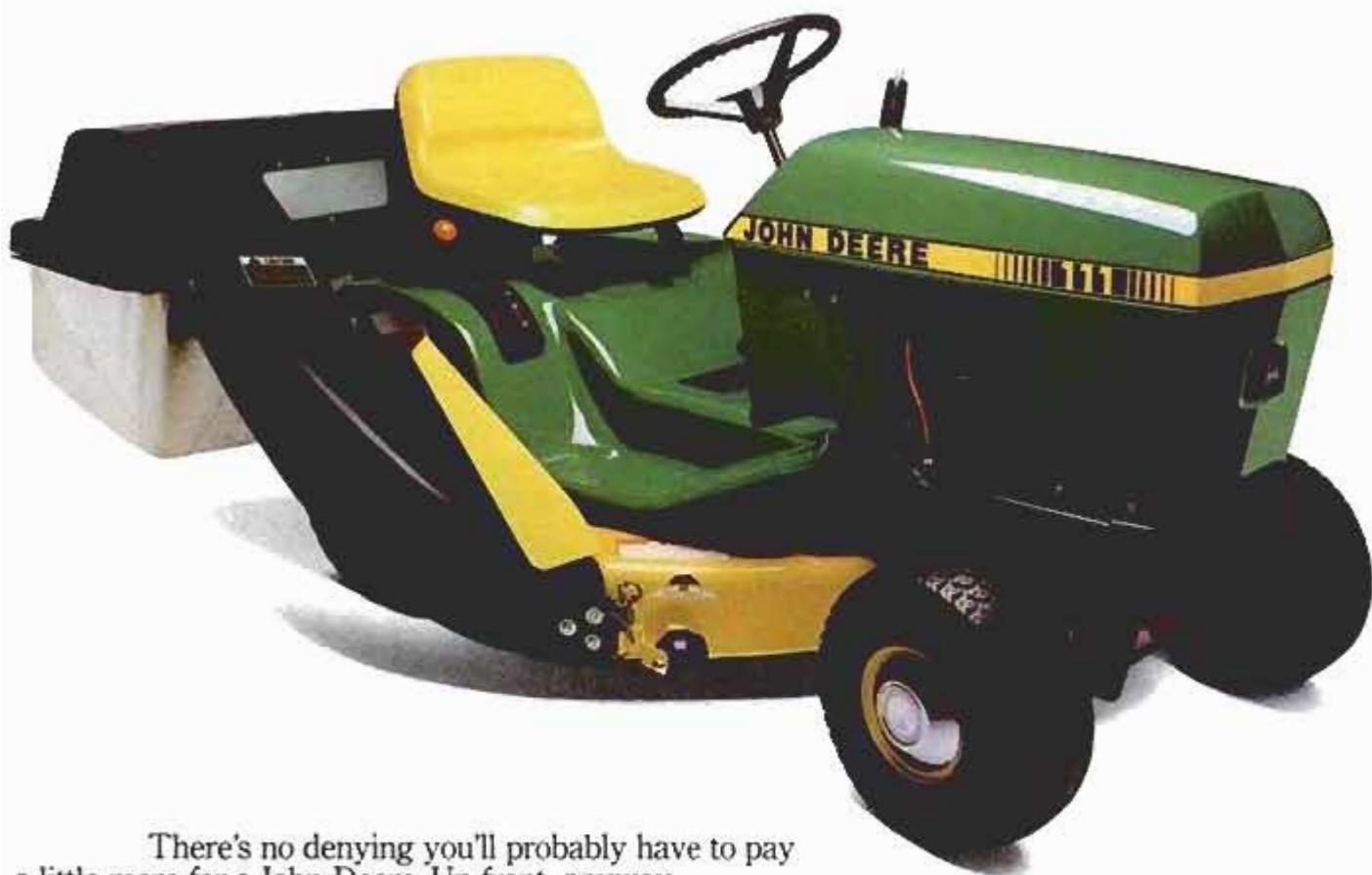


5 conveniences... make your yard a better place to be.



An in-ground pool you can build for less than \$2,500... see inside for plans offer.

Isn't it better to have a John Deere Lawn Tractor for 10 years than a "bargain" tractor for 4 or 5?



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Build a picnic table for summer fun

This handsome and functional back-yard table features slotted joints and dowels for quick, easy assembly.

by Rosario Capotosto

The simple construction of this slip-together picnic table will ensure years of family use. The graceful "sculpted" legs are actually two layers of 3/4-in. plywood. The table shown is con-

structed of medium-density overlaid (MDO) plywood, which readily accepts and holds water-base acrylic paints. The other wood members are fashioned of 2x6 and 2x8 pine or fir.

Draw the pattern for the legs (see the drawing on page 110 and the materials list at the end of the story). Cut out the legs with a sabre saw. Do not cut on the line. Instead, cut about 1/2 in. outside the line so the legs are slightly oversize—these will be trimmed precisely, after laminating the plywood pieces together.

Stack two plywood cutouts together and drive two 1 1/4-in. nails partly into opposite ends of the waste area. This prevents the plywood parts from sliding laterally as you tighten the clamps. Separate the panels and apply resorcinol glue to mating surfaces. Use 2x4s and as many

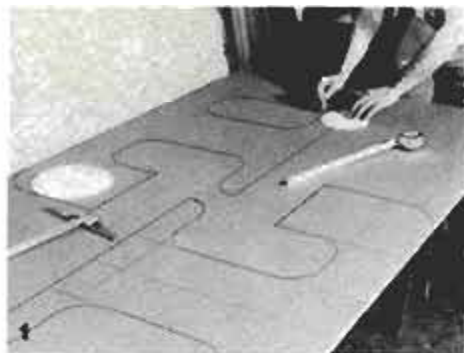
Design: Georgia Pacific Corp.
Construction by the author
PM color photo: George Ancona
Black-and-white photos: Rosario Capotosto



Marlboro

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

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Dec. 79



Use a T-square, rule and suitably sized circles (plates) to lay out legs. Draw patterns close together so you'll have usable waste remaining. With a jigsaw, cut the legs $\frac{1}{8}$ in. oversize to simplify gluing.



After legs are glued, you can use a table saw to trim the excess off the straight sections. Use a sabre saw and a blade with coarse-set teeth to trim the curves.



This U-shaped jig (see the drawing on page 110) can help you cut the notches perfectly true. The back of jig supports saw base.



After rough-cutting parts, apply glue with a short-nap paint roller. This conserves glue and leaves an even deposit. Coat the surfaces of both pieces to be joined.



Sand parts to remove saw ripples. Use a portable drill with drum sander on the curves and an orbital sander on the flats.



Remove jig after making two parallel cuts and cut the waste between them freehand.



After laminating both legs, stack them together and apply pressure with clamps. You can distribute the pressure by adding 2x4s between the legs and the clamps.



Corner-round the edges of the legs, except at the top where they join the seat slats.



The jig also helps make the interior cutout on the legs. First bore two holes tangent to the line of blade entry. After making two parallel cuts, remove the jig and cut the ends of the opening freehand.

clamps as possible to provide uniform pressure.

Use a table or portable circular saw to make the straight outside cuts on the legs. Use a sabre saw with a coarse blade and heavy-set teeth to make the contour cuts. Don't make the cuts with a hollow-ground blade; it tends to veer off the cutting line.

Smooth out the saw marks on the inside curves, using a drum sander in your electric drill. Round the edges with a $\frac{3}{8}$ -in.-radius rounding-over router bit.

You can cut the notches precisely with a sabre saw and a simple guide jig (shown in the drawing on page 110). Use a piece of plywood about $\frac{3}{8} \times 8 \times 18$ in. to

make the guide. Cut an opening wide enough to shift the sabre-saw base laterally, since the blade must make two parallel cuts to outline the notch width.

To notch the legs, clamp the jig in place and make the two parallel width cuts. Remove the guide and, working freehand, cut out the waste in between the parallel cuts. Then bore two holes for blade entry to make the internal cutouts in the legs; use the same jig to make these.

If you have a radial arm saw, use it to make the notches in the 2x8 seat slats and upper stretchers (parts B). Make a series of kerf cuts with a regular blade. Otherwise, use a notching jig with a sabre saw. The 2x8 lumber has a different

thickness than the laminated plywood, so make a separate guide jig.

Use a pivot guide and sabre saw to cut the curved ends on the stretchers, table and seat slats. Round edges with router.

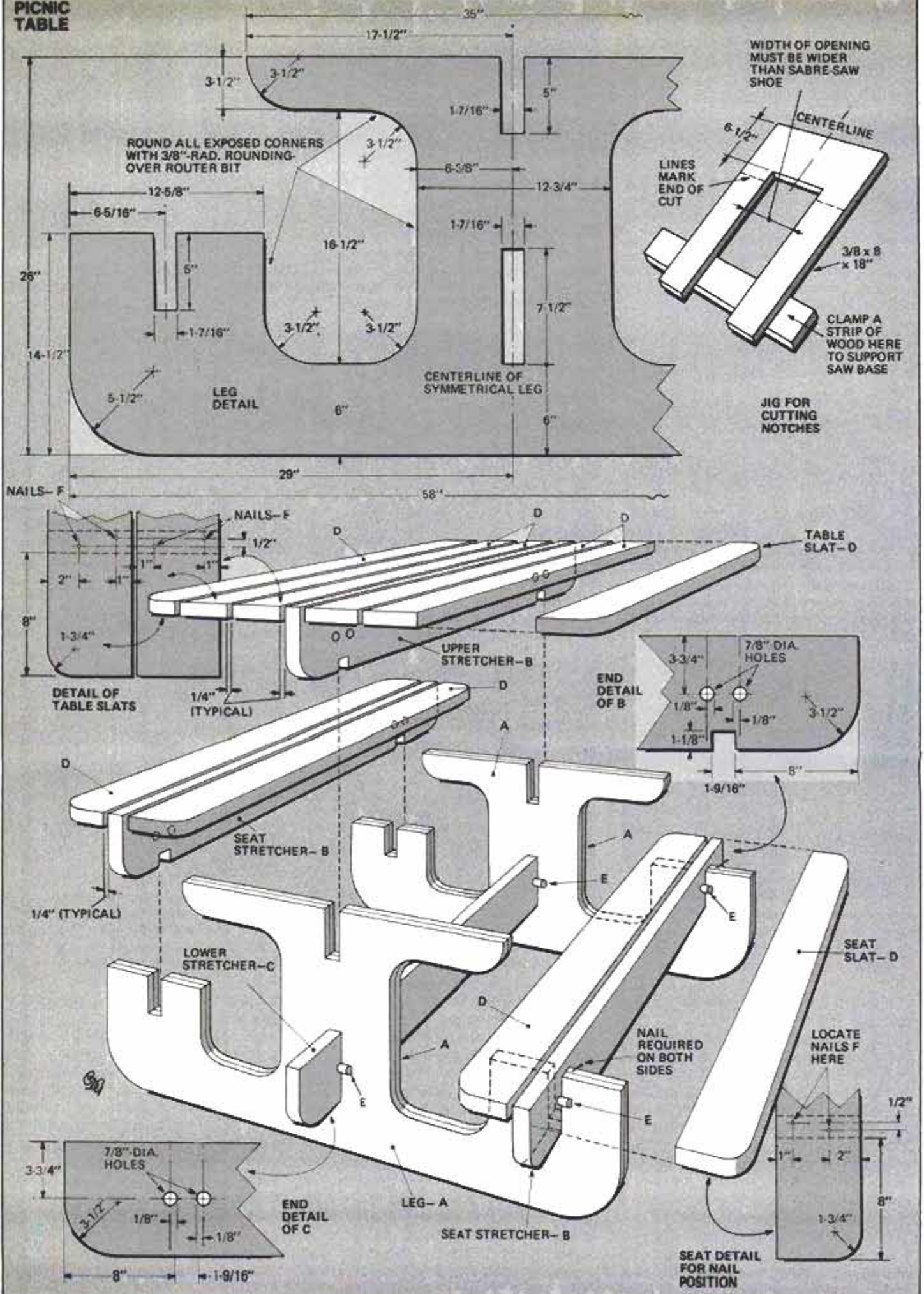
Bore $\frac{7}{8}$ -in.-dia. holes for the dowel pegs $\frac{1}{8}$ in. inside the joint line (see drawing on page 110). With this setup, you can insert slightly flattened dowels which will hold more effectively.

Glue all stretchers in place with the exception of the lower one (C), which you should insert without glue. Use a block plane or a sander to flatten the dowels for a snug fit.

Attach the bench and tabletop slats (D)

(Please turn to page 142)

PICNIC TABLE



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'Hinged' deck allows access to basement

This lift-up deck is built to provide easy access to the basement. The lift-up part is built in three sections—C, B, A—and lifted in that order (see drawing below).

Build the stationary part of the deck in one piece to help assure that the deck will remain level. Position the joists to allow clearance for the basement doors. Cut away the front header to allow for the lift-up sections. You can add decking later.

Bolt 2x4 supports along the lower perimeter of the joists and header. Next, hinge the 2x4s so they are part of the lift-up sections. Position the hinge knuckles 3/4 in. above the joists.

There must be clearance between section C and the sliding door from the house. Otherwise, section C can't open (see hinge detail).

Without removing the hinged 2x4, construct section A, allowing 1/4-in. clearance between other movable sections. Size A so you and others can lift it with little effort. Brace A temporarily; add joists after proper operation is certain. Build B, C the same way.

Add 1x8 fascia boards to dress the header joists. Then add the decking and railings. In the open attitude, hook sections A and B to the railing post and house. This prevents inadvertent closings.

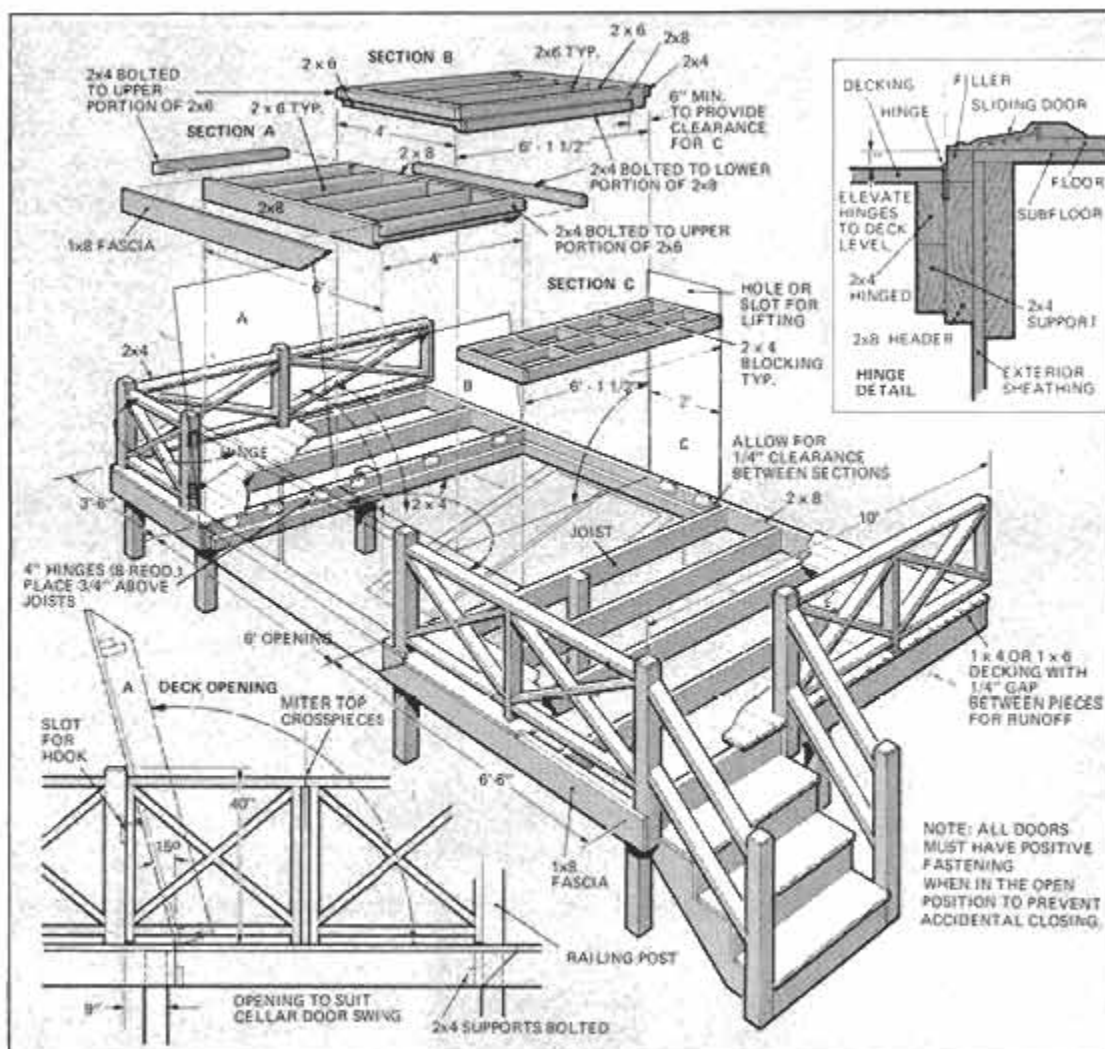
Section C is secured to the house by a hook and eye to prevent anyone from walking onto the deck when it's open. Bore a hole in C for two fingers to lift it.

The right-hand railing door must open inward so its hinges won't prevent section A from opening. Secure the railing doors to the deck. Fasten the doors with a gate latch.

—Donald A. Clermont



Deck is a good place to entertain. Section C is hooked to the house to prohibit deck access when it's open (above). Sections B and A lift, then are secured to house and rail post, respectively (right).



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OUTDOOR RECEPTACLES



HOSE BIB

5 conveniences you can add to your yard

We've rounded up the five most wanted back-yard conveniences and created the how-to you need so you can install them, too.

by Rosario Capotosto

Warm weather means more time for the great outdoors—your own comfortable back yard. Here are a few ideas that can make yard life more enjoyable.

The convenience of outdoor electrical receptacles is obvious to anyone who spends much time in the yard. Whatever electrical appliance you wish to use outside may be plugged in on the site. Then it is no longer necessary to run a long—and possibly dangerous—extension cord into the house through an open window or

through a screen door forced to stand ajar by the cord.

Remember that all electrical work must be done in accordance with the National Electrical code, or your local code, whichever is more stringent. In fact, it's very possible that your local building code may require the work to be done by a licensed electrician.

All approved electrical systems are protected with circuit breakers or fuses, but the National Electrical Code requires that outdoor receptacles be further protected

with a special device called a Ground Fault Interrupter, shown above and on the following pages. Fuses and circuit breakers protect against overloads and short circuits, but GFIs protect you from a fatal shock, so don't forget to use them.

An in-ground garbage can serves two purposes. First, you can keep the can convenient, yet virtually out of sight. The second advantage is that animals can't get to it; thus, tipped-over cans are eliminated.

Another idea is to add a yard entrance to the basement of the house. As both basement and yard are used for recreational activity, easy passage makes everything more fun. Installing a basement entrance is a major construction job, but you will find the basics for installing an entryway on the following pages.

The maker of the door shown in the photographs also includes complete "how to" installation instructions.

There's no doubt that a hose bib in the yard makes life there more convenient. With the use of plastic vinyl tubing, you no longer need a plumber to install an outdoor faucet.

Basement entry photos: the Bilco Co
Other PM photos by the author

Two electric receptacles

Decide where you want exterior receptacles in the wall of the house and then adjust the position slightly if necessary to locate it between studs. Be careful not to cut the opening oversize, as the electrical box has ears with screw holes for attachment to the wall.

Trace the box outline onto the wall, then bore two $\frac{3}{8}$ -in. holes centered at the top and bottom. These holes allow clearance for receptacle-to-box connecting screws and permit blade entry to complete the cutout.

Inside, run the cable to the box, making certain it is securely fixed to the framing with staples spaced no more than 24 in. apart. Cut the cable and install it in the box, using the appropriate connector. Do not connect the circuit to the house service panel until the box installation is completed.

The remaining work is done from the outside. Bare the ends of the black and white leads and join them with solderless connectors to the black and white leads that extend from the receptacle. Connect the bare ground wire to the receptacle's green lead. One red and one gray lead marked LOAD on the box (not visible in photo) are capped with solderless connectors.

If the receptacle that you are installing were not a terminal receptacle (end of run), those installed downstream from this one would also be GFI-protected.

Fold all wires neatly inside and then attach the receptacle to the box. Next, mark and make pilot holes for the screws to secure the flange to the wall. Use four flathead screws.

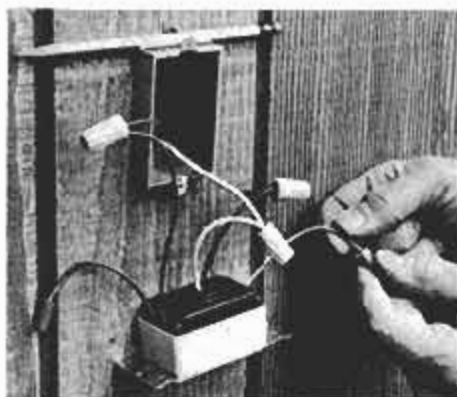
The cover plate comes with a waterproof gasket, but the flange may hold this gasket away from the wall of the house. If you anticipate this situation, buy a second gasket and cut $\frac{1}{4}$ -in.-wide strips from it to insert around the perimeter of the flange.

After attaching the spring-loaded cover plate, connect the cable to the panel box. Test the unit as indicated in the detailed instructions provided by the receptacle maker.

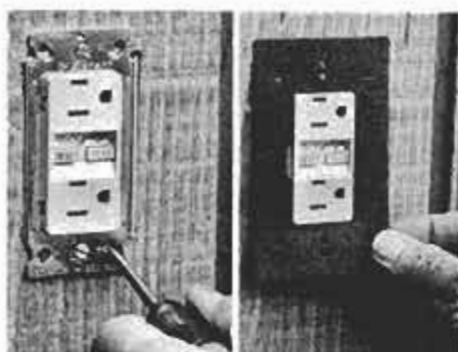
The GFI shown on this page is called an SIR (Slater Interrupter Receptacle, made by Slater Electric Inc., Glen Cove, N.Y. 11542). It retails for approximately \$28.

In-ground receptacles

Codes may permit the use of UF cable that can be buried directly in the ground, requiring only that conduit be used for those portions where the cable is not in the ground (from house to ground and from ground to fixture). Some codes require conduit throughout.



Join white to white, black to black and the bare ground wire to the green receptacle lead. Cap unused red and gray leads.



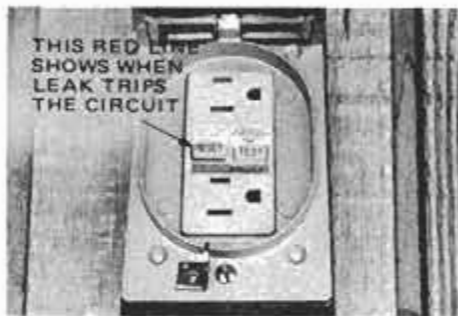
Use an awl to mark holes for the screws. Bore pilot holes with a drill. Use gasket to cover the mounting plate as shown. Add an extra piece of gasket underneath if plate holds gasket away from the wall.

A trench for direct-burial UF cable should be 12 in. deep (at least 24 in. deep for a 30-amp. circuit). Plastic or thin-wall conduit must be buried at least 18-in. deep.

The installation shown in the drawing is for a UF direct-burial installation. Galvanized rigid conduit is used to protect the cable from the point where it leaves the wall to a depth of 18 in. in the ground. A 30-in. length of conduit is used at the in-ground receptacle secured in a concrete collar. The NEC requires in-ground receptacles 12 in. to 18 in. above ground and the box secured to the conduit with a threaded bushing.

An LB fitting is used on conduit to carry the cable from the house down to the ground. A nipple joins the LB to a junction box inside the house. This fitting, threaded both sides, has a removable plate which permits fishing the cable around the bend. A rubber gasket keeps water out. A weatherproof box houses the junction.

Begin by locating the site for the in-



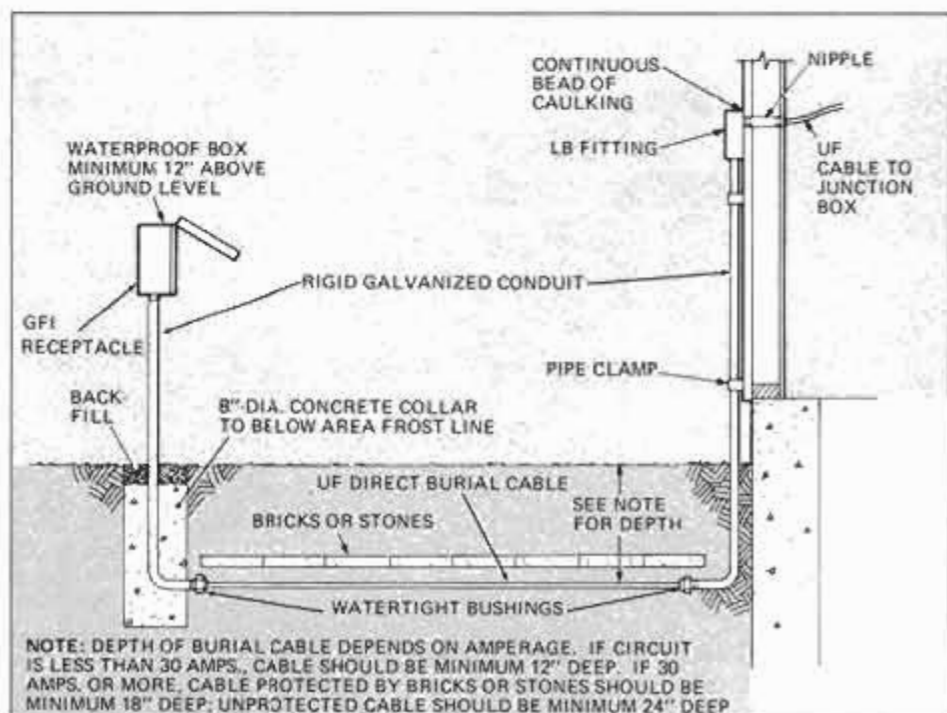
The receptacle has a reset button which pops out when a fault or slight leak occurs in the circuit. To test interrupter, press the test button. If it doesn't pop out, the interrupter isn't working properly. All wiring should then be checked.

ground receptacle. Lay out and dig the trench from the power location at the house to the receptacle site.

If your lawn is in good shape, make neat slices so that the sod can be lifted out and saved for reuse.

With the trench dug to desired depth,

(Please turn to page 117)





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

Kings, 9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method;
100's, 9 mg. "tar", 0.7 mg. nicotine av. per cigarette, FTC Report Jan. '80.

install a plywood form across the trench end, braced by stakes, so you can pour the concrete collar around the conduit. Bend the conduit to shape and position it in the form. Secure it in the vertical position, using three diagonal stakes and wire.

The lower end of the conduit, of course, must exit through the form at the desired elevation. Wrap both ends of the pipe to prevent any chance of concrete entering.

Pass the cable through the plastic bushings and then fish the cable up into the receptacle and junction box. Tighten the bushings.

Bricks or stones provide natural protection from a stake or some other object driven into the ground. They also act as a warning reminder that the cable is present at the time of a later excavation. Before placing the bricks, bury the cable with three or four inches of soil. Tamp the soil firmly around the cable, then lay in the bricks tightly together.



Waterproof gasket is inserted over the receptacle. The cover seats tightly against it.



Closeup shows unit ready for use. Tape keeps spring-loaded cover open for photo.

Screw the LB fitting to the conduit. Connect the LB fitting to a junction box on the interior wall using a nipple of the required size. Remove the knockout from the back of the junction box, pass the nipple through, then secure it with a star nut. Screw on a plastic bushing. Strap the conduit to the wall.

Fish the cable through. Connect the in-ground receptacle box with a threaded bushing, then pass the cable through. Connect the GFI receptacle.

Inside the house, join the outdoor cable to a cable running to the panel box. Caulk around the LB fitting on the exterior wall.

Basement entryway

First, decide how you will use your basement, and lay out a plan showing where various activities will take place. Locate the new entrance where it does not interfere with partitions, utilities, piping or with any outside construction.

When considering the outside access area, a low grade will save steps and simplify construction. The grade should also slope away from the areaway to provide good drainage.

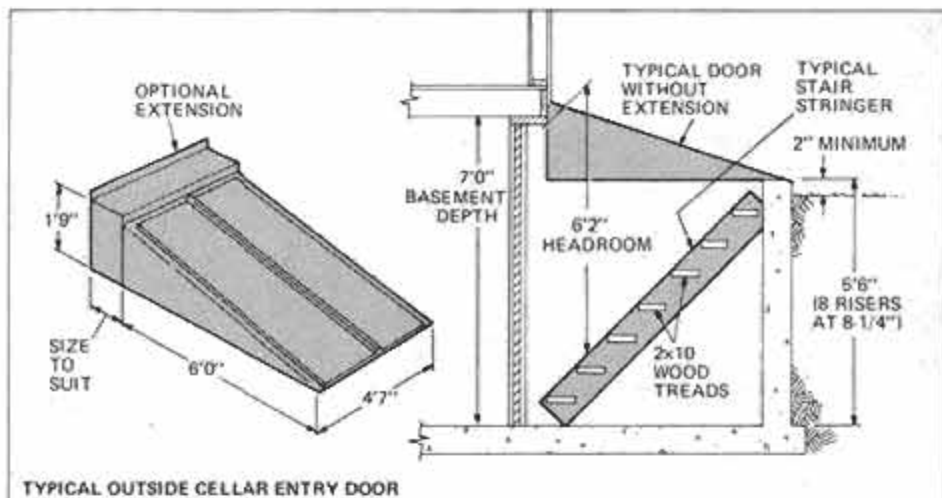
Our photographs show installation of a door made by the Bilco Co., New Haven, Conn. 06505. The maker claims the materials cost less than \$300. Bilco provides a complete installation booklet, including the steps outlined here.

Draw vertical lines on the foundation to indicate the location and width of the opening. Stake off the area to be excavated, allowing at least an extra foot all around for the footing and for application of waterproofing materials.

To lay out the areaway square with the wall, use the 3-4-5 triangle method: Measure along the wall three units from one corner of the areaway to start. Then measure four units out at approximately a 90° angle. The hypotenuse between the marks must be five units to make the lines square with the wall. Lay out the areaway, leaving adequate room for the footings.

Do all excavating first. Dig to a depth of 4 in. below the level of the basement floor. Then dig a footing trench around the areaway to the depth of the house footing and about 12 to 16 in. wide. After the footing has been poured and has set for two or three days, masonry work begins.

Hollow blocks used to construct the



TYPICAL OUTSIDE CELLAR ENTRY DOOR



After three or four blocks have been laid, corner block is used for correct alignment.



Adjustments are made before the door is attached. Here, header slips under siding.

areaway are called stretcher blocks and have both ends hollowed. There are also corner blocks which have one end flat. Each course takes two corner blocks.

The first course is most important; it's a good idea to lay it out without mortar. Check for alignment and square with house and footing. Use the triangle method again. When satisfied with position of the first course, remove the blocks,

spread and lay on mortar to create a 1/2-in. joint.

Cement blocks are laid with their thick surface up (the side with the smaller holes); this provides a larger surface for the mortar bed. For vertical joints, only the ends of the face shells are "battered" with mortar. Each block is brought downward into the mortar bed and against the previously laid block, thus

producing well-filled mortar joints.

Vertical joints between blocks on successive courses should be staggered. The top course should come slightly above ground level and about 3 in. from the required areaway height as given in the instructions. Should the standard block not permit this, half blocks may be used.

The deepest areaway will require about nine courses while most require only four or five. After mortar has set for two or three days, apply a masonry waterproofing material to the exterior wall following the instructions on the can.

The next step is to assemble the frame of the areaway door. Position it over the wall and against the house. Use stone or block shims if necessary to get the door into the desired position. Be certain to locate the frame exactly as you want it. Mark the frame's outline against the house.

Remove the door and, following its outline, cut out the shingles or clapboard.

Start pouring the cap and, when it is an inch or so below the desired height, set the door back in position with the header flange between the siding and the sheathing underneath. Make sure the frame is square. Insert the mounting screws with the spring steel nuts in the side pieces and sill, and embed in the wet concrete.

Continue pouring the cap, bringing the

concrete flush with the bottom of the sill and side-piece flanges. Don't bring the capping above the bottom of the door; the door should rest on top of the foundation. With a little extra work, the cap outside the door can be chamfered to ensure good positive water runoff.

If you have not done so already, you may want to break through the foundation wall into the basement. The opening should be the full inside width of the areaway to take full advantage of the new entry. In block foundations, it can be cut with a cold chisel and hammer, but a masonry bit in a power drill is faster.

If the basement wall is reinforced concrete, a heavy-duty electric hammer with chisel attachment will be required. Either way, call in an engineer to determine the best method for breaking out the wall, and whether you will have to install additional support above.

Drill and chisel from the outside and knock the wall out from the inside to minimize the rubble in your basement. You can now clean up the areaway and pour the floor to the same level as the basement floor.

If you plan to use a vertical door in combination with the areaway door, have it on hand when you break through. Give this matter consideration—you don't want to leave your home unprotected.

Keep an eye on the weather when planning this project. You don't want to chop



Stair stringers are attached to areaway walls with masonry nails. Install treads.

a large hole in your foundation at the onset of a rainy period, for example. When the job is completed, the doors are watertight and designed to ensure water runoff.

The areaway doors are easily installed once the concrete cap has set around the screws which are threaded through the frame.

If the frame does not wiggle, doors may be attached as soon as the frame is in place.

HOW TO USE THIS TO TRIM

Seven years ago, the Weed Eater string trimmer revolutionized lawn and yard care. Today it's still the number-one selling brand of trimmer in America. Simply because it works hard. It's priced right. And it holds up. What's more, Weed Eater's got a complete line of both gas and electric models to handle all sorts of trimming and edging jobs. And now you can use one to save **WEED EATER** some money.

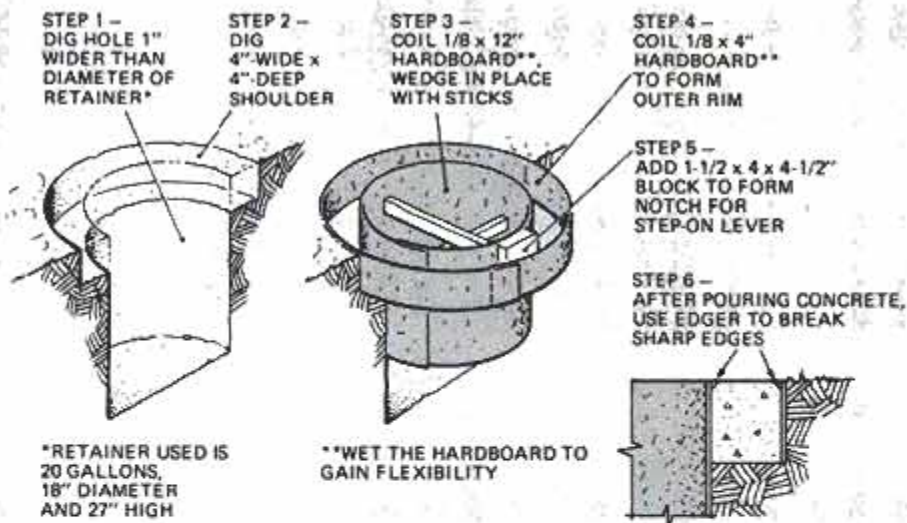


In-ground garbage can

Here's a smart way to keep a garbage can by the back door—yet virtually invisible. In-ground units have retainers and inserts. Available in 10-, 15-, and 20-gal. sizes, the units have all parts made of galvanized steel. The retainers are made with single- or double-action covers. The single-action unit at right is a 20-gal. size retailing for about \$50 and made by the Dover Stamping Co., 427 Plymouth Ave., Fall River, Mass. 02722.

Dig a neat hole 1 in. wider than the retainer. Then dig a ring as shown in the drawing and set up a form for the collar. Using any packaged premixed concrete, mix it with water and fill the ring halfway. Lay in a few rings of heavy wire for reinforcement and then fill up the ring. After surface water has disappeared, level with a wooden float. When the concrete has set but is still wet, you can round over the edges as indicated by the arrows in the drawing. You may also need to carve out a small indentation in the collar to accommodate the lever hinge on the lid. To check, place the retainer in the hole as soon as the hardboard form is removed—a day after the collar has been poured.

(Please turn to page 121)



Lid to can is opened by stepping on a lever. Garbage is easily deposited without mess.



To remove garbage, insert is lifted out. Can stays clean with a plastic bag liner.

\$10 OFF THE PRICE OF THIS.



Just buy any Weed Eater Brand string trimmer between April 1 and August 15, 1981, and we'll give you a \$10 refund when you buy the hot-selling Weed Eater Brand Home 'N Yard Power Blower. The powerful new machine that uses a hundred and twenty-five mile an hour blast of air to breeze through leaves, grass, dirt—even light snow. In no time, with no sweat.

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To receive a \$10.00 refund check from WEED EATER return this coupon, along with the original bills of sale with purchase price circled for both a WEED EATER Brand string trimmer and a WEED EATER Brand power blower purchased between April 1, 1981 and August 15, 1981. This coupon and the sales slip from each product may not be mechanically reproduced and are not transferable. Good only in U.S.A. and Canada. Void where prohibited by law. Limit one refund per WEED EATER string trimmer/power blower purchased. Separate requests that are illegal or that contain materials altered in any way are automatically void.

Your request for \$10.00 refund must be postmarked no later than September 1, 1981. Please allow 6 weeks for refund.

Return to: WEED EATER, P.O. Box 725, Dept. WE, Lubbock, Texas 79491

RAM TOUGH DODGE PICKUP. NEW DESIGN FOR '81. BUILT TOUGHER. BETTER MILEAGE.



New tailgate. Easier operation. More galvanized steel.

More galvanized steel in box. Fights rust in critical areas.

Redesigned roof line, aerodynamic side styling. Reduce drag coefficient.

New parking and turning lights. Relocated to avoid stones, parking damage.

Strengthened steel areas around hood, fenders and grille.

Massive impact grille. Resists dents.

3-year corrosion perforation limited warranty. Under this Chrysler Corporation warranty any part of the 1981 Dodge Pickup, except exhaust system components, which develops perforation from corrosion in normal use within 3 years of retail purchase will be repaired without charge for parts or labor, regardless of mileage. See dealer for details.



more strength, durability and efficiency.

Last year Dodge introduced Ram Tough... a line of trucks engineered beyond "tough." For 1981, Dodge Pickups have a bold, new look, with even

More than Ford or Chevy.

This year, Dodge achieves the best EPA gas mileage estimates* with automatic transmission. Improved aerodynamic styling, reduced weight, and the dependable, efficient Slant Six engine all contribute to this Ram 150's superior gas mileage.

More than Ford or Chevy.

Last year Dodge Pickups had more galvanized steel than Ford or Chevy. This year we've more than *doubled* the galvanized steel that provides critical area rust protection, maintaining our lead over Ford and Chevy.

We weld our pickup boxes to cross sill brackets. Ford and Chevy bolt theirs through the box. Brackets eliminate rust-prone bolt holes.

Ram Tough suspensions help give Dodge Pickups the biggest standard payloads. Our 8-foot box has more load area than Ford or Chevy.

That's Ram Tough, 1981-style. Tougher on the outside. Tougher on the inside. Tougher on the competition. See your Dodge Ram dealer about buying or leasing a Ram Tough Dodge today!

18

EPA
EST.
MPG

22 EST.
HWY

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



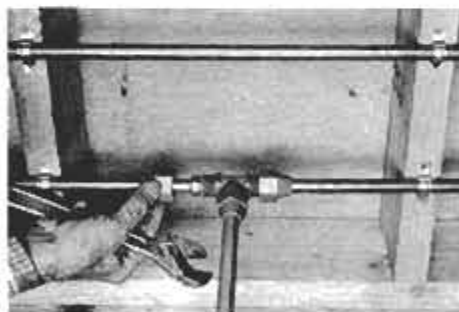
**DODGE
TRUCKS ARE
RAM TOUGH**

Satisfaction guaranteed or your money back. If you're not satisfied with your new 1981 Dodge truck, just bring it back in good condition with no metal damage within 30 days or 1,000 miles whichever comes first. When the dealer gets clear title, you'll get your money back, excluding finance and insurance charges. Trade-in refund may differ from trade-in allowance on retail sales contract. Ask participating dealer for details.

Extra hose bib

To install a hose bib, you'll need to tap into the cold-water supply line in the house. This is done by inserting a tee fitting in the line as shown below. Your installation may be more complicated than what we show here. Keep in mind that you always want to get to your destination in the straightest possible line. Also remember that the faucet should always be positioned below the level of the feed line so that water can be drained from the

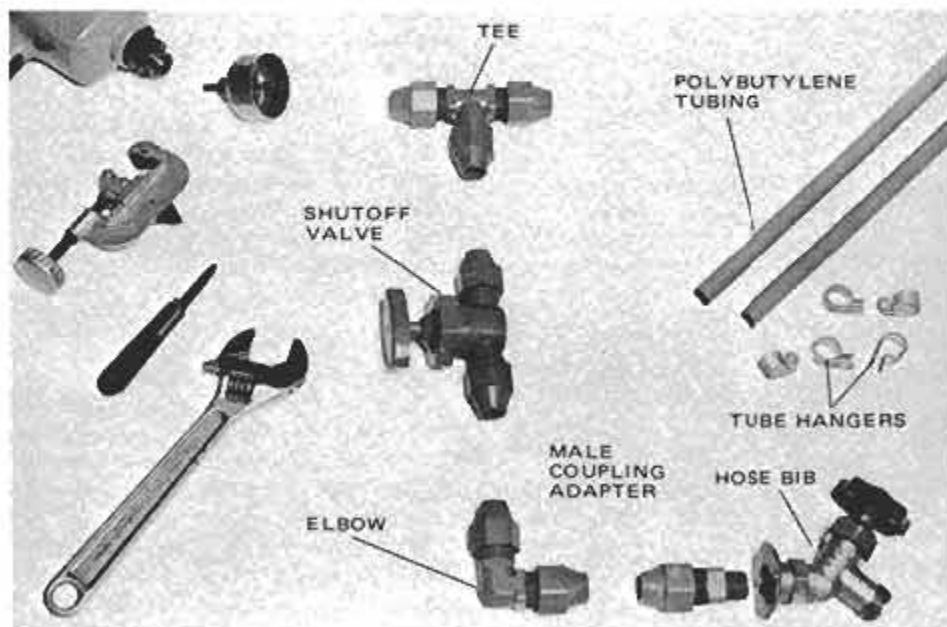
(Please turn to page 122)



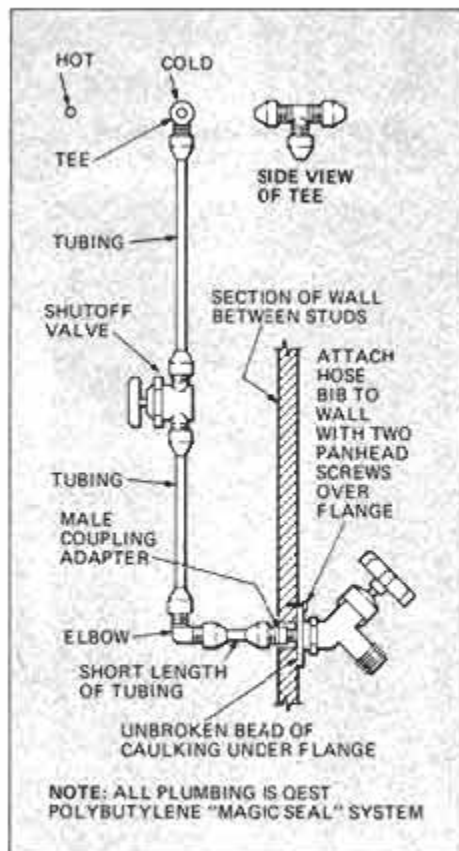
Existing systems are connected easily. Tee, with cones, inserts in section of cold-water line. Nuts contain special seal.



Teflon tape is used on thread-to-thread connections. Male adapter is needed here.



Here are fittings and tools needed for typical installation. Pipe is cut with a knife.



Pack caulking around hole for a tight seal. Bore pilot holes before caulking hole.



The pride of your toolchest... Screw-setting Profile Bits countersink or counterbore.

Improves drilling accuracy and screw grip. Four separate bits to match 6, 8, 10 and 12 gauge woodscrews. Adjustable collar makes pilot holes of varying depths. Depth gauge lets you counterbore to exact depth for flush plug or button plug. Shanks: 1/4". Includes illustrated instructions.

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5 CONVENIENCES

(Continued from page 121)

added section of plumbing. This fitting and all plumbing to the outside faucet can be done with remarkable ease with plastic plumbing.

We chose the Qest polybutylene system that features "Magic Seal" fittings which will let you make positive, sound joints without solder, solvents or the need for threading.

The material adapts readily to existing copper, brass, galvanized or other plastic plumbing without expensive transition fittings. If you have a long run, you can save on fittings by using flexible tubing, which is available in coils.

The tools required are few: tubing cutter, knife and wrench. The cutter is needed to cut into an existing copper system. In addition, you'll need a hole saw or spade bit of appropriate diameter to cut the hole in the house wall.

Installing the bib

After shutting off the water, use the tubing cutter to remove a section of the cold-water line equal to the length of the tee fitting with connecting nuts removed. Slip the nuts over the ends of the pipe; then slide a ring and cone over each end.

Make up the branch assembly to include a shutoff valve inside the house. To prevent unwelcome use of the faucet, you will want to keep the water turned off from the inside except when you plan to use the faucet yourself. This indoor valve also allows you to cut water off to the exterior during the winter when water near the bib could freeze and cause it to crack.

Use a sharp knife to cut the plastic tubing to length. Bore a hole through the outside wall. Make the hole just large enough to pass the fitting through, thus allowing enough wall material around the hole to receive two screws to hold the faucet.

Engage the cone and fitting and turn the nut onto the fitting hand-tight. Next, wrench-tighten it one to two full turns until you hear a squeak. That's all that's needed to tap into the supply line.

Now you can attach a coupling adapter to the hose-bib faucet for the transition from threads to threadless tubing. Here you must use Teflon tape to seal the joint. (Tape is necessary only when joining threads-to-threads as the "Magic Seal" device is not present.)

Finishing the job

Seal the opening around the faucet with caulk, after you have marked and bored pilot holes for the screws. Pass the faucet through the wall and secure it with the screws. Then make the final connection to the elbow.

Turn the water on again and inspect for leaks. If any are found, an additional twist with a wrench should cure the problem. If it doesn't, turn the water off again and inspect your fittings.

PM

REDWOOD

THE ONE WOOD TREATED WOODS TRY TO IMITATE

If you're planning a deck, fence, or any garden structure, no other woods, even pressure-treated woods, come close to the natural beauty and performance of redwood garden grades.

When you work with redwood, you'll know it's the best wood. It's easy to saw and nail. It goes down flat and stays flat. It takes finishes easily and weathers beautifully.

And nature, herself, protects the heartwood from insects and decay. Unlike pressure-treated woods, this protection goes all the way through. So all sawn ends, nail holes and other exposed areas are always protected.

It's your deck. Why use an imitation? Get the real thing—redwood.

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Send 50 cents for our Redwood Garden Idea Booklet.



PM's wooden swimming pool— build it for under \$2,500



Pressure-treated lumber can make you an expert in-ground pool builder. And the savings over masonry are substantial.

Those warm and lazy days of summer are almost upon us again and so are the dreams of a back-yard pool. You may dream on if you wish, or else you could consider building the real-life swimming pool that's shown above. Besides the considerable savings possible from our do-it-yourself version, the satisfaction you get from building your very own pool will be an additional advantage.

Plans are easy to understand and they include all the information that's needed to install the vinyl liner, expanded-polystyrene-foam insulation and a concrete-vermiculite mixture floor.

The pool can be constructed without



Plans for the cabana (above) are available with those for the pool. The 4x4-foot changing room is built of plywood panels covered with diagonal strips of redwood.

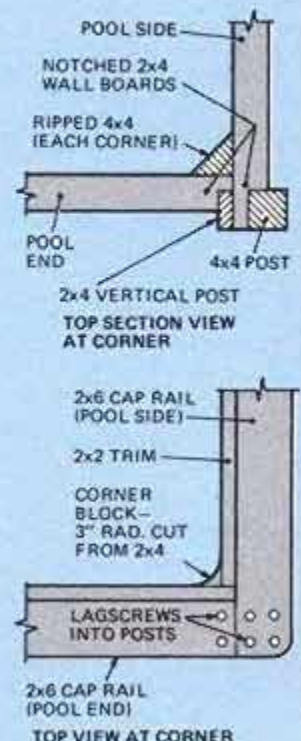
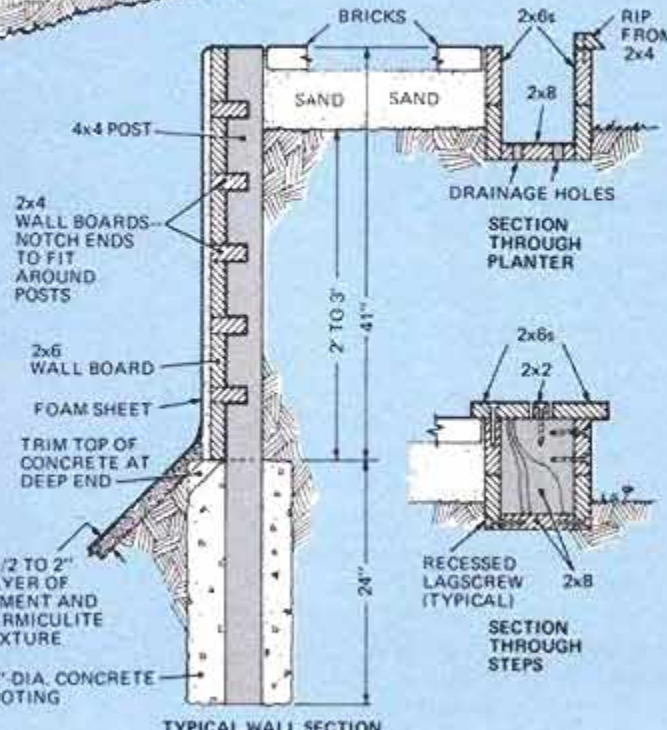
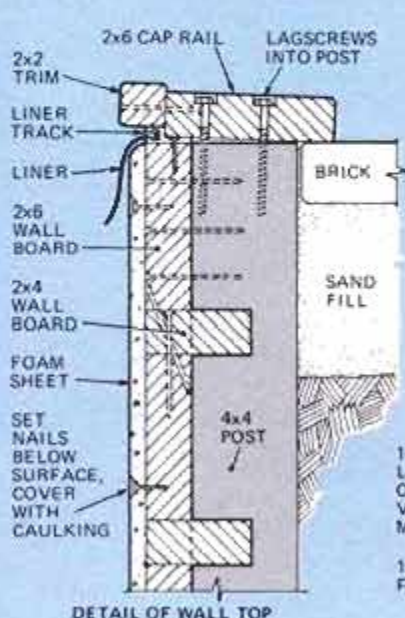
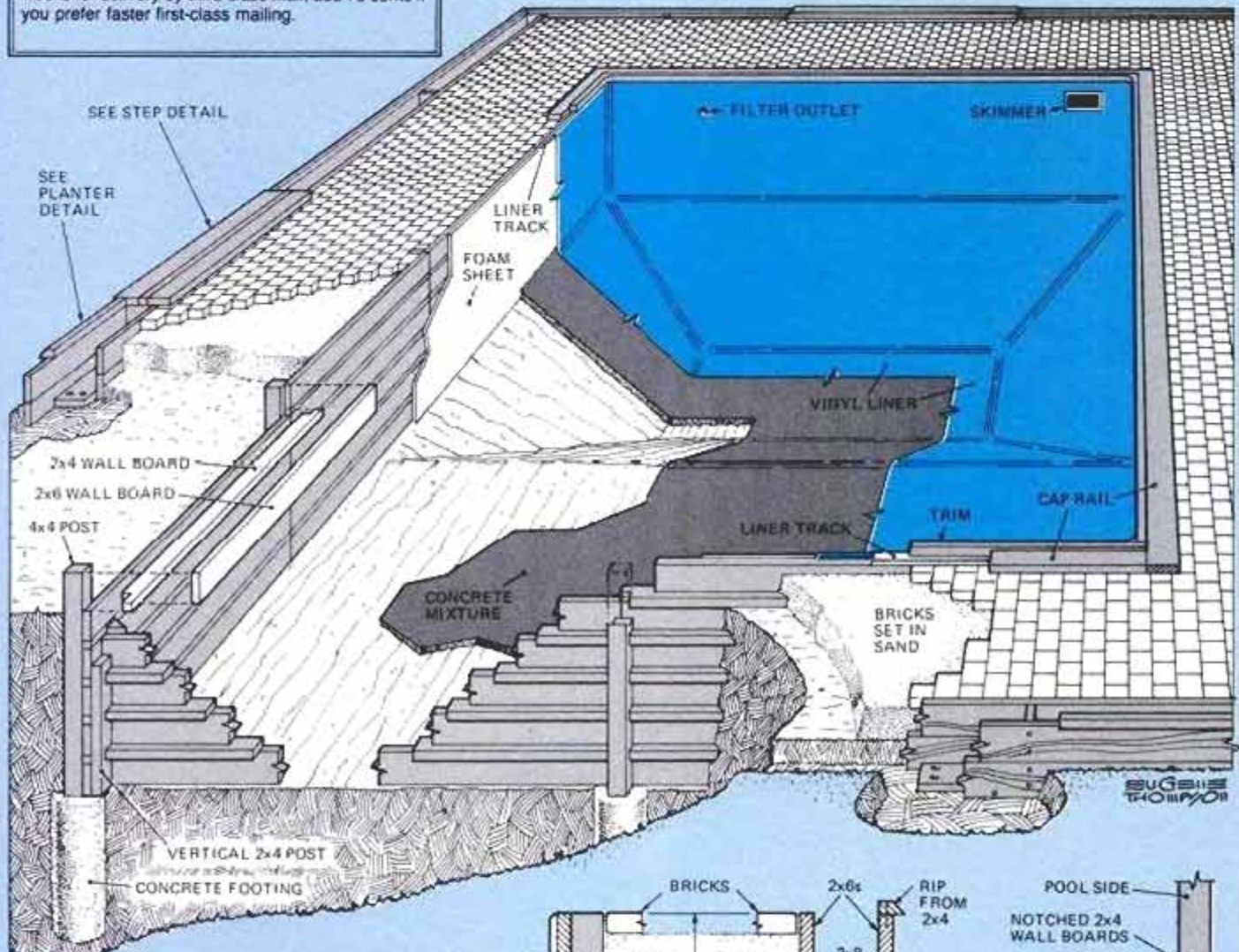
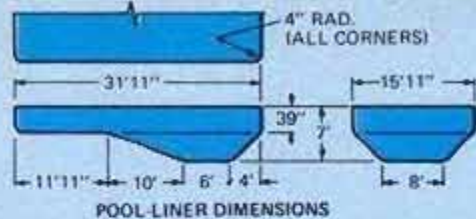
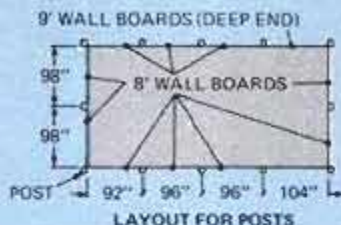
leveling the lawn—on a grade slope of up to 18 inches over 32 feet. If you plan to excavate the hole yourself, you should expect the project to take from two to three weeks with the full-time help of an enthusiastic neighbor.

There are several advantages to a pressure-treated wood and vinyl pool structure over a masonry one. For example, the former requires less maintenance. According to the vinyl manufacturer, the plastic contains a bacteriostat that retards the growth of algae and bacteria. This also means that the water stays fresher and clearer with less use of chemicals. And because the pool is insulated, the swimming season can be extended.

Except for lumber and concrete supplies that are available locally, the plans include the addresses of pool-equipment manufacturers who can supply all other necessary materials. If you choose to use these suppliers, the equipment is available by mail order at a discount rate. **PM**

HOW TO ORDER PLANS

Complete plans for PM's wooden swimming pool, including how-to-build instructions and a list of materials and suppliers, are available for \$8; the cabana plans cost \$3. Both sets together are \$10. Send your check or money order to PM Pool, Stevenson Publications, Box 584, Del Mar, Calif. 92014. Specify which set of plans you want. Allow two to four weeks for delivery by third-class mail; add 75 cents if you prefer faster first-class mailing.



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Find the case of C.C.® we hid along the Lewis and Clark trail.

We retraced Lewis and Clark's historic expedition up the Missouri River into Montana. And where they found their roughest going, we hid a case of the smoothest whisky, Canadian Club.

Where Lewis and Clark had floated the unspoiled river, Canadian Club's rafts followed. We tested our nerves, as the explorers had, on the wild rapids of the Clark's Fork.

As we explored those historic Montana streams, we buried a case of Canadian Club overlooking the very site of one of the expedition's most important sightings. One clue: neither Lewis nor Clark made it.

Discover the taste of the world's finest whisky.

As you search along this historic trail, remember Canadian Club has a proud history of its own. For over 120 years it's been enjoyed by those who seek the very best. Canadian Club is lighter than Scotch, smoother than bourbon, and enjoyable on the rocks, in a sour or Manhattan, or with your favorite mixer.

So come search along the Lewis and Clark trail to discover why it's "The Best In The House," or simply venture down to your favorite bar and say, "Canadian Club, please!"

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WORTH WRITING FOR

LOOKING FOR IDEAS ON THE HOME, OUTDOOR LIVING AND MORE? CHECK THESE LISTINGS. THEN USE THE COUPON BELOW.

426 The Devil Tells You How To Do It!

Illustrated booklet from Red Devil tells you about the first caulk warranted to last as long as you own your home. Lifetime Caulk can save you hours of recaulking every few years, protects against moisture damage and energy-stealing drafts. Includes how and where to apply. Free

427 Outdoor Foods For Thought

The Mountain House, featuring "gourmet food for the great outdoors," lists a selection of over 100 freeze-dried foods. Now available in compact cans, as well as the traditional foil pouch. Easy preparation makes them ideal for family camping and other outings. Catalog from Oregon Freeze-Dry Foods. 25¢

428 Wood's A Natural

McCloskey Varnish has introduced a full-color, 12-page consumer handbook on exterior stains, "Step by Step Protection." This illustrated booklet answers commonly asked questions on staining a house and includes a product chart to help you determine which product is best for your particular exterior wood surface. 25¢

429 Real Cool, Men!

From family-sized ice chests to small beverage containers, Igloo offers the cool way to survive the real world. Illustrated, full-color brochure pictures models for picnic, fishing trip, or backyard party. Free

430 Keeping Trim

From home-use to professional gardening and forestry, the Green Machine line-up offers trimmers, pruners, brush cutters and blowers for every job. Illustrated brochure includes full specifications. Free

431 Good Times Outdoors

The Coleman Company wants everyone to know that good times are waiting in the outdoors for families across America. Helping to make them happen is their 12-page booklet of special rebates, premiums and special items from Coleman, Shakespeare, AMF Voit, O'Brien and Wolverine. Free

432 A-Door-Able

A Perma-Door replacement unit offers a beautiful way to save energy costs. The insulated steel door unit comes pre-hung, ready for easy installation by the do-it-yourselfer. It gives extra security, energy efficiency and design flexibility. From American Standard. Free catalog.

433 Home Audit Guide

"Keeping Your Home in Shape" is a 12-page, fully illustrated brochure designed to help you identify the most common weathering problems that can affect your home. From roof to foundation, you can spot needed repairs and protect your home's long-term value. From Owens-Corning Fiberglas. 50¢

434 Safety Savvy

John Deere offers a 12-page guide to the safe operation of lawn mowing equipment, tillers, snow throwers and chain saws. It discusses ways to landscape your lawn for mowing safety and how to handle fuel safely. Illustrated with humorous cartoons that tell an important story in a memorable way. Free

435 Respect Your Wood & Be Rewarded

Minwax offers "Tips on Wood Finishing," a comprehensive 22-page booklet which includes numerous tips that save time and trouble for do-it-yourselfers. Information ranges from how to apply a preservative stain to a house exterior to restoring the finish of a priceless antique. Includes chart showing full range of colors available. Free

436 Decorating Accents

A colorful new decorating idea booklet from Georgia-Pacific illustrates how just one, two or three sheets of paneling can give rooms a fresh decorating outlook. Shows how to use paneling to build-in seating or storage, create dramatic feature walls, enlarge small spaces or enhance furniture projects. Free

437 Flavor The Outdoors

Structo Division of King Seeley Thermos Co. offers an exciting full-color brochure featuring Structo's full line of gas barbecue grills. 12 pages; includes model features chart. Free

438 Cure Cavities With Caulk

Geocel offers a 16-page do-it-yourself guide on how and where to caulk. Includes tips on how to make a home more watertight and energy-efficient. You also receive a cured sample of ELASTOMERIC caulking sealant and a redeemable coupon worth \$1.25 upon purchase. All for only \$1.00.

439 Put Your Home & Garden Jobs On Wheels

Informative and colorful brochure pictures versatile wheelbarrows and garden carts for contractors and homeowners. Specifications, load capacities and construction features. From Radio Steel & Mfg. Co. Free

440 The Ins & Outs Of Doors

Installation of replacement steel door entry systems are outlined in a new brochure from Therma-Tru Sales Corp. Highlights energy efficiency and security features of their insulated door systems. Free

441 Picnic Table Stowaway

Finding storage space for a picnic table indoors when summer is over is almost impossible. POPULAR MECHANICS helps solve this problem with its plans and instructions for a folding picnic table. Both table and benches fold scissor-fashion for easy storage in a small space. Complete plans. \$3.95

442 Outdoor Recreation That's A Daisy

Daisy's 1981 catalog features their full line of 23 Daisy and Power Line air rifles and air pistols. Ammo and accessories are also highlighted in this four-color, 12-page booklet. Free

443 How To Hold An Edge

Buck Knives has just published a new full-color pocket-size catalog of its expanded line of knife products. Includes Buck's new classic (Model 111) and the first two knives in their all new pocket knife series (the Colt and the Mustang). Plus new sharpening devices and accessories. Free

444 What Cams Can Do

Here's a brochure explaining the mechanics of the Crower Mileage Systems. These units consist of a hydraulic lifter camshaft. Also available with specially designed pistons. Mileage increases up to 76% are detailed. From Crower Cams & Equipment. \$1.00

445 Just Tool Much!

If you're looking for a multi-system woodworking tool, the Master Shop Multi-Tool may be it. Combines five basic tools in one: table saw, lathe, vertical drill press, horizontal drill and disc sander. Free illustrated booklet.

446 Bookshelves Shape Up

To help keep your magazines and bookshelves trim and orderly, POPULAR MECHANICS is now offering a sturdy high-gloss lacquer Magafile. Keep a year's supply of PM issues neatly together. Have a wealth of do-it-yourself information at your fingertips. \$2.95

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THE TEST OF A IS FINDING HOLES



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Television star, Vickie Lawrence, finds someone got to her magazine before she did. Taken from one of our current TV commercials.

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We operate 3 television stations and 7 radio stations in major markets like Baltimore, Pittsburgh and Milwaukee. We're even launching cable TV networks.

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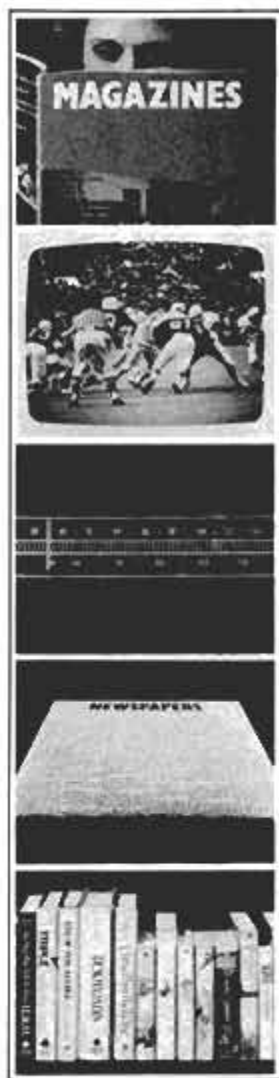
But basically, if you can read it, watch it or hear it, chances are Hearst is involved in it.

We inform you, entertain you, challenge you.

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THE HEARST CORPORATION

We talk to millions of you. One at a time.



Build PM's play tower for your kids

You can make this sturdy playhouse using your chain saw.

There can be little doubt that many chain-saw owners bought their tools for no other task than cutting firewood. It's true that a small but powerful chain saw makes relatively quick and easy work of cutting up a cord of firewood. But the tool can also be used for many project-building tasks.

The project shown on these pages was developed jointly by Homelite, a promi-

nent maker of chain saws, and *Popular Mechanics*. Our aim was to create an attractive, useful project that could be built using very few tools besides the chain saw.

The challenge we gave designer David Stiles was to come up with a functional back-yard play structure, built of sturdy members to assure a long life. Master craftsman Rosario Capotosto took the

designer's sketch and created the structure shown, working out all construction details as he went. The result is the easy-to-follow plans on the following pages.

The basic structure is made of 2x4, 2x6 and 4x4 pressure-treated stock. (The actual measurements are given in the materials list.) We recommend that you use pressure-treated stock (Wolmanized was used in the structure shown) where members are in contact with the soil, because this lumber is both water- and insect-resistant. If you prefer, use cedar posts and conventional fir 2x4s and 2x6s. To prevent rotting, apply at least three coats of a wood preservative.

Chain-saw joinery

Before starting, make certain that the chain is sharp. Begin by making the 35° angle cuts at the top of each post. Wear safety glasses and clamp the work firmly to your sawhorses. A chain saw does have muscle, and you don't want the posts shifting about during cutting.

Next, make the 35° shoulder cuts in the posts. Then flop the post on its side and make the rip cut. By stopping both cuts just short of their mark, and removing the waste by hand, you will get the neatest possible joint. The straight notches are made in the outriggers with six parallel 1¼-in.-deep kerf cuts. Clean these out with a sharp chisel, keeping in mind that all edges will be exposed.

Cut all four rafters to length, then cut the tail detail with a sabre saw. Use waterproof glue and 2-in., hot-dipped galvanized nails to attach the plywood gussets to both sides. Because there are no joists or collar beams in this tower, it is extremely important that the joint between the rafters be properly constructed.

Framing the tower

Next, working on a flat surface such as your garage floor or driveway, lay the posts down in pairs. After making certain that the paired posts are parallel and square to each other, tack-nail three braces between them, one each at the top, bottom and on the diagonal.

By setting the rafter assemblies into the



Clamp post firmly to sawhorse; keep saw level when making mitered shoulder cut.



To avoid error, use a felt pen to mark a clear line; the Xs show which side is waste.



Hold saw at downward angle and rip slowly. Taking extra time now will pay off later.



Stop cuts just short of the desired depth. Finish the notch with a handsaw or chisel.



Make inside notches 1¼-in. deep with repeated saw-kerf cuts spaced ¼ in. apart.



Use wide chisel to remove waste, straighten edges and level bottom of the notch.

PM photos: George Ancona (color)
Rosario Capotosto (black and white)



The tower roof (above) is covered with handsome cedar shakes. It has a wide protective overhang, so kids can wait out a summer shower and remain dry. The out-

rigger (right) is high enough to provide good sport, but low enough to be nonhazardous. As shown below, the tower can easily accommodate four youngsters and more.



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"Because Popular Mechanics/Motor wrote the book on my car."

"Now I can fix my own car myself. So I save on upkeep and repairs. I even save gas every mile I drive!"

"I can do it ever since this guidebook came out on my make, my model—with the variations between models clearly shown."

"This book pictures what to do and how to do it, step by step. They've got clear drawings, diagrams and detailed photos with simple captions. So they've made it easy for me."

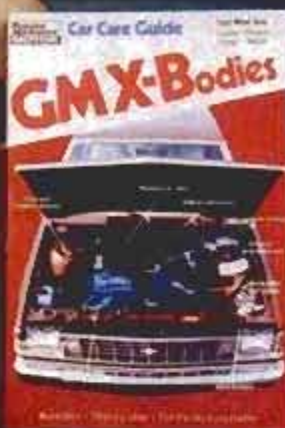
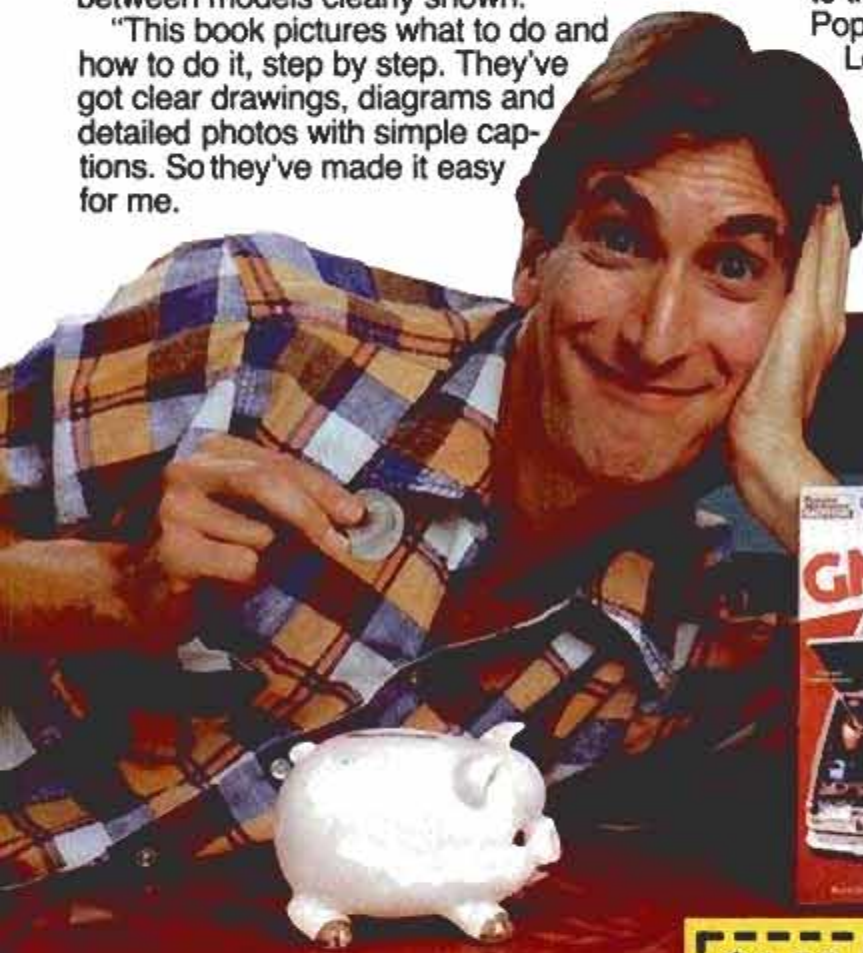
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rafters and supports with 6d common nails. Because the underside is the visible surface, put the better side of the panels down. Add the peak stiffeners (R) by nailing them from above with 4d common nails. Hold each stiffener securely with one hand while you drive the nails from above with the other.

Next, staple on 15-lb. felt to cover the roof, overlapping the peak. Then apply the hand-split cedar shakes using 4d, hot-dipped galvanized nails. These nails

extend through the plywood and *must be clipped flush to the surface with an end nipper.*

The holes for the swing and the dowels can now be bored in the outriggers and the dowels glued in place. Then bolt the outriggers to the posts. Next, preassemble the railing units with nails and glue to assure maximum strength and notch them as shown to fit over the outrigger bolts that extend past the posts.

Bolt the railings to the posts and joists,

then cut the lower railings below the outriggers. These are nailed in place from the far side of the post with 6-in. nails. Pilot holes should be bored first to prevent splitting.

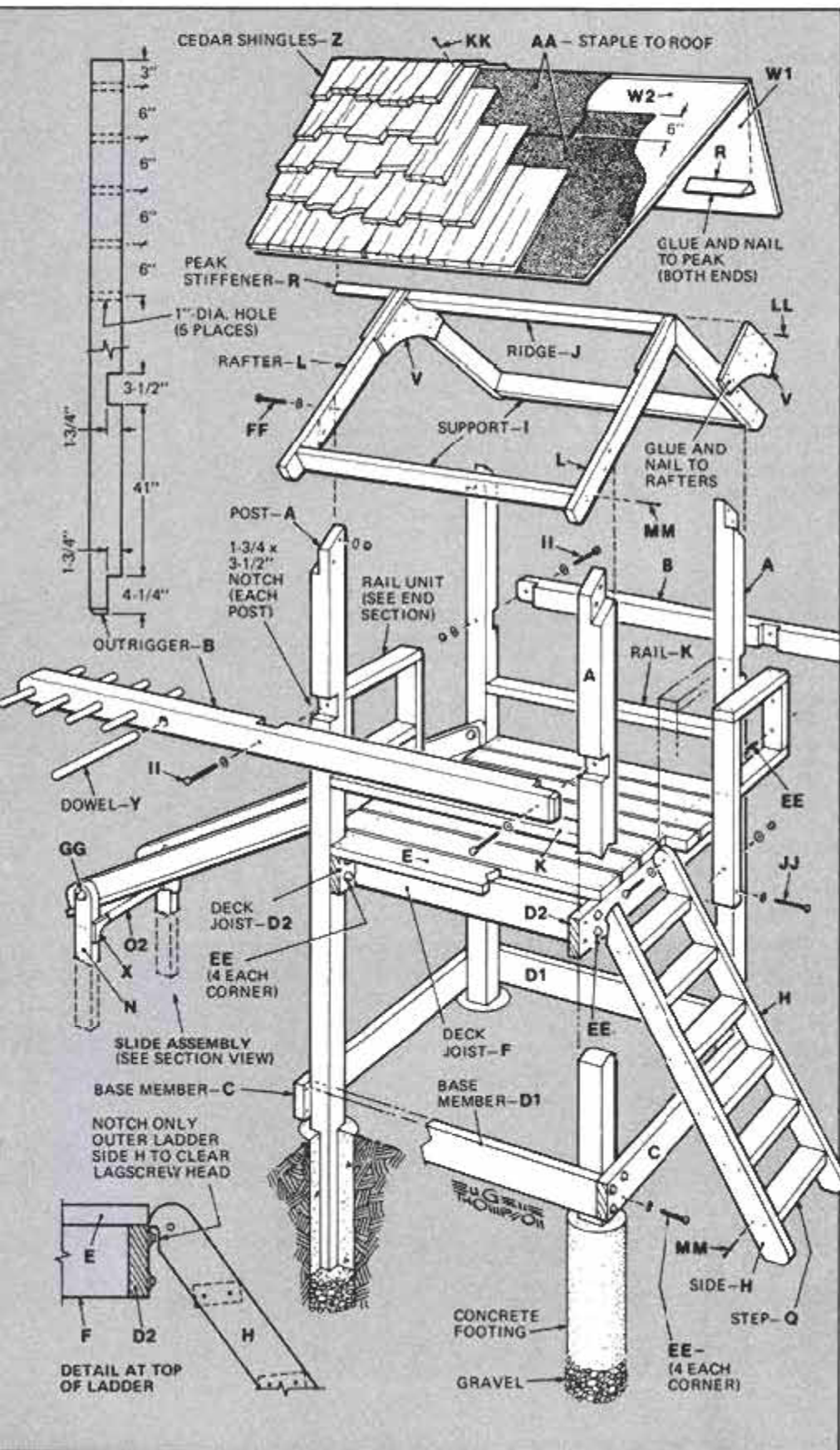
The slide is made by stapling 20-in.-wide aluminum flashing to the plywood along the edges; the heads will be covered later by the slide sides. Because aluminum flashing comes in a roll, it tends to curl, so cut it to length and reroll it in the opposite direction to straighten it out. At the top and bottom of the plywood, gently bend the flashing around the edge to avoid creasing and then nail the cleats over the ragged edges as shown.

Complete the slide by sanding all edges and making the slide support. Support holes have to be dug about 1 ft. deep for this. They can be positioned by merely holding the slide in its proper location and marking where the holes should be. No gravel or concrete is needed in these holes, but be sure to tamp down the back-filled dirt.

Finally, attach the slide and the ladder with capscrews as shown and cut and nail the deck boards to the joists.

We used redwood stain on our tower, painted the underside of the roof yellow and coated the dowel grips with wood preservative. Whatever you do, keep in mind that all surfaces should be as smooth as possible to prevent any chance of splinters getting into young hands.

FPM



MATERIALS LIST—YARD PLAYHOUSE


Key	No.	Size and description (use)
		(Parts A through T are Wolmanized lumber)
A	4	3 1/2 x 3 1/2 x 10' (post)
B	2	3 1/2 x 3 1/2 x 7' (outrigger)
C	2	1 1/2 x 5 1/2 x 51" (base member)
D1	2	1 1/2 x 5 1/2 x 48" (base member)
D2	2	1 1/2 x 5 1/2 x 48" (deck joist)
E	8	1 1/2 x 5 1/2 x 48" (deck)
F	2	1 1/2 x 5 1/2 x 38" (deck joist)
G	2	1 1/2 x 3 1/2 x 84" (slide side)
H	2	1 1/2 x 3 1/2 x 58" (stringers)
I	2	1 1/2 x 3 1/2 x 45" (roof support)
J	1	1 1/2 x 3 1/2 x 43 1/2" (ridge)
K	2	1 1/2 x 3 1/2 x 41" (lower railing)
L	4	1 1/2 x 3 1/2 x 38 1/2" (rafter)
M	2	1 1/2 x 3 1/2 x 29 1/2" (railing)
N	2	1 1/2 x 3 1/2 x 26" (slide post)
O1	2	1 1/2 x 3 1/2 x 20 1/2" (railing)
O2	1	1 1/2 x 3 1/2 x 20 1/2" (slide brace)
P	2	1 1/2 x 3 1/2 x 19" (railing)
Q	6	1 1/2 x 3 1/2 x 17 1/2" (ladder steps)
R	2	1 1/2 x 3 1/2 x 11 1/4" (peak stiffener)
S	2	1 1/2 x 3 1/2 x 11" (railing)
T	2	3/4 x 1 1/2 x 20" (slide cleat)
U	1	3/4 x 20 1/2 x 81" plywood (slide)
V	4	3/4 x 10 x 10" plywood (gusset)
W1	1	1/2 x 40 1/2 x 72" plywood (roof)
W2	1	1/2 x 40 x 72" plywood (roof)
X	4	1/2 x 3 1/2 x 3 1/2" plywood (gusset)
Y	5	1"-dia. x 15" wood dowels
Z	2 1/2	Handsplit cedar shake bundles
AA	1	36" x 18" 15-lb. asphalt felt
BB	1	20 x 86" rolled aluminum flashing
CC	1	Old tire
DD	1	3/4"-dia. x 9' nylon rope
EE	36	3/8 x 4" lag screws and washers
FF	8	3/8 x 4" capscrews, washers and nuts
GG	4	3/8 x 3 1/2" capscrews, washers and nuts
HH	2	3/8 x 5 1/2" capscrews, washers and nuts
II	4	3/8 x 4" capscrews, washers and nuts
JJ	2	3/8 x 5 1/2" capscrews, washers and nuts
KK		2" hot-dipped galvanized shake nails
LL		2" hot-dipped galvanized roofing nails
MM		3" hot-dipped galvanized nails
NN	8	6" nails
OO		1 1/4" hot-dipped galvanized nails
Misc.		Staples, waterproof glue, 6d and 4d common nails.

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OUTDOOR LIVING
GUIDE



Roma lawn furniture has white wrought-iron frames with PVC plastic straps in lemon and white or sand and chocolate color combinations. The grouping includes: end table (\$52), chair (\$80), chaise (\$155), umbrella table (\$115, umbrella not included) and settee (\$150) from Lawnlite, 3789 Northwest 46th St., Miami, Fla. 33142.

Computerized spray pest control called Mug-a-bug sprays a biodegradable mist for one minute each half day in each of six directions, to eliminate mosquitoes. The unit, priced at \$129 postpaid, holds a gallon of insecticide which lasts about two weeks. It runs on batteries or house current. From Thermo-Tech Corp., 28 Randolph St., Boston, Mass. 02118.



The Casita 10101 screenhouse is 11 ft., 5 in. square and 8 ft., 5 in. high at the center. The frame is brown-painted aluminum with fiberglass screening. The tangerine-colored vinyl top filters out ultraviolet light rays to help keep the screenhouse cool; \$416 from General Aluminum Products, 1023 Reynolds Rd., Charlotte, Mich. 48813.



(Please turn to page 138)

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The Energy Sweep automatic swimming-pool cleaner hooks to, and is directly powered by, the filter pump. According to the maker, this system renders the standard cleaner booster pump obsolete and reduces electrical costs. It's \$395, installed during construction. By Jandy Industries, Box 3828, San Rafael, Calif. 94901.



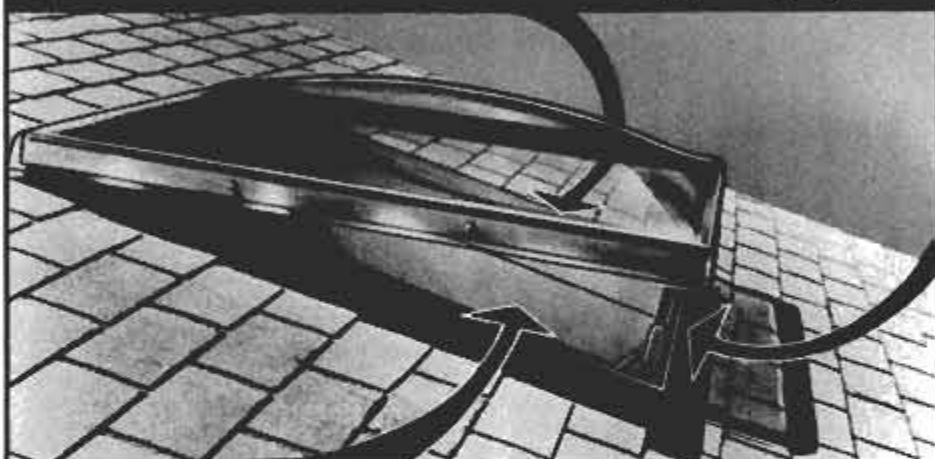
A photocell accessory in this ultraviolet lamp bug killer turns the unit off at dawn and on at dusk. It fits onto the 25- and 50-watt units (\$110 and \$140 respectively) and is \$16 extra. Wall brackets and mounting poles are also available from Emerson Environmental Products, 8400 Pershall Rd., Hazelwood, Mo. 63042.



Brightly colored polyethylene bench ends in yellow, green, brown or white combine with 2x4s to create a weather-resistant, portable bench. It disassembles easily for storage. Porta-Bench ends are available for \$54 a pair postpaid (you supply 2x4s) from STM Industries Inc., 7435 Saybrook Center Rd., Ashtabula, Ohio 44004.

(Please turn to page 140)

VENTARAMA the plastic-domed ventilating skylight



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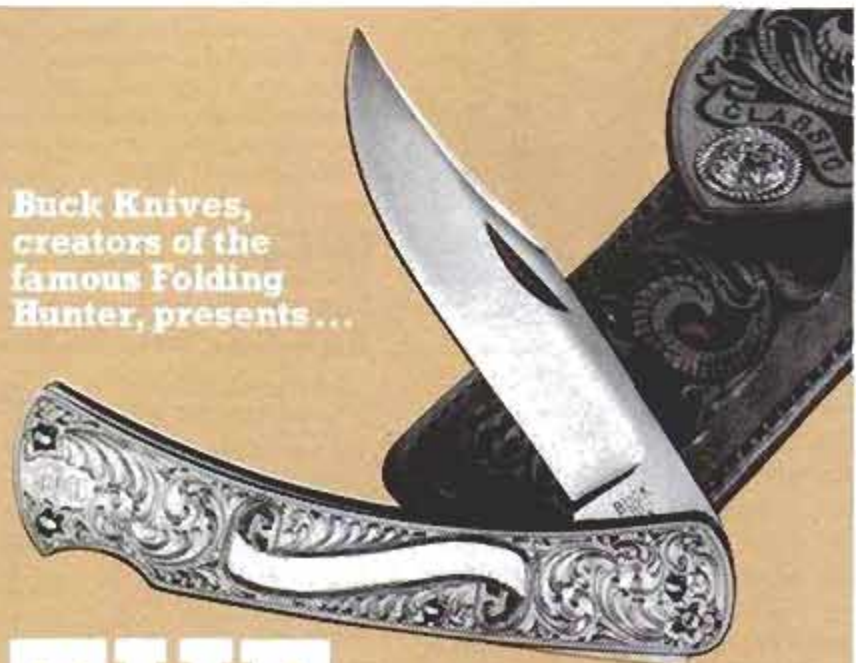
(Continued from page 138)

Easy Embers charcoal lighter is a speedy yet safe way to light back-yard barbecues without the use of lighter fluid. Simply place crumpled newspaper into the heavy-gauge steel cylinder as it rests in a grill, add charcoal and light the newspaper through side vents located near the bottom. The charcoal is lighted in the updraft created, which is similar to that of a fireplace. Easy Embers is priced at \$12.95 postpaid from Alma Products, 125 Alma St., San Francisco, Calif. 94117.



The Avanti liquid propane (LP) gas grill is mounted in a redwood cart that provides food preparation and storage space. The cart has handles on both sides, condiment storage space, a place for spare 20-lb. LP tank, shelves on both sides of the grill and one in front to provide 710 sq. in. of work space. Shelves fold down when the grill isn't in use. Model 824J shown is priced at \$549.95 from Charmglow Products, Box 127, Bristol, Wis. 53104.

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The Esquire outdoor cooker can smoke, roast, steam, barbecue, shish-kebab or fry food. It has an easy-access door so that you can add fuel.

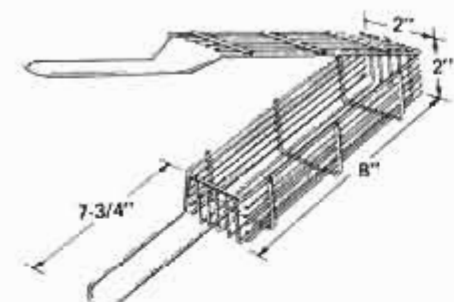
The unit comes in black, pewter or orange for \$75 plus shipping from Smoker Products Inc., Drawer S, Mabank, Tex. 75147.



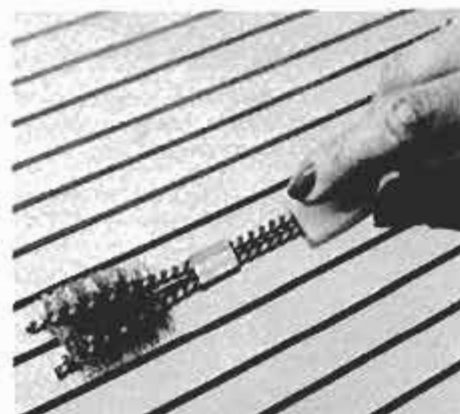
This jumbo quartz barbecue provides 270 sq. in. of cooking area. The quartz radiant rods heat up in seconds to seal in juices and cook food quickly, thereby saving energy, according to the manufacturer. This cooking method lets you have the pleasure of outdoor cooking without the usual mess. The 1350-w., 120-v. unit is \$230, including the roll-about steel stand. It's from Contempra Industries Inc., 371 Essex Rd., Tinton Falls, N.J. 07753.



The Forkula barbecue tool is designed to help you turn with ease meat cooked on a grill. The tong-like instrument has four tines on each side; slip one side through the grill and under the food to grasp and support it. Hamburgers, hot dogs, chicken, steak and ribs are some of the foods you can turn with the Forkula. It is 17 in. long and made of chrome-plated steel. Forkula is available at hardware and specialty stores or \$5.95 postpaid from the Drannan Co., 1103 Aledo Dr., Dayton, Ohio 45430.



Now you can have a shish kebab without slipping, sliding and splitting vegetables by using this Shish-ka-basket. This utensil takes the place of a skewer on the barbecue grill. Shish-ka-basket is made of steel with nickel plating. You can precook meat in the basket and add the vegetables later. The top is easily removed so you can serve the contents. Shish-ka-basket is about \$11 at houseware stores or from United Standard Industries Inc., 2062 Lehigh Ave., Glenview, Ill. 60025.



This sturdy brush has a double set of spiral, rustproof, high-tensile steel bristles. The brush is specially designed to clean barbecue grills with minimal effort on your part. It has a contoured, plastic handle that is comfortable to use and hangs for convenient access when needed. You can also use the brush to clean oven racks. Bar-B-Que Grill Brush is available for about \$2 at hardware, houseware and specialty stores. It's made by Brushtech Inc., Box 1194, Plattsburgh, N.Y. 12901.

This portable tabletop gas grill has 160 sq. in. of cooking area. It is compact enough to use on city patios and on back-yard picnic tables; you can also carry it handily on picnics and camping trips. Its legs fold to lock the top on for storage and safe carrying. The grill is constructed of porcelain-finished, heavy-gauge steel. It has teak handles and comes equipped with lava rocks that heat over the gas flame. The tabletop grill uses disposable LP gas cylinders; however, an adapter accessory allows hook-up to standard LP gas tanks. The unit is priced from \$59 to \$69 and is made by Weber-Stephen Products Co., 100 North Hickory, Arlington Heights, Ill. 60004. **FM**



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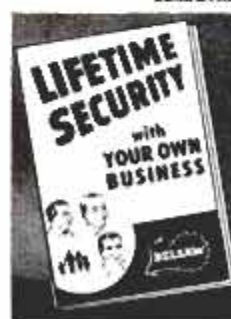
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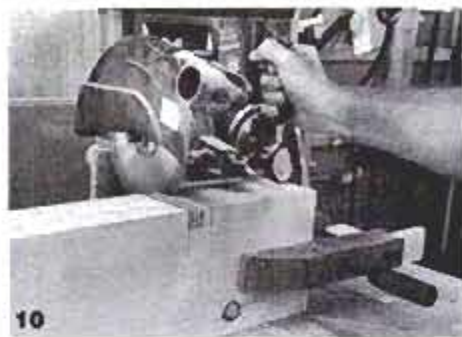
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PICNIC TABLE FOR SUMMER FUN

(Continued from page 109)



A radial-arm saw cuts slots in the 2x8 stretchers easily. Clamp three boards together and cut them simultaneously by making repeated kerf cuts with a regular blade. Don't use a small dado cutter—saw's motor housing will get in the way.



Cut curves on the stretchers and slats with a sabre saw and pivot guide. Adjust pivot so it's in line with the blade teeth.



Dowels with flattened sides provide better surface contact. Bore holes for the dowel pegs slightly beyond the joint line.

with glue and 3-in. hot-dipped, galvanized finishing nails. Sink the heads and fill the holes with wood putty.

Use acrylic latex or alkyd paint over two coats of zinc-free primer on the plywood. Use three coats of quality varnish for the other wood parts.

PM

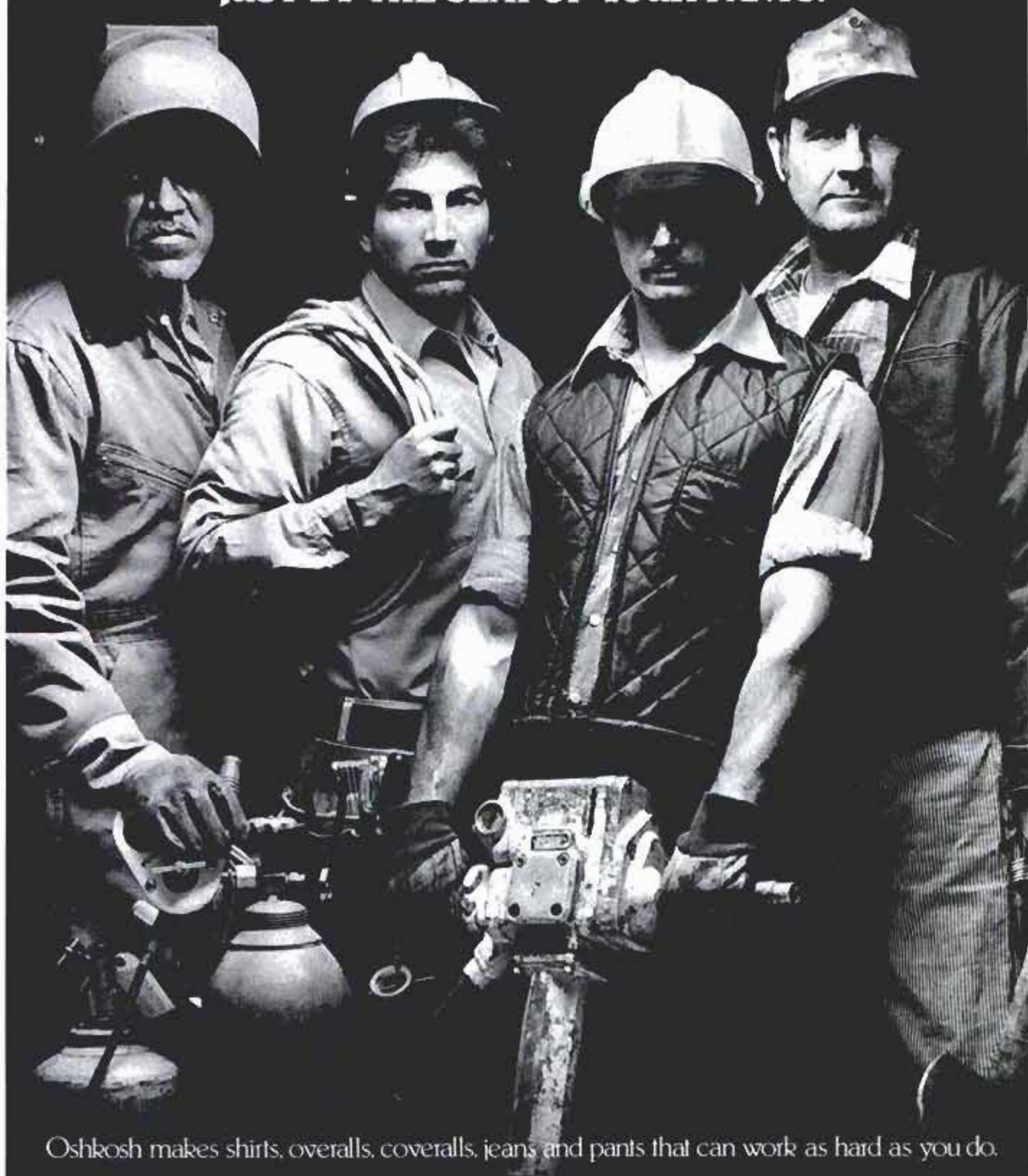
MATERIALS LIST—PICNIC TABLE

Key	No.	Size and description (use)
A	2	1 7/8" x 26" x 58" MDO (medium density overlaid) plywood (legs); glue 2 pieces of 3/4-in. plywood together
B	3	1 7/8" x 7 1/2" x 6' sugar pine (seat, upper stretcher)
C	1	1 7/8" x 7 1/2" x 6' sugar pine (lower stretcher)
D	10	1 7/8" x 5 1/2" x 6' sugar pine (seat, table slats)
E	16	3/4"-dia. x 3 1/2" hardwood dowels
F	as reqd.	10d hot-dipped, galvanized finishing nails

Misc.: Resorcinol glue, wood filler, varnish, acrylic or alkyd paint and primer.

Note: Fir may be substituted for pine on B, C and D.

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	Tar mg./cig.	Nicotine mg./cig.
Kent	11	0.9
Kool	16	1.3
Marlboro Lights	12	0.8
Merit 100's	10	0.7
Virginia Slims	16	1.0

	Tar mg./cig.	Nicotine mg./cig.
Benson & Hedges Lights 100's	11	0.8
Pall Mall Light 100's	10	0.8
Salem Lights	11	0.8
Vantage 100's	12	0.9
Winston Lights	14	1.1

Carlton Box—lowest of all brands.

Less than 0.01 mg. tar, 0.002 mg. nic. Carlton Menthol—Less than 1 mg. tar, 0.1 mg. nic.

Box: Less than 0.01 mg. "tar", 0.002 mg. nicotine av. per cigarette by FTC method. Soft Pack: 1 mg. "tar", 0.1 mg. nicotine; Menthol: Less than 1 mg. "tar", 0.1 mg. nicotine av. per cigarette, FTC Report Dec. '79.

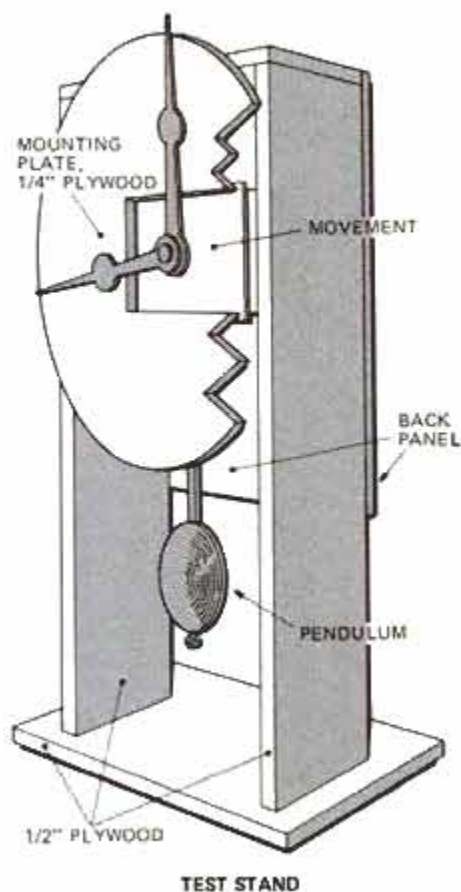
Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health.

Build PM's schoolhouse clock — and make the honor roll

This updated version of the old-time schoolhouse clock is made of solid oak. It strikes the hours and half hours. Originally, however, the schoolhouse clock was for time only—pupils didn't hear it, nor were they supposed to be looking at it.

The parts of the clock case are small and easily handled with workshop power tools. Have the clock movement, dial and bezel at hand before you cut stock for the case, as you may have to adapt the plan to suit the specific parts you use. (See the materials list on page 147 for the source of clock parts used on the clock shown.)

A test stand built like the one below will save you time in the long run. It is a simple affair made of plywood, with the sole purpose of determining the space required for the



TEST STAND

movement and swing length of the pendulum when adjusted for accurate timekeeping. The swing of the pendulum on typical movements will average 5 to 5½ in. The movement used here requires front mounting on a plywood disc.

If you use a strike movement that must mount on the back of the case, you can eliminate the plywood disc. But you may have to shim the movement brackets to get the hands in proper relation to the dial.

With some striking movements, the hammer is positioned below the movement rather than at the back. This requires the movement to be front-mounted on the plywood disc.

Building the oak frame

To build the octagonal dial frame, rip a length of oak or other hardwood to width. Cut eight segments, each precisely miter-cut as shown on page 146. Cut a saw kerf slightly over ¼-in. deep in both ends of each piece for the splines.

Next, rip splines from hardwood stock and cut to ¼-in. width with the grain running across the width. Make a trial assembly of the frame to check fit of the miter joints. Spread glue on the kerfs and on joining surfaces. Secure the parts with band or web clamps. Be sure all sections are flat and let the glue dry completely. Then smooth the surface with 80-grit abrasive.

If you use a striking movement requiring front mounting on a plywood disc, temporarily mount the dial frame on a ½-in.-thick plywood disc and mount this disc on the outboard end of the lathe spindle. Before you cut the rabbet, check the overall diameter of the clock bezel. The bezel should overlap the rabbet by ¼ in.

Building the cabinet

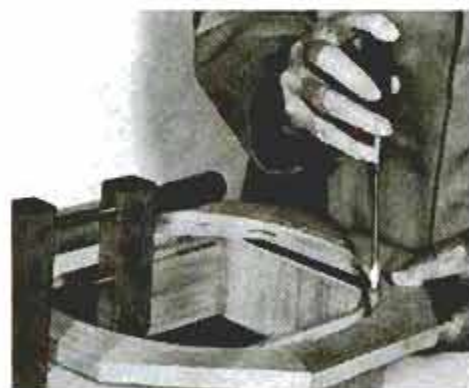
The main parts of the cabinet are two side pieces (D) and two bottom pieces (E), assembled at the lower end with mitered joints. The back edges of these pieces have rabbets to



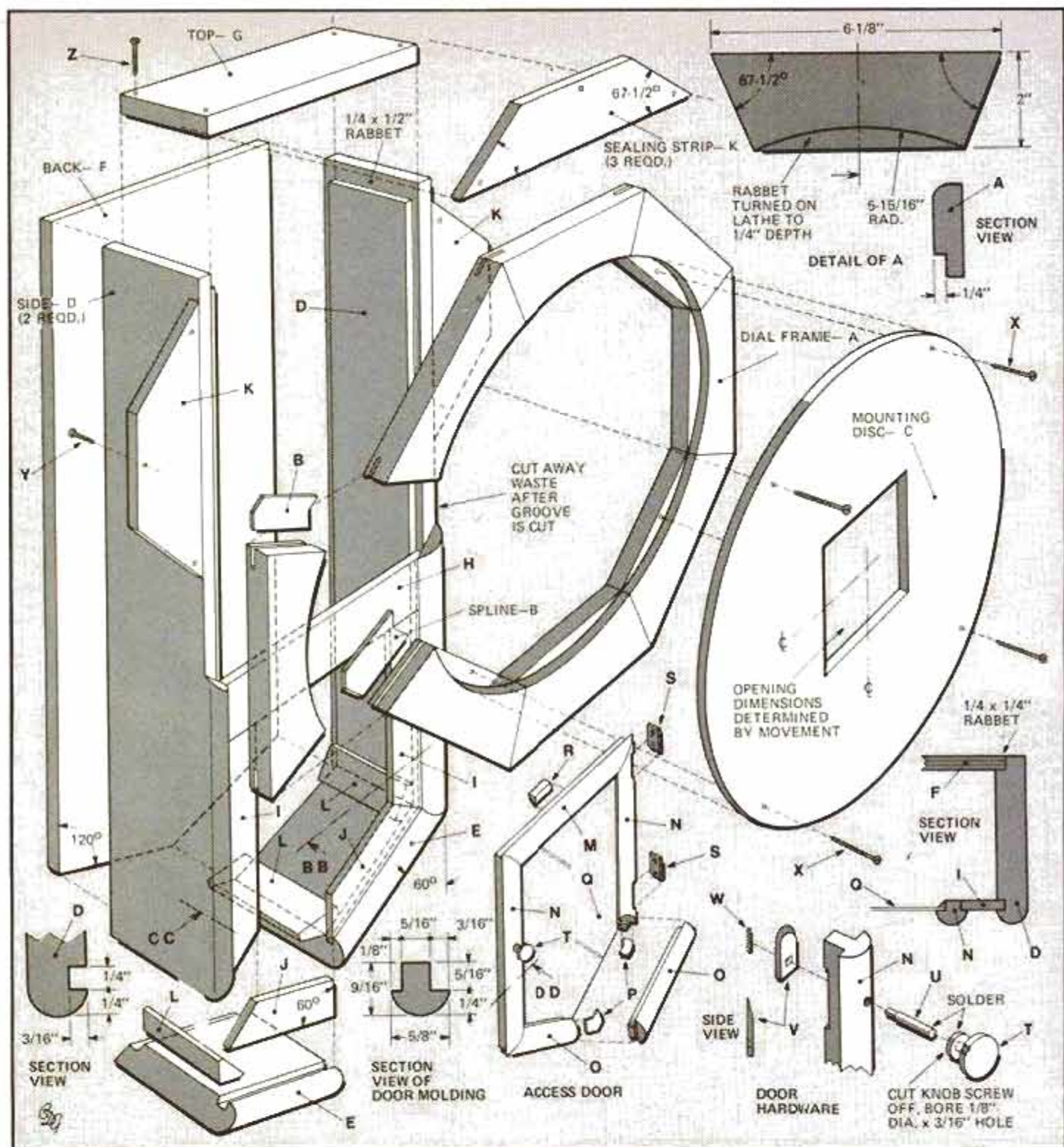
Follow the plans for building this beauty from days of the one-room schoolhouse.

take the back panel, which extends to the top of the case. Before assembly, groove the front edges of D and E (section CC in the drawing) and round the edges to the groove. You can easily run the grooves in parts D from top to bottom rather than making a stopped groove. Cut a waste strip off the front edge of D where the dial frame will be joined; angle the remaining wood below this strip to fit the octagonal frame contour. Four countersunk flathead screws hold the frame.

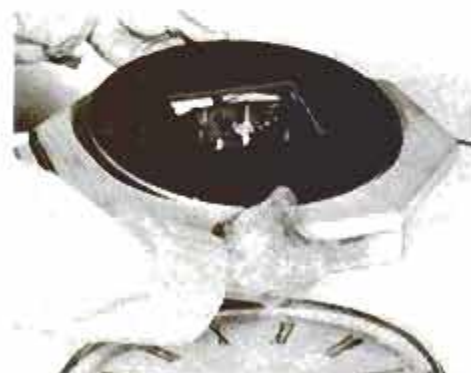
Cut door framing spacers and hold them with glue blocks L. Close openings between dial frame, sides and top to keep out dust with thin seal-



Clamp the dial frame in place to secure it. Then fasten frame to the cabinet sides with four flathead wood screws as shown.



Carefully hinge the access door so it doesn't bind when it closes. Hinges are mortised into both door and the frame.



Front-mounted movement is attached to the plywood mounting disc, which drops into a rabet in edge of dial frame.

ing strips (K) screwed in place.

If you plan to use a striking movement, determine the gong location by trial. This needn't be precise; you can bend the strike-hammer arm as needed to position it.

Making the access door is a matter of miter-joining small pieces with special care. The joints have splines. Rabbits are along both sides of each piece, one for the glass panel, the other for door spacers (see sections BB and DD). Hold the glass with blocking.

The latch is a 3/8-in., screw-type brass knob with the threaded screw



Mount the wire going to the back. Bend the strike-hammer arm slightly to adjust it.

part cut off and a hole bored to accept a length of brass round. Square the free end of the round to go through a square hole in the latch tongue.

Solder the brass round into the knob or use an instant (cyanoacrylate) adhesive and bore a tiny hole transversely through the squared end of the round to take a retaining pin. This pin holds the tongue. Install hinges so the door closes tightly and smoothly.

The original schoolhouse clocks were finished in a yellow-ochre coloring called golden oak. Cases were also made of walnut, mahogany, black cherry and pine veneered with

more exotic woods. Remember that with open-grain woods, such as oak, you must fill the pores with paste wood filler between staining and finishing steps. Follow the manufac-

turer's directions on the labels for all three products.

Finally, attach a sawtooth hanger centered on the back panel (F) about 1½ in. from the top edge.

After you have hung the clock, adjust the pendulum until the movement keeps accurate time.

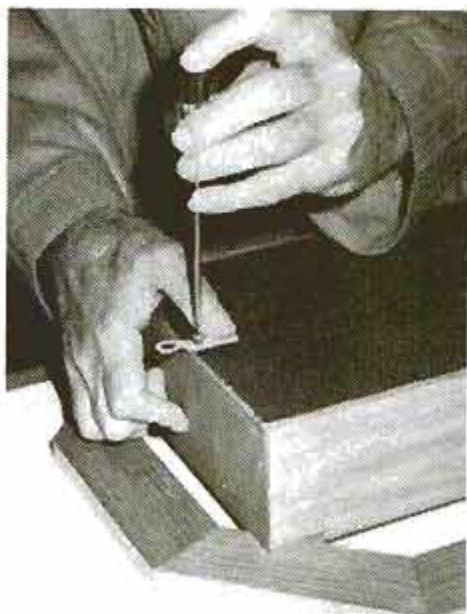
—W. Clyde Lamme

MATERIALS LIST—SCHOOLHOUSE CLOCK

Key	No.	Size and description (use)
A	8	5/8" x 2" x 6 1/8" (dial frame sections)
B	8	2 3/8" x 3/8" x 2" with grain running across 3/8" width (splines)
C	1	3/4" x 5 1/2" rad. plywood (mounting disc)
D	2	5/8" x 3 1/2" x 2 3/8" (cabinet sides)
E	2	5/8" x 3 1/2" x 4 1/8" (cabinet bottom)
F	1	1/4" x 7 1/4" x 22 1/4" plywood (back)
G	1	1/2" x 3" x 7 1/4" (top)
H	1	1/4" x 1 3/8" x 7 1/8" (crosspiece)
I	2	1/4" x 1 5/16" x 4 1/8" (door side spacers)
J	2	1/4" x 1 5/16" x 4 1/8" (door bottom spacers)
K	3	1/4" x 2 3/8" x 9 1/8" (sealing strips)
L	3	3/4" x 3/4" x 2 3/4" (blocking)
M	1	5/16" x 5/8" x 5 1/2" (door-frame top)
N	2	5/16" x 5/8" x 3 7/8" (door-frame sides)
O	1	5/16" x 5/8" x 3 7/8" (door-frame bottom)
P	5	1/16" x 1/2" x 1 7/8" with grain running across 1/2" width (splines)
Q	1	1/8" x 4 3/8" x 6 1/8" glass
R	5	1/4" x 1/4" x 1/2" (glass blocking)
S	2	3/4" brass butt hinges
T	1	3/8"-dia. round brass knob (cut off threads and bore hole)
U	1	1/8"-dia. x 7/8" brass round (knob shank)
V	1	3/16" x 7/16" 16-ga. brass (latch tongue)
W	1	1/16" x 1/4" brass (retaining pin)
X	4	1" No. 7 fh screws (disc fasteners)
Y	9	3/4" No. 7 fh screws (sealing strip fasteners)
Z	4	7/8" No. 7 fh screws (top fasteners)

Misc.: Stain, finish, carpenter's glue. *Hardwood

Note: School clock dial with bezel and glass (cat. No. SCD-44, about \$41.25 plus UPS); 8-day time movement (cat. No. SM-401, about \$35.75 plus UPS) or 8-day strike movement (cat. No. SM-402, about \$60.50 plus UPS) from H. De Covnick & Son, Box 68, Alamo, Calif. 94507.



Carefully center a single hanger and attach it to the back part of the clock cabinet.

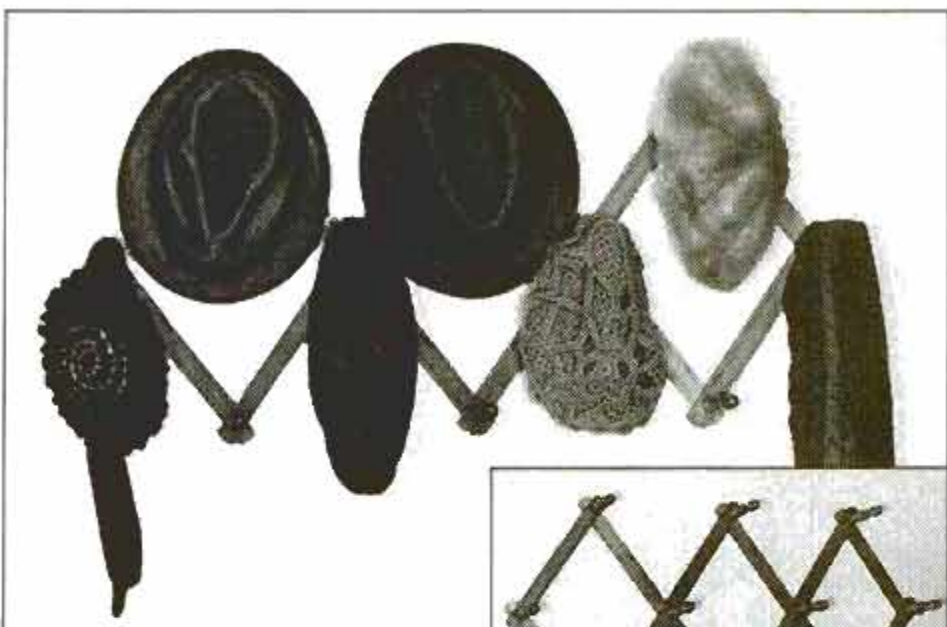
Build this heirloom hat rack

With the right tools, you should be able to make this heirloom hat rack during one Saturday workshop session. I cut the wood strips from 1-in.-thick cherry that came sanded on two sides. If your stock isn't a full 1-in. thick, you will have to do a little more sawing, resulting in more waste.

Try to cut the needed wood strips from a board long enough to make at least two strips at a time with an inch or so to spare. Run the wood through the jointing and sanding operations and make the decorative grooves with a 1/8-in. veining bit in a router. (I mount my router in a table to create a small shaper.) Then I cut the wood to length.

After cutting the four longer wood strips A (see drawing on page 148) and the four shorter strips B, you can shape their ends. Draw a 1-in. radius at each end with a compass; then saw and sand to shape.

Next, mark and center-punch be-



This reproduction of an antique hat rack is an attractive way to keep outdoor apparel organized and at hand. The rack is of cherry wood, but any hardwood will do.

fore boring holes at the ends of all wood strips.

Bore the holes in two strips at a time after aligning and clamping them together. Place a dowel or a turned peg in the completed holes and repeat at the other ends. Bore the center holes in the four longer wood strips.

Shaping the wooden pegs

Turn the pegs on a lathe with the tenon end positioned at the tail-stock. With this setup, you can remove each peg and test-fit it in the wood strips as you work. Turn and sand the upper part of the tenon (close to the peg) so it is slightly smaller than the end portion. After

assembling, the front wood strips of the rack must pivot on the upper part of the tenons, while the lower parts are glued to the back wood strips.

After all parts are completed and test-fitted in place, stain and varnish before assembling. Be careful not to get finish on the tenons or in the holes.

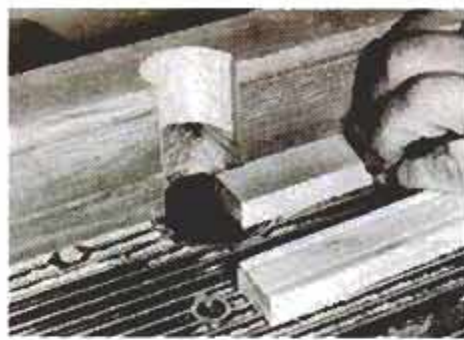
To make the final assembly, fit all pieces together without glue. Remove one peg at a time. Put a little glue on some wax paper; use a matchstick to coat the walls of the holes in the back strips only with glue. Don't apply the glue to the tenons.

Press the pegs firmly in place, turning them to spread the glue. Be careful not to pull the pegs upward, as this will spread glue to the upper, nonglued holes.

Antique hat racks often had decorative white porcelain or brass heads in the ends of the pegs. Upholstery tacks with large brass heads are a reasonable substitution.

Hanging the rack

You can hang the hat rack in several ways. On plasterboard walls, you must locate hangers about 16 in.



A 1/8-in. veining bit in a table-mounted router cuts the 1/16-in.-deep decorative grooves in all wood strips as shown.



Turn the pegs with tenons toward tailstock end; test-fit occasionally. Sand upper part of tenon so it turns easily in front strips.



To bore holes, center-punch after clamping two strips together. Insert peg or dowel in finished holes and bore other end.



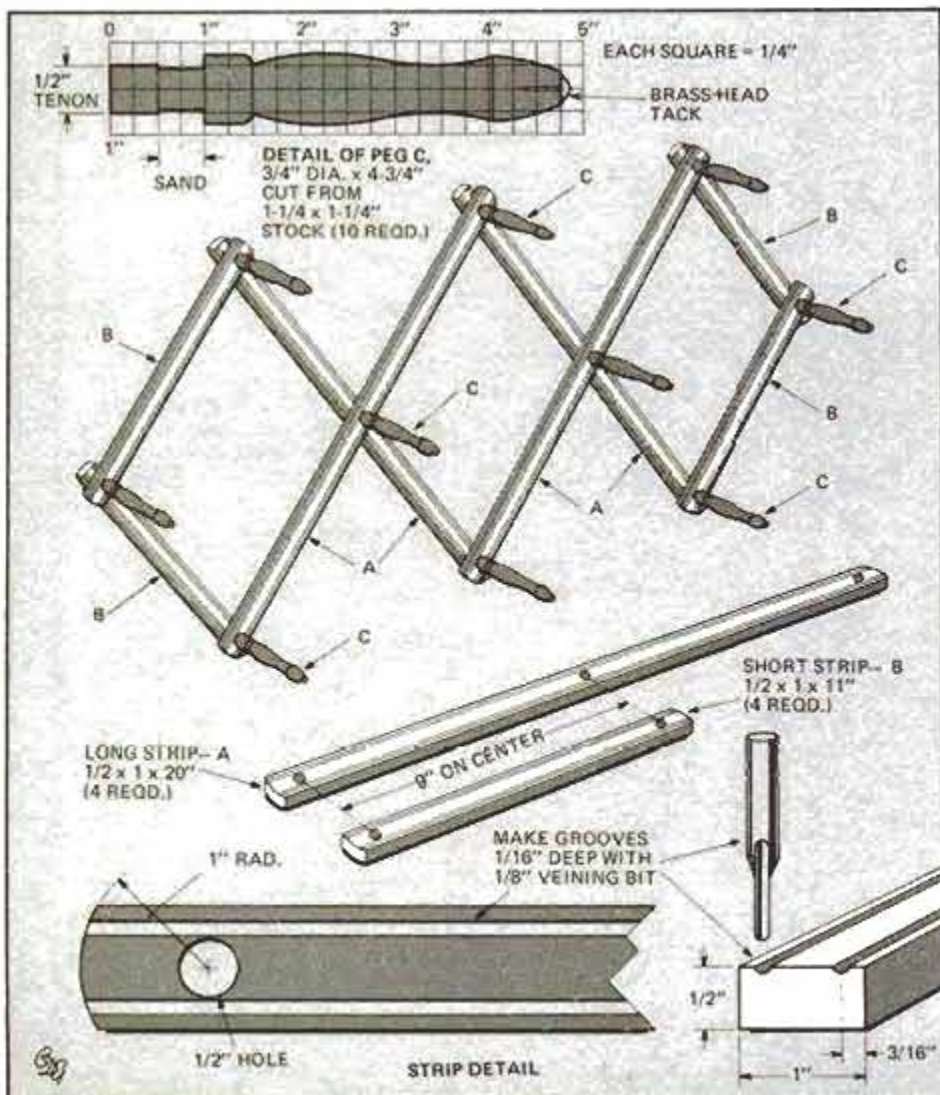
Assemble parts without glue. Attach one peg at a time; with a matchstick, apply glue to the holes on the back strips only.

apart so they will go into the studs. Originally, square-bend screw hooks were screwed into the wall and the rack was hung over these. Sometimes holes were bored directly through the wood strips and round-head wood screws or nails were used to secure the rack.

Hiding the hangers

One way to conceal the hangers is by cutting 3/8-in.-deep slots in the back of the hat rack. You can do this with a dovetail cutter in a router. Then simply slip the slots over flat-head wood screws protruding from the wall.

After the rack is built, stretch it to suit. Measure two points on the rack 16 or 32 in. apart where you can make slotted cuts. Finish with wax, if desired.—*Ralph S. Wilkes*



MATERIALS LIST—HAT RACK

Key	No.	Size and description (use)
A	4	1/2 x 1 x 20" cherry wood (long strips)
B	4	1/2 x 1 x 11" cherry wood (short strips)
C	10	3/4-in.-dia. x 4 3/4" cherry wood (pegs)

Misc.: Carpenter's glue; stain and varnish or other finish; square-bend screw hooks, 1 1/4" No. 10 rh screws or other fasteners.

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SMALL \$200 SPEAKERS

(Continued from page 73)

And all these speakers may be driven by any amplifier with 15 watts per channel. All will deliver room-filling volume.

The minis

■ **ADC MS-650** (\$250/pair; 11 × 8½ × 7½ inches). Our drawing on page 72 explains how the nonparallel sides of this little gem discourage unwanted internal resonances. The same design encourages smooth transition of sound from front surface to open air. The enclosure is sealed and a tweeter attenuation knob can tailor the treble to room and taste.

■ **Allison Six** (\$250/pair, white; \$270/pair, black; 11¼-inch cube). This cubical speaker bounces the bass notes upward (or to the side if placed

that way) and uses the solid wall to boost the lows. This results in smaller, simpler cabinetry and a reduced load on the amplifier.

■ **Cizek Sound Window** (\$159/pair, oak or walnut; 12 × 12 × 3 inches). These 3-inch-deep speakers can be put in unusual places. The light bass benefits from corner placement. They can even be used in RVs.

■ **Design Acoustics LDM** (\$390/pair; 11 × 7 × 5½ inches). The initials LDM stand for low diffraction miniature speaker. Beveled edges act as transition areas on the enclosure to help speed the sound on its way.

■ **Ohm M** (\$290/pair; 7 × 4¼ × 4¼ inches). Although it's the tiniest speaker in this survey, it still unleashes giant sound. Its vented, cast-aluminum body contains a sophisticated electronic crossover along with a tweeter and an athletic 4-inch woofer that really delivers the bass.

The speaker is small enough to be hung on its swivel mount from a wall or ceiling, or even in a car or boat.

■ **Ohm N2** (\$385/pair; 15 × 16 × 15 inches). This sub-

woofer is meant to be used in conjunction with other speakers, such as the Ohm M. Two 8-inch woofers (paired in one enclosure) use a vented system. Not surprisingly, the bass was excellent.

■ **Polk Mini Monitor** (\$300/pair; 14 × 6 × 4¼ inches). A 4½-inch woofer is coupled via a fluid drive to a passive, flat radiator. The flat radiator accentuates the bass and seems to be very responsive. The Polk's 1-inch dome tweeter is fuse-protected.

■ **Speakerlab S-11** (\$298/pair; 26 × 11¾ × 9¾ inches). This company started out with kits—but now, many models, such as this one, are available only as assembled units. A rosewood finish sets off the vented enclosure.

■ **Yamaha NS-10M** (\$155; 15 × 8½ × 12 inches). This speaker has the best bass of all the minis listed plus unusually fine stereo imaging. The



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Yamaha's good-looking, black-finished wood cabinet attracts attention.

The bookshelf lineup

■ **Advent 2002** (\$200/pair; 18½ × 11 × 8 inches). Here's a speaker that's on a par with larger systems. The Advents pump out solid bass with fine treble dispersion.

■ **AR 28** (\$250/pair; 21½ × 11¼ × 8 inches). This big brother to the popular AR 18 features a new 1-inch dome tweeter. The smooth sound is now spread out over a slightly broader listening area.

■ **Boston Acoustics A-70** (\$260/pair; 24 × 14 × 7¾ inches). Wider and taller than most mentioned here, this speaker is only 7¾ inches deep. The large front surface provides a good radiating area for critical treble and midrange output.

■ **EPI 100** (\$240/pair; 21 × 11 × 9 inches). Epicure's responsive mid-size bookshelf model boasts solid engineering and a quiet, unobtrusive look. Good power handling complements a tolerance for room placement.

■ **ESS PS-9A** (\$356/pair; 20 × 11 × 9 inches). The new air motion transformer has a unique way of creating high-frequency sound. A pleated metal foil squeezes air instead of pushing it. It produces superb highs and a versatile overall response.

■ **Infinity RSe** (\$320/pair; 20 × 13 × 11 inches). This no-nonsense design can handle 100 watts per channel without finching. Thanks to a unique rotating tweeter, this speaker can be used lying on its side or standing upright.

■ **JBL L119** (\$360/pair; 20 × 13 × 11 inches). The smallest member of JBL's L series, the L119 can still take on a 200-watt amplifier. This handsome speaker is smooth and accurate.

■ **KLH 170** (\$200/pair; 18 × 10 × 19 inches). A new material for speaker cones, polypropylene, is a success here. The speaker seems less susceptible to the bass resonances and distortions that plague some conventional speakers with paper cones.

■ **Wharfedale Laser 60** (\$270/pair; 16½ × 10½ × 9½ inches). Here is a finely crafted speaker from a British firm. The sound is—as the British would say—tasteful.

There you have our lineup—18 speakers that share attractive prices, state-of-the-art technology and the capability of meeting just about any at-home need. No longer can the term "mini" be used as an insult—and the once-humble bookshelf designs deliver really thunderous bass. Who says you can't find a bargain anymore? **FM**

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DE LOREAN SPORTS CAR

(Continued from page 67)

character and a styling all its own.

Moss: There are only two seats, of course, separated by a fairly high center console that houses control switches for the windows, lights and so on. The console is quite handy actually, because under really severe cornering it helps to keep you put. Not that you really need it, because the seats are well bolstered.

Behind the seats there's an elastic net over a small luggage compartment—a good idea, since it keeps small items of luggage in place when you're driving quickly. There's also a little luggage compartment in the front end of the car that holds very small items of baggage.

Visibility from the driver's seat is good in front, but poor out the back. Rear vision is aided by a pair of rear-view mirrors, but you sit so low in the car that you can't really see the front and sides of the car. This makes passing or maneuvering difficult in confined spaces.

But of course, the De Lorean is a car intended for the open road. Here, I must admit, that I found the performance didn't quite match up to the car's looks or pedigree. However, it handles very nicely, with good transient response and fairly neutral cornering attitudes.

It has a good, firm suspension, independent at all four corners; nice, light and very direct steering response, and very powerful Lucas-Girling disc brakes all around, good for 60 to 0 mph in 135 feet.

At speed, the noise level is low and the engine is well damped. You're not conscious of a power unit churning away just a few feet behind your head as you would be, let's say, in a Maserati or a Lotus. I found wind noise to be more obvious, mainly due to the gull-wing doors.

Assenza: Unlike the vast majority of cars running on the road, the De Lorean doesn't have a unitized body. Also, unlike some of the exotics, it doesn't use the race-car derived monocoque tub. Instead, it uses a separate chassis and body combination.

The chassis itself looks like two Ys joined at the base. This central backbone is the platform upon which the body and the suspension is attached. It's not surprising that this wishbone configuration is somewhat similar to that used in Lotus cars, since Lotus engineers were consultants in the design and development of the De Lorean.

The engine is placed at the rear of the car, just behind the rear axle. So

this is a true rear-engined car, rather than the more common mid-engined cars which fit the engine just in front of the rear axle.

Front and rear suspension is coil over shock with upper and lower A-arms—it could be called a classic racing suspension.

The plastic fuel tank is at the front of the car, nestled between the two arms of the Y. This seems to be a very safe place to store it, since it would be almost impervious to rupture, even in the most severe crash.

The powerplant is the jointly developed Peugeot, Renault, Volvo V6 displacing 2.85 liters. It is fitted with Bosch K-Jetronic fuel injection and runs on a fairly low 8.8:1 compression ratio.

Moss: I suspect the performance is a consequence of the car's main market. The version I drove was modified to meet the stringent U.S. emissions regulations, which must have knocked the heart right out of the engine. Still, this is a problem all other sports-car manufacturers must face if they want to sell cars in the United States, and the De Lorean seems to have done as good a job with the engine as most of the others. You'll get 0 to 60 mph in about 9 seconds.

At speeds over 100 mph, the car seems very stable due to the downforce created by its very aerodynamic shape (top speed is about 130 mph). It does seem a bit sensitive to crosswinds, however. This, I suspect, is due to the extreme rear-weight bias. Weight balance is 69 percent at the rear and 31 percent at the front.

In cornering, though, where it really counts, this rear-weight bias, which could cause oversteer, is reduced by suspension tuning and the larger tires at the rear.

Assenza: The man responsible for engineering the De Lorean is Mike Loasby, formerly of Aston Martin, who was also responsible for the Volante, Lagonda and the Bulldog. His goal was to make the car handle well enough for the enthusiast to appreciate, but also make it very forgiving for the "average" driver. He has apparently succeeded, because the car is remarkably vice-free, especially in light of its rear-heavy balance.

The most striking feature of the car is certainly the stainless-steel body. It's rustproof, naturally, and comes in a brushed natural finish without any kind of coating at all. If you like, you can wax it and even paint it, but that would be taking away part of the car's uniqueness. De Lorean Motor Co. won't offer a

paint job as an option, although they expect dealers to offer it.

Body maintenance is fairly easy. All you need is an Engis wheel, a round attachment on a drill with flaps of 200-grit sandpaper attached. Steel wool or any kind of abrasive which contains iron is not recommended because bits of iron will deposit themselves in the steel and create small brown spots.

The inevitable dings and dents can be banged out using traditional methods.

The cars are assembled in a 750,000-sq.-ft. plant which is capable of producing 20,000 cars a year. Currently, it produces 22 cars per day.

Moss: The task of designing, developing and producing a new motor car is fraught with every kind of risk and problem, especially when making expensive sporting cars for the discriminating few. Still, to make a car like this from the very beginning in just a couple of years is a remarkable achievement.

The De Lorean has the makings of an extremely desirable sports car. The details that need improvement, such as the fit and finish of certain body and trim parts, are trivial indeed, compared to problems that have already been solved. **FM**

SPECIFICATIONS DE LOREAN SPORTS CAR

Engine

Configuration: V6
Bore and stroke: 91 x 73 mm, 3.58 x 2.87 in.
Displacement: 2.85 liters, 174 cu. in.
Compression ratio: 8.8:1
Maximum power (SAE net): 130 hp @ 5,500 rpm
Maximum torque (SAE net): 162 ft.-lb. @ 2,750 rpm

Suspension

Front: Independent; parallel, unequal-length upper and lower control arms; coil springs with coaxial shock absorbers; antiroll bar.
Rear: Independent; trailing arms with upper and lower unequal-length, parallel, transverse control arms; coil springs with coaxial shock absorbers.

Wheels and tires

Wheels, front/rear: Cast light-alloy 6 x 14 in./8 x 15 in.
Tires, front/rear: Goodyear NCT steel-belted radial, 195/60 HR-14; 235/60 HR-15

Dimensions and weight

Wheel base: 94.8 in.
Front track: 62.6 in.
Rear track: 62.5 in.
Curb weight: 2,712 lbs.
Fuel-tank capacity: 13.5 gal.

Body

Two seats, two gull-wing doors, stainless-steel skin over glass-reinforced plastic.

Standard features

Stainless-steel body panels; counterbalanced gull-wing doors with cryogenically preset stainless-steel torsion bars; leather seats; airconditioning; multispeaker, high-output stereo system; power windows; adjustable steering wheel; electrically operated door mirrors; full instrumentation; centralized door-locking system; tinted glass.

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In fact, with its optional diesel engine and 5-speed transmission, the VW Pickup gets an estimated **38** mpg, 51 est. highway. (Use "estimated mpg" for comparison. Your mileage may vary with speed, weather and trip length. Actual highway mileage will probably be less.)

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ples smaller than a pinhead. Often it is vitally important to sort the very elements that make up a particle of evidence picked up at the scene of a crime, so it can be compared with a bit of unknown material found on a suspect's body, clothes or shoes. Neutron-activation analysis does this by irradiating materials so that they become radioactive. Then these materials can be identified according to the radiations they emit.

How can that solve crimes? Take the case of the woman who spiked her husband's coffee with arsenic over a period of months. She wasn't particularly interested in killing him with poison—just weakening him enough so that she could shove him back on his bed and strangle him with a rope. Then she hauled him to the back yard and burned the body to fine ash in a bonfire.

State police were understandably suspicious, but they had no concrete evidence of foul play. They combed the area, but didn't find any particles resembling bone or flesh that were large enough to yield data by chemical analysis. They sent the only available crumbs of evidence to the FBI labs, where neutron-activation analysis soon identified excessive amounts of arsenic. The woman was convicted.

The real bear trap in this unit, say FBI scientists, is a mass spectrometer (which sorts atoms of anything, according to their mass), used in tandem with a gas chromatograph (which sorts components of gases). These two are linked into one unit and tied to a computer. The computer takes the breakdowns of a sample and compares them with breakdowns of some 30,000 known chemical items. In minutes, it can identify the sample, via a readout.

Assailant stole a diaper

Technology has revolutionized the whole operation, the experts will tell you. They cite a Florida rape case in which the victim said her assailant left with a diaper she'd used to mop up medicine spilled from bottles on her night table.

Investigators found a suspect, searched his home and found a diaper with stains, which they sent to the FBI along with the medicine bottles. Lab sleuths injected a sample of the stain into their super-instrument and got a readout with peaks for Tylenol and codeine. The suspect was nailed.

Frequently, today's techniques help clear innocent people, as well as convict the guilty. In one recent case, voiceprints helped investiga-

tors find a criminal in a crowd of close to 40 potential suspects.

Voiceprints are investigated in the FBI's Signal Analysis Unit. The readout looks like the chart of a marine depth finder, replete with its peaks, troughs and middle layers. The voiceprint readout maps rises, falls, modulations and other vocal characteristics. While no two voices look exactly alike repeating the same phrase, neither does the same voice. There's the rub. But certain characteristics make each voice unique within limits.

A recent case involved ransom-demanding phone calls from a man who'd kidnapped a young girl in a small, western town. Before money could be paid, he'd killed her. There were no clues, but luckily, his voice had been taped. For three months, agents went around taping every male voice in the village. They wound up with about 40 voice samples. Analysis of the voiceprints enabled lab sleuths to eliminate all but one voice. Faced with that evidence, the killer confessed.

In other cases, the way that wood, metal and plastic are bent out of shape in a crime can explain how the deed was done, or even "whodunit." In the Minerals and Metallurgy Unit, rugged but delicately calibrated machines bend, fracture, stretch, squash and otherwise mangle and measure the resistance of almost every known material.

Hook in the money bag

Not long ago, a plastic money bag with \$2,700 of gas-station receipts was dropped at the night depository of a Washington, D.C. bank. The officer opening up next morning found the bag unzipped and empty on the street. It appeared to have been hooked and hauled out by two fish hooks on a line—one imbedded beyond its barb in the bag. That hook wound up on the lab's "tensile tester"—a hydraulic device that exerts and measures any force from mini-ounce tugs or pressures to multiton pulls or pushes. The tester told scientists that the force needed to imbed a hook in that material would unbend the hook. Someone, they concluded, took the money, pushed in the point with thumb and forefinger, and dropped his hooked red herring beside the depository. When confronted, the manager, who made the station's daily deposits, confessed he'd done just that.

The work of medical examiners in developing forensic evidence is well known. Less familiar are experts in geology, anthropology, dentistry

and other fields, who may be called in to help solve mysteries. One such expert is Dr. Lowell Levine, whose specialty is forensic odontology (the science of tooth structure and growth).

Teeth have long helped identify burned or mangled corpses, but now they're being used to identify compulsive "biters" in some homicide cases. Recently, at the trial of one Theodore Bundy, accused of the murder of a Florida sorority girl, Dr. Levine linked photographs of bite marks on the slain woman with the gnarled teeth of the suspect. Levine helped get a conviction.

Computer with an eye for art

Use of computers in forensics is burgeoning. One new application is in the field of stolen art, where electronic memories are making things tough on crooks. A computer data bank stores pictures of stolen masterpieces, which it transmits to a monitor screen.

Recently, in a truck stopped for a traffic violation, police found a cargo of drugs, plus an abstract painting, unsigned and untitled.

At the "stolen art" keyboard in the FBI lab, the operator punched in: "Abstract. Straight lines. Curved lines." The computer replied: "38 on file. ?color." Dominant colors were punched in and the field was narrowed to eight possibilities. At the computer's request, the secondary colors were entered: The work was quickly identified as a Picasso. The computer told the operator where and when it was stolen, the owner's name and address and other significant data. Then a photo of the painting was displayed on the screen. The thieves were nailed.

So it goes. In the FBI's Document Unit, an electrostatic device "magnetizes" paper so that black metallic particles will adhere to impressions many layers under the top sheet of a pad. This can make it possible to read script that may have been written days before. When the Pope received an anonymous threatening letter during his visit to the United States in 1980, the instrument revealed identifying information about the writer from a blank sheet under the one he'd used on the same pad. Faced with this, he confessed.

The future for lab sleuths may become even brighter. In Quantico, Va., a new forensic science research center opened its doors recently. Mysteries, such as why the laser beam does what it does, will be studied and ways in which technology can be applied to the solution of crimes will be explored. The object: a safer world for decent citizens. **PM**

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PM TESTS SIX 4x4s WITH SPLIT PERSONALITIES (Continued from page 77)

pounding—nothing broke. That's remarkable in itself.

SUBARU GL WAGON

Assenza: "The biggest surprise was the Subaru. The smallest, cheapest, most lightly built of the six, it's really nothing more than an unassuming front-wheel-drive Subaru wagon straightforwardly converted to part-time four-wheel drive. It's far and away the best bargain in 4x4s, and the hands-down winner of our test on the strength of its all-around usefulness and economy."

Taylor: "In many ways, the Subaru wagon is the Volkswagen Beetle of the '80s. Its 1.8-liter, flat-Four engine is much like the VW Beetle motor and transaxle with water jacketing added and mounted in the front. Noisy and rough, it's reportedly indestructible and it can be repaired easily with duct tape and wire by almost anybody. The vinyl interior is distinctly utilitarian, and the styling is—well—unusual. Indeed, there's nothing special about the Subaru—except its superb four-wheel-drive system.

"This clever 4x4 is made by taking the fifth-speed shaft in the two-wheel-drive transaxle and running a driveshaft aft to the rear wheels. The 4wd cars are thus restricted to four speeds forward, but the trade-off is well worth it. New this year is a dual-range lever for the four-wheel drive. This 4x4 system is remarkably efficient; our Subaru delivered over 21 mpg even in subzero weather, flat out in 4wd. Remarkable."

Witzenburg: "I always considered the older Subarus well built and durable, but pretty primitive. This new, restyled model represents a tremendous improvement in appearance. The four-wheel-drive system is terrific; you can shift in and out of 4wd with just a flick of a lever, even while on the fly. The only disadvantage—you can't use 4wd over 50 mph.

"The Subaru would be a terrific car for a skier, or for a family living in the country where roads are poor. It's not really much use in true off-road situations. But it will go almost anywhere there's a semblance of a road, no matter how bad the surface or the weather."

AMC EAGLE SX/4 DL

Witzenburg: "Eagles are not much for fuel economy, as you can see from the 12-mpg showing of this one, but they're good for most everything else. I admit this Eagle is too heavy and inefficient in its ratio of inside

space to exterior size, especially in light of more modern mid-size machines like the X-cars or K-cars.

"However, take this outdated Gremlin chassis and put a very slick, all-hydraulic four-wheel-drive system underneath it, and I believe you have one heck of a versatile vehicle. You wouldn't even know this Eagle has 4wd. Since it's full-time, there's no selector lever. You just get in, put it in DRIVE and pull away, on-road or off-road.

"AMC's new Select-Drive, part-time four-wheel drive will probably pick up 3 mpg, making this car look more reasonable to drive every day. Personally, if I were going to buy an Eagle, it wouldn't be this one. The larger, four-door wagon, equipped with part-time Select-Drive and four-speed manual transmission, offers a lot more practicality in terms of interior room and fuel economy." (See the report on the Select-Drive wagon, page 77).

Assenza: "The SX/4 has a good, soft ride. It handles surprisingly well for a car with this much ground clearance on a jacked-up suspension. Road-holding is fine until you get up to 70 mph or so on dry pavement. Then it seems to go around standing on tippy-toes."

Taylor: "I suppose the Eagle is a decent enough vehicle, but it seemed very old-fashioned and not very well assembled. There is no luggage room to speak of, and the back seat is pretty much unusable. To me, this is a vehicle of very limited use—a two-seater with neither the handling of a sports car nor the cargo bed of a pickup. The excellent viscous drive is all that stands between the Eagle and mediocrity."

FORD BRONCO RANGER XLT

Assenza: "We were walking across a field to the vehicles at the end of the test, and I thought 'Which one do I want to drive home?' And out of all six, the Bronco was the one.

"The Bronco has a certain combination of features which really appeals to me. I like the interior room, the first-class trim and the quiet, well-insulated engine. It has a large capacity for luggage, stored safe and dry inside. I think it's very well styled, massive without being ungainly, and it handles the same way. It's actually quite nimble to drive."

Witzenburg: "The Bronco is not a hill-climber, as we found out in our tests. It's not in the same league as the Dodge off-road, and at 10 mpg, it is certainly not economical to run. Yet the Bronco showed the quickest acceleration of all six vehicles, even

with a 'small' 302 V8, which makes it fun to drive. It also has that indefinable something—character, personality—which the Eagle and LUV lack. For me, it's the best compromise. It's a very carlike truck, quiet, easy to drive, and roomy."

Taylor: "The Bronco is much better finished than the others, especially inside. It's also the prettiest of the three big vehicles. Controls are much more intelligently placed than those in the Dodge. For example, the four-wheel-drive selector lever is on the driver's side of the driveshaft tunnel and easy to reach."

"Cruise-control buttons are on the steering wheel as in Ford passenger cars—very convenient. This top-line Ranger XLT package has reclining captain's chairs with armrests and all sorts of fancy touches, from full instrumentation to a full-house stereo. It's high in what Detroit product planners label 'perceived value.'

"The Bronco is a very smooth, very luxurious 4wd for someone who wants to look like an off-roader, but never really gets his tires dirty. It's an Urban Cowboy."

DODGE RAM CUSTOM SE

Taylor: "What a wonderfully extravagant vehicle. Driving this Dodge truck is like driving a full-size 1970 Dodge Charger; it kind of hunkers down and flies with an agility that belies its size. It was also far and away the most effective vehicle off-road, motoring over obstacles which stopped the others dead in their tracks. Plus it has a huge cargo bed."

"What kills the Dodge is less than 11-mpg fuel economy from a 318 V8 which would have been tiny 10 years ago, but seems huge today. This kind of truck keeps the aftermarket auto parts companies in business. With a free-flow dual exhaust system, carburetor, camshaft, intake manifold and headers, you could probably get it over 20 mpg in two-wheel drive on the highway and still have trailer-towing ability."

"What we have here is the apotheosis of the full-size American pickup. It's probably faster than any other vehicle in this group, pavement or no, and better over the road than many passenger cars. It's heavily built, easy to work on and service, virtually unbreakable and, unlike so many new vehicles, is sized for a full-size American man. Plus it has real charisma. It's a heck of a vehicle—if you can afford the gas."

Witzenburg: "Unlike the Bronco and GMC, the Dodge needs no con-

stant steering corrections. It definitely tracks the best. The ride is a bit harsh, but I'm sure it would settle with a load in the bed. This truck feels indestructible, a very positive feeling. It would be hard to break it, even in the worst off-road situation. I'm not much of a truck fan, but I do enjoy driving this Dodge."

Assenza: "This is a man's kind of pickup, very spartan and business-like, despite the flat-black paint, treatment and macho appearance package. The interior is very large, with some neat touches—like a center console big enough to hold a small drink cooler, and a sporty padded steering wheel from the Omni. Visibility is terrific because you sit up so high. It would make a good camper, and even with a heavy slide-in camper, you could go places the Bronco just couldn't reach. The whole truck seems to work quite well. It has this awesome invulnerability about it."

GMC SUBURBAN SIERRA GRANDE 2500

Taylor: "In 1981, how can you excuse a 350-cu.-in., 2½-ton, 9-mpg station wagon? The only way the Suburban begins to make sense is if you car-pooled with eight people all week and towed a 35-foot Airstream every weekend with six kids in back. Even then, a van is probably better. You can't use the four-wheel drive at any kind of highway speed on smooth pavement—it's strictly an off-road option. How often are you going to go off-roading in an eight-passenger station wagon? The 4x4 Suburban is a superbly executed answer to a question that nobody asked."

Witzenburg: "The GMC is surprisingly good off-road, because it has excellent weight distribution, big tires on 16.5-inch wheels and plenty of power. But on pavement, it hops all over the road. You have to constantly make steering corrections. It's work to drive."

"In all fairness, I've owned two Suburbans similar to this, but with two-wheel drive, and both were amazingly good vehicles. They handled well and had excellent brakes, a good ride—much like a big, luxury car—and very comfortable interiors. They were not at all like this 4wd version. I used mine as tow vehicles, and they were superb. Like the ones I've owned, this Suburban is amazingly free of rattles and squeaks, and has the same feeling of durability."

Assenza: "It wouldn't be my (Please turn to page 160)

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PM TESTS SIX 4x4s

(Continued from page 159)

choice, but I can see if you needed a large vehicle with lots of secure luggage room—let's say a tow truck for a race car, in which you could remove the rear seats and store equipment, put in a cot for the off-duty driver and haul across country—a two-wheel drive Suburban could actually solve a problem no other vehicle could handle. It's very well screwed together with none of the rough edges that mar the Eagle, for example. It does quite well on- and off-road; it's just that you're proceeding from an obsolete premise which is difficult to defend these days."

CHEVROLET LUV 4x4 MIKADO

Assenza: "Of all these vehicles, the LUV is my least favorite. It's too small, is underpowered and the seating position is almost unbearable. It's noisy and squeaky—little bits rub against each other all over the place. On the road, it's squirrely, bumpy and slow. It's just too specialized. I don't see anybody who'd want to buy this except a very small person who constantly hauls lightweight things between not too distant places."

Witzenburg: "I'm not very enamored of this truck. On the highway, it's rough riding—a combination of short wheelbase, stiff suspension and light load; your body moves up and down like a sine wave on an oscilloscope. It's not very pleasant to stay in for any length of time."

"The LUV is considerably underpowered but that's the price you pay for 18-mpg. You can drive fast on the flat, but it bogs down on hills. The transmission is quite good, though it would be nice to have an overdrive fifth speed."

Taylor: "I'm the only one who liked the LUV even a little. It costs considerably less than the big Dodge pickup, yet could carry almost as much. I was surprised at how little difference there was in our acceleration testing—four-tenths of a second—while the difference between the Dodge's 10 mpg and LUV's 18 mpg is significant."

"This new body is very nicely styled, at least as pretty as any other Japanese pickup, though Chevy's paste-on vinyl trim package is tastelessly tacky and already coming off. A major failing is the single-wall bed; you'd have to put in a bed liner before you could carry anything. The Mikado interior, nicely trimmed with full headliner, A-pillar trim and no visible screws, is as pleasant as any pickup interior." **PM**

CADILLAC CIMARRON

(Continued from page 84)

stabilizer bar is 28 mm thick, beefier than the 22-mm stock bar on other Js. On those, the 28-mm bar is available only as a special-handling package.

The same is true at the rear, where Caddy has a 19-mm sway bar as standard equipment. There's no stock sway bar on the others; the regular production option is a 15-mm-thick bar. On the other Js, the 19-mm bar comes with the special-handling package only.

Caddy engineers didn't just pick up the heavy-duty handling package the others offer, however. They kept the standard J-car springs, but revised the shock valving. There's



The geometric high point of the tire and the low point of the alloy wheel are matched to yield a perfect balance at speed.

about the same amount of overall control as on other Js, but the shocks dampen a bit more on compression and less on rebound. This cuts fore-aft body pitching and provides extra smoothness on rough roads, Cadillac engineers claim.

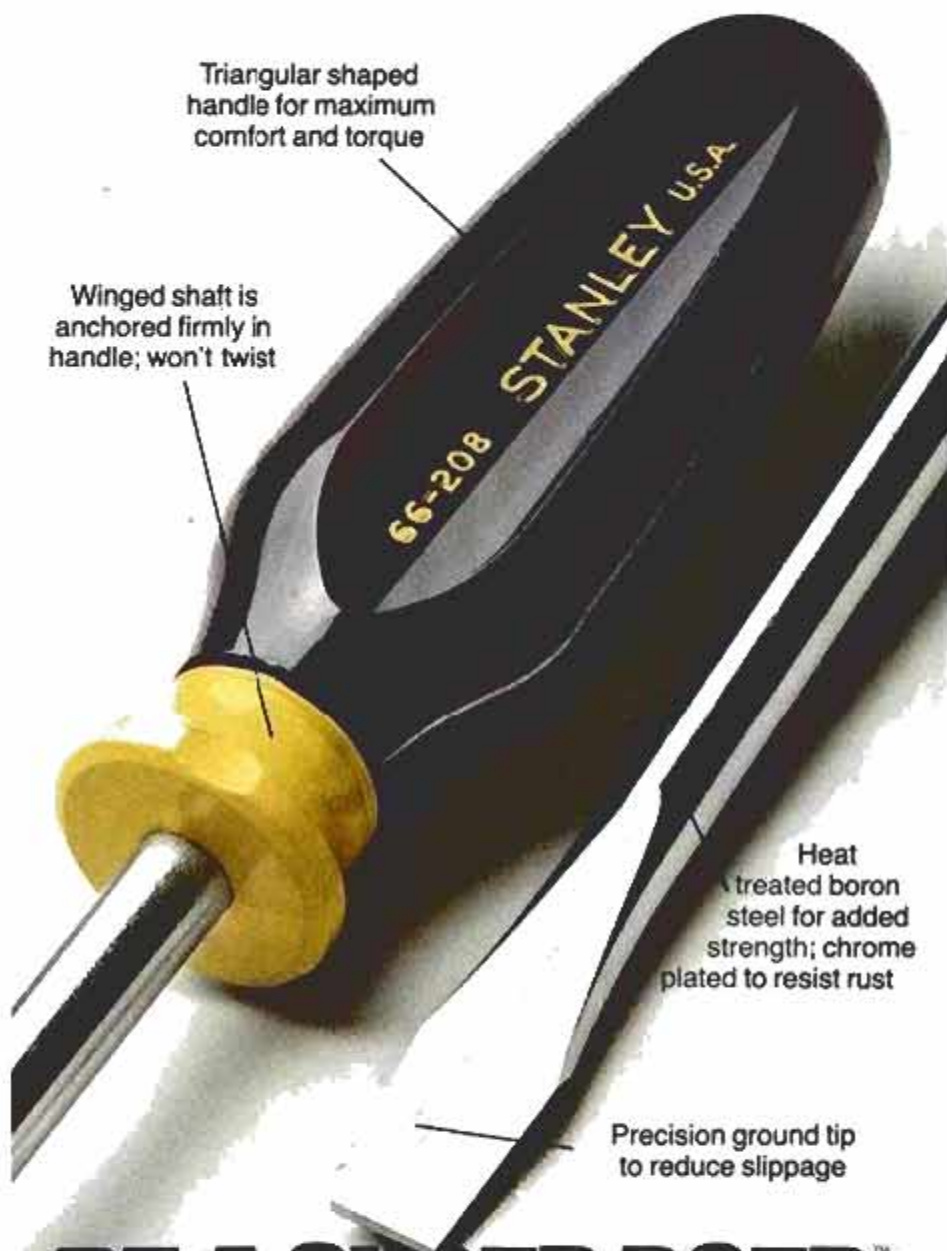
An important change in the Cimarron rear suspension was made to the control-arm bushings, which are a dual-control design in all Js. The bushings have an air gap that softens their response to fore-aft loads (the air provides less resistance).

With its suspension modifications, Cadillac found it had a bit of oversteer (the rear end swung around). So the bushings' air gap was reduced. The extra rubber that fills part of the gap adds some stiffness against lateral loads and keeps the rear end stable. However, there's enough of an air gap remaining to provide adequate fore-aft softness for a smooth ride.

The success of these suspension changes depends on the tires: Tire problems have ruined the reputations of some of the best suspension designs. Cadillac is not taking any

(Please turn to page 162)

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CADILLAC CIMARRON: GM GOES AFTER BMW

(Continued from page 161)

chances. It's using a P-195/70 R-13 tire, wider than the standard P-175/80 R-13 on the other Js. The tires are radially ground (a standard Caddy procedure). However, this truing is performed with the tire in free form, not under any load. So the next step is taken: The tires are operated on a force-measuring machine under load and the high point is marked.

The wheel is also measured with a dial indicator and its geometric low point is marked. The high point on the tire and low geometric point on the wheel are aligned. When you mount them on an axle, they should do a dandy job of cancelling out the imbalances. Low- and high-point measurements can be as small as 1/1000 inch.

When a tire wears out, you can get a replacement that has a specific part number from a Caddy dealer. The replacement will be radially ground and its high force point will be marked.

The Kelsey-Hayes-produced wheels, incidentally, are something special. They're forged aluminum alloy (made in presses, not cast in molds). Forged alloy wheels are very expensive and are normally sold in auto accessory boutiques. They respond well to polishing, so they don't have to be painted—the usual procedure for cast alloy wheels.

There are few idiot lights on this Cadillac. The car has a tach, oil pressure and coolant temperature gauges, as well as a voltmeter. The gauges are conventional analogs (needle and dial).

Since Cadillac has lots of experience with electronics and dashboard digitals, why aren't some of these exotic instruments on the Cimarron? Because Cadillac made up its mind to go with its own J-version only 11 months ago. There wasn't time to perform needed surgery.

Soon, the Cimarron will be further massaged in the Cadillac tradition.

A two-liter version of the 1.8-liter four-cylinder, with throttle-body fuel injection instead of a carburetor, will be available for J-cars in about six months. At approximately that time, the Cimarron will become available to the entire Cadillac dealer body. (Only exclusive Caddy dealerships will have the early Cimarrons because of limited initial supplies.)

Cadillac is anxious to upgrade the performance image of the car and throttle-body fuel injection certainly fits in with the rest of the Cadillac line. So Cimarron may be the first of the J-cars to offer the upgraded engine as standard equipment.

The target market

The first Cimarron is a four-door sedan, because that model seemed to have the widest appeal for the potential market, according to Cadillac marketing people. And time limitations dictated that one model would have to suffice. The Mercedes experience notwithstanding, a wagon is probably not in the cards and we doubt that a Cadillac buyer would go for a hatchback.

Cadillac envisions two potential purchasers: The first is the man who already owns a full-size Caddy. He would like something smaller, but as plush as the knockabout grocery-getter.

The other potential buyer is probably considering a BMW 320i, a Datsun Maxima, a Saab or a Volvo. These cars comprise the luxury sport sedan market—with the emphasis on sport. Whether Cadillac can shake its sedate—dare we say, comatose—motoring image and capture a sporty, youthful market remains to be seen.

At any rate, since plans call for only a 10,000-unit production run the first year, Cadillac probably won't have any trouble selling the entire inventory. **RM**

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10 BIG CAMERAS

(Continued from page 87)

under 8 ounces. It offers fully automated exposure. A feature that may be helpful to snapshotters is an LED warning signal in the viewfinder. When the shutter is set slower than 1/60 second, the LED comes on as a reminder to hold the camera extra steady. Suggested list is \$219.50.

Rollei 35SE

With its left-handed advance lever, Leica-style collapsible lens mount, baseplate-mounted rewind crank and flash shoe, the Rollei is a



Miniaturized cameras offer both standard and unique features made tiny. Switch on lens of Minox 110 (top) lets you focus to 7.7 inches. Wheels on Rollei 35SE (above) have been placed on the front of the case instead of on the top surface.



These carry-alongs can go anywhere, so their lenses could get into trouble. Olympus XA (above) uses a sliding front to protect its lens. Two barn-door-style arrangements are used on Chinon Bellami camera (top) to keep lens clean—and unbroken.

true oddity. In this new version, three stacked LEDs in the viewfinder indicate overexposure, correct exposure and underexposure. Weight is 11.2 ounces. A black SE lists for \$292; chrome is \$277.

Rolleimat AF

It weighs almost 14 ounces and measures more than 5 inches long, but the Rolleimat features automatic focus, automatic exposure and built-in flash. The autofocus operates from 4 feet to infinity. Suggested retail is \$159.95.

Canon AF35M

Another compact on the hefty side, the Canon weighs 14.2 ounces. But it may not be so weighty if you consider that it has everything you can think of: autofocus, autoexposure, built-in, pop-up flash, and built-in motorized film advance and rewind. The cost of absolute automation: \$240 list.

When shopping for a compact camera, remember that the 35s have a picture area four times larger than 110 models. As a result, you can expect sharper enlargements from a 35. And 35-mm films are available in a wide range of emulsions to suit a great variety of photo jobs. The choice in 110 is limited. But film loading with the 35s is not quite as quick and convenient as it is with 110 cartridge cameras. A final note: Careful shopping should reward you with prices considerably lower (15 to 30 percent) than the manufacturer's list prices we have indicated.



A wide choice in system designs is offered by various manufacturers. Real pros will appreciate interchangeable lenses on Pentax 110 (top). Snapshotters might be happier with automation of Chinon 110 (below). Flash unit is built in on this one.

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HOME STEREO SPEAKERS LIVE IN A QUIET ENVIRONMENT. Car speakers live with wind and road noise. Delco compensates for their effect on high- and low-frequency sound reproduction when designing auto sound systems.

HEAT, HUMIDITY, VIBRATION — TOUGH ON SPEAKERS. We build our speakers to take it. Specially designed Delco speaker cones reduce deterioration caused by severe environments. Plus Delco adds an acoustically transparent dust cover to help shield out sound-destructive dirt and sun rays.



SPEAKERS SHOULD BE LISTENED TO ON THE ROAD. Not in the showroom. So when you buy your new GM car or truck ask your dealer to demonstrate a Delco-GM sound system. Nobody knows the inside of GM vehicles quite like the automotive sound specialists at Delco Electronics Division of General Motors Corporation.

Delco **GM**

**MILES AHEAD
IN SOUND EXPERIENCE.**

DRIVING GM'S J-CARS

(Continued from page 82)

cars for photos and engineering inspection.

The Chevy and Pontiac versions come in four-door sedan, three-door hatchback and four-door wagon versions. The Caddy is only a four-door sedan. The only engine is an all-new 1.8-liter pushrod Four; standard transmission is a four-speed manual, with automatic optional.

GM also gave us comparison cars. They were a Honda Accord, VW Rabbit, Datsun 810, Toyota Celica and one of its very own X-cars.

These J-cars do go, particularly with the four-speed manual transmission. But the automatic tends to hold them back a bit. Zero-to-60-mph acceleration nets about 14 seconds with the manual gearbox and 16 seconds with automatic. The only comparison car that comes close is the Honda Accord. In fact, the Accord seems closest in all respects.

The J-cars feel tight. They're quiet on the road at any speed. Even the standard suspension has a welcome firmness; it's not at all mushy. However, hard and fast cornering under power tends to bottom the outside front MacPherson strut with the standard suspension—something that doesn't happen with the optional sport suspension.

Zippering through turns

Both the Cavalier and J-2000 have a certain amount of understeer. But through quick turns, they react beautifully. Steering is rack-and-pinion. It's very precise, and in standard form the ratio is 22:1. With power, the ratio goes to 16:1, and with handling suspensions it's 14:1.

The J wagon has 64.8 cu. ft. of cargo room with the second seat folded, which beats the Escort wagon by 3.8 cu. ft. The J's front seats feel good. There's plenty of legroom and headroom, fore and aft.

The manual transmission, with an 0.81:1 overdrive high, shifts easily. The remote cable linkage feels almost direct, except going into third. I found third gear a little balky.

Brakes feel good, too. Rear drums are shared with the X, as is the wheel-bolt pattern. Wagons and Js with automatic use vented front rotors; all others have solid rotors. All J-cars braked strongly and stopped without rear-wheel lockup.

Whether the J-cars measure up to import standards in workmanship as production models come off the lines remains to be seen. But, if GM's engineering claims bear out (see *Engineering the J-Cars*), these cars will stem the import tide. **PM**

LIGHT UP YOUR LIFE.



The Honda EM-500 portable generator can light up your campsite without weighing you down. It gives you up to 500 (max.) watts of power in a lightweight 40 lb. package. And it's as compact as a small, portable TV. The EM-500 starts

easily, runs quietly and needs no fuel pre-mixing.

To find the Honda Generator dealer nearest you, just look in the Yellow Pages, or call toll-free 800-228-2056, ext 640. In Nebraska, 402-571-4900, ext 640.

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PM OWNERS REPORT: IMPERIAL

(Continued from page 89)

from one-quarter to 100 miles. The dealer was very cooperative, but it took four visits to finally find the problem and replace the system. I've had more compliments on this car than any other I've ever owned, not just from friends, but from strangers in parking lots. Now that the

engine runs right, I'm extremely happy."

An Illinois private investigator: "It's the best looking car on the street and looks especially good parked next to Seville's. Excellent workmanship—better than the two Eldorados and three Toronados I've owned since 1971. The only problem has been the digital fuel readout, which hasn't been corrected because the factory is coming out with a new type. Handling and

performance are excellent, and while acceleration is a bit sluggish, mileage in the 15-to-22-mpg range is double what I used to get."

And finally, this from an Alabama dermatologist: "It's an unusual-looking car, wouldn't you agree? It turns heads wherever I go. It handles easily, is comfortable, well-engineered and the best-looking car on the road. I love it!" **FM**

SUMMARY OF 1981 CHRYSLER IMPERIAL OWNERS REPORTS*

Total miles driven 784,809	Small gas tank 4.9	Went gauges 4.4	Good 37.6	Fair 19.3	Poor 11.0	Poor 5.3
Average miles per gallon:	What changes would you like?	No changes 19.9%	A four-door model 13.1	Better headroom 11.0	Seat shape, mobility 7.3	Better computer device 4.7
In town 15.8	Workmanship opinion:	Excellent 76.6%	Good 18.9	Fair 3.0	Poor 1.5	Number of vehicles owned:
Long trips 22.4	Comfort opinion (front seats):	Excellent 71.9%	Good 24.1	Fair 3.0	Poor 1.0	Imperial only 27.9%
Why did you choose an Imperial?	Comfort opinion (rear seats):	Excellent 32.0%				Two cars 50.2
Styling 64.6%						Three cars 12.4
Past experience 16.7						Four or more cars 9.5
Quality 14.1						Makes of other cars owned:
Performance 9.6						Chrysler 33.8%
Warranty 9.6						Dodge 13.1
Specific likes:						Chevrolet 11.7
Style 66.1%						Plymouth 11.7
Comfort 38.0						Cadillac 10.3
Handling 35.4						Age distribution of owners:
Performance 20.8						Under 40 years 13.3%
Ride 19.8						40-49 years 20.4
Specific dislikes:						50-plus 66.3
No complaints 43.2%						Would you buy another Imperial?
Computer control 7.1						Yes 91.3%
Car rattles/noises 6.0						No 8.7

*Percentages might not equal 100% due to rounding or insufficient data.

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ENGINEERING THE J-CARS

(Continued from page 83)

regardless of load, and ride quality is assured by rubber isolators and bushings (front and rear) that are stiff laterally for good handling, but soft fore and aft to soak up road impacts.

Brakes are diagonally split with low-drag discs in front, self-adjusting drums in back and an electric auxiliary vacuum pump to boost the standard vacuum-assist when necessary. The 14-gallon fuel tank is under the rear seat, forward of the wheels for rear-impact safety.

The powerplant

Related to the X-car's 2.8-liter V6, the J's 1.8-liter Four is designed around a "fast-burn modified open combustion chamber" with the sparkplug near its center which allows a fairly high 9.0:1 compression ratio.

Cross-flow inlet and outlet ports are computer-optimized for efficient flow, and the staged two-barrel carburetor is regulated by GM's CCC (Computer Command Control) combustion and emissions system.

The in-block camshaft (driven by a double-row roller chain), says Chevy engine chief engineer John Zwerner, "provides the largest displacement for a given-length engine, with bore sizes and spacing that allow large valves and porting for breathing."

Although it's 12.5 percent larger in displacement than the ohc 1.6-liter Chevette engine, it weighs the same—and thus doesn't need an expensive aluminum cylinder head. At any rate, its specific output at 48 hp/liter (88 hp @ 5100 rpm) is impressive.

Standard transaxle is the wide-ratio, X-car four-speed with a shorter lever, shortened throw, smaller self-adjusting clutch, reduced shift effort, a new reverse inhibitor and a 0.81:1 overdrive fourth gear. The optional three-speed automatic is a refined version of the X-car unit with a higher stall speed, greater torque multiplication and computer-controlled lockup in top gear.

Aerodynamically, the bodies range from good (0.398 Cd for the sleek Pontiac hatchback, with its soft-fascia front and rear ends and optional rear spoiler), to fair (0.43 for the sedans). However, "road-load" horsepower (to overcome rolling resistance and wind drag) is an excellent 10.3 at 50 mph. EPA-estimated fuel economy should be around 30 mpg city and 46 highway for the most efficient manual-shift version, 26 city and 42 highway with the optional automatic. **PM**

SHED SOME LIGHT ON EMERGENCIES.



With a Honda EM-500 portable generator, you'll never be left in the dark. When an emergency knocks out power, you've got 500 (max.) watts just a pull-start away. And it's a compact 40 lbs. so it stores easily. It's simple to operate. Rugged. Quiet. And dependable. If

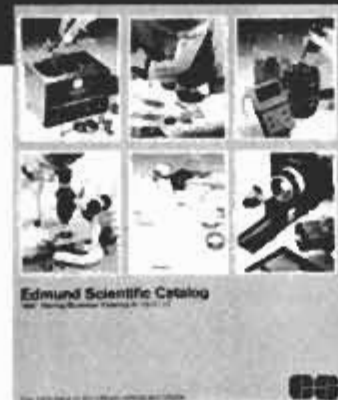
you've ever been left powerless, you already know how valuable an EM-500 can be.

To find the Honda Generator dealer nearest you, just look in the Yellow Pages, or call toll-free 800-228-2056, ext 640. In Nebraska, 402-571-4900, ext 640.

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Gas Saver Tested & Patented

DENVER—The Copley News Service reported that United States Patents have now been issued to Wm. Trevas-kis, California veteran electrical engineer, for his Vapor-Jet® brand water vapor injector.

Trevaskis has developed what amounts to a 20 cents per gallon "rebate" potential on gasoline, by designing a low-cost injector for automobiles, light trucks, vans and recreational vehicles.

The Vapor-Jet® system has survived lab testing by a certified independent automotive testing laboratory. Test results showed miles per gallon improvement of 17.3 per cent on Trevas-kis' 1971 Ford Galaxy and 13.3 per cent on a 1973 Olds Starfire.

Water injectors were developed to a highly refined state during World War II, to give combat planes increased speed and extended range. However, up to now, the low price of gas and the high cost and extremely difficult installation required for earlier injectors combined to make them unattractive.

The Vapor-Jet® has an unconditional 60 day guarantee.

How does the Vapor-Jet® system work?

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and a mist to form in the upper part of the reservoir. This mist is then drawn by vacuum through a hose which is connected to any intake manifold suction hose. This connection is made very simply by our exclusive hypodermic-like injector nozzle which contains a regulator to allow just the right amount of mist to pass into the combustion chamber.

The introduction of this mist into the fuel air mixture has a cooling effect that increases the mixture density, extends the burning rate, and improves combustion efficiency. This eliminates ping (predetonation) and dieseling (after running of motor). Since steam is a good cleaner it also helps dissolve carbon deposits on the spark plugs and cylinder walls of older vehicles and helps prevent carbon buildup in new ones.



How much mileage increase can be expected?

This varies from car to car. Independent testing on Trevaskis' car obtained improvements from 13.3% to 17.3%.

Will Vapor-Jet® fit all cars and is it easy to install?

Yes. Vapor-Jet® is easily installed on all domestic and foreign cars, vans, light trucks, R.V.s, campers, motor homes, and small boats. It will work on fuel injection, lean burn cars and cars with turbo chargers and super chargers and rotary engines. It will also work with unleaded gas, gasohol, or propane burning cars. The same kit fits all cars and contains everything needed. Simple installation instructions with a diagram are included and even a novice should be able to install it in less than 10 minutes. Simply take an ice pick or drill and make a small hole through any intake manifold suction hose (i.e.; PCV hose, brake assist hose, vacuum advance hose, etc.). Screw the injector nozzle into the hole, mount the reservoir by means of the bracket and screw supplied and connect the reservoir to the injector nozzle by means of the hose supplied. If you don't want to install it yourself most service stations will for a few bucks.

Can Vapor-Jet® damage my engine or cause rust?

Absolutely not! Vapor-Jet® cools down the fuel air mixture giving a better burn and suppresses ping thus aiding your engine. The mist that enters into the engine turns immediately into vapor and exits out the exhaust.

What is the purpose of the methanol V.I.M. (Vapor Injector Mix) and how long does 1 pint last?

The reservoir measures 3½" x 5½" x 7½" and holds just under ½ gallon. A full reservoir should last about 1,000 miles. Methanol (wood) alcohol is mixed with water mainly to prevent freezing and to keep the injector nozzle clean in non-freezing weather. The cost of methanol is minimal (about \$5 a gallon). One gallon will last 8,000 miles. Sources of methanol are chemical supply houses, paint stores and drug stores. Substitutes are gas line antifreezes that contain methanol such as "Heet" or dry gas.

Further details on Vapor-Jet® may be obtained from Progressive Energy Corp., 3148 So. York, Englewood, Colo. 80110 or contact by phone toll free (800) 525-8624 or in Colorado call (303) 762-1385. For purchase send \$29.95 and \$3.00 for shipping. Dealerships available (Offer void in CA.)

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- **Can tanks still win a war?**
- **Build an entertainment center from PM's vacation home.**

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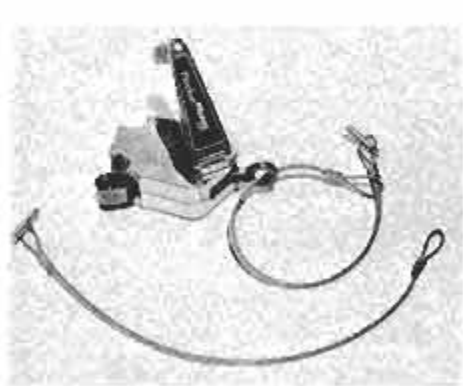


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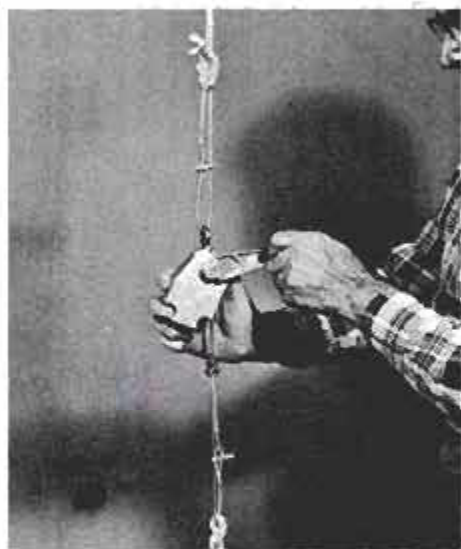
ware stores and home centers for \$2.98, it's made by Loctite Corp., 4450 Granwood Port, Cleveland, Ohio 44128.—Rosario Capotosto

Vest-pocket hoist

The Pocket Hoist 500 is a durable, portable hoist with a tough aluminum casing and permanently lubricated gears. According to its maker,



The hoist comes with two 18-in. attachment cables. Crank folds for compact storage.



A pushbutton engages the gearing system and the lifting strap extends up to 12 feet.

it's powerful enough to lift or pull a quarter ton, yet it weighs only two pounds. Cranking the handle easily does the trick. Its small size permits working in tight quarters (as close as 10 in.) and it stores conveniently in a toolbox, glove compartment or pocket. It's available by mail from Lilze & Associates, 10669 Porto Court, San Diego, Calif. 92124 for \$39.98 postpaid.—H.W.

Know your wires

Identifying wires is quick and easy with AMP Wire Markers. Each package contains a variety of peel-off tabs backed with pressure-sensitive adhesive. They can help out in such jobs as identifying the maze of wires behind stereo components. They're also good for keeping track of home wiring circuits when adding to, or changing, the system. Each package costs about \$8 at electrical supply houses only. They're made by AMP



Deck of markers includes numbers, letters and abbreviations for current polarity.



The pressure-sensitive adhesive bonds fast when tab ends are pressed together.

Special Industries, Valley Forge, Pa. 19482.—Rosario Capotosto

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The tool's squeeze handle drives a spring-loaded punch that does the nibble cutting.



The Nibbler cuts 16-gauge copper sheet, and it can perform equally well on plastic.

drill a $\frac{3}{16}$ -in. hole and insert the cutting tip. The tool costs \$8.45 and replacement punches are \$4.45 at hardware and electronic stores; from Adel Tool Co., 4640 Ronald St., Chicago, Ill. 60656.

—Rosario Capotosto

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

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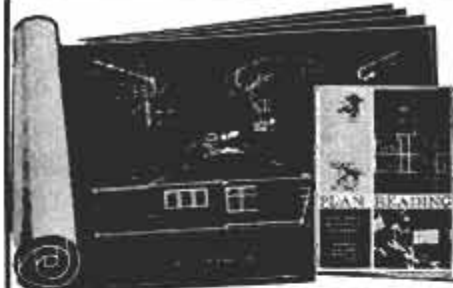
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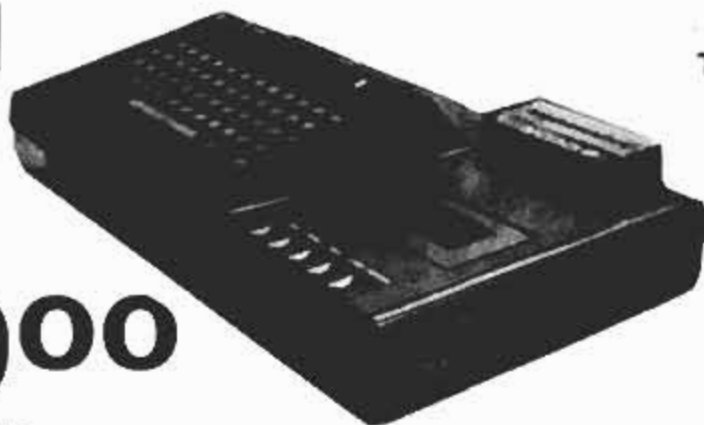
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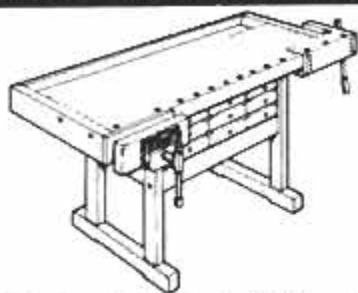
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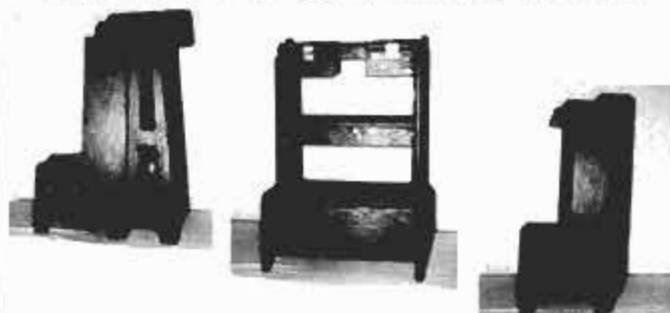
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MAKE DELICIOUS CHEESES in your own kitchen. Illustrated CATALOG \$1.00. (Refundable). CHEESEMAKING BOOK \$6.95. NEW ENGLAND CHEESEMAKING SUPPLY COMPANY, Main Street, Box 85PM, Ashfield, Massachusetts 01330.

SPINACH - Bats plus other recipes-\$2.00. Judy's, Box 4366, London, Ontario, Canada

TEXAS Original Bar-B-Q Sauce Recipes, \$2.00. Box 10231, Austin, Texas 78766

HOME WINEMAKER BOOKLET Simple illustrated procedure for small quantities. Common household equipment. 20¢ to 75¢ per bottle. Dry or Sweet, your preference. Red, White, Rose from Grapes, Fruit, Berries. \$6. Postpaid. Weinhaus, Dept. PM-1, Box 623, Cedar Falls, IA 50613

WINE/BEERMAKING -- HOMEFOOD PROCESSING Equipment & Supplies -- Free Catalog. Pantry Shelf, P.O. Box 7678, Tyler, TX 75711

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FINEST Equipment! Save! FREE CATALOG! AAS, 185-B Oxmoor Road, Birmingham, AL 35209

BURGLAR PROOF YOUR WINDOWS FOR UNDER \$4.00 -- Send \$3.98 for instructions SASE. J & R Enterprises, P.O. Box 111, Fayetteville, North Carolina 28301

"LIGHTED" ADDRESS FIXTURE 24 hr. Protection Sale. Low Voltage. Free Brochure. Trinitite, Box 182PM, Sikeston, Missouri 63801

BURGLAR/FIRE ALARMS. Send 25¢ for information. Multisystems, Box 80331, Baton Rouge, Louisiana 70896

PROTECT The Valuables In Your Garage! Automatic Door Closer Added to Your Garage Door Opener, Reduces Exposure To Theft. Send \$5.00 For Plans And Complete Information. THE Enterprises, 4444 Arden View Court, Dept M, St. Paul, Minnesota 55112

STOP BURGLARS BEFORE they enter your home

Protect your family with this new micro-computer burglar alarm "FREE" for 30 days.

Burglars seek easy targets. Few have the daring or the knowledge to challenge the new Perim-A-Tron™ Home Security System. No other burglar alarm under \$2,000 can give you more protection...or match it for features that will give you and your family safety and peace of mind. For starters, it is wireless, installs in minutes, and is portable should you ever move.

THE BRAIN VS. THE BURGLAR

Perim-A-Tron's™ central console, or "BRAIN", employs a microprocessor, making it the most advanced security system available for consumer use. With Perim-A-Tron™ on duty, small sensors monitor doors and windows ready to signal the "Brain" from as far as 250 feet, in the event of a break-in attempt. The "Brain" processes each signal instantaneously and sounds not only a self-contained 85db internal alarm, but also a second 95db remote siren to augment the inside alarm or for placement outside to alert neighbors and police.

The Perim-A-Tron™ is so easy to live with that pets can come and go through partly-open windows or sliding glass doors without triggering it, yet so vigilant that an intruder will set it off before he can enter.

THOUSANDS OF OPTIONS

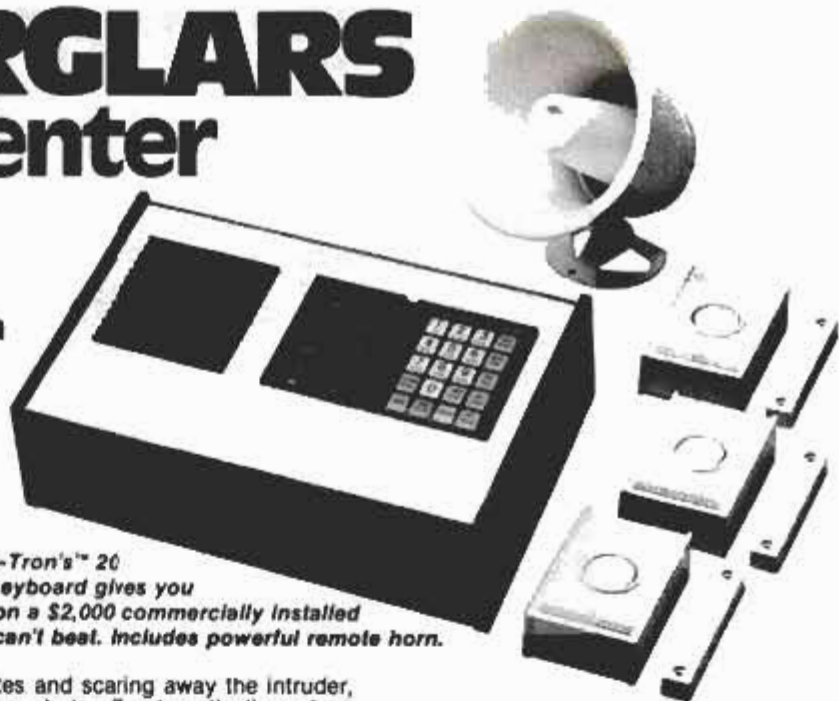
Perim-A-Tron's™ micro-computer lets you choose from thousands of three digit disarm codes. Only you know your code. But if your son's friend receives a "demonstration", you can easily change the code again...and again. You need no specially coded key which can be lost, misplaced, or stolen. The system even has two separate channels, each with its own distinct alarm sound. This feature allows you to zone your system. For example: Channel 1—house, Channel 2—garage, or Channel 1—doors, Channel 2—windows.

HOW IT WORKS

Operating the system is simplicity itself. When leaving, a light on the console tells you that you've armed the system properly, and have from 5 to 45 seconds to leave the house. This variable delay feature, not found on some expensive commercial systems, is selective so that it can apply only to frequently used doors. All other openings would be set for instant alarm. Upon returning home, you have ample time to turn the system off, thereby avoiding a false alarm.

If a break-in attempt occurs while you're away, an alarm memory light on the console tells you so. What's more, after sounding for

This photo shows a transmitter & magnet installed. If a break-in attempt occurs, separating the two, the transmitter sends a signal to the console which sounds an alarm to scare away the burglar. Installation takes only a few moments & doesn't even require a screwdriver.



Perim-A-Tron's™ 20 button keyboard gives you protection a \$2,000 commercially installed system can't beat. Includes powerful remote horn.

10 minutes and scaring away the intruder, the system shuts off automatically and re-sets itself.

A CONSTANT GUARDIAN

Leave Perim-A-Tron™ in Test Mode during the day and it will signal when anyone leaves or enters. This thoughtful signal will not operate the remote horn but gives a 2½ second warning on the internal speaker only.

If power fails (or is cut-off), the console has a battery back-up. And each battery powered transmitter/sensor will signal at the console if the battery runs low.

The Perim-A-Tron™ system is highly resistant to false alarms because it is not sensitive to motion or sound. Pets can roam at will, curtains can blow in a breeze, you or your children can visit the kitchen for a midnight snack—all without setting off an alarm.

COMING HOME SAFELY

There is nothing more frightening than finding a prowler lurking near your house when you arrive home at night. Our system's EXTRA PROTECTION DESIGN lets you carry a transmitter in your pocket, purse or glove compartment (it's about the size of a cigarette pack). With simple modification, it serves as a PANIC device and will set off the alarm at the press of a button.

COMPARE IT

Hard-wired "commercial" burglar alarms can cost \$2,000 PLUS a monthly fee (and you still never own it). Motion and sound detectors cost up to \$200 per unit and cover only limited areas. Your home may require two or three of these units and, in most cases, no alarm will sound until AFTER a prowler is inside for 30 seconds or more. Perim-A-Tron™ combines pre-entry protection with micro-electronic circuitry to provide the most protection at the lowest cost.

U.L. APPROVED

The Perim-A-Tron™ Home Security System is listed by Underwriters Laboratories as a burglary protection device, a rating which goes beyond electrical safety. To earn this listing our alarm was thoroughly tested for critical burglary protection functions such as transmitter range, sound volume, battery back-up, keyboard component life, battery failure warning, and test function. This tough-to-get U.L. listing resulted from the exacting standards engineered into the Perim-A-Tron™.

YOU BE THE JUDGE

We urge you to order just the basic Perim-A-Tron™ system (pictured above) for a 30-day trial period. Use it to protect your family while you sleep and to protect your home while you're away. Then if you're not convinced that the Perim-A-Tron™ is the most advanced, efficient security system available today, return it undamaged for a complete, no-quibble refund—including return postage. You are protected by a 90 day manufacturer's warranty as well as Shelburne's 25 year reputation for satisfied customers.

HERE'S HOW TO ORDER

To order simply send your check for \$224.95 plus \$5.65 for shipping and handling to the address below. Credit card holders can speed delivery of their system by using our toll-free number listed below. We will then promptly ship your Perim-A-Tron™ complete with remote horn, easy-to-understand instructions and decals warning that the premises are protected. Additional transmitters are available for \$29.95 each, but one is not required for every door and window. Instead, magnetic contacts can be purchased and easily connected to the transmitter, allowing you to cover additional openings for as little as \$5 each. The instruction booklet is quite useful in helping you determine the correct combinations to protect your home or office at the lowest possible cost.

Give yourself some peace of mind—order a Perim-A-Tron™ today at no obligation.

Maryland Residents add 5% Sales Tax.

CREDIT CARD HOLDERS

CALL TOLL-FREE:

800-638-6170

from 9am-5pm EST Mon.-Fri.

Maryland Residents Call 363-4304

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