

AUGUST 1982 \$1.50

Popular Mechanics

**PLANS: Build
This Air-Cooled
Harvest Cellar**

COBRA: WORLD'S HOTTEST KIT CAR

**Surest Ways To
Burglarproof
Your Car**

**How 5 Presidents
Hid Bugs In The
Oval Office**

**PLANS: Make 4
Timesaver Tools
For Your Shop**

**PM's Pick of
Great Knives:
Buy Or Make 'em
Yourself**

**New Computers
You Carry
In A Pocket**

**New Satellite Watch
For That Coming
Killer Hurricane**



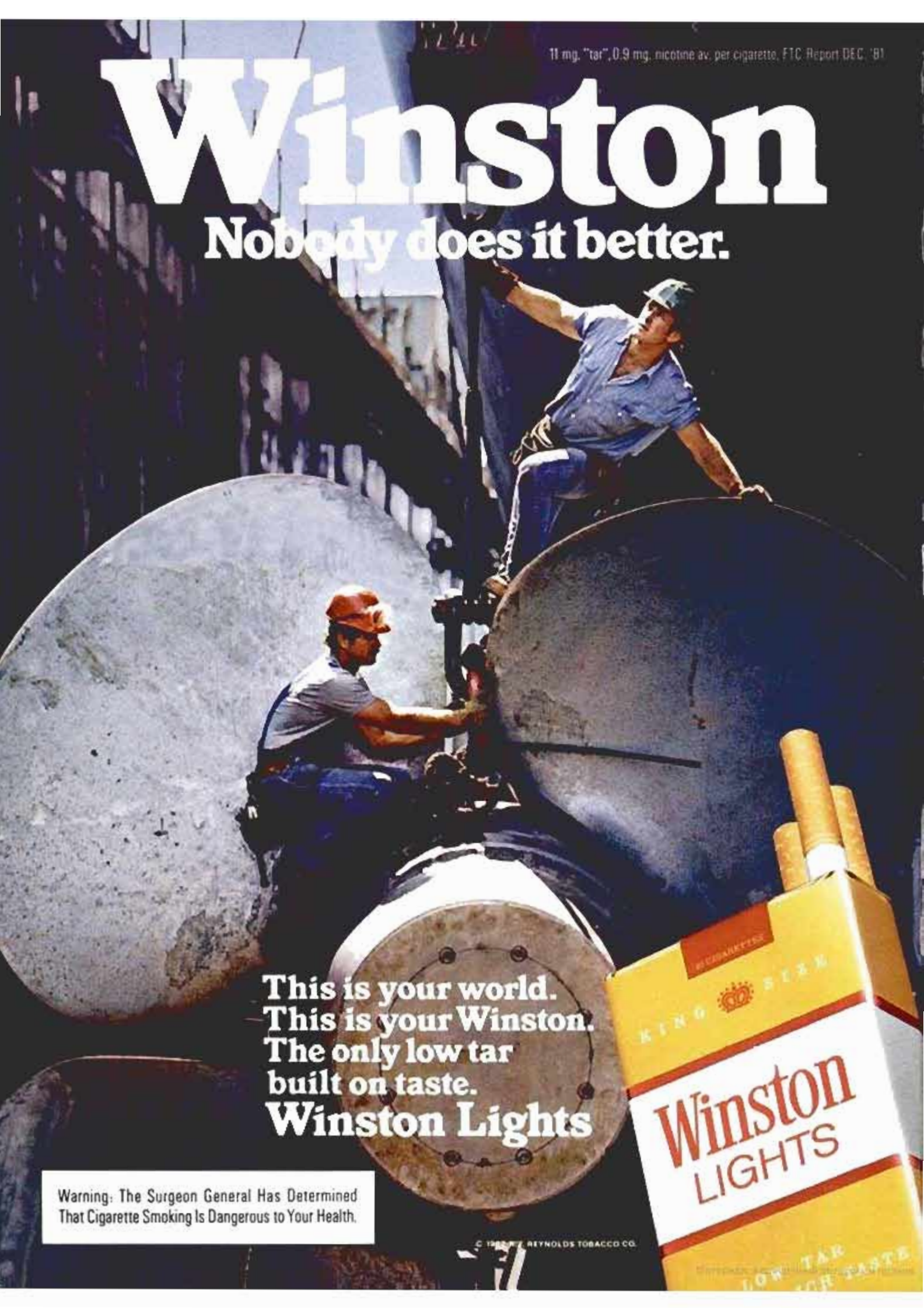
Kit-built replicas of the classic Cobra sweep around Lime Rock in PM's drive test.



11 mg. "tar", 0.9 mg. nicotine av. per cigarette, FTC Report DEC. '81

Winston

Nobody does it better.

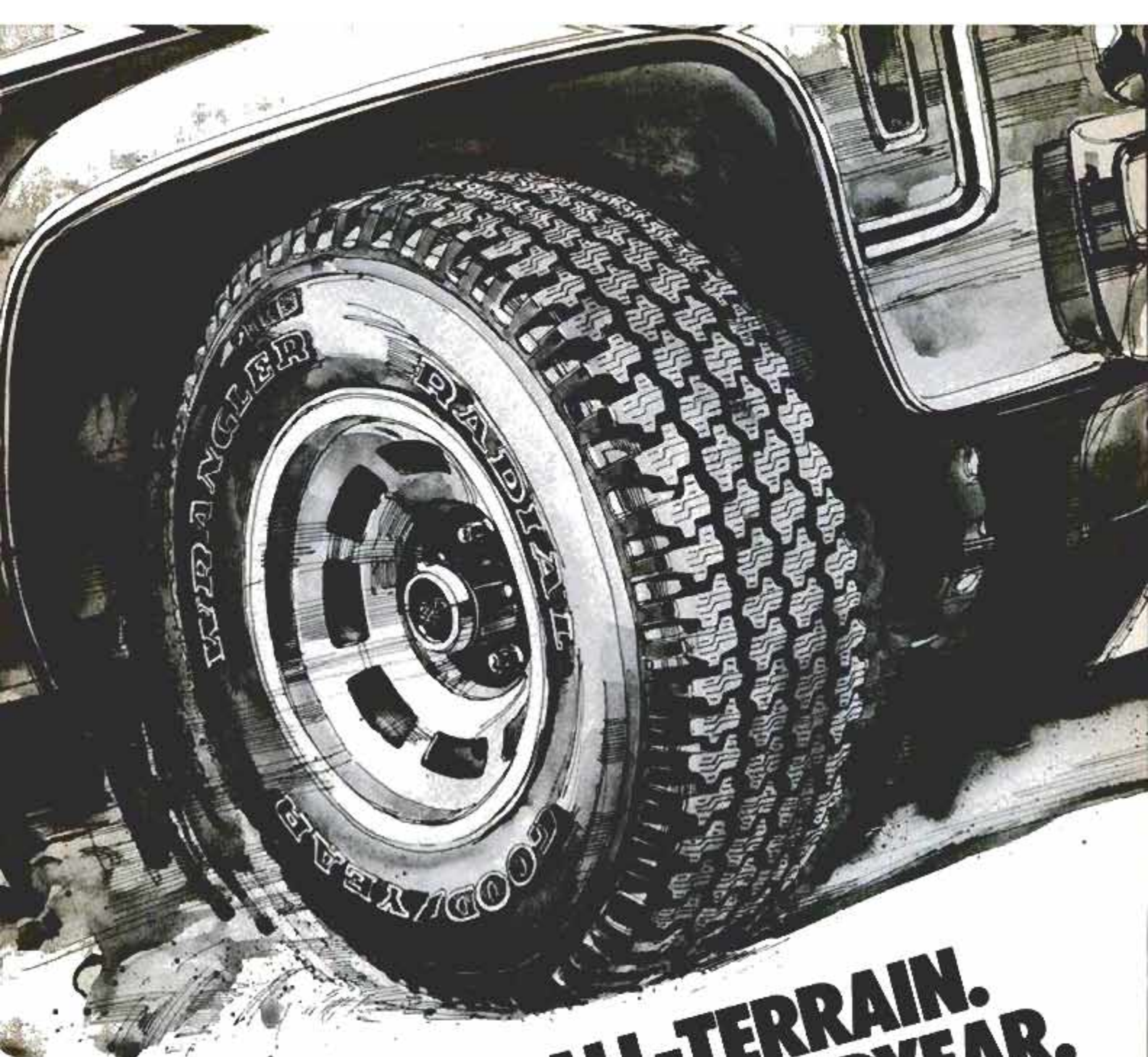


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Warning: The Surgeon General Has Determined
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On the cover

In classic echelon, three different kit versions of the now ultracult Shelby Cobra car race along at Lime Rock track during PM test. The story on page 74 tells why Cobra kits got so hot and compares them to the original item.

—PM photo by Rich Taylor

Popular[®] Mechanics

AUGUST 1982

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when the load's
a hare too big
for your Rabbit?



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The new Coleman Caboose lets your quick little car
carry like a wagon.

The Caboose
is light, lithe and
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Just the ticket for

your luggage
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Spangler, Conrad M. Stowers, Steven Wilson,
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Editorial Production: Peter Easton, chief; John
Bostonian Jr., art; Shannon K. Kelley, Steven C.
Fox, assistants

Art: Don Mannes, technical art director; Douglas
Quinn, Alan Andresen, assistants

Special Publications: Clifford B. Hicks

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Advertising Manager
Frank P. Camastro

Advertising Offices:

New York: 224 West 57th St., New York, N.Y.
10019; (212) 262-7280

Chicago: 520 North Michigan Ave., Chicago, Ill.
60611; (312) 527-2400

Detroit: 377 Fisher Rd., Grosse Pointe, Mich.
48230; (313) 881-3520

Cleveland: PDC Building, 3659 Green Rd., Cleve-
land, Ohio 44122; (216) 292-7334

Los Angeles: 460 East Carson Plaza Dr., Carson,
Calif. 90746; (213) 532-8101

Production Manager: Ronald Tuosto

Advertising Production: Patricia Woods
(212) 262-4800

Classified Advertising Manager: H. E. Kappel
(212) 262-4825

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President

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President, Magazines Division

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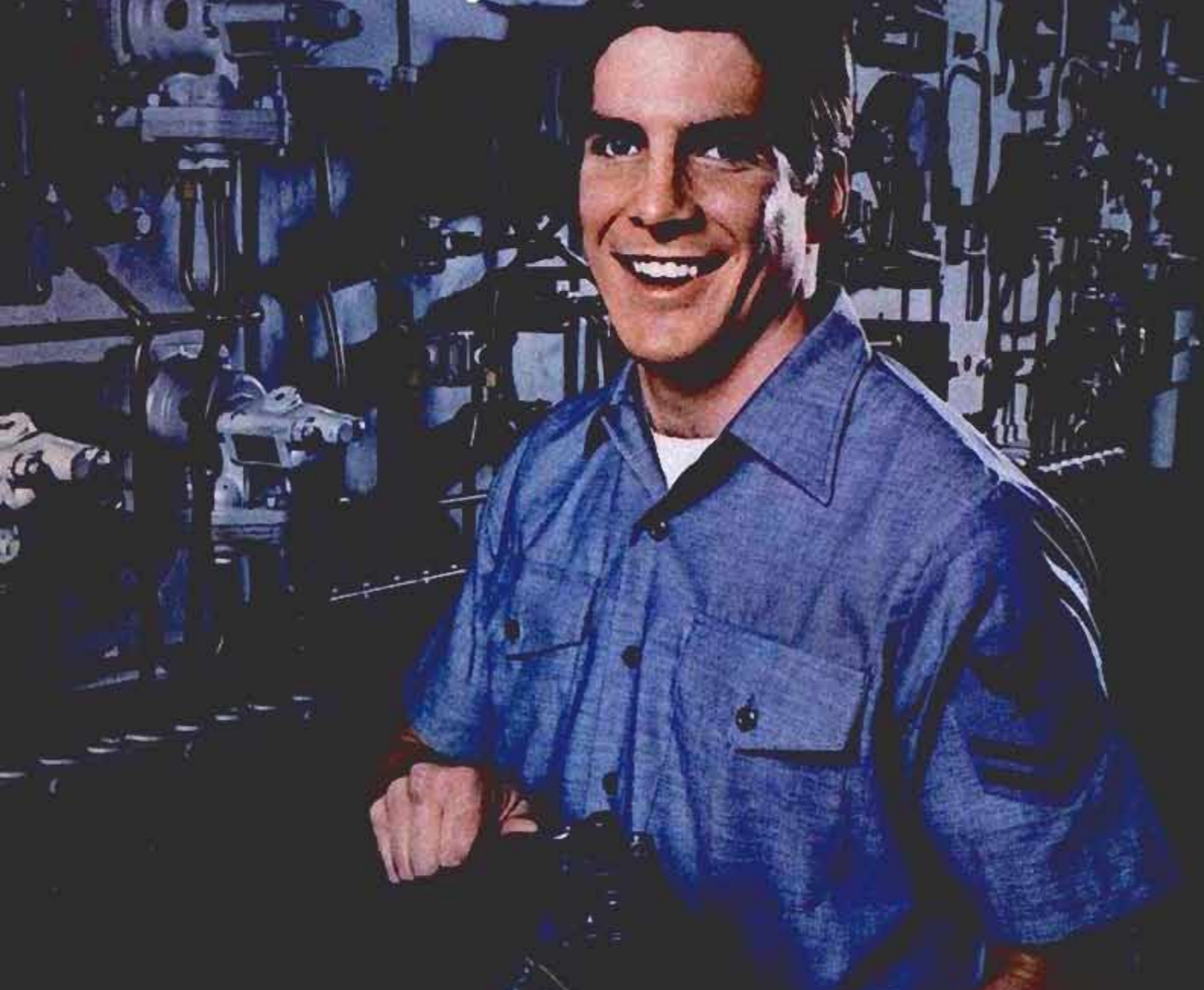
Daniel J. Coleman

Publishing Consultant

Richard E. Deems

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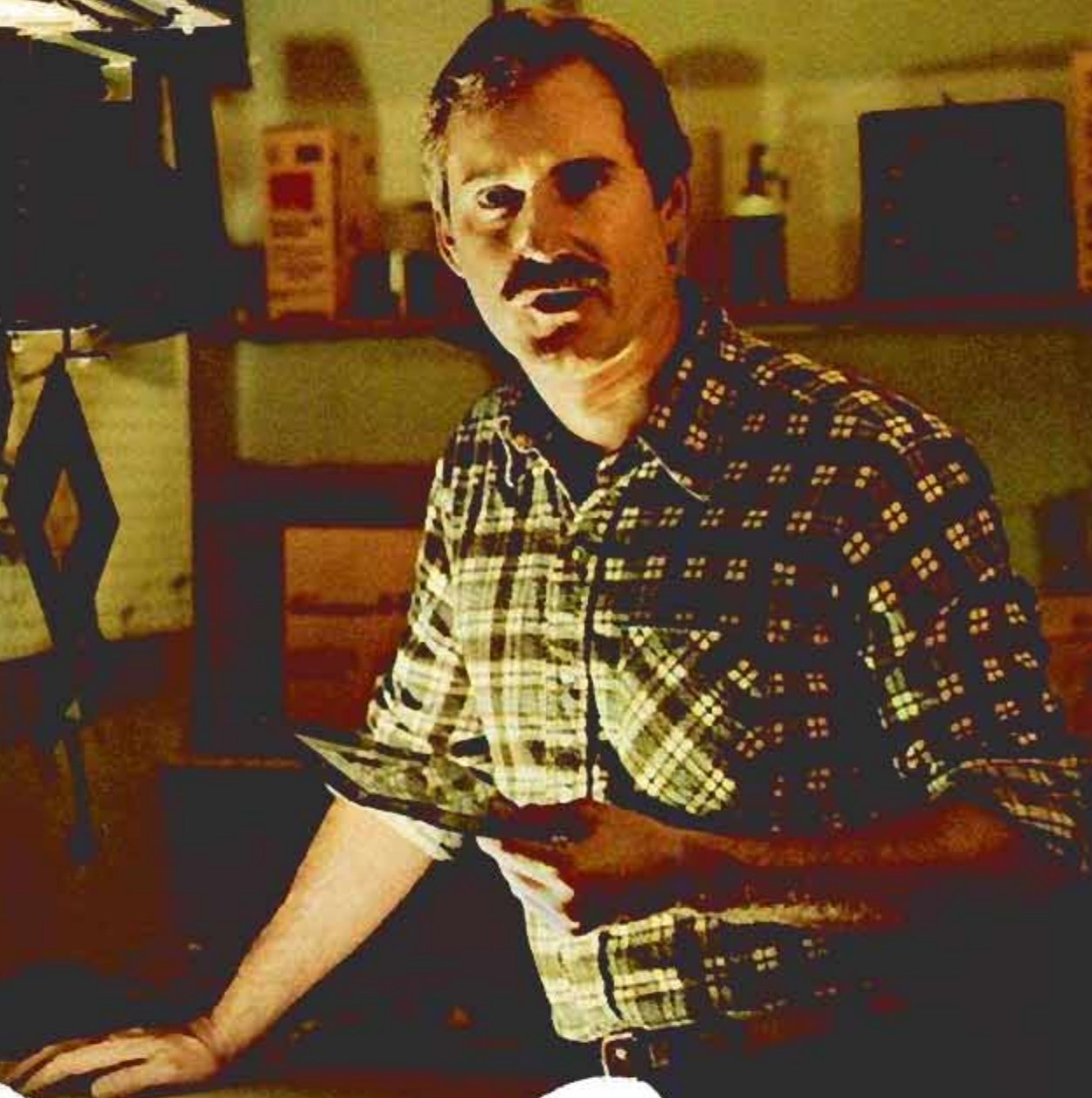
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work on my car.**



Mr. Good

**But I want the same kind of careful
work I'd do myself.**



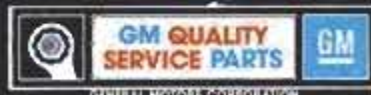
Professional workmanship makes a difference . . . even on small jobs. That's why I take my GM car to Mr. Goodwrench. He has the right tools. He has the right training—GM training. And he has the right parts available—genuine GM parts.

Mr. Goodwrench is committed to reasonable prices—he has pledged to be competitive with other mechanics I could go to around here. And he even offers while-you-wait quick service on many popular service jobs. I'm in and out in a jiffy!

So keep that great GM feeling with genuine GM parts at participating independent Mr. Goodwrench dealers selling Chevrolets, Pontiacs, Oldsmobiles, Buicks, Cadillacs, GMC and Chevy trucks.



Mr. Goodwrench



IMPORTS & MOTORSPORTS

Future Jags

I bet Jag's bag of tricks for its future cars won't affect sales of the sensuous XJ6 and XJS models, which are breaking all sales records this year. In a month or two, Series III sedans will quietly become 1983 models, with very slight changes, but around mid-'83 we'll see an open version of the XJS coupe. At this point, we can only wonder how closely it will resemble Pininfarina's XJS idea car of a couple years ago (see *Return Of The Roadster*, page 62, July '79). Later in '83 we'll get an '84 model XJ sedan with turbodiesel engine. How will twin-cam fans greet that? For '85, Jaguar will have a smaller, lighter new sedan, the XJ40.

Keep on dieselin'

Are all those pastel-colored cars horning in on your diesel pump—is that what's bothering you, trucker? Well, get on line; more are coming. Now you even hear the diesel clatter at the track: A Peugeot 505 Turbodiesel is being campaigned in the



Turbodiesel Peugeot rallies with 100 hp.

Sports Car Club of America (SCCA) Pro Rally Series. Driver Gary Eaton has tricked it for more hp, but finds the flat torque curve the biggest advantage for pulling power in unpredictable off-road conditions.

Over at VW, the '83 lineup, soon to be introduced, will include a heavy emphasis on diesel power. Already available is a mid-'82 intro of an optional, economy automatic transmission for diesel Rabbits and Jettas. With the shift lever in the "E" position of the automatic (between N and D), there is no transmission braking effect.



VW has new automatic tranny for its diesels.



Down the road for Jaguar is a sedan with subtle evolution of current Series III styling.

VW compares it to coasting when you stop pedaling a 10-speed bike. With the E-Automatic, the Rabbit and Jetta are the most fuel-efficient automatic transmission cars sold: 37 mpg city and 47 highway.

We tried out another VW recently: the diesel Vanagon. The seven-passenger living room on wheels took us from New York to Florida and back (2,782 miles) on \$125.21 worth of fuel. The 105 gallons we used averaged \$1.20 a gallon this past March, and our average mpg was 26.5.

Nice surprises department

Even before we get behind the wheel of the many cars we drive each year, we know what they'll be like (you get to know a manufacturer's approach to his cars). In the case of the Renault Fuego, however, I had no hint; in fact, it wasn't even on my list of cars that I wanted to try. I saw lots of Fuegos in France, and regarded them as so weirdly French that I couldn't imagine them on the road here.



Fuego power option is 1.6-liter turbo Four.

Well, the Fuego is here, and when I had a chance to drive the turbo model, it surprised me on two counts. The first was finding out how much I enjoyed this car, and the second was how everyone—from greasers to proverbial little old ladies—stopped and stared. And I thought it appealed only to French boulevardiers! The interior is luxurious, comfortable and versatile. Split rear seats fold to load things from the

wide hatch. Front seats have seat-back adjustment wheels at the inside and outside of the seat—a thoughtful touch. And the car is a ball to drive—fast, smooth and predictable, with the five-speed gearbox adding economy to its virtues. Set up the way you might like it, the Fuego could cost \$11,000, but it's still a heck of a value.

European Ford

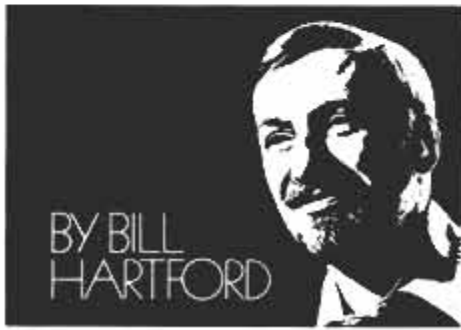


Sierra coupe is a two-door with hatchback.

Ford of Europe is replacing its Taunus with an all-new, mid-size car, named Sierra, which will be introduced next month in Paris. The unusual styling is evident on the coupe above. Other models include a four-door (also with hatch) and a station wagon. We could get the Sierra here, and variations on its styling will surely appear on other Fords.

Three bright wagons

If you want a station wagon with a factory sunroof, choices are limited to the Maxima, Quantum and 300TD: Let's hear it for Datsun, VW and Mercedes, sunworshippers! **PM**



BY BILL HARTFORD



Come to
**Marlboro
Country.**



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

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

Kings: 16 mg "tar," 1.0 mg nicotine—100's: 16 mg "tar,"
1.1 mg nicotine av. per cigarette, FTC Report Dec '81

It's times like this you've got a Wagner

3 mins.

We painted a shutter
in 3 minutes
with a Wagner
Power Painter.
It took us
22 minutes
with a brush.

6½ hrs.

We painted this house in 6½ hours
with a Wagner Power Painter.
It took us 17 hours with a brush.
Both were done excluding trim.

4½ mins.

We painted this wicker
chair in 4½ minutes
with a Wagner Power
Painter. It took us 1
hour with a brush.

21 mins.

We painted an eight-foot
section of this fence
in 21 minutes with a
Wagner Power Painter.
It took us 1 hour and
20 minutes with a brush.



that'll make you glad Power Painter.

Every once in a while you come across a product that offers significant advantages over a tried-and-true method of doing things.

In the case of painting, consider a Wagner Power Painter, instead of a brush.

A Wagner Power Painter's speed should quickly make a believer out of you. Just among the examples we've shown, the time saved is astonishing.

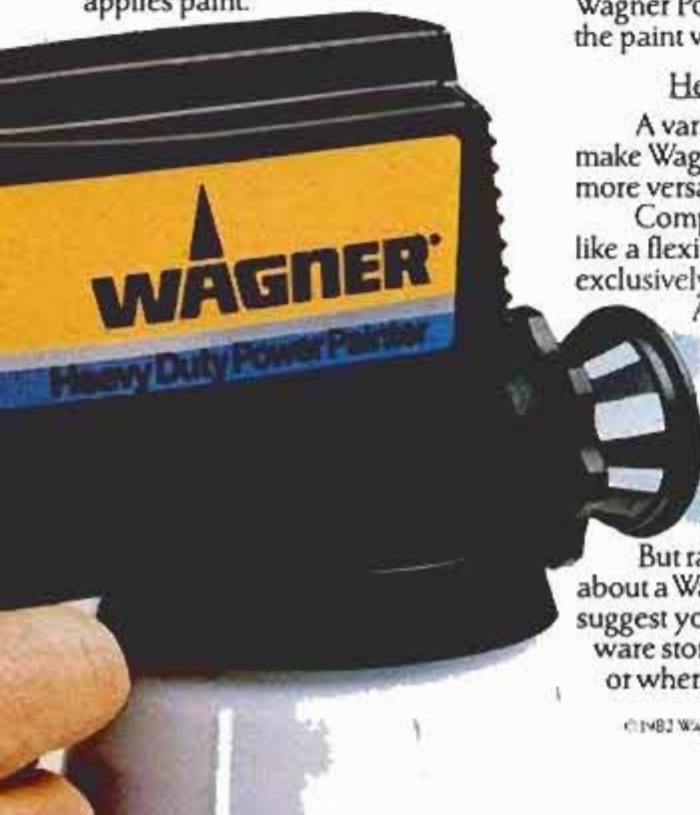
And a Wagner Power Painter is ideal for dozens of other painting chores around the house.

Professional-looking results made easier

Of course, speed isn't a Wagner Power Painter's only long suit.

A Wagner Power Painter also makes it remarkably easy to achieve professional-looking results—the spray lays down a smooth, even finish with no brush marks.

And when it comes to intricate painting jobs like wrought iron railings, louvered doors and bicycles, it's amazing the way a Wagner Power Painter reaches into crevices and applies paint.



That's also why a Wagner Power Painter is so effective on rough, textured surfaces like shake shingles.

Spray paints, lacquers, stains, varnishes, and more

Virtually any kind of latex or oil-based paint is compatible with a Wagner Power Painter.

It can also apply stains, varnishes and lacquers. Or spray almost any other liquid, even pesticides.

So a Wagner Power Painter is a lot more than just a "one project" tool.

And cleanup is simple—just run the appropriate solvent through until it's clean.

No air compressor

The secret to a Wagner Power Painter is a precision electric, piston-driven pump.

It creates a pressure that propels liquid out through the tip, which then forms the spray.

There's no bulky air compressor to lug around. And significantly reduced "fogging" that usually accompanies painting with compressor-powered sprayers because a Wagner Power Painter doesn't mix the paint with air.

Helpful attachments

A variety of helpful attachments make Wagner Power Painters even more versatile.

Complete outfits include things like a flexible spray tip designed exclusively for floors and ceilings.

And a tube that replaces the reservoir, so you can draw paint right from the can.

You can even get an optional spray tip that narrows the spray for precision painting.

But rather than simply reading about a Wagner Power Painter, we suggest you visit your local hardware store, paint store, home center or wherever quality paints are sold.



Then ask to examine a Wagner Power Painter first-hand.

Whether you're painting your '57 Chevy or the broad side of a barn, you'll discover there's a Wagner Power Painter that's just right for you.

And we think you'll also discover it's high time you owned one.



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Minneapolis, MN 55441

Please send your free "How to..." brochures to help me learn more about painting with a Wagner Power Painter.

Name _____

Address _____

City _____

State _____ Zip _____

Allow 4-6 weeks for delivery

PM-21

WAGNER

The Right Tool for Painting.

LETTERS TO THE EDITOR

Solar ballooning heats up

I enjoyed your article *Now We're Ballooning On Solar Power* (page 100, Apr. '82). However, the British balloon of Don Cameron was definitely *not* the first solar-powered design. In 1978, Frederick Eshoo successfully flew his Sunstat, a true solar-powered balloon. And way back in 1973, Tracy Barnes flew his Solar FireFly.

I don't think it's fair to ignore the pioneering efforts these people have made in behalf of solar ballooning.

RUTH F. SALZBERG
ALADDIN BALLOON
WEST HARTFORD, CONN.

Your point is well taken. We did refer to the even earlier work of Lee Ashman in the mid-'60s, and perhaps we should have mentioned the Barnes and Eshoo flights also. But they were of short duration. The British balloon was notable for its record-breaking crossing of the English Channel—a feat that may have somewhat overshadowed the worthy efforts of others.

Keeping fit with PM's help

Your article *Physical Fitness And The Machine Age* (page 91, May '82) was very interesting. It alluded to the many myths that are perpetuated by the apparatus industry to promote their equipment. Unfortunately, the general public does not fully understand the capabilities of such machines and, hence, must rely on advertisements that, at times, can be misleading.

Articles such as yours help to promote a healthier lifestyle for people and are welcomed by health professionals.

HAROLD STAPLES, Ph.D.
KINESIOLOGIST
ST. THOMAS ADULT REHABILITATION
AND TRAINING CENTRE
ST. THOMAS, ONT.

Crowning achievement

I was very interested in your article on new ceramic dental crowns (*Science Worldwide*, page 10, Apr. '82). How can I get more information about this new material?

BRIAN D. HOWARD
BRANCY DENTAL LABORATORY
SEBRING, FLA.

A number of readers wrote in to ask about this development. Further information can be obtained by writing

to Rosemary Templin, Coors Biomedical, Suite 210, West Cedar Dr., Lakewood, Colo. 80228.

PM bike cart takes a trip

Here in Iowa we have a yearly bicycle event called the RAGBRAI (Register's Annual Great Bike Ride Across Iowa). It's a 500-mile tour of the state, and we wanted to take our young daughter along with us. After pricing commercial bike trailers, I remembered your plans for a home-



PM's bike cart built by reader McCleary for his 4-year-old daughter. Added "fenders" help shield wheel spokes.

made version (*Bicycle Cart*, page 132, May '80).

The enclosed photo (above) shows the results. Because our daughter was only 4 years old, I extended the sides up and out to form "fenders" over the wheels. These prevent any chance of small fingers getting caught in the spokes.

The cart worked out fine and cost less than a third as much as a manufactured trailer. We got many comments on it along the way and were happy to tell everyone it was made from PM plans.

MELVIN McCLEARY
CEDAR FALLS, IOWA

Thanks for letting us know. For others who may be interested, photocopies of the cart plans are available for 25 cents from *Popular Mechanics*, Box 1014, Radio City Station, New York, N.Y. 10101.

How not to get zapped

In your article *10 Tips For Home Computer Care And Repair* (page 112, Apr. '82), you correctly point out that static electricity can erase a computer's memory and damage delicate ICs. Why, then, do you tell readers to poke around their computers' innards without the protection of an electrostatic discharge

(ESD) grounding strap? This inexpensive wrist strap, connected to the equipment's frame ground, keeps its wearer and what he's working on at the same potential, eliminating any chance of an ESD zapping the components.

WILLIAM P. YEHLE
NEW BERLIN, WIS.

Electronics editor Neil Shapiro replies: If you're handling entire circuit boards and not individual ICs, the normal rule is that a grounding strap is not required because the pins are connected by circuit traces and other components. RAM chips, such as we were talking about, are rarely subject to ESD damage. A grounding strap is needed only if you're working with sensitive ICs such as CPU chips.

If you do use a wrist strap, however, do not ground it to the equipment frame. You could get zapped yourself if the ground fails with the equipment plugged in. Instead, you should connect the strap to an independent ground (such as the screw in a wall outlet) and make sure that the equipment is unplugged.

It's easy when you know how

Your article *How To Repair And Reshingle Your Roof* (page 130, Apr. '82) was extremely informative and easy to understand. It opened up a whole new area of technical expertise that was thoroughly unfamiliar to me.

SAM LANDAU
WOODMERE, N.Y.

As a manufacturer of clay roofing tile, I found the article well written and enjoyable, but there was one discrepancy I feel should be brought to your readers' attention. You listed the cost of clay tile as \$190 to \$205 a square.

This is misleading and might turn cost-conscious readers away from this fine product. Our current cost range is \$91 to \$155 per square, and other West Coast tile makers may quote even lower prices.

GARY CRAYCROFT
CRAYCROFT BRICK CO.
FRESNO, CALIF.

Our prices were obtained from reliable industry sources, but we are glad to learn that such roofing may be available in some areas for less than what we stated.

PM

OH
WHAT
A
FEELING!



TOYOTA

A TWO SEAT SPORTS CAR WITH A 7-FOOT TRUNK.

THE 1982 SR5 SPORT TRUCK. Two-seat sports cars are fine...if all you travel with is driving gloves and sunglasses.

But if you like to bring your toys when you go places, take this two-seat sports machine.

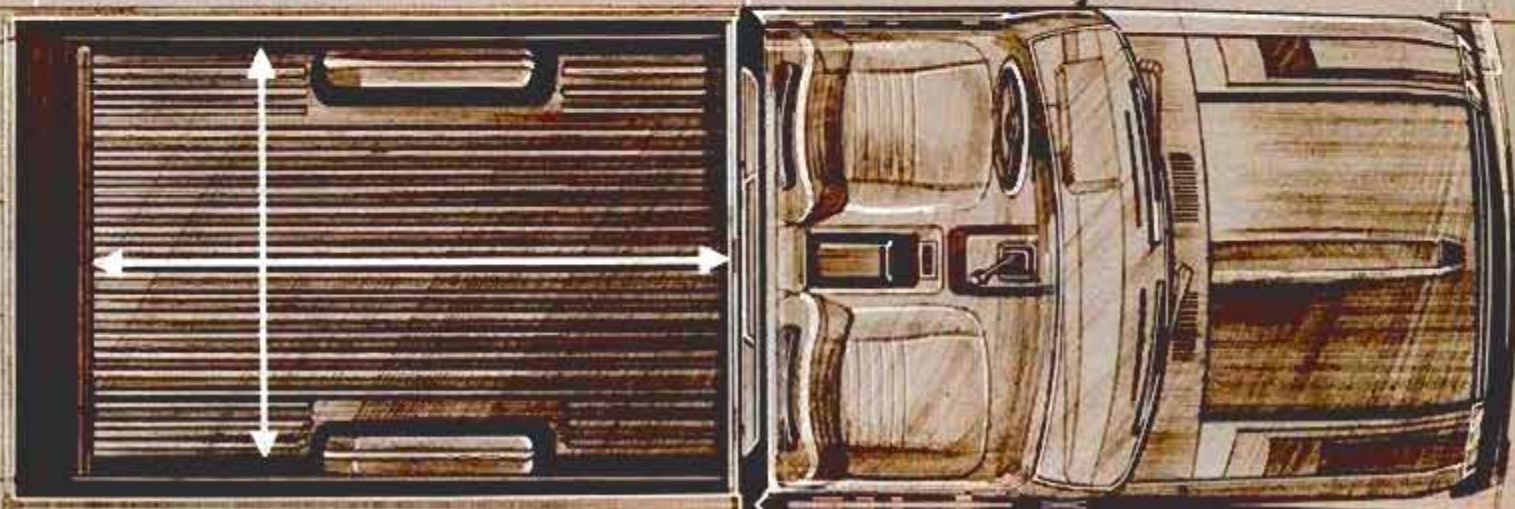
Its 7-foot trunk holds a dirt bike, a snowmobile...almost any payload up to 1100 pounds.

And inside, the Toyota SR5 Long Bed Sport Truck really is outfitted like a sports car. With bucket seats. Big, blacked-out gauges. Even an AM/FM/MPX stereo radio. All standard.

Start the 2.4 liter 4-cylinder overhead cam engine and the sports car feeling gets even better. You've got power-assisted disc brakes up front. A sporty 5-speed overdrive transmission. Or you can order Toyota's innovative 4-speed automatic overdrive.

And one more thing — mileage you wouldn't expect from a sports car! The Toyota SR5 is rated at 34 EPA Estimated Highway MPG. ⁽²⁴⁾EPA Estimated MPG. Remember: Compare this estimate to the EPA "Estimated MPG" of other small trucks. You may get different mileage, depending on how fast you drive, weather conditions, and trip length. Actual highway mileage will probably be less than the EPA "Highway Estimate."

The Toyota SR5 Sport Truck. It isn't hard to believe you really are in a sports car. Just don't look back!



ALL OUTDOORS

World's Fair fishing

Sportsmen heading for Knoxville, Tenn., this summer to see the Fair should pack along their fishing tackle. Within an hour's drive of the city are six lakes noted for their healthy largemouth, smallmouth and spotted bass. And there's a healthy payoff if you catch a big one: In addition to the Du Pont Marching Band that opens the Fair every day, Du Pont's monofilament division is sponsoring a Stren Fishing Line Big Bass Tournament. Prizes of \$1,000 in cash and \$1,500 in assorted tackle will be awarded to the Tennessee resident under 16 (no fishing license is necessary) who catches the biggest bass over three pounds. Equal prizes will go to a state resident over 16, and out-of-state fishermen over and under 16, with preliminary weekly and monthly awards, as well.

Information about the contest is available from local tackle shops, but no advance entry registration is necessary. Just take your lunger to any one of 10 lakeside marinas for weigh in, and when the Fair is over in October, the big winners will be announced. A day or so of fishing could be a rewarding change from days of touring displays of "Energy Turning the World of Tomorrow."

Better and brighter

The biggest and best energy news for outdoorsmen is arriving in very small, light and compact packages that were first perfected for the space program and moon landings. The key names are lithium batteries and rechargeable batteries.

Away from home and power lines, a camper must rely completely on the batteries in his flashlight and weather radio. When these fail, he can be in big trouble. Heat and cold will also seriously change battery output, as boatmen, skiers, photographers, divers, climbers and cave crawlers have discovered. There are few situations as discouraging as pausing to take pictures at the frigid peak of the mountain you've just climbed, clicking the camera shutter and getting no response.

But lithium batteries can practically ignore normal cold. An ordinary carbon-zinc flashlight battery has only 5 percent of its normal-temperature (70° F.) capacity when the thermometer sits at 20° F. and none at 20° below. And an alkaline retains just 15 percent at 20° F. and zero percent at -20°. A lithium cell, however,

keeps about 96 percent of its 70° F. capacity at 20° and 85 percent at -20° F.

And lithiums have a remarkable life span. The carbon-zinc and alkaline batteries may maintain at least 75 percent capacity for a year or two on a shelf or in your flashlight at 70° F., but the lithium should last 10 years. Under hot conditions (130° F.), figure a shelf life of one to two months for standard batteries, eight years for a lithium. Even when light



General Electric's rechargeable battery systems rejuvenate an Ikelite dive light or any unit using AA, C, D or 9-volt cells.

from a lithium finally starts to go—and this happens after 10 to 15 hours of use, not after one or two, as is generally the case with ordinary batteries—the light doesn't dim slowly. Instead, the lithium keeps its brightness almost until the end and then drops off rapidly.

This characteristic is particularly valuable in a camera. You don't need to wonder if the exposure meter readings are slowly going sour or if the electronic shutter is sagging and ruining pictures. Lithium's long life and reliability have been found to be invaluable indoors to safeguard the memories of computers. With these batteries, a utility power interruption won't kill huge programs or erase all the statistics stored in a computer data bank.

These energy cells are not cheap. The lithium battery for a flashlight costs about \$12 to \$20. But because it provides 3 volts instead of the usual 1.5, you use only one in place of two, and buy a dummy battery to fill the leftover space. Panasonic, a leading producer and the supplier of the "lifetime" lithium coin-sized batteries in Kodak's new disc cameras, makes lithium in flashlight cell sizes, models for cameras, watches

and the memory-backup systems for computers, and remarkable "paper" cells in sizes that look like a small business card or stick of chewing gum.

The Yak Works, Early Winters, Mountain Safety Research and Stow-A-Way Industries are among the retail mail-order sources that stock the new lithium cells.

General Electric also manufactures lithium cells for cameras, but of special interest to outdoorsmen are GE's rechargeable nickel cadmiums.

Home users of flashlights usually need one only occasionally, but the camper may rely on his hand-light or portable radio for hours every evening. Rechargeables that are about a dollar each can be the answer here, and can save the user money. Frequently, a camper is away from campgrounds with power lines for only a few days at a time, and can plug in his batteries for an overnight recharge on his return. GE's latest AA, C, D and 9-volt rechargeables don't suffer if left on charge an extra day, week or even year, and they can be recharged up to 1,000 times for only pennies a month in current.

For the outdoorsman, technology is shedding welcome new light.

Beating the heat

Sportsmen have learned much recently about the clothes to put on to keep warm, but there have been few studies on what to take off. Now, there is one, called *A Matter Of Degree*, by Lucy Kavalier and published by Harper & Row. The book gives valuable information on how to keep from being knocked out by the heat after a hike, a game of tennis or even a day at the beach. Experts predict that over 1,000 people will be killed by the heat this summer, because they won't know the precautions this author outlines. **PM**





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**NOTES
FROM THE
EDITOR**

John A. Sillitto

With more presidential tape recordings scheduled to be released to the public this summer, we got to wondering just what kind of equipment our Presidents installed to "bug" the Oval Office. After all, we reasoned, it's not the kind of thing you do with a Dictaphone. But it turned out we were wrong: One President (John F. Kennedy) *did* use a Dictaphone.

We also were surprised to learn that President Franklin D. Roosevelt employed an *optical* recorder to create a sound track much like that on Hollywood movies.

All the techniques are described in *The Bugging Of The White House* (page 71), by noted Washington columnist Jack Anderson and his associate, Bob Sherman.

Even those veteran Washington reporters found surprises while preparing the PM article. "I had never heard that Lyndon Johnson was such an electronics freak until I started researching this story," Sherman said. And Evelyn Lincoln, President Kennedy's secretary, "considered the taping system something personal between her and JFK," he went on. "She told me Kennedy didn't tape unless he told her to turn on the machines—even though he had the ability to do it himself."

Then there's the time Robert Kennedy foiled Johnson's tape recorders . . . but you'll have to read the story for that anecdote.

Want to play weather forecaster? Well, you can—sort of. This month's article on predicting killer hurricanes (page 65) tells you how to get the National Oceanic and Atmospheric Administration's hurricane tracking chart (page 103). You can get one at no charge—other than a self-addressed and stamped envelope. (The only other thing you need is a radio.)

It takes steady nerves to drive a 15-year-old sports car some 110 mph at Lime Rock. On the other hand, it takes some fortitude to *supply* PM's drivers with two such cars—especially when they're classic Cobras worth, together, about \$150,000. Ken Eber (photo), president of the Shelby American Automobile Club, is the brave person who did it for our article on Cobra "clones" (page 74). There were no mishaps, but a new surface on the track caused such pebble damage that both cars had to be extensively repainted. A true sportsman, Ken smiled through it all (while we winced). **PM**



Ken Eber alongside his restored Cobra 289 (left) and his original Cobra 427.

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PM ELECTRONICS MONITOR

Pocket guides

The TRS-80 Pocket Computer from Radio Shack has become very popular (see *Calculator Or Computer—Which Should You Pocket?*, page 68). About its only drawback has been the lack of prewritten software. It's not easy to cram a useful program into the little machine's 4K of programmable memory.

However, three new books from Micro Text Publications provide listings for various useful and entertaining programs. And all the pocket computerist has to do is type them in.

Pocket Computer Primer by Hank Librach uses the computer as an educational tool. To teach geography, there's a program called "747 Global Flight Planner." In this simulation, you chart a course from New York City to Hong Kong. You'll have to be familiar with geographic relationships of major cities so as not to get lost—especially when some of the airports close down due to political unrest! You can even learn something about ecology by typing in and running the program that simulates an environmental study of a gypsy moth population versus a wasp population. It offers a lot of learning—and a lot of fun.

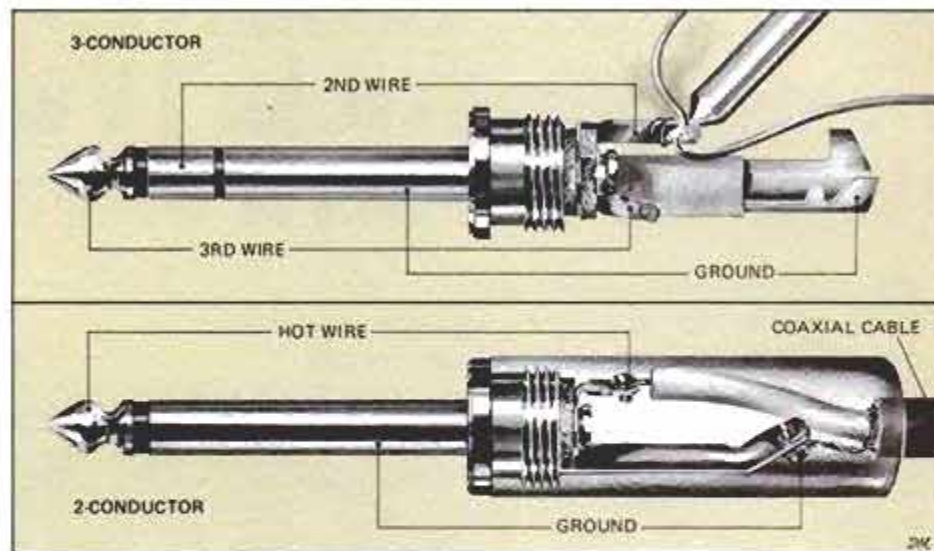
Then, there's *Pocket Magic* by Bill L. Behrendt, which features some very interesting games for the little computer. Many of the programs use a form of animated graphics to enliven the computer's one-line display capability. In "Dynamite!" for example, you can watch your fuse burn down as you set a charge to blow up a rock—without blowing yourself up in the process.

Rounding out the new line is *Science and Engineering Sourcebook* by Cass Lewart. Many mathematical and engineering programs are solved via pocket computing in this one. You can convert numbers from one base to another and find factorials, Gaussian deviations and the like.

The *Primer* and *Sourcebook* volumes are \$9.95 each; *Magic* is \$8.95. Check your bookstore or order postpaid from Micro Text Publications, One Lincoln Plaza, Suite 27C, New York, N.Y. 10023.

Low-cost printers

So you've just purchased one of the new, inexpensive home computers and now you're looking for a printer? If so, your mouth probably dropped when you realized that it could cost



Know your phone plugs

Quarter-inch phone plugs are available in two "flavors," as detailed above. The two-conductor plug is used for hooking up simple microphones, keying circuits and any two-wire application. Coaxial cable, for instance, is often used with the braid attached to the plug's

ground terminal. A three-conductor plug (sometimes called a "stereo" plug) has a ground terminal plus two other connection points. The drawing shows which terminal in each plug connects to which area of a phone plug's sectioned shaft.

\$600 to \$900 for a printer that attaches to your \$100 to \$300 computer.

There is a new company, however, which is offering some very attractive and low-priced printers. Alphacom is the company, and the printers range from \$175 to \$295.

We looked at the Alphacom 40, which is the top of the line. It's a 40-column, graphic-capable, thermal printer. Though it operates on the thermal principle (heat causes type to appear on specially treated paper), the paper looks the same as normal stock. The letters are of the dot-matrix variety, which means that the type is not of correspondence quality. But the price is right and the printer is fast: This quick little devil has a four-line-per-second output.

We think Alphacom's printers may be just what many people have been seeking.

Book source

If you're a radio enthusiast, you've probably often been disappointed in finding the latest books about shortwave and scanners from a local bookstore. Many of the best references in that hobby are put out by small publishers who don't have the distribution needed to make their publications widely available.

So, if you're looking for an out-of-print *Communications World* or a new *World Radio TV Handbook*,

maybe a *Callbook* or just about any book from any electronics publisher, you can be faced with a long—and often fruitless—hunt. We found a place, however, that offers one-stop mail-order convenience for the radio hobbyist.

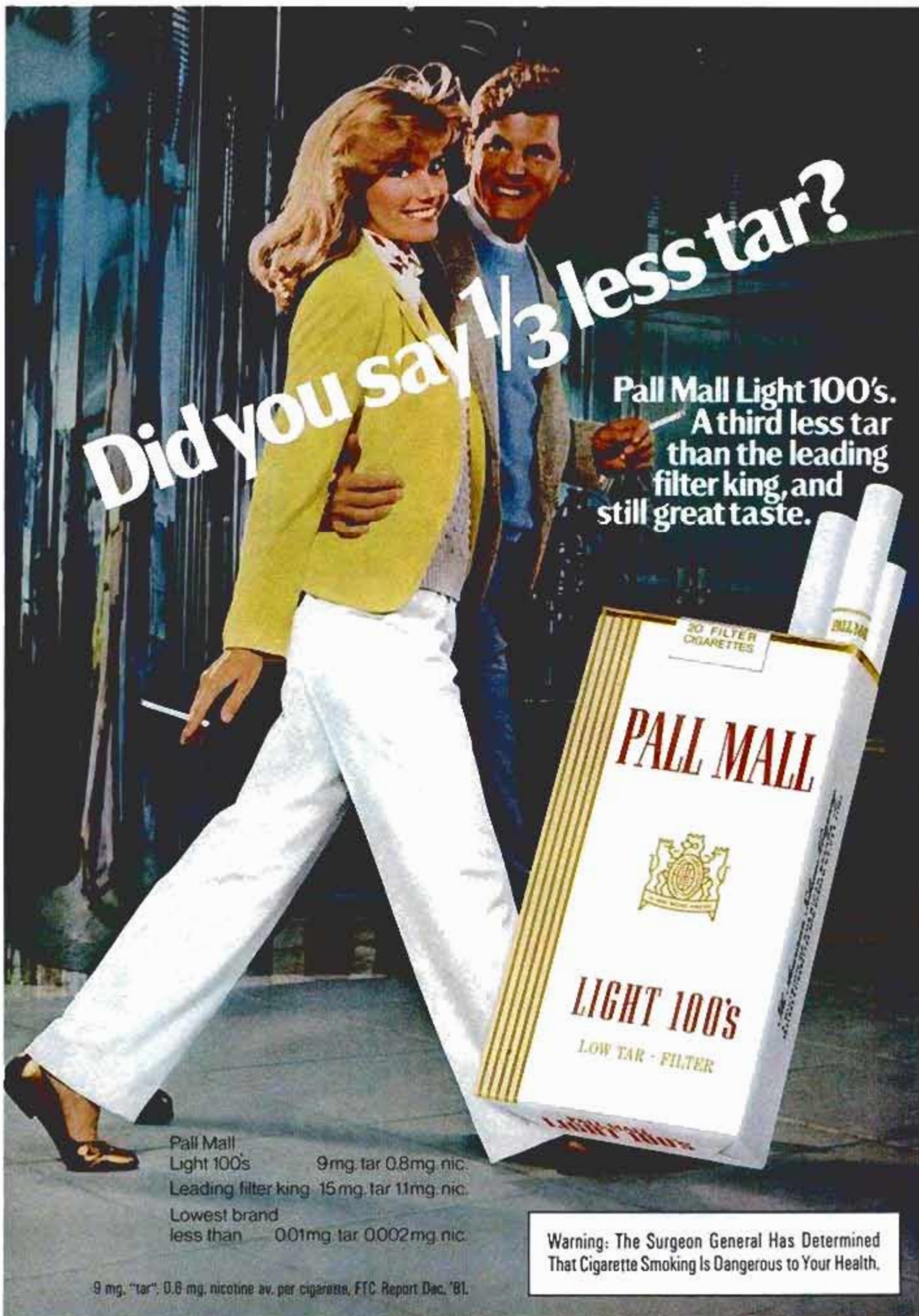
It's called the Century Print Shop and we believe that it is unique. It stocks just about every electronic publication that you can possibly think of.

SWL (shortwave listener) Don Erickson started the shop as a non-profit service, but it was such a success with electronic enthusiasts throughout the world that he decided to go commercial. He may be making a profit now, but he still has some of the lowest prices I have seen. Century will mail you a catalog if you send a legal-size, self-addressed envelope, carrying 37 cents postage. The address is: Century Print Shop, 6509 Essex St., Riverside, Calif. 92504. **PM**



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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

VW valve tool

To adjust the valves on water-cooled Volkswagen engines, you change valve shims to get the correct clearance. But you need a special tool to force down both tappets of a single cylinder for room to withdraw shims with magnet and pick. Another special tool is needed to compress the valve springs. I found that a single



Combination tool for water-cooled VWs helps adjust valves, compress springs.

tool from Lisle Corp. helped with both jobs. I used one end of the tool to force down the tappets. And I was able to compress the springs using the tool's two thin prongs. It's about \$20 from Lisle Corp., Clarinda, Iowa 51632.—T.A.

Radiator cap

Air in your car's cooling system contributes to corrosion, coolant foaming and radiator deterioration. While all radiator caps purge the system of air, I tried a new heat-resis-



Plastic radiator cap purges air from cooling system, won't warp, crack or corrode.

tant plastic cap that doesn't warp, crack, rust or corrode like some of its metal counterparts.

The cap uses an O-ring design that allows steam and superheated coolant to vent through the overflow tube when the cap is turned to the safety position.

Two different stock numbers fit most cars and light trucks. One is rated at 7-12 p.s.i. and the other at 13-17 p.s.i. The C.R.S. Cap sells for \$5 at most auto outlets. From Gila Products, 6615 West Boston St., Chandler, Ariz. 85224.—Joel Breault

Locking ratchet

There's a new twist in ratchet wrenches. This one fixes the problem of sockets popping off the wrench in the middle of a job.

I was able to lock sockets and extensions onto this ratchet by rotating the knurled release button. When I rotated the button back to its original position, the socket popped off when I pressed the button.



Sockets and extensions are locked onto ratchet and won't pop off until released.

Price of the ratchet ranges from \$16 for a 1/4-inch drive to \$21 for a 3/8-inch drive and \$27 for a 1/2-inch. They are sold under the Indestro and Duro-Chrome names, and you'll find them in discount and auto parts stores. The manufacturer is Duro Metal Products Co., 2649 Kildare Ave., Chicago, Ill. 60639.—T.A.

Flexible funnel

Finding those buried engine and automatic transmission oil filler tubes is one thing. Getting oil into them without spilling any is another. Then there's the problem of what to do with the oilcan when you only use part of the contents.

I found an inexpensive solution to all of the above problems with the Sealbest Flex-N-Fill funnel.

A built-in puncture blade pierced and held the can while I poured the oil. A cover cap sealed out dirt when I stored the partially full can in the funnel. There's also a built-in foam



Flexible funnel pierces, holds and stores engine oil can. Cover cap seals out dirt.

filter that I could remove and wash in solvent. Stancan Consumer Products Div. makes the funnel. They're at Box 48427, Atlanta, Ga. 30362.

—Paul Weissler

Speedy screwdriver

I've found a new screwdriver with a speed-handle design that takes most of the drudgery out of a job that requires installing or removing a great many screws—especially the long variety. I worked the handle with a little wrist action, and the crank-shaped shank spun the screw in or out. When I turned down the screw finger-tight, I just grasped



New handle design for screwdrivers can speed turning of slotted, Phillips screws.

the shank at the bend to give the screw a final tightening.

The screwdriver comes in slotted and Phillips versions and costs about \$3 at parts stores. It's made by Vaco Products Co., 1510 Skokie Blvd., Northbrook, Ill. 60062.

—Paul Weissler

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DETROIT LISTENING POST

Mustang police cars

The California Highway Patrol has purchased 400, 1982 high-performance, 5.0-liter V8 Mustangs for the express purpose of chasing speeders.

The cars offers 7-second 0-to-60 acceleration, as well as excellent handling, and they're being tested and considered by other law enforcement agencies around the country. Notice the roll bar inside and the lack of a drag-producing light bar on the roof. Looks like Smoky's determined not to let The Bandit get away next time.

Hot-rod fever

It seems like 1966 all over again. Bored as their customers with the nice, competent, efficient, practical, ever-improving and thoroughly unexciting transportation devices they've been trying to sell these last few years, the Detroit makers are finally falling all over each other in a determined effort to inject more fun into owning and driving automobiles again.

The new performance seed took root last year with mini-hot-rod Citation X-11s and Charger 2.2s, and it blossomed for '82 with Turismo 2.2s, 5.0-liter HO Mustangs and Capris, injected Camaro Z-28s and Firebird Trans Ams. Now, it's about to germinate into a whole enthusiasts' garden of delights.

Chevy's X-11 package (largely forgotten in the new Camaro's wake) may be dropped, but the X-11's lively 135-hp, 2.8-liter, HO V6 engine (perhaps with fuel injection) will remain available in the fwd Citation and, with a five-speed transmission, in '83 Camaros and Firebirds. The cooking, 110-hp version of that same V6 may be squeezed into a budget hot-rod Chevette, complete with trick suspension and other goodies.

Chevy is developing multipoint (port-type) fuel injection for the 5.0-liter V8 Camaro engine, boosting it to a rumored 200 hp. And, get this: A few of the current Corvette's 220-hp, injected, 5.7-liter V8s may find themselves in '83 Z-28s, as well.

Performance-oriented dealers are beginning to do their things again with hopped-up Detroit products. Briggs Chevrolet, of South Amboy, N.J., once the mecca for Chevy performance enthusiasts, has introduced a Citation Super Sport with a juiced V6 engine, beefed suspension



California Highway Patrol recently ordered a fleet of high output 5.0-liter Mustangs.



Specially tuned Citation from Briggs Chevrolet reflects reborn grass-roots hot rodding.

and a racy spoiler and graphics package, and promises SS editions of other Chevy models in the near future. Remember the old factory SS Chevies?

A San Gabriel, Calif., outfit called Gale Banks Engineering has just shattered the land speed record for stock-bodied cars (unlimited GT class) by more than 35 mph with a highly modified, turbocharged Corvette fueled by twin Holley 4150 four-barrel carburetors. It clocked 240.738 mph on the Bonneville Salt Flats.

Buick plans a very special black-trimmed, Euro-style version of its fwd Century A-car for '83 (similar to the gorgeous idea car that's been making the auto-show rounds), powered by a port-injected, 3.0-liter V6 with computer-controlled ignition. Pontiac by now will have completed its run of 2,000 specially equipped '82 gold-on-black Recaro Trans Ams, but will have more exciting stuff for '83—including a super 6000 to compete with Buick's trick Century.

Ford's Mustang and Mercury's Cougar (face lifted for '83) get a new four-barrel carb and fresh-air hoods

for their already-potent 5.0-liter, HO V8, bumping output to 175-180 hp. Big, 11-inch disc brakes (borrowed from the Lincoln parts bin) will provide the necessary stopping power.

For those with more exotic tastes, the company's Special Vehicle Operations (SVO) group is cooking up a batch of wild-looking, turbocharged, fuel-injected 2.3-liter "Turbo GTI" Mustangs. Look for these ohc turbo fours to pop up also in special versions of the coming '83½ Thunderbird and Cougar XR-7. And Ford is rumored to be talking with sports

(Please turn to page 27)



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The 'kit car' concept is not new. For years custom coach builders have been designing stylish new bodies like this *Jaguar XK-120*. Manufacturers all over the country sell them as full-size bolt-on body kits designed for easy home assembly.

Jaguar XK-120



See dozens of kits you never knew existed. You may already recognize the popular *Gazelle* roadster. But, did you know that there are more than 4 other Mercedes look-alikes including a 450SL, a 540-K, and a 1927 touring replica. This comprehensive annual reveals dozens of models you won't find anywhere else.

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Pantera



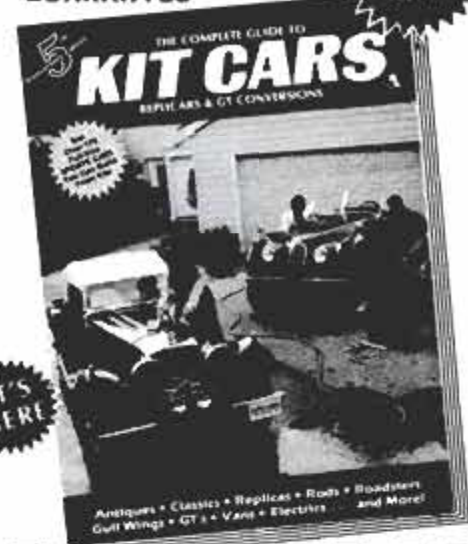
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and racing carmaker Lotus of England in hopes of renewing a relationship that spawned hot, Lotus-powered English Fords in the 1960s.

Another fruitful partnership in the '60s involved Ford and former racer Carroll Shelby, and resulted in the awesome Ford-powered Cobra sports cars (see *Cloning The Cobras* on page 74) and the banzai Shelby Mustangs. Lee Iacocca headed up Ford Div. then; now he runs Chrysler, and he's rumored to be talking again with Shelby about collaboration on future high-performance products. These could be turbocharged Charger and Turismo 2.2s, or maybe super K-cars. Imagine a Dodge 400 "426" (four-cylinder, 2.6-liter) or a Plymouth Reliant "Road Runner"!

Of course, such youth-oriented performance products won't appeal to everyone. But they'll surely create new interest and put some excitement back into the long-suffering car business again, and that's got to be good.

GM update

With a U.S. version of the fwd European S-car definitely not in the cards, General Motors now intends to import a Japanese-built, Giugiaro-styled mini, jointly developed and manufactured by Izusu and Suzuki, beginning in 1985.

Rumored specs include a 145-in. overall length on an 86-in. wheelbase, base weight of 1,650 pounds and well over 40 EPA city mpg from a 1.5-liter, four-cylinder engine.

GM also is continuing talks with No. 1 Japanese maker Toyota, reportedly centering around joint (U.S.) manufacture of a 1.6-liter small car slated for about the same time period. Volume of about 300,000 units per year from an existing GM plant is rumored, with Toyota supplying the engines and most drivetrain components.

At the same time, both a fuel-injected engine and a new notch-back version of the aging, rear-drive Chevette/T1000 T-car are reportedly in the works for the mid-1980s, indicating that the corporation plans to freshen and improve this dated but economical series for some time to come. Could this be the object of the proposed General Motors/Toyota collaboration, rather than an all-new fwd design?

The excellent, X-based, fwd A-cars are first in line for a new four-speed overdrive automatic transaxle in mid-'83, followed closely by the X-cars and J-cars from all five GM car

divisions. We haven't heard anything lately about the long-promised five-speed manual transaxle, but they *must* be close to offering that by now, as well.

The all-new Corvette is due this winter, and Pontiac's exciting mid-engine economy sports car is a definite "go" project—at last! Also for '84 are all-new, downsized fwd C-car luxury models to replace the current big Olds, Buick and Cadillac series. The C-cars' slightly smaller B-car derivatives, however, will likely stay

around little changed through 1986 or so to satisfy rear-drive, large-car fans. (See *GM In The Fast Lane*, page 81.)

Also in the planning stages for '85-'86 are a downsized and thoroughly redesigned fwd Toronado, Riviera, Eldorado and Seville luxury E-body series (on about a 103.5-in. wheelbase), plus a smaller and all-new N-body replacement for the current Monte Carlo, Grand Prix, Cutlass Supreme and Regal G-car coupes. These latter models will be on a stretched 103-in.-wheelbase fwd J-car platform. **PM**

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Build PM's Broadcast Antenna Booster



Antenna-Booster coil is held just above and parallel to the radio's own antenna (above). An AM radio antenna is usually a long, coil-wound rod that's easy to find (it's tinted in the photo at left).

Perk up any AM radio's reception with this electronic antenna. It will boost distant signals for your pocket transistor or table model.

by Herb Friedman

The modern transistor radio is small, convenient and most efficient in its use of battery power. Even today's table radios are smaller than the monster grandpa kept in the living room in a fancy wood cabinet. But grandpa did have one advantage: an outdoor wire "aerial" hundreds of feet long, positioned high in the air. He could pull in stations from almost the other side of the world as if they were in his backyard.

Today, with houses jammed together side by side, few people have

the room to string an outdoor antenna. And without a really good antenna, there's little chance you'll ever hear broadcast-band DX stations (stations great distances away).

But even if there's no "south forty" out back where you can erect an antenna, there's still a way to hear DX on the AM band. All it takes is an "electronic antenna," a device that pre-receives and amplifies signals too weak to be received by an ordinary radio's compact antenna. These now-strong signals are then "rebroadcast" into the radio. With

an electronic antenna ahead of the radio, you can actually hear many "strong" stations in what is usually a "dead spot" on the dial.

In less than an evening, you can build the electronic antenna shown in the photographs for a moderate total cost.

And you won't have any need to modify, change or rewire your radio to use it, because the amplified signal from the electronic antenna is radiated directly into your radio through a "rebroadcast coil." It's part of the Antenna Booster and connects to the case through a short length of shielded wire and a miniature plug and jack.

The electronic antenna is assembled on a printed-circuit board that also serves as the cover for a $5 \times 1\frac{1}{2} \times 2\frac{1}{4}$ -inch plastic cabinet. Under no circumstances substitute a metal cabinet or a metal cover, because such a case won't allow antenna L1 to pick up as many signals.

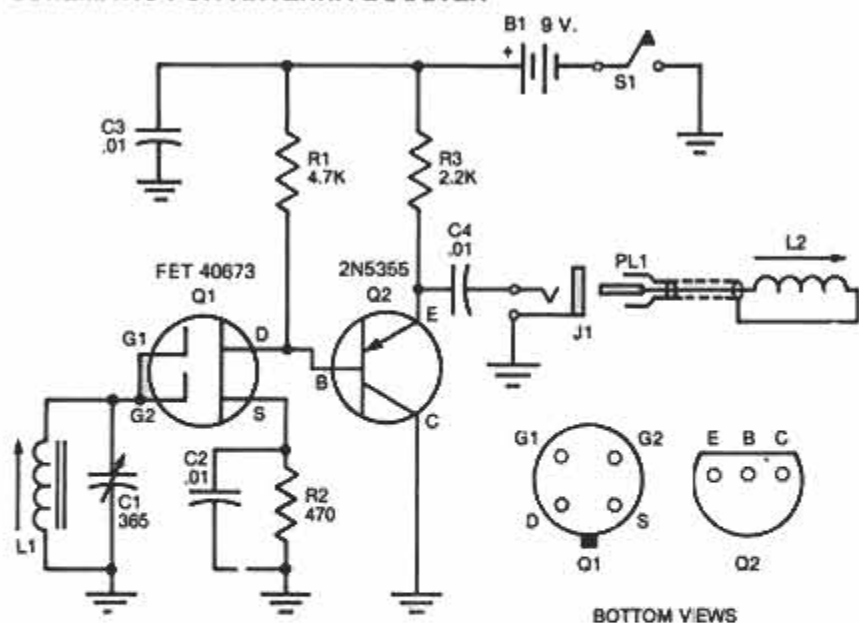
The layout of the components is critical to the circuit, so use the printed-circuit template shown. Some of the plastic cabinets have corners that are rounded, while some are square. If you don't know which you'll be using, make the printed-circuit board with square corners; you can always file them if the cabinet has rounded corners.

Make the printed-circuit board any way you like: The copper-clad boards from Radio Shack are particularly easy for the hobbyist to use. The component hole sizes are: $\frac{3}{16}$ inch for tuning capacitor C1; $\frac{1}{4}$ inch for output jack J1 and power switch S1; $\frac{1}{8}$ inch for the corner mounting screws and the two holes through which the wires from antenna coil L1 pass to the underside of the board; No. 56 or No. 55 drill bit for all other components.

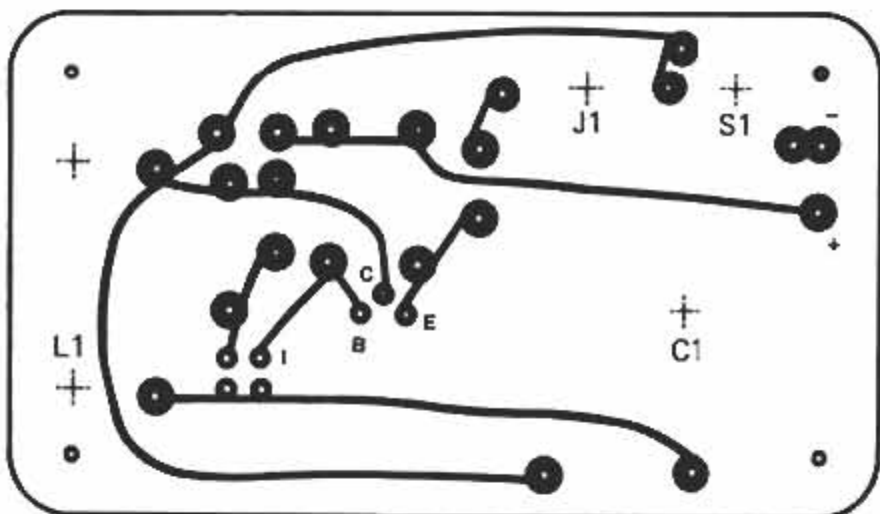
Install all components except antenna coil L1. Note that the small "tab" on transistor Q1's case faces the farthest edge of the board, while the "flat" side of transistor Q2 faces the nearest edge of the board. Q2 has three leads arranged in a straight line: Twist the leads slightly to fit the printed-circuit board.

Install all board components, including the battery connector and the tuning dial, before installing coil L1. The tuning dial is supplied in a package along with a large-flange retaining screw and tuning capacitor C1. Match the flat side of the dial's mounting hole with the flat section on C1's shaft and press the dial lightly into place. Don't attempt to rotate the dial in order to make it fit: If it's aligned properly, the dial should drop right on the shaft. Run down the retaining screw with your

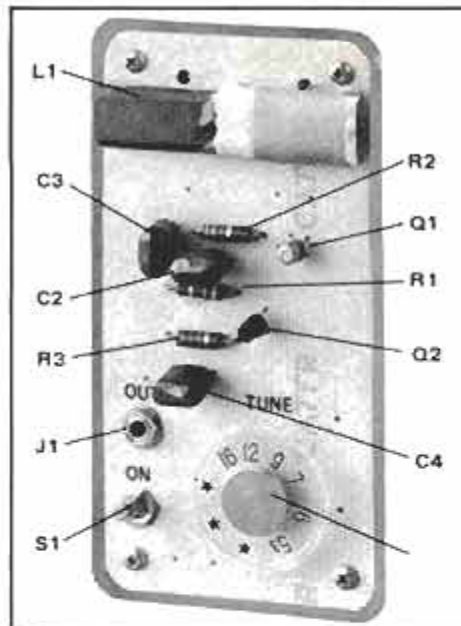
SCHEMATIC FOR ANTENNA BOOSTER



Schematic diagram (above) details pins of transistors Q1 and Q2. Variable capacitor C1 is main tuning "dial." Cable connecting L2 to board is detailed in text.



Printed-circuit template above may be cut out and used to make a photo-process board. Labeled cross-points are references for component-mounting holes.



Completed circuit board has all its components in place. The board mounts on top of the cabinet and the components are protected by a hinged lid. The layout is critical, so follow parts placement closely.

thumb and stop as soon as the screw stops turning. *Don't* use a tool to tighten the screw, because any excess force will damage C1.

L1 is a ferrite antenna coil with a 2¼-inch "bar." It is supplied with the coil loose on the bar because it must be adjusted and cemented in place. The coil has three wire leads: one on each end and a "tap" within a few turns of an end.

Very carefully unwind the end nearest the tap to the tap and cut off the excess. There's no harm done if you leave a turn or two on the coil. Just be certain you *don't* cut what was the tap.

Using L1's leads full length (don't attempt to cut them short), pass the leads through the two holes in the board from the top to the foil side; tack-solder the wires to the two large solder pads. Then, set the electronic antenna aside while you assemble L2.

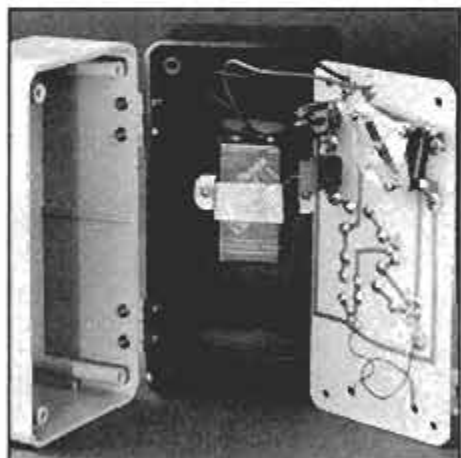
Rebroadcast coil L2 is an adjust-

(Please turn to page 31)

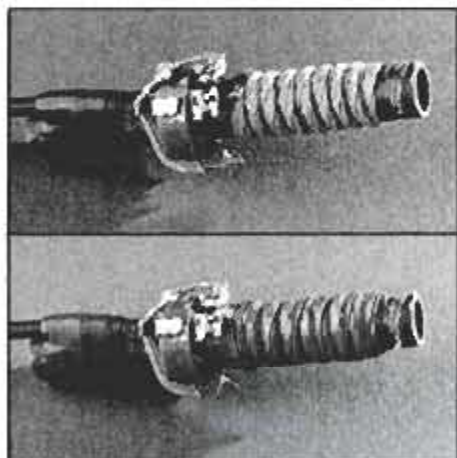
PARTS LIST—ANTENNA BOOSTER

- B1—9-v. d.c. transistor-radio battery
- C1—365-mfd. miniature tuning capacitor with dial
- C2, C3, C4—.01-mfd. capacitor, mylar or disc
- J1—Miniature, two-circuit phone jack (3 mm)
- L1—2¼-in. ferrite-rod antenna
- L2—Ferrite antenna coil, slug turned (see photo at left)
- PL1—Miniature, two-circuit phone plug (3 mm)
- Q1—Transistor, FET 40673 or equivalent
- Q2—Transistor, 2N5355 or equivalent
- R1—4,700-ohm (4.7K) resistor*
- R2—470-ohm resistor*
- R3—2,200-ohm (2.2K) resistor*
- S1—s.p.s.t. miniature switch, ¼-in. mounting
- Misc.: Plastic cabinet, shielded cable (see text), battery connector

*All resistors are ½-w., 10-percent tolerance.
A complete kit is available for \$34.95 from Custom Components, Box 153, Malverne, N.Y. 11565. A printed-circuit board (included in complete kit) is available separately for \$9.95 from the same address.



You could use a shallower case than shown in our prototype (above), since all the components mount on the outside of the PC board. Just leave sufficient room for the back sides of J1, S1, C1 and a battery.



The rebroadcast coil L2 is shown above in two views. Photo at top shows the coil after it has been wired to the cable assembly. Photo above shows how tape is wrapped around the coil to protect the windings.

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Hampton, Va.	June 24-27
New York	June 25-July 4
Minneapolis/ St. Paul	July 12-18
Cincinnati	July 12-17
Seattle	July 30-Aug. 6
Milwaukee	Aug. 11-15
Newport, R.I.	Aug. 21-22
Chicago	Aug. 30-Sept. 5
Detroit	Sept. 1-6
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Houston	Sept. 16-19
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BUILD PM'S BROADCAST ANTENNA BOOSTER *(Continued from page 29)*

able, slug-tuned, ferrite antenna coil which might have two or three connections, depending on the particular coil you obtain. If yours has three terminals, ignore the center terminal: Use the two outside connections. Connect a 30-inch length (no longer) of type RG-174/U miniature coaxial cable to the coil. It doesn't matter which coil terminal connects to the cable's shield. If you can't get miniature coaxial cable, substitute up to 25 inches of thin, two-conductor microphone wire. This will cause only a small loss in performance. Remove the small metal cap at the top of the coil: The tuning slug will come out with the cap. Unscrew the cap from the slug, slide the slug back into the coil, set the bottom of the slug approximately flush with the bottom of the coil form and cement the slug in place with a drop or two of model-airplane cement. When the cement dries, wrap the coil with a single layer of plastic tape for protection. Use several layers above the coil itself to secure the wire to the coil's form. Connect plug PL1 on the free end of the cable. Make certain the center conductor of the shielded wire connects to the "tip" of the plug. Finally, you can cement a piece of Velcro fastener material about 1 inch long to the side of the coil. This will hold the rebroadcast coil on the radio. Velcro can be purchased in fabric stores or hardware stores. Or you can place the coil in a handheld arrangement made from a plastic bottle (see the photos on page 28).

Best boosting

Next, get the project ready for final adjustment and assembly. Set power switch S1 to OFF, install the battery, secure the printed-circuit board to the cabinet, plug in the rebroadcast coil and get your radio.

Any radio can be used with the electronic antenna, from pocket-portable to table models. Open the radio, as if you were installing a new set of batteries, and note the position of the antenna coil: It may closely resemble the antenna coil used in the electronic antenna. Rebroadcast coil L2 will be placed near the radio's antenna coil. If you've used Velcro on the coil assembly, close the radio and apply the other half of the Velcro fastener to the case of the radio as close as possible to the antenna coil. Keep in mind that the rebroadcast coil must be parallel to the antenna coil.

Tune in a very weak station near the top of the dial—around 1600. If you can't find a station on the top of

the dial, just listen to the background noise. Move the electronic antenna at least 12 inches away from the radio and turn on power switch S1. Set the tuning dial to the very top (16, which stands for 1600) and then back it off a smidgen, maybe 1/16 inch.

Very carefully and slowly, move L2's coil along the bar until you hear the radio station or the noise pick up dramatically. Then rotate the entire electronic antenna slowly for maximum signal and readjust the coil on the bar. Without disturbing the coil, tune the radio to a station on the low end, around 550 to 600, and try to peak the signal by adjusting the electronic antenna's tuning dial. If you have adjusted L2 correctly, the tuning dial should peak signals from one end of the band to the other. Don't be concerned if the calibrations on C1's tuning dial don't correspond exactly with those of the radio; the dial calibrations are ballpark figures. The final adjustment will always be made by adjusting the tuning dial for maximum volume from the radio.

Don't try to adjust the coil, or even to use the electronic antenna, on very strong signals. Radios have an inherent characteristic called AGC—for automatic gain control—that equalizes the volume of moderately weak to strong stations. AGC automatically compensates for any extra sensitivity which the electronic antenna provides strong signals.

Permanent attachment

If you want a permanent attachment, secure the coil to the radio with one or two drops of model-airplane cement. Don't coat the whole coil and bar. Just a drop where the coil meets the case—or directly on the antenna bar—is sufficient. Then secure the whole ferrite antenna coil with a small amount of silicon rubber cement. Depending on the particular antenna coil you use and its adjustment, it might overhang the sides of the cabinet; this is okay.

For clarity of illustration, the photographs show the radio immediately adjacent to the control box. In actual use, however, the radio and coil must be at least 12 inches from the control box to avoid feedback, a condition that produces interference with reception. If you hear a garbling or warbling of the received signal, simply separate the radio and antenna a few more inches, or position the radio on the other side of the antenna.

To restore normal radio reception just turn off the antenna. **PM**

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ly without splitting it. When most of the nail has penetrated, you simply pull the drill away to release the friction grip. A hammer and nailset is then used to finish the job. Especially useful for practically any finishing-nail application, the spin nailer can drive 4d, 6d and 8d nails without any need for predrilling. Available at Sears, Roebuck and Co. stores for \$4.99, the stock number is 2601.—H.W.

Alcohol torch

Good news. The alcohol torch, an old-time favorite, is back. The unit is safe and easy to operate since it requires no pumping, priming or blowing. It burns any high-proof grain or wood alcohol, producing a clean blue flame about 3 inches long. It's just right for soldering or heating small, delicate parts and for working in confined areas. The torch is sold nationwide, but you also can



Safe and odorless, handy torch burns either grain or wood alcohol. The pointed blue flame is ideal for small jobs.

buy it directly from the manufacturer: Production Machining, 2212 West Vernon Ave., Kinston, N.C. 28501. It's \$12.45 postpaid.—Rosario Capotosto

The plywood (dis)connection

Recently, several readers have written to complain about the quality of plywood being sold these days by some outlets. Unhappily, we have run into the same problem.

The plywood in the photograph is the stuff that was delivered—and had to be used—when we built the wine racks that appeared in our May issue (page 104). The product was an

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Check for splitting plies in "off" brand plywoods before paying your lumber dealer.

"off" brand; that is, there was no major manufacturer's label printed on the panels. The lumberyard dealer didn't have the slightest idea who might have produced it. Though he would have exchanged the product, there simply wasn't time.

The splits (delaminating) shown in the photo occur, as many PM readers know, when the 4x8 sheets are ripped to size for use. Since we were pressed for time, we had to relaminate all pieces of plywood after they were cut, then fill in the edge voids. The task was time-consuming and aggravating.

Because this looks like it will be a recurring problem, our only suggestion is that you insist upon brand-name products—which have never caused us any trouble.—Rosario Capotosto and Harry Wicks

Home and Shop updates

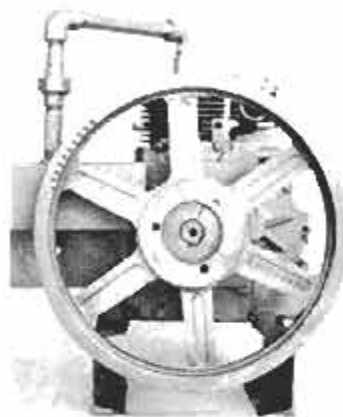
In our story, *Now: A Do-It-Yourself Shingle* (page 88, May '82), we reviewed a new instructional kit designed for do-it-yourself roofing. This kit is no longer made by the Celotex Corp., but the shingles are still available from Celotex. They are sold under the Cove II name for about \$30 per square.

The supplier has changed for parts listed in *Build Our Challenging Table Soccer Game* (page 124, Nov. '78). Parts are now available from Armor Products, Box 290, Deer Park, N.Y. 11729.

In *Build PM's Adirondack Furniture Set* (page 117, June '82) we mistakenly credited Eugene P. Thompson with the technical art. The excellent drawings were done by Henry Iken. **PM**

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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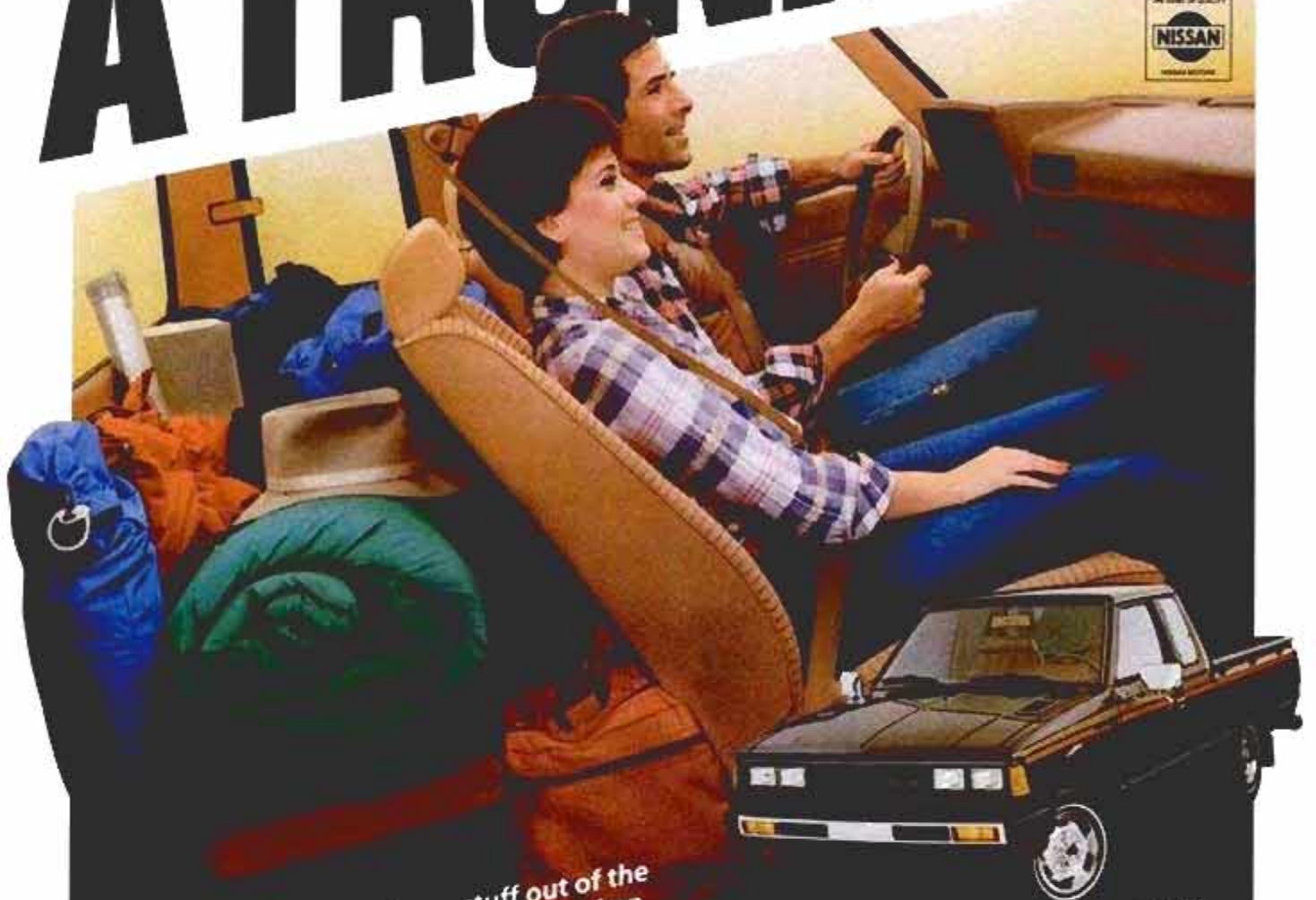
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EPA EST
HWY

26

EPA EST
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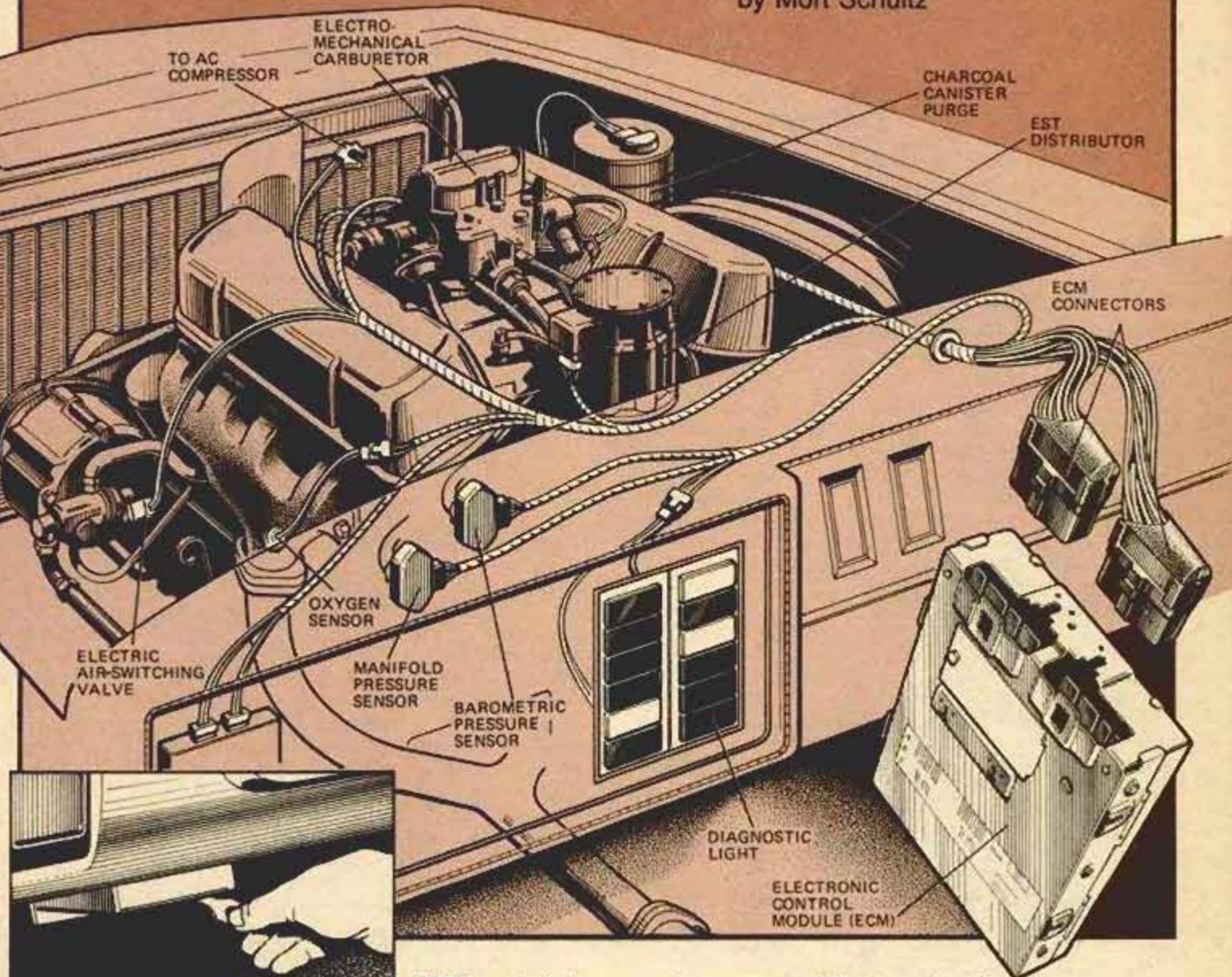
DATSUN WE ARE DRIVEN

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Troubleshooting GM's Computer Command Control System

PART 2

by Mort Schultz

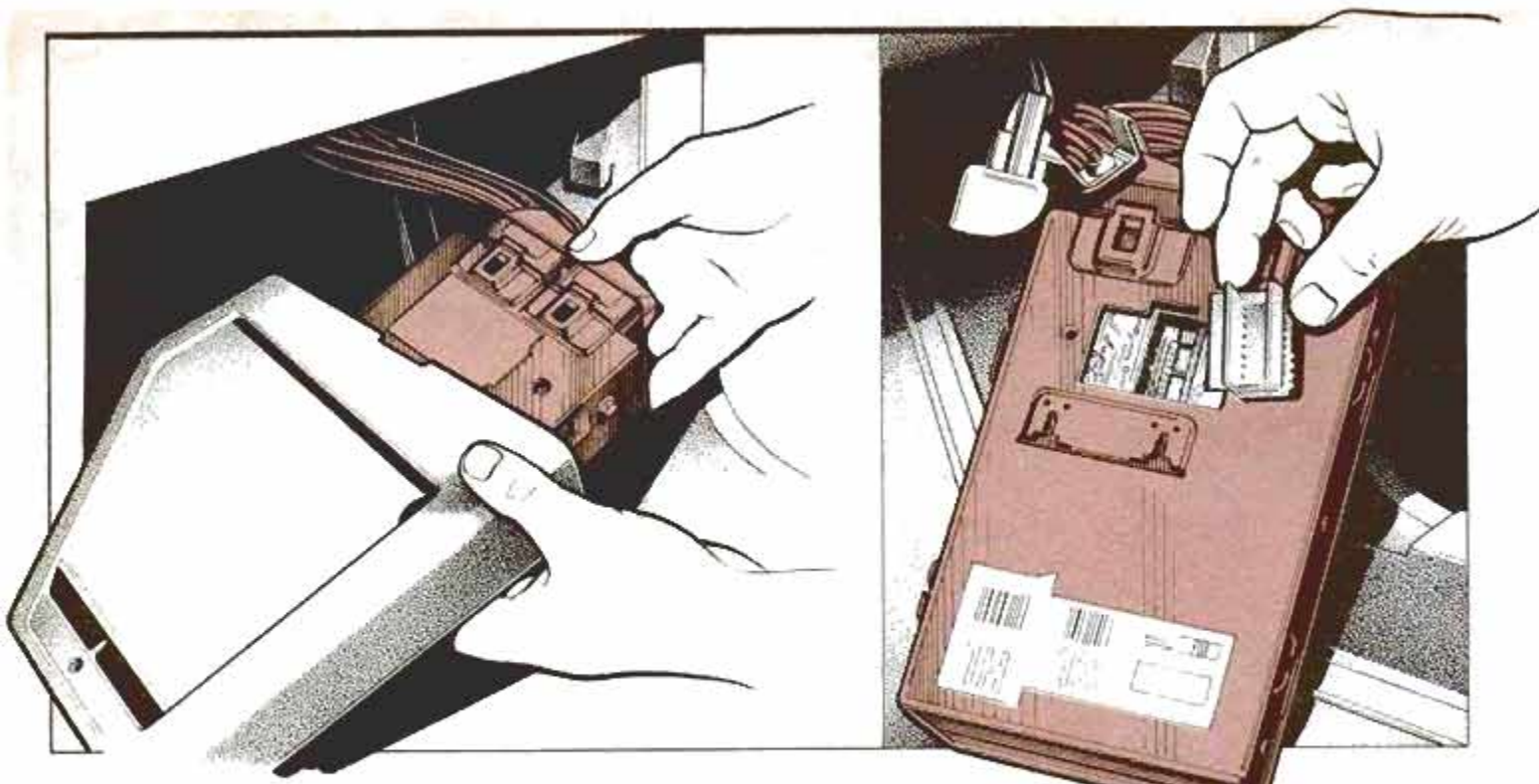


The layout of a typical CCC system is illustrated above. The ECM is located in footwell on the passenger's side, where it's protected by a plastic casing. Test connector (inset) is under dashboard.

"You don't have to know anything about electronics to troubleshoot the Computer Command Control (CCC) system in GM cars," says Ken Jacobson, staff supervisor at General Motors Service Research in Warren, Mich.

While you may not have to know much about electronics to troubleshoot the CCC, you should never even begin unless you are an accom-

plished engine diagnostician. As Jacobson explained: When an engine-performance, fuel-economy or exhaust-emissions problem hits a car that has a CCC system, a mechanic starts troubleshooting as if the car didn't have CCC. First, he looks for loose and damaged vacuum hoses, loose and corroded electrical connections, fouled spark-plugs, bad secondary voltage cables,



Your car's Electronic Control Module can be removed for inspection if you suspect that it is causing some sort of malfunction. First, you should remove the ECM from its protective plastic casing (left). The chip can also be removed from the ECM, but you will need special tools for such an operation. This kind of service is delicate and, therefore, is best left to a car dealer's service department.

conventional carburetor problems, electronic ignition failures, PCV valve clogging, EGR valve leakage or failure, inoperative thermostatic air cleaner system—and a multitude of other possibilities. Included in that multitude are the whole range of internal engine problems from a bad camshaft to a burned valve or broken piston ring.

If extensive and thorough troubleshooting fails to uncover the cause of an engine-performance problem, he'll then turn his attention to the CCC system.

In last month's *Saturday Mechanic*, I discussed CCC components and what they do. This month, I'll explain how the CCC's self-diagnostic mode functions. However, before you dig into your car's CCC system, remember that all emission control parts, including CCC, are covered by a five-year, 50,000 mile warranty.

The 'Check Engine' light

When GM engineers boast that the CCC system is self-diagnosing, they mean that the diagnostic light, or CHECK ENGINE light, on the instrument panel reveals the existence and location of a CCC-related malfunction.

Before I explain how to unlock the secrets of CCC self-diagnosis, you should know the following facts about the CHECK ENGINE light:

■ If the CCC system is working

properly, the CHECK ENGINE light will come on and stay on momentarily as you start the engine. Then it will go off. If the light doesn't come on, the fuse or lamp circuit has failed. If the light doesn't go off, there's probably a problem in the CCC system.

■ When a malfunction develops in the CCC system and causes the CHECK ENGINE light to stay on, a signal in the form of a trouble code is locked into the memory of the engine computer, called the Electronic Control Module (ECM). This trouble code reveals the CCC subsystem in which the problem exists.

■ The computers of most GM engines are programmed to retain 18 or 19 trouble codes. Exceptions are computers of 1982 Chevrolet Chevettes and Pontiac T-1000s equipped with automatic and four-speed manual transmissions. These minimum-function systems, as they are called, retain only seven trouble codes. However, computers in 1982 Chevettes and T-1000s with five-speed manual transmissions are full-function components that are capable of receiving and "memorizing" up to 19 trouble codes. The engine control system on Cadillac DEFI engines, which is similar in design to CCC but uses a different computer, has 62 malfunction codes and provides direct readout of battery volts, spark advance, coolant temperature and a variety of other parameters.

■ If a CCC malfunction causes an intermittent engine problem, such as an engine surge at a particular speed, the CHECK ENGINE light will come on. The trouble code will be sent and locked into the computer brain. As the vehicle surpasses or drops below the speed range, the CHECK ENGINE light will go off, but the trouble code will be retained, even if the ignition is turned off.

This is not the case with 1982 Chevettes or T-1000s, which have a minimum-function system. Once you turn off the ignition, the trouble code is wiped out. Therefore, with these particular models, you should check for trouble codes before stopping the engine.

CCC diagnosis

Important: All of the following checks should be made with the engine warmed up. Remember also that a normal engine malfunction can fool the CCC system into thinking that one of its sensors (or the computer itself) is not working properly. That's why a conventional, engine diagnostic check is the first thing that must be done when the CHECK ENGINE light is illuminated. Once the first diagnosis has been completed, the computer's memory can be checked for trouble codes.

A trouble code is displayed as a series of flashes (pulses) by the CHECK ENGINE light. To activate the

light, ground the trouble code "test" terminal with a paper clip or jumper wire.

Find the "test" terminal by reaching under the dash, either to the left or right of the steering column, until your fingers touch a segmented connector. A rectangular, four-segmented connector is used in 1980½ models with 4.3-liter engines that have CCC; a square, five-segmented connector is used in 1981 models and 1982 J-cars (Cavalier, Cimarron, J-2000, Firenza, and Skyhawk); and a two-row, rectangular, 12-segmented connector is on all other 1982 GM cars that have CCC.

Connectors are used at the vehicle assembly plant to check CCC system operation before cars are shipped. You can use the connector to get the CHECK ENGINE light to reveal what's in the computer memory.

You can tick off each segment with your finger until you reach the correct terminal, which is the "test" terminal. The illustration below lets you identify the "test" terminal for your car.

To ground the "test" terminal on 1980½ models, connect a jumper wire from the terminal to a nearby metal part of the car. To ground the "test" terminal of a five-segmented connector, push a paper clip between segments D and E. You'll find that the bar between the terminals is notched to permit this. To ground the "test" terminal of a 12-segmented connector, fashion the paper clip into a hoop, so it can bridge the bar between the segments that form the terminal.

Note: Turn on the ignition key before activating the "test" terminal, but don't start the engine.

Now, the CHECK ENGINE light

should flash a code 12 to indicate that the self-diagnostic system is working. Code 12 is given as one flash, followed by a short pause, followed by two flashes in quick succession. Then, after a longer pause, code 12 will be repeated. Code 12 will always flash unless the fuse or lamp circuit has failed.

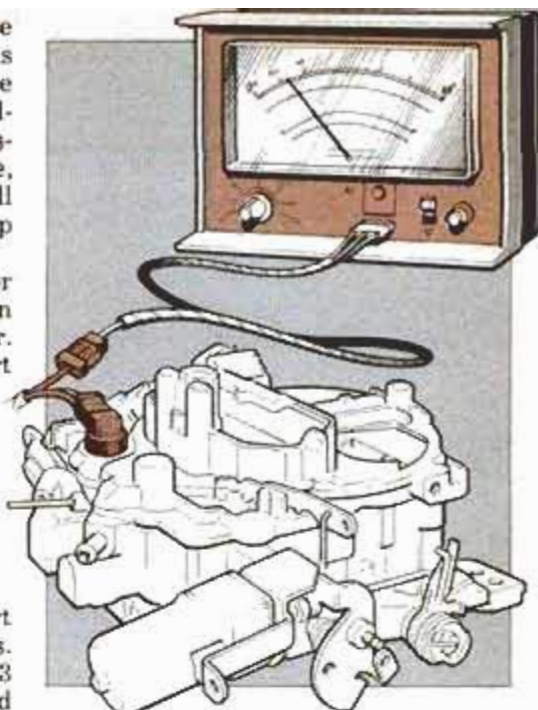
Disconnect the paper clip or jumper wire. Start the engine, then reconnect the paper clip or jumper. The CHECK ENGINE light will start pulsing if a trouble code is stored in the computer memory.

The two digits of the trouble code are derived from the number of pulses which are flashed on the CHECK ENGINE light. A trouble code 23, for example, is displayed as two flashes in quick succession, followed by a short pause, followed by three flashes. After a long pause, trouble code 23 will flash twice more. This would indicate a problem in the mixture control solenoid subsystem.

At this point, if there's more than one trouble code locked in the computer (there may be more than one malfunctioning CCC component), another trouble code will flash. Each trouble code will flash three times, in numerical order, with the lowest code going first.

For example, suppose trouble codes 15 and 54 are locked into the computer memory, in addition to code 23. First, code 15 will flash three times; then, 23 will flash three times; finally, trouble code 54 will flash three times. This sequence will repeat itself as long as the connector "test" terminal is kept activated.

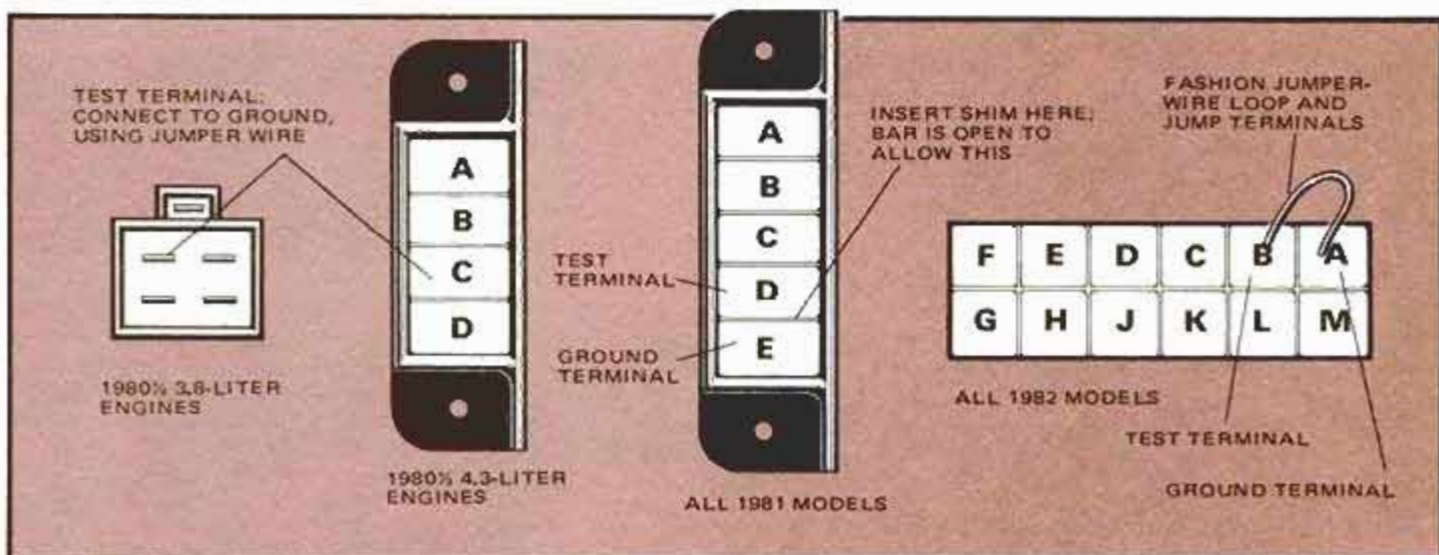
Suppose that when you activate the "test" terminal with the engine running, you get code 12. This is



Once the CHECK ENGINE light registers a trouble code, a dwellmeter will lead you to the exact location of the problem. In the drawing above, the mixture control solenoid at the carburetor is being checked.

trouble code 12 and it is not related to the initial code 12 that tells you the self-diagnostic system is working. This code means that there is a failure of the reference (rpm) signal to the computer from the distributor. (For an explanation of this signal, see *Troubleshooting GM's Computer Command Control, Part 1*, page 49, July '82.) The fault may lie in the computer, but chances are there is an open or grounded lead between the computer and ignition module, or the ignition module is bad.

There is a fairly extensive trouble-



The test terminals, as well as the procedure for actuating the test sequences, vary according to a car's model year. The test terminal location and activation techniques are illustrated above for two

different '80½ engines and all '81 and '82 models. Be sure not to insert the ground into the wrong terminal. It might short out the entire system and destroy the ECM.

shooting procedure that must be followed to track down the specific cause of any single trouble code. For this reason (and because of that five-year, 50,000 mile warranty), it is impractical for the average do-it-yourselfer to go beyond the trouble code stage in diagnosing the CCC. Being aware of what's going on, however, can help you determine if you're getting good service. (It's probably not a good idea to tell your service facility that you've activated the trouble codes. You will void your warranty.)

There's another fact to note. Trouble codes for some conditions, such as an open-oxygen or coolant sensor circuit and lean or rich fuel problems won't flash unless the engine has been running a while or is accelerated at part throttle. When testing, therefore, it's a good idea to run the engine until the upper radiator hose feels warm and to make a test with the engine accelerating.

Beyond the trouble codes

The trouble code reveals the subsystem in which the malfunction

lies. It does not tell you which component of that subsystem is at fault. For instance, code 14 indicates that the coolant temperature sensor subsystem is shorted. This subsystem, however, consists of the sensor, connector, wiring harness and computer. The trouble may be in one or more of these.

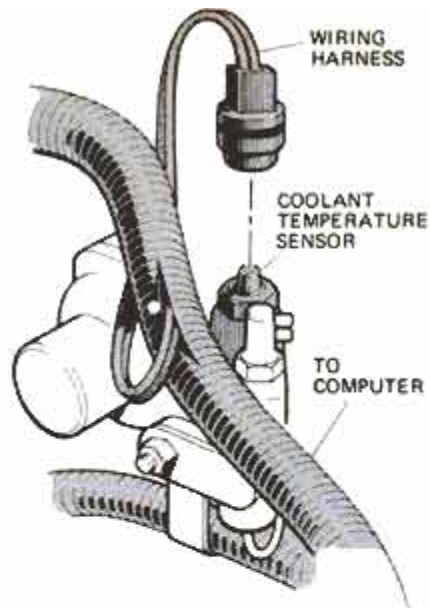
To pinpoint the faulty component, a technician would do the following for some CCC systems:

- Turn off the engine and connect a dwellmeter to the mixture control solenoid. The test terminal should remain grounded. (See the July '82 *Saturday Mechanic* for the location of the parts I mention here.)

- With the dwellmeter set on the six-cylinder scale, remove the connector from the coolant sensor, and start the engine.

If the dwellmeter needle stays fixed at 30°, the coolant sensor is bad and should be replaced.

If the dwellmeter needle wavers, troubleshooting gets complicated, because you have to go to the computer and remove the particular connector coinciding with the cool-



You'll have to isolate a subsystem by traditional methods (voltmeter or ohmmeter) to find the problem, once you've located the trouble area with the CCC. In the coolant temperature subsystem, for instance, the trouble might be with the sensor, the wiring connector or the harness itself.

ant circuit. Don't attempt to do this yourself. If you unplug the computer's power source while its activated, the voltage surge could destroy it. Next, you should connect a test light from the battery positive terminal to the terminal of this connector.

If the test light comes on, the coolant sensor wire to the ECM has developed a short. If the test light doesn't illuminate, a short may exist between the coolant sensor wires. If they are not shorted, the ECM could be at fault.

Trouble codes

Zeroing in on a particular component that's causing a problem is not possible without the benefit of a detailed set of instructions. These instructions would occupy most of the pages of this magazine. However, we do list all the trouble codes at left. Again, attempting to go beyond the trouble code stage is not recommended.

Finally, I'd like to remind you that the CCC system isn't really a substitute for all the conventional ways of tracking down many engine problems.

You'll still have to get into your engine, check the sparkplugs, inspect all vacuum connections and loose electrical connections, and perform all the usual diagnostic procedures you'd try on a car that didn't have the CCC system. More often than not, you'll find that you're able to track down your engine's problem without even referring to the trouble codes.

CCC TROUBLE CODES

CODE NO.	INDICATION
12*	Self-diagnostic network activated
12	No distributor (rpm) reference signal to ECM (nothing stored in memory; flashes only when problem is present)
13	O ₂ sensor circuit problem
14	Shorted coolant sensor circuit
15	Open coolant sensor circuit
21	Throttle position sensor circuit problem
23	Mixture control solenoid circuit problem
24	Vehicle speed sensor circuit problem
32	Barometric pressure sensor circuit problem
34	Manifold absolute pressure or vacuum sensor circuit problem
35	Shorted idle speed control switch circuit
41 ('82 models)	No distributor (rpm) reference signal to ECM (stored in memory)
42	Open or grounded electronic spark timing (EST) bypass or EST circuit
43 ('82 models, except J-cars)	Excessive electronic spark control signal
44	Lean exhaust indication
44, 45 (one after the other)	Faulty oxygen sensor circuit
45	Rich exhaust indication
51	Faulty or improperly installed PROM
52 ('80½, '81 models)	Faulty computer
53 ('80½, '81 models)	Faulty computer
54	Shorted mixture control solenoid circuit and/or faulty computer
55	Grounded ECM 5-v. reference terminal, faulty oxygen sensor, faulty computer or faulty wiring harness

Note: The only trouble codes which are displayed by the minimum-function system in 1982 Chevettes and T-1000s with automatic or four-speed manual transmissions are: 12 (to indicate no distributor (rpm) reference pulse to the computer), 15, 21, 23, 44, 45 and 51.

*With engine stopped; all other readings taken with engine running.

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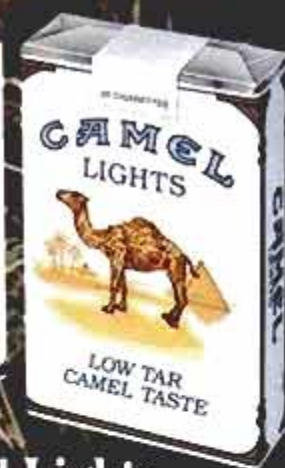


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APPLIANCE CLINIC

QUESTIONS ANSWERED

Tired wash-arm support

I have a portable KitchenAid dishwasher model No. KDD-67, serial No. 220-227-5222. The arm in the bottom, which circulates the water from underneath, becomes caught on the ridge that supports the bottom roll-out rack. When the water is on, the pressure forces the arm to push up against the ridge and the arm becomes stuck. It can't turn to circulate the water. Do you have any ideas as to what could be causing this and how we can remedy it?—Richard N. Johnson, Lyons, N.Y.

You should change the wash-arm support. This is the support on which the wash arm is located. Probably the pin in the top of the support has worked itself loose. When the water comes up through the support, the pressure forces the wash arm off its seat.

The support is held in place by four screws and can be replaced easily. The part is No. 111431 for the support. It is available through any local KitchenAid service company.

Mid-cycle crisis

Our Sears electric dryer model No. 110-6858700 stops (both heating and tumbling) in mid-cycle. If it sits for about 30 minutes, it usually restarts operation. I have looked at the schematic, but I can't find a thermal device on the drive motor. Do you have any suggestions?—R. Simmons, Litchfield Park, Ariz.

Motors used on Sears dryers since 1966 are of the nonrepairable type. They do have an externally mounted centrifugal switch, however, which can be serviced. The motor is either welded or cemented together, which makes it impossible to repair internally. The thermal device or overload protector is built into the motor windings.

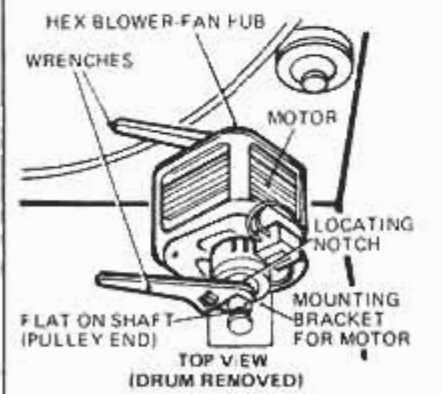
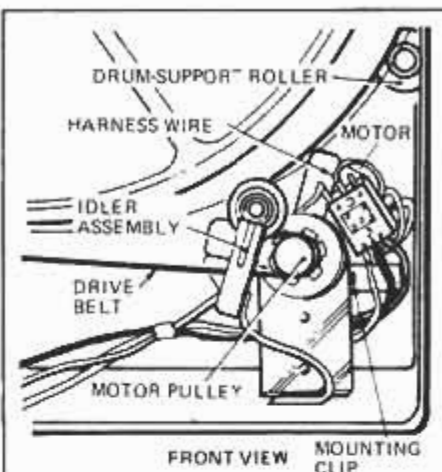
From your description, it sounds as if either lint or dust is blocking the airflow through the motor, causing the motor to heat up and trip the overload protector in the motor.

My suggestion is to remove the motor from the dryer and blow it out with compressed air, both front and rear. *Note: Disconnect the power to the dryer before removing the motor.* Remove the two screws under the lint lid and raise the top. Next, remove the front panel. Remove the drive belt from the motor pulley. Raise the drum slightly and remove it. Disconnect the harness wires

from the motor and mark them. Remove both motor-mount clips.

Now you can remove the blower-fan assembly by placing a wrench on the flat of the motor shaft (pulley end) and another wrench on the hex fan hub. Hold the fan hex firmly and rotate the motor shaft clockwise (left-hand thread).

While you have the motor out, you



To prevent the motor of this clothes dryer from overheating, locate the motor (front view); remove it to blow off lint. Remove the drum so you'll be able to reach and take off the blower-fan motor (top view).

might want to add a little lubrication to its bearings. You can do this by putting some turbine or high-temperature oil, available from Sears, on the motor shaft and lifting

the motor up on one end. Turn the motor shaft by hand. This will allow the oil to run down the shaft and into the bearing housing. Turn the motor over and do the other side.

Now that the motor is lubricated and free of lint, put it back into the dryer. Reassemble the dryer and give it a test run. If the dryer works, you're in business. If it fails, you'll probably have to replace the motor.

Taking precautions

We bought a house with a General Electric built-in dishwasher, model No. 1SU60P, which hasn't been used for 10 years. Would it be okay to use it as is, or should I have it checked first? Thank you.—R.C. Smolik, St. Louis

Your dishwasher is a 1957 model. Parts are still available from the maker. Because the machine has been sitting unused for such a long time, I would be concerned about a water leak or possible deterioration of the lid gasket.

Before turning it on, pull out the machine. Open the top, remove the racks and examine the gasket around the top of the tub. Make sure it's still pliable and it hasn't turned into a gummy material. If the gasket needs replacing, parts and labor will cost you about \$45.

Inspect the finish of the tub for chips or rust spots. Next, reach down into the tub. Turn the wash impeller (it looks like a metal bow tie) and make sure it turns freely. Pour some water into the tub and check underneath the machine with a flashlight for leaks around the motor assembly. If water leaks, the motor water seal probably needs to be replaced. Parts and labor for this will cost approximately \$100.

If there are no leaks underneath, the impeller turns freely and the lid gasket seems okay, turn the power on; the machine should work. **PM**

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



SCIENCE WORLDWIDE

Pretender to the throne

Since the turn of the century, chemists have known that of all the "noble" gases, helium is the noblest, refusing to turn liquid all the way down to 4° above absolute zero. But somewhere in the universe, there may lurk a gas that's even more noble.

In his laboratory, Dutch physicist Jok Walraven has magnetized hydrogen atoms to make some particles change course so that they all spin in the same direction. When this happens, he reported to the American Physical Society, the hydrogen stays in the gas state down to a fraction of a degree above absolute zero. If it works in the lab, it might also work elsewhere, perhaps in a stellar object in the deepest, coldest reaches of outer space. The discovery may help astronomers learn why some distant stars exhibit unusual chemical or physical properties.

Heavyweight atoms

The "Big Bang" theory says the universe began with an explosion that sent matter hurtling randomly across space. Some scientists also theorize that an unknown number of atoms trapped very heavy subatomic particles in their nuclei dur-

could find them in any element on Earth. Greenlees has chosen to use vaporized sodium for his search. If his laser strikes a superheavy atom in the gas, an unusual wavelength will be reflected, bringing to light a new shred of evidence corroborating the Big Bang theory.

Pure science/pure art?

Is the Shroud of Turin the true burial cloth of Jesus Christ or a clever



For some, Shroud of Turin is not a mystery.

work of art? Most members of an American scientific team studying the cloth since 1978 have been reluctant to give a verdict.

But the consensus of researchers writing in a recent issue of the journal of the Committee for the Scientific Investigation of Claims of the Paranormal favors the work-of-art theory. (The shroud is a man-sized piece of cloth bearing the outline of a crucified man and what some have called "blood stains." It has been regarded by many since about 1452 as the true burial cloth of Jesus.)

Physicist Marvin M. Mueller believes there is "strong evidence" that the alleged bloodstains are partly composed of pigments foreign to blood. And Walter McCrone, who was permitted to touch sticky tape to the Shroud's surface for chemical analysis, says flat out: "The image was created by an artist." He doubts, however, that either the artist or those who commissioned him ever intended to fool anyone.

Reversing a curse

It began like a grade B horror film: The art conservator was restoring a tapestry taken from an ancient tomb in Peru. During weeks of clean-

ing and sewing the tapestry, she became haunted by her own behavior. She was irritable, tired, dizzy and suffering muscular pain.

Writing in the *Journal of the American Medical Association*, Dr. Alf Fishbein says the patient was suffering from lead poisoning. She had inhaled lead contained in materials taken from the tomb and ingested lead from the tapestry when she put the sewing needle in her mouth. Solution: Move to a better ventilated setting and work more carefully.

Exercise fever—catch it

If you exercise regularly, you may often run a fever, which may not be so bad for your health. University of Michigan researchers Joseph Cannon and Matthew Kluger report that blood taken from humans right after exercise and given to rats raises their body temperatures. This suggests to Kluger and Cannon that exercising produces *endogenous pyrogens*, chemicals that cause fever.

Kluger and others in recent years have established that fever helps the body fight major infections and may even prevent many bacterial illnesses. The findings should prompt research into the cold and flu symptom records of exercisers.

Kids in space

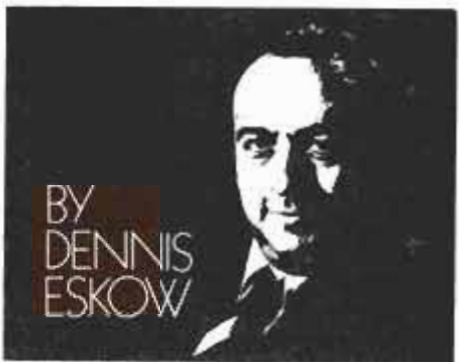
Want to be the first on your block to take part in the space program? If you're a high school student, the American Chemical Society invites you to propose an experiment to be conducted aboard the space shuttle sometime in 1984. If your experiment is chosen, and it weighs 60 pounds or less and can fit into a 2½-cu.-ft. canister, the space shuttle will carry it into orbit. For rules and an experimental handbook, write to: Frank Bigger, American Chemical Society, 1155 Sixteenth St. N.W., Washington, D.C. 20036. **PM**



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GM re SE, SF

The manual for my new Olds Omega (2.5-liter L4 engine) stresses using motor oil having the SF designation. I'm stuck with two cases of SE oil. Can I use it if I change oil more frequently than what's recommended in the manual?—Al Sharkee, Higganum, Conn.

General Motors does not recommend using oil designated SE in engines calling for oil designated SF. SF oil contains a different blend of additives to prevent sludge, varnish and rust, and to help reduce heat. Using and changing SE oil more frequently gets rid of sludge, varnish and rust, but the rabbit in this cabbage patch is heat. Engines in 1981-82 GM cars run hotter than engines in 1979-and-older cars. Oil designated SE will break down under this more intense heat. Maybe you can sell your two cases of SE oil to someone with a pre-1980 car.

What about 1980 models? GM manuals and service bulletins say to use SE oil in 1980 engines, but some GM fuel and lubricant engineers I spoke to urge the use of SF oil. The year was a transition period during which SF oil was first being marketed; hence, the conflict. If I owned a 1980 GM model and were using SE oil, I would switch to SF.

In the long run, this discussion of which oil to use may be academic. No matter what year car you drive, there may be no choice but to use SF oil. It's difficult to find SE oil at service stations and other places selling oil.

As long as I'm on the subject of oil and GM, these are the company's latest recommendations of which oil to use in its engines:

■ In gasoline engines, use oil designated SF, SF/CC or SF/CD. In 1979 and pre-1979 gasoline engines, you may substitute oil designated SE or SE/CC, if you can get it. Oil designated SE/CD should *not* be used.

■ All diesel engines can use oil designated either SF/CC or SF/CD. Oils marked SE/CC can be used in 1979-81 diesel engines only. If you have a

1978 diesel, you may substitute SE/CD, but the designation CC must not be on the label.

Belts strap him

My 1981 Ford Escort is using alternator drive belts at an alarming rate. I've never owned a car which had to have a belt replaced before 10,000 miles. It's getting expensive. My mechanic tells me he's seen several Escorts with the same problem. Have you encountered this? Is there a solution?—John L. Layton, Erie, Pa.

Yours is the first letter I've received voicing this complaint about the Escort. Chances are pretty good that if you examine the crankshaft pulley, you will find that a sharp edge is fraying belts. If there is a cutting edge—I can't imagine any other reason for the trouble—you can eliminate it by removing the belt and raising the car. From below, turn the crankshaft pulley to 3 o'clock. Find the sharp edge by feeling the pulley grooves. Include the timing indicator notch in your examination. If you find a burr, use a small file to get rid of it. Be careful that you don't let the file slip. It could damage the grooves. Finally, brush off metal filings and reinstall

the belt. If you don't find a cutting edge at the crankshaft pulley, try your luck at the alternator pulley.

Leaky compressor diagnosis

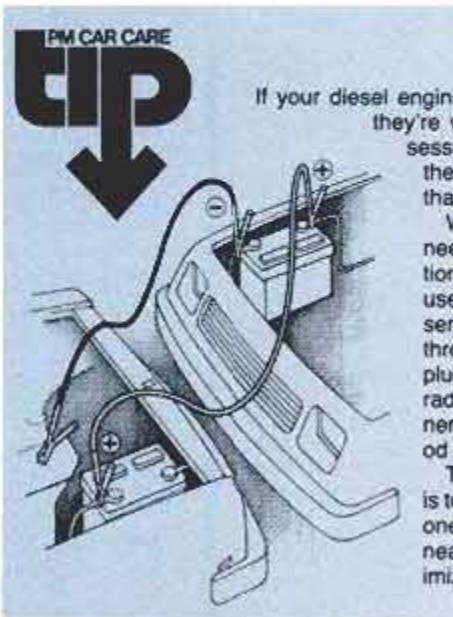
Soon after I bought my 1979 Chevrolet Malibu, I noticed a film of oil about two inches wide on the hoses and fender well next to the air-conditioner compressor. The hood insulation over the compressor (Delco Model 1131129) was soaked. My mechanic, who is not affiliated with a dealer, replaced the compressor seal and recharged the system. He also pressure-tested the unit, but no leak appeared. Yet, the compressor leaked on the way home from the garage and continued to leak. Since then, my mechanic has replaced the seal four more times and also replaced the compressor clutch bearing. But the leak continues. I've been doing business with this mechanic for 20 years and have full confidence in his ability, but now we need your help. Can you suggest a possible solution?—Harley L. Foster, Stone Mountain, Ga.

Since you didn't return the car to a Chevy dealer for repair under warranty, I assume the car wasn't new when you bought it. In any event, there are several reasons why oil will leak from an air-conditioner compressor. Let me give you a fast rundown.

One reason is a damaged compressor seal. This, apparently, has been ruled out by your mechanic. Incidentally, an overtight compressor drive belt can cause seal and bearing failure.

However, it should be mentioned that all compressor seals leak somewhat, and on many cars you'll find evidence of this leakage on the hood insulation. A certain amount of

(Please turn to page 46)



Avoid capital punishment

If your diesel engine is equipped with two batteries, remember that they're wired in parallel. This means that your car possesses a normal, 12-volt electrical system. However, the dual batteries provide greater capacity for starting than a single 12-volt battery in a nondiesel car.

Why should you keep this in mind? Because if you need to have your car jump-started, the service station attendant or tow truck operator may mistakenly use a 24-volt battery or two 12-volt batteries wired in series (24 volts). Don't let him. The 24-volt surge through the electrical system may damage glow plugs, voltage regulator, starter-motor components, radio, circuit boards and light bulbs. Some components may fail immediately—others after a brief period of time.

The correct way to jump-start a dual-battery system is to use one 12-volt battery as a jumper connected to one 12-volt battery in the car. If possible, the battery nearest the starter motor should get the jump to minimize resistance between jumper and starter.

POWER RAM 50



Dodge introduces the "Four Wheeler of the Year."

"...the Power Ram 50 is one of the all-around great mini 4x4 pickups to hit the market!" *Four Wheeler, Jan. 1982*

"...any way you slice it, the Power Ram 50 is the best there is among small 4x4 pickups." *Pickup, Van & 4WD, Jan. 1982*

"This is not a mini pickup like all the others from Japan but rather a mini 4x4 that rivals the power and performance of any (small) pickup you choose to stick it against!"

4 Wheel & Off-Road, Jan. 1982

That's a sampling of what the experts have to say about the new Dodge Power Ram 50. Here are some key facts behind the raves.

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Power Ram 50 hauls the biggest standard payload in its wheelbase class. It's got the biggest engine you can get in a small 4x4 pickup. Most horsepower, most torque. Its independent front suspension shows you true grit over rocky terrain.

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already know: in the tough world of 4-wheel drive, Dodge Power Ram 50 is the toughest small pickup of them all.



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Winners: In 1981 Dodge Ramcharger won *Four Wheeler* magazine's "Four Wheeler of the Year" award. Now Dodge Power Ram 50 is 1982's winner, and *Off Road* magazine's "4x4 of the Year."



	Dodge Power Ram 50 Sport	Datsun Sport 4x4	Toyota SR-5 4x4
Engine, liters, cyl.	2.6 Four	2.2 Four	2.4 Four
Horsepower @rpm	105 @5000	98 @5200	100 @4800
Torque @rpm, lbs.-ft.	139 @2500	127 @2800	129 @2800
Payload, lbs.	1510	1400	1400
Fuel tank capacity, U.S. gal.	18.0	15.9	13.5
Box length, in.	81.5	73.4	72.2
Steering type	Power	Manual	Manual

*Base sticker price excluding title, taxes and destination charges. Price as of 3-15-82.



CAR CLINIC

(Continued from page 44)

refrigerant leaks along with the oil. If your system does not discharge rapidly, the seal leakage is normal.

On the other hand, your system might be leaking oil and refrigerant from somewhere other than the front seal. It could be coming from a hose, a hose connection or a head seal, for example. If the system discharges rapidly, have your mechanic check for leaking refrigerant with a propane or electronic leak detector. This will pinpoint the location of the refrigerant leak, which is also the source of the oil.

If the leak detector shows that the front seal is the source of the leak, and if the leak allows refrigerant to escape to the point where cooling efficiency is diminished within a single season, it may be that your mechanic has been installing the wrong compressor seal or that the compressor shaft is damaged.

One . . . six, hike

Why do sparkplugs one and six in my 1980 Plymouth Volare foul so badly that new plugs last only a day or two? My mechanic called a Plymouth shop, which said that my carburetor

needs a one-and-six plate. Have you ever heard of this solution?—A. Cinnelli, Saugatuck, Conn.

The one-and-six carburetor plate was a field fix issued by Chrysler for six-cylinder engines built in 1975 and 1976. Since then, an improved intake manifold has been used that virtually eliminated No. 1 and No. 6 sparkplug fouling. Before blaming this condition on a distribution problem, all normal causes should be eliminated. Therefore, let me offer these suggestions:

■ Make sure that you really have a rich mixture condition and not an oil consumption problem. These engines are noted for valve guide and seal wear. If the plugs are black and wet when you pull them, it's an oil problem. If they're black and dry, it's probably a fuel mix problem.

■ Make sure that both of these cylinders have cranking compression pressure that is within 25 percent of all other cylinders.

■ Be sure the camshaft doesn't have worn lobes at these two cylinders.

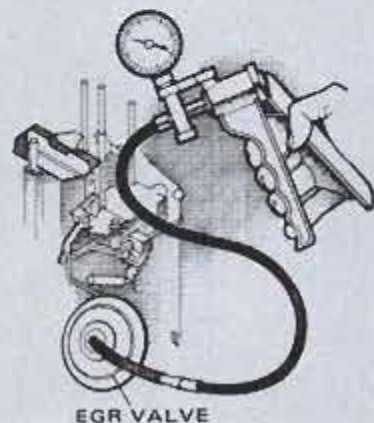
■ If the condition is accompanied by a miss, check the resistance of your sparkplug cables.

■ Inspect the other four plugs. Do they indicate a rich mix, but perhaps to a lesser degree? If so, you

Immediate return On an investment

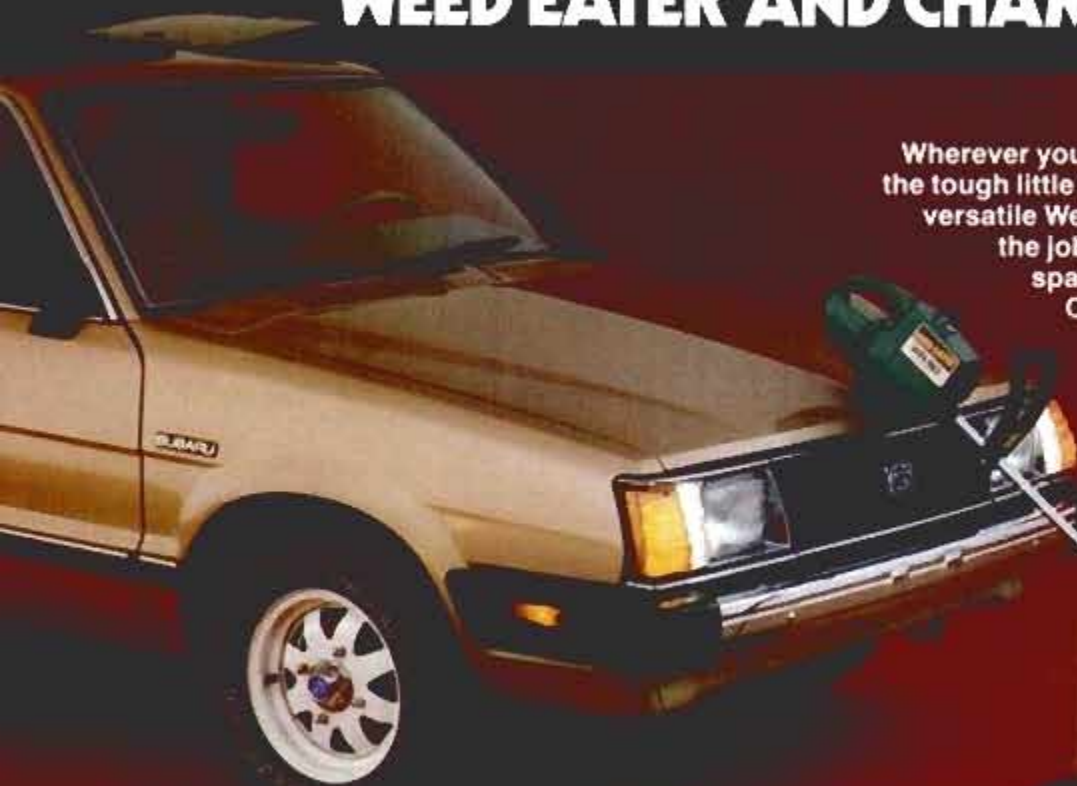


So you bought a hand-vacuum pump, thinking that every well-equipped shop should have one. Good show, especially if your engine is not running smoothly. You can put the pump to use right away by testing for a bad exhaust gas recirculation (EGR) valve—a part that's caused headaches for many motorists. Start the engine and let it idle. Pull the vacuum hose off the EGR valve nipple and attach the hand-vacuum pump hose. Pump up the vacuum until the gauge reads at least 10 inches. If there is a noticeable drop in idling speed, the EGR valve is in good shape. But if idling speed remains the same, replace the EGR valve; it's bad.



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may have a conventional fuel system problem. Check choke system and idle mixture adjustments. Make sure that the manifold heat control valve is operating properly. Ask your mechanic to adjust the idle mixture while watching HC/CO readings on an emissions analyzer. If idle emissions can't be reduced by adjusting the mixture, check for improper float adjustment, a leaking float needle valve and a leaking power valve.

■ If you can rule out all potential causes listed above, try installing the one-and-six plate.

Placing blame

For the past month or so, I've been going nuts trying to keep my 1979 Oldsmobile diesel engine operational. After driving for several hours and then parking for an hour or longer, I'm left with two completely discharged batteries. The batteries, which test out perfectly, are fully charged after each incident, and I get normal starting for about three days. Then, bingo—the same thing happens. The dealer has tested the entire electrical system and has given it a clean bill of health. Can you help?—George Place, Lincoln, Neb.

I'll bet the glow-plug relay has

shorted and is causing the batteries to drain. This has been a pretty common problem with the GM diesel.

If the glow-plug relay is not the source of the problem, you'll have to begin checking circuits with an ammeter until you find one that draws current when the car is shut off.

What a Cad

I recently wrote you for advice about trouble I was having with an extremely fast idle on my 1976 Cadillac Seville. Before you could answer, the problem was solved by the Cadillac agency. The choke heater had failed. This caused the choke to stay engaged, and the richer mixture that resulted produced the fast idling.

This is a Bendix part (No. 1181290) costing \$72.50. With tax and labor, the bill was \$88. But the problem is fixed. My dealer said he replaced three other choke heaters the same week he did mine.—Charles Naylor, West Newbury, Mass.

Thanks for the tip, Charles.

GOT A PROBLEM WITH YOUR CAR?

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

SERVICE TIPS

■ If your 1982 GM car has a 3.8- or 4.1-liter V6 Buick-built engine, and you hear a rod knock only when the engine's warm, your No. 2 and/or No. 5 exhaust valve seats may need remachining. To check, short out No. 2 and No. 5 cylinders. If the knock disappears, it confirms the condition. See your dealer.

■ Before you have a new head gasket installed in your 1981-82 Chrysler Corp. 225-cu.-in. engine (service bulletin 09-06-82), have your dealer read service bulletin 09-05-82. It warns that oil can leak from the engine through a faulty crankcase vent inlet air assembly. You may need a new assembly (part No. 4273322) installed. This problem has also surfaced in older cars with 225-, 318- and 360-cu.-in. engines. *

■ A new service manual covering repair and maintenance procedures for Toyota Corolla Tercels is available for \$19.95 from Robert Bentley Inc., 872 Massachusetts Ave., Cambridge, Mass. 02139.

■ A new coolant has been issued for the engines of Escort, Lynx, EXP and LN7. It's "mandatory" (Ford's word) that you use this coolant to avoid eventual radiator breakdown. Look for Ford specification No. ESE-M97B44-A and/or Ford part No. E2FZ-19549-A on the can. Aftermarket coolants labeled as okay for use in engines with aluminum components may also be used. This type of coolant may be used in all other engines, as well. **PM**

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HINTS FROM READERS

Broken sabre-saw blades



Don't discard your broken sabre-saw blades. Just chuck the blade in a pin vise and use it whenever you have a job that requires a small saw.—*Bob Berger*

Remove plating



One of the most convenient methods of forming threaded bosses and studs to metal plates is to weld bolts or nuts to the steel. Weld the nut in place and use it as a guide for running the tap drill through plate; use tap to match thread with nut guide.

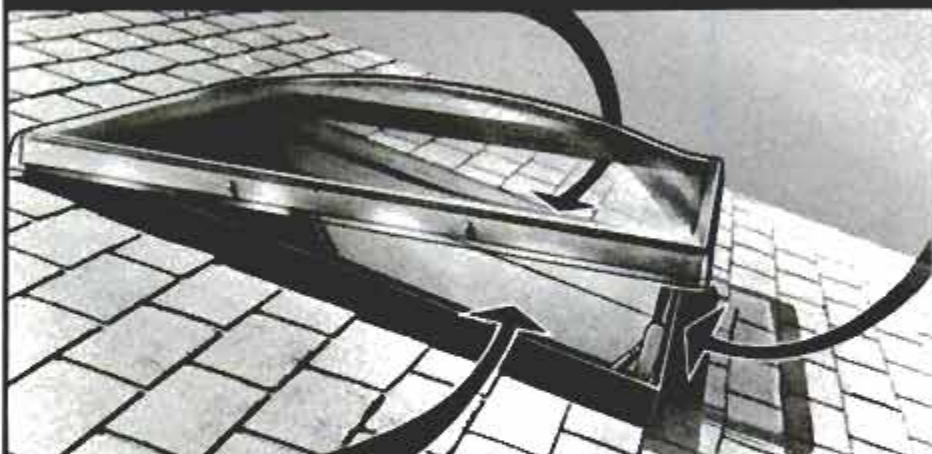
Unfortunately, most hardware stores carry only plated or galvanized nuts and bolts; these emit dangerous zinc or cadmium oxide fumes when heated with arc or torch. Not only are these fumes dangerous to the lungs, but the oxides often cause faulty welds.

To remove the zinc or cadmium and make the parts safe for welding, immerse them for a few minutes in a mixture of half muriatic acid (hydrochloric acid) and half water. When the plating is gone, rinse in clean water, and you'll have clean, unplated metal. Tie a string to the part for easy removal from the acid.

After the bath will no longer remove galvanizing zinc, save the solution. You can use it as soldering acid to flux steel for soldering.—*Parry C. Yob*



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HINTS FROM READERS

Removing rusted bolts



When you can't reach the nut on a rusted bolt with a tool, or the nut is so tight that it cannot be budged, here's how to remove the bolt. Detach the head, then use a punch, if the bolt doesn't fall out unaided. Remove a bolt head by boring through it with a bit about the size of the bolt body.

Boring a starting hole in a slotted head without breaking a twist drill is tricky. Here's how I bored a hole to remove 1/4-in.-dia. round-head bolts from a wrought-iron railing: I hacksawed a second slot at a right angle to the original one. With a ball-shaped, 1/4-in.-dia. rotary file in a portable drill as shown, I made a cup-shaped depression, more or less centered, in the bolt head. (The file wasn't grabbed by the slots as a twist drill would be.) Then it was easy to bore a pilot hole in the bottom of the depression, using a small-diameter bit, and enlarge the hole to the desired size with larger bits. If you bore the hole off center, use a punch to drive the bolt out; the head usually breaks off in the process.—*Walter E. Burton*

Tightening loose screws

You can tighten a loose wood screw by wrapping it in adhesive tape and then reinserting it.

—*Robert Slade*

Doubled-up sandpaper

I put two pieces of sandpaper in my handheld sander. After the first is dull, I uncover the fresh sheet. On small jobs, I make the second sheet a finer grit for finish sanding.—*Morrow Olcott*

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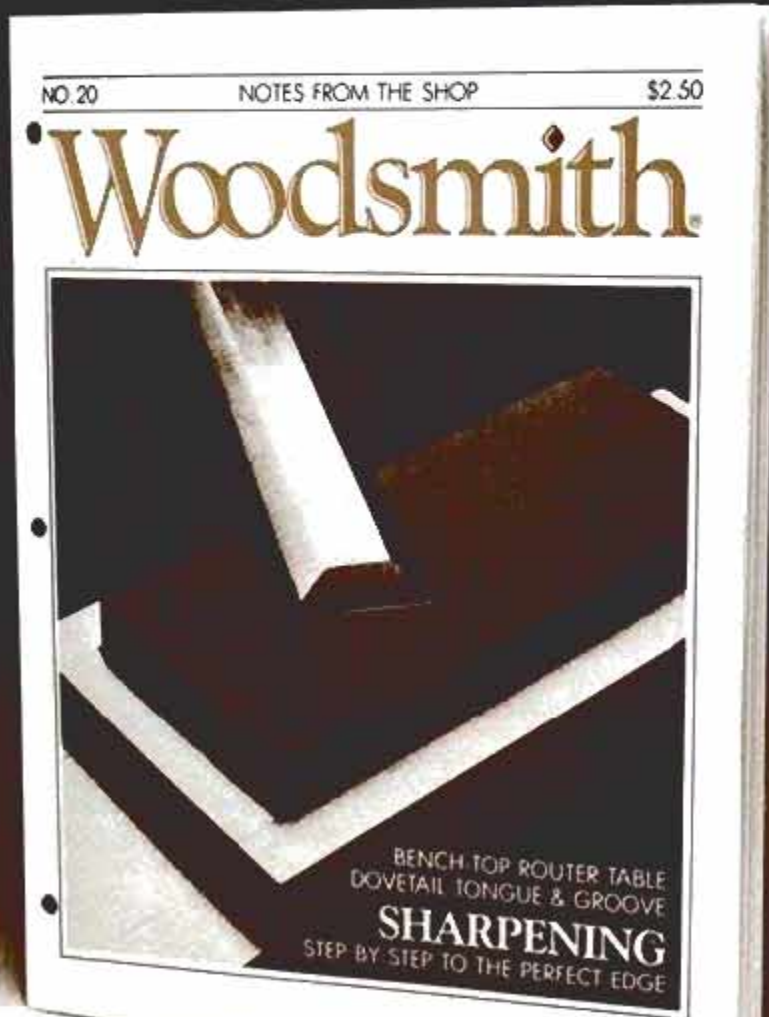
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HINTS FROM READERS

Fitting tubing on round stock



Don't be stumped by this problem . . .



Cut tube at 45°; lead with lower lip . . .



Then, pull on the tip of the tubing.

The next time you need to stretch tight-fitting tubing over the end of a pipe, try this trick: Cut the tube end off at 45° and press the inner, lower lip over the pipe first. Then, pull on the tip of the tube. If the fit is quite tight, warm the tubing and simply apply soap suds before you insert the pipe.

—C.E. Janeke

Positioning a cotter pin

Before attempting to seat a cotter pin in a tight hole, insert a small nail through the pin eye. This lets you tap on the pin without bending the eye out of shape.

—Lane Olinghouse

PHOTO HINTS

In the shade



Though ready-made lens shades are inexpensive, the light, plastic base from a soda bottle can do the same job. Spray inside with flat, black paint to stop reflections.

—Gene Hennessey

Safelight viewing



Most amateur photographers lack a full-size light table, but still need even illumination to inspect negatives. Stretch a piece of white plastic over your darkroom light after removing the lens. Secure it with a lens-retaining ring and you're set.—A. Weber

Film washer



Get the most from wash water by directing it into a plastic funnel set into a film reel's center hole. This forces water to the bottom of the tank instead of just splashing onto top surfaces.—A. Weber

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HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Sealing an inside brick wall

A year ago, we purchased a 100-year-old house; the upstairs bedroom and bath have double, exposed-brick walls. I don't believe bricks were fired well in those days, since these are very soft and porous. We would like to seal them to prevent further decay, and also to prevent the residue from coming off on anything that touches them. I want to preserve the red color of the bricks (some sealed bricks that I have seen turn yellow). Any suggestions would be appreciated.—Barbara E. Gummo, Parowan, Utah.

My top-notch authority on bricks and their use has run across an almost identical case in southern Georgia. He found that the deterioration was due to the moisture coming through from the outside. (This migration of salts from outside to inside, which then forms a whitish powder through loss of water of crystallization is called efflorescence.)

In this case, the mortar was soft, so the homeowner had to paint the holes and cracks. Once the moisture was prevented from passing through the wall, the brick deterioration stopped.

If the exterior bricks themselves are porous, apply a sealer on the outside only (see *Homeowners' Clinic*, "Porous Brick Wall," page 6, Aug. '81). If you seal the inside surface, you'll trap the moisture within the wall. If you have stopped the moisture from passing through from the outside, and would still like to "coat" the inside, use a waterproof coating. One such product is White Roc 7 from Sonneborn Contech, Building Products Div., 7711 Computer Ave., Minneapolis, Minn. 55435. It can be sprayed, rolled or brushed on. This will allow the interior surface to breathe, while stabilizing the face of the brick.

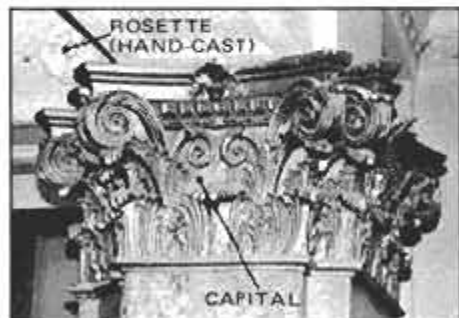
Powdering plaster walls

My two-family house has a front hall under a sun porch that has leaked on and off, for years. The house has plaster walls and ceilings, with plaster cove molding at the wall-ceiling joint. The plaster has become very powdery; every time I try to apply compound, the compound rolls right off. Have you any suggestions on how to correct this problem in my 60-year-old house?—Peter Moeschel, Long Beach, N.Y.

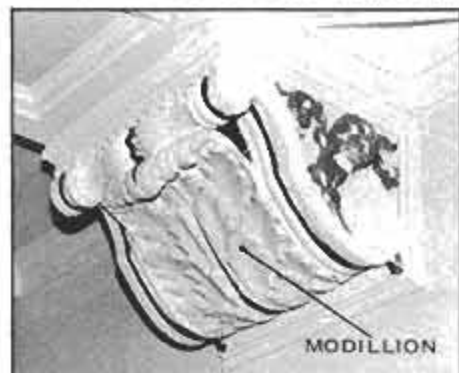
After observing the professional plasterers working on the trim and

molding on the restoration of the Seelbach Hotel in Louisville, Ky., I realize the artistry that can be achieved with plaster (see photos). If you're certain that the leak has been repaired and the wall is dry, these professionals advise the following:

Instead of using quick-setting joint compound, use a mixture of 60-



Restoration of the Seelbach Hotel involved extensive plaster repair to the 75-year-old trim. Note the detail in the capital, rosette (above) and modillion, the ornamental block or bracket under a cornice (below).



percent molding plaster and 40-percent mason's lime. Molding plaster sells for about \$10.50 per 100-pound bag, and is usually available at lumberyards. (Art students also use it for modeling.) The addition of lime makes the mix more pliable.

My advisers caution that the mix must set a bit before you "strike" the cove. As you'll have ample plaster, I suggest you "try" a few coves in your shop, prior to attacking the problem area. Be sure to use mason's lime, not the type of lime that is used on lawns and gardens.

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

Shrinking floors

My flooring consists of 1/2-in. tongue-and-groove plywood subfloor, covered with 1/2-in. particleboard underlayment. The finish floor is Armstrong Solarian. I installed a wood stove on a heat pad over this floor, after leveling and bracing the floor system. During the winter, the finish floor started to show cracks where the underlayment joints were formed. These cracks appear to close up in the summer. Could the heat be causing the particleboard to shrink? If so, what can I do to correct it?—Randy Dixon, Taylorsville, Ky.

It's not the heat, Randy, it's the humidity—or rather, the lack of humidity.

The experts at both Armstrong and The Wood Burning Lab at Auburn University tell me that outside winter air is drier than moist summer air. The air is used for combustion; its very dryness is causing the underlayment to shrink, which allows the joints to "read through" the finish floor.

Both authorities suggest that you add humidity to the room. Either add it by keeping a bucket filled with water on the stove (as Grandma did); or, if that doesn't provide enough moisture, install a humidifier. One caution: Place the bucket so that it can't tip over and burn someone with hot water.

Furnace conversion

The house I just bought has an oil-burning furnace. Is there an economical way of changing this furnace to burn wood?—Tim Reisenaner, Kennewick, Wash.

The size of the fire box, adaptability for the installation of grates and lack of access doors are only a few of the reasons why such a modification isn't practical or safe. My consulting mechanical engineer advises that if your oil burner isn't designed for conversion to a wood burner, don't attempt it.

PM



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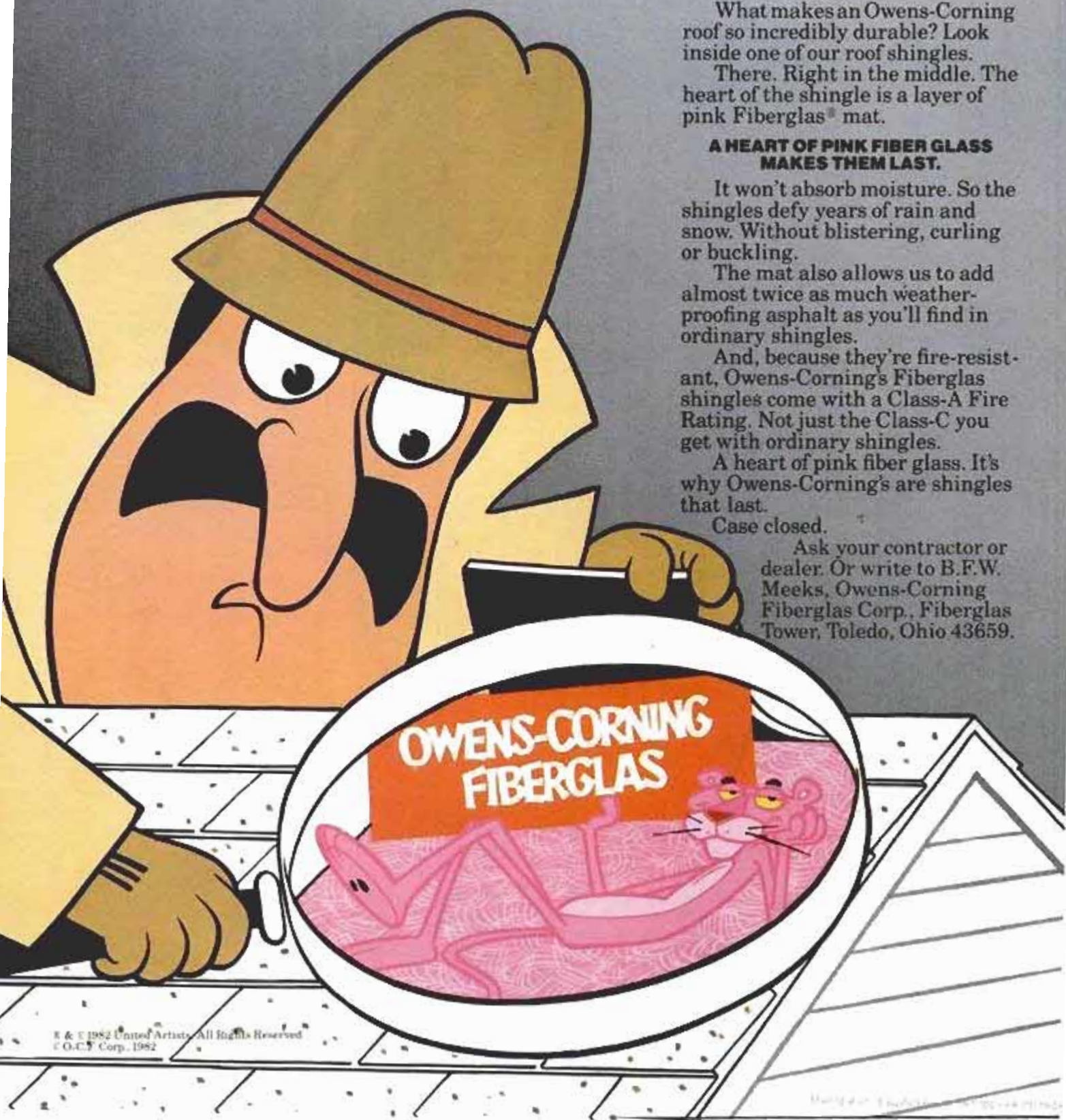
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This back-lighted, stained-glass display is a handsome accessory, as well as a source of low-level lighting.

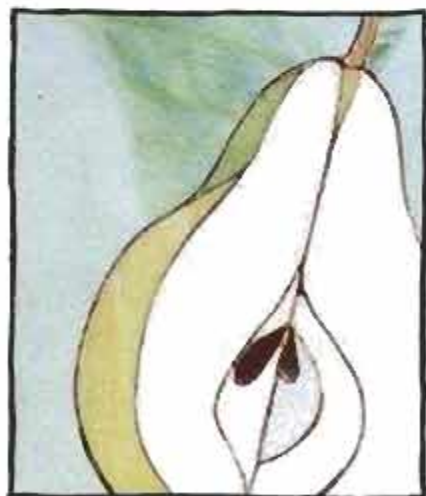
by George Sell

The clean, classic design of this back-lighted, stained-glass panel looks at home in a variety of contemporary and traditional settings. Hung on a wall or placed on a table, the illuminated panel gives off a mood-setting glow.

In addition to the stained-glass apple design, we supply patterns for making the pepper, orange and pear glass panels shown here. Choose one design, or make interchangeable panels—they slide in and out of the light box in seconds.

Before you begin work, assemble

[\(Please turn to page 120\)](#)



Stained-glass apple, framed in ash wood, glows above a rough-hewn table. Alternate stained-glass panels (right, top to bottom) are pepper, orange and pear.





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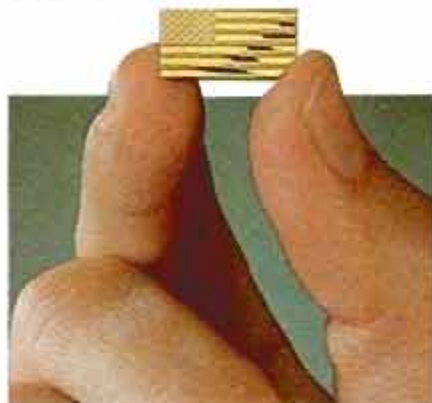
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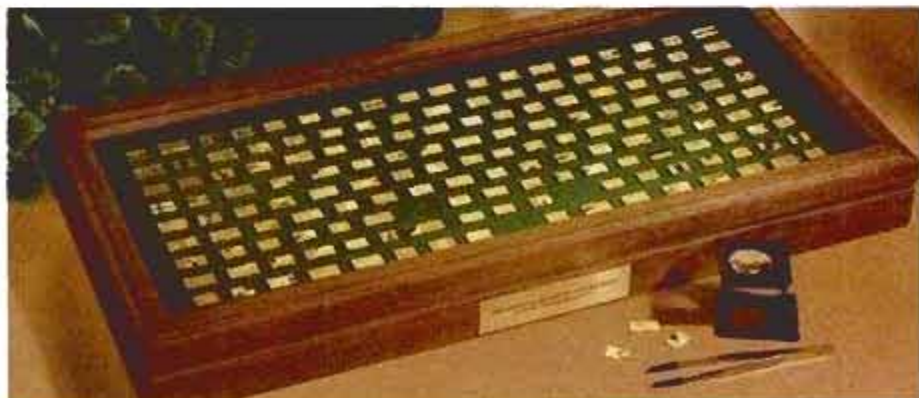


Miniatures above shown actual size.

So that you can immediately study each flag in all its fascinating detail, a special magnifying glass and a pair of collector's tongs will be included with your first group of miniatures. And, to house and display your complete collection, a custom-designed collector's case will also be provided as part of your subscription.

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IPM BRIEFS



PM's Whatsit

You'd like to see the flea that would survive this collar? So would we. But this is a different kind of canine accessory. See next page for the details.

I fell for it

A Swiss company called Intamin makes it. The Six Flags Over Texas theme park in Arlington opened it first, followed shortly by Six Flags' Magic Mountain park near Los Angeles. I had the bad sense to be the first journalist to try it out, along with Hollywood stuntman Dar Robinson.

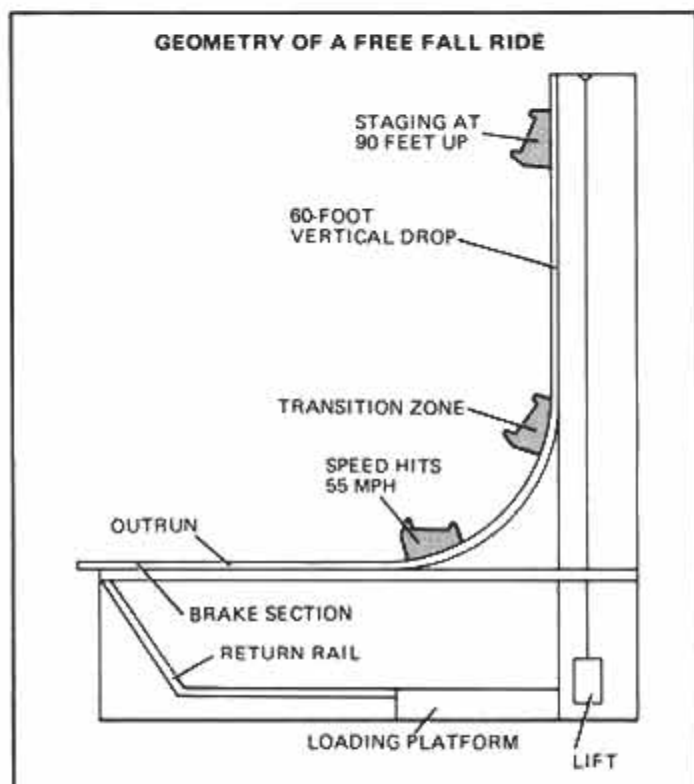
It's what its maker calls the Free Fall ride, the newest way to find out if the pit of your stomach is alive and well (see *Screamers*, page 111, July '82). Ride designers have known for a long time—and Intamin is a leader in the field—that height and speed are somewhat meaningless numbers when it comes to how the public will actually react to a new thrill machine. It's the geometry that counts. And straight down is absolutely the most thrilling way to fall.

A fast lift shoots four riders (per car) to near the top of a 128-foot tower, where they are then staged a few feet forward, so that rollers at the top and bottom of the upright car are placed in a vertical track. A bell sounds for each of five seconds, then...you just drop. Instant zero-G. The vertical fall is about 60 feet, then the car begins following the rail into a transition to a horizontal outrun. You're still accelerating, though, and you'll hit about 55 mph in less than 2.5 seconds. On your back then, staring at the clouds (if you keep your eyes open), you zoom into an 86-foot braking section. Air pressure regulated by sensors that measure the speed of the car every two feet closes the brakes for a smooth stop—but you'll still pull about 3.5 Gs.

That just describes the mechanics; after the first of five cycles on the Texas Cliffhanger (as Six Flags has branded the initial

version), I was surprised to find Dar Robinson visibly moved by the experience. The man who has jumped 14 stories into an air bag—Hollywood's stunt record—explained: "I never go off feet first. This is something different because you feel you have no control at all!"

He didn't have to tell me. After five rides, I knew that even another 500 wouldn't produce total acclimatization in your faith-



PM Technology Editor Robin Nelson with Dar Robinson (right) on the Texas Cliffhanger. Stuntmen never go feet first, says Dar.



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Clear Your Home of Mice, Rats, Roaches and Other Pests--and Keep Them Out!

SCRAM™ is a home-size version of the commercial pest control device that's safe for people, pets and the ecology. Try it in your home for 30 days.

They don't call them pests for nothing. Bugs and rodents can make life miserable. And the warmer it gets, the more creeping, crawling pests show up in your home. Traps, sprays and poisons seem to have little effect . . . and professional exterminators don't come cheap. But now you can eliminate troublesome pests and keep them out thanks for new ultrasonic SCRAM.

The electronic SCRAM unit doesn't kill rodents or insects--it repels them. Early laboratory research showed that ultrasound was effective in modifying the behavior of mice and rats.

As exterminators began using ultrasonic sound to control rodents, other studies indicated that certain frequencies affected the behavior of insects, too. Now, professional pest control companies acknowledge the usefulness of ultrasonics in controlling certain rodents and insects.

UNIVERSITY TESTED

The heart of this new, electronic marvel is a special quartz crystal speaker. It enables SCRAM to emit ultrasonic sounds that only pests can hear.

These ultrasonic frequencies "attack" the auditory and nervous systems of rodents and certain insects causing pain and discomfort.

SCRAM is effective in repelling:

Mice	Rats
Roaches	Carpenter Ants
Crickets	Silverfish
Water Bugs	Locusts
Fleas	...and many other pests

Note: In spite of some claims, studies show that ultrasound is not effective in controlling bats or spiders.

The pests are forced to abandon the covered area and will not return while you continue to use SCRAM.

A leading university tested SCRAM as absolutely safe for humans and pets. And since there are no poisonous chemicals, the ecology is not harmed in the slightest.

The ultrasonic output is above the hearing range of humans and household pets, so SCRAM is safe for use anywhere. It will not interfere with any electronic burglar alarms, fire or smoke detector, TV reception or other electronic equipment.

SET UP A BARRIER TO KEEP PESTS OUT THIS SUMMER.

When you get your SCRAM you'll begin to notice some results in a few days. In two to six weeks your infestation will be eliminated. Then continual operation of your unit will prevent further nesting and inhabitations.

JUST PLUG IT IN.

There's no installation with SCRAM. All you do is plug it into any 110-Volt AC outlet. The solid-state electronics and quartz crystal speaker require only 5 watts of power--just pennies per month--and it's maintenance free.

Put SCRAM anywhere: home, apartment, store, warehouse, or factory. It's the perfect answer for facilities where food is stored or handled such as schools, hospitals, and nursing homes.

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SCRAM is state-of-the-art technology. Un-

til now, commercial units used by professional pest control companies cost up to \$200--but lower cost solid-state components allow SCRAM to give you the same pest repelling power for only \$49.95 (plus \$2.85 shipping and handling). Now there's no need to empty messy traps or buy poisonous chemicals again and again.

TRY IT FOR 30 DAYS WITHOUT RISK.

We urge you to try the SCRAM unit for 30 days. If you don't see proof that it is the most advanced, efficient pest eliminator available today, return it for a complete, no-quibble refund--including return postage. You are protected by a one-year manufacturer's warranty as well as Shelburne's 26-year reputation for satisfied customers.

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IPM BRIEFS

ful correspondent. Six Flags has exclusive rights to Free Fall for a year, but Intamin president Kurt Lucas hinted that, typically, rival parks are lined up already to buy a "higher and faster" model. The increments may make for good ballyhoo, but it will

need a lot more braking outrun as well—and it's really the first few feet of drop that do the job. At about a \$2 million cost to the park, the ride is far less expensive than looping roller coasters. And nothing beats it from 0 to 55. —Robin Nelson



Whatsit revealed

This on-duty watchdog is wearing body armor. It's made with layers of Dupont's Kevlar by a British firm, Production Versatility Ltd. of Winborne, in Dorset. It's light enough to allow the dog comfort and freedom of movement, but will stop a .38-caliber bullet at point-blank range, according to the manufacturer. Jackets must be made to measure for individual animals.

Possible candidates for the new uniform include the valuable dogs that have been trained to sniff out drugs and explosives. One such dog, employed at a European air terminal's security station, was said to have recently received a death threat by mail. **PM**



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Build PM's Delivery Wagon

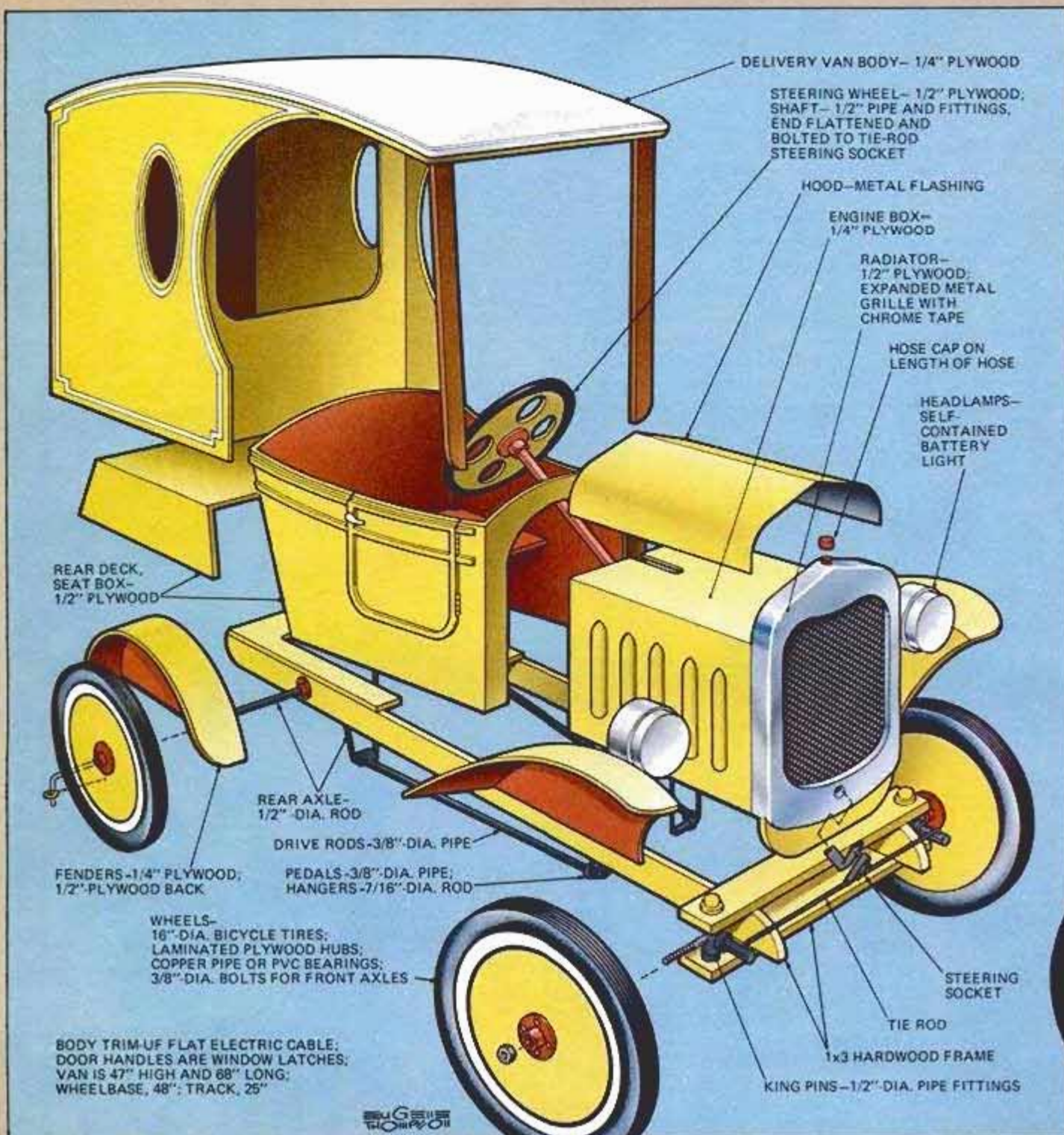
We received enthusiastic response to our plans for a pedal car that readers could build themselves (*Build The GT8*, page 124, June '80). Interest in pedal cars developed more than seven years ago along with interest in the motor-powered Mini-Indys (*Build The Mini-Indy Racer*, page 36, Aug. '75, and *Build PM's Mini-Indy II*,

This wagon converts to a dump truck or roadster. Kids'll never be bored with a play vehicle as versatile as this one.

page 110, May '78). This delivery wagon is made of laminated plywood. The plans are simple and the instructions are easy to follow.

The greatest challenge in pedal-car design is the wheels. The delivery van requires lightweight, old-style wheels that are both sturdy and reasonably priced.

Designer Peter Stevenson met this challenge by choosing standard bicycle hubs to use in the wheels; they produce an almost friction-free rolling wheel. Other parts for the



cars are generally available in hardware stores and home centers at low cost. The designer estimates that the total construction cost for the wagon should be around \$100.

The newest addition to our minipedal line, PM's Delivery Wagon, converts to either a pickup/dumpster or a roadster. The pickup/dumpster unit is attached with two hinge pins

and the delivery van hooks up with two wingnuts and two screws. The body trim molding is UF (underground feeder) electrical cable. Louvers on the hood are quarter rounds with the ends rounded. The handsome grille is expanded aluminum screen door protector.

The kids will think the neatest feature is the removable radiator cap.

It is really a hose cap attached to a length of hose that is open at the bottom. It will take all the water the little guys want to add.

Ordinary butt hinges are used on the doors in combination with a window latch. Headlights (self-contained battery lights) are a new accessory that will also be very popular with the kids. And the lights are a great safety feature if play sessions continue after dark.

The plans (see below) include a materials list to make shopping easy. It's possible that you already have many of the parts around the house. This will let you build the car for well under the estimated cost. **PM**

HOW TO ORDER PLANS
Complete plans for the PM Delivery Wagon, including how-to-build instructions and materials list, are available for \$9.95, which includes first-class postage and handling. Send check or money order to Delivery Wagon, Stevenson Projects, Box 584 PM, Del Mar, Calif. 92014. Canadian residents please remit in U.S. funds.





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It's hard to believe this is the lowest-priced truck sold in America.

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Not one of these features is available on Toyota's or Datsun's lowest-priced truck, each of which costs hundreds more.

Just one look inside the cab and you'll see more of the Mazda B2000's exceptional



value. There you'll find a three-passenger seat detailed in textured vinyl. New instrumentation with electronic check panel. And handsomely trimmed door panels complete with armrests.

You can also believe this

truck is built to haul a heavy payload—1400 pounds of it. Even so, its 2-litre, 4-cylinder engine delivers outstanding fuel economy.

38 **27** .. If you still find it all a little hard to believe, we invite you to visit your Mazda dealer for a close-up look at the B2000 Sundowner.

Seeing is believing.

MAZDA

The more you look,
the more you like.

*Manufacturer's suggested retail price for B2000 Sundowner Shortbed. Actual prices set by dealers. Taxes, license, freight, options and other dealer charges extra. Prices may change without notice. Availability at dealers of vehicles with specific features may vary. **1982 EPA estimates for comparison purposes for B2000 Sundowner Shortbed. Your mileage may vary with trip length, speed and weather. Actual highway mileage will probably be less. Calif. 36 Est. hwy. mpg, 26 Est. mpg.

NEW SKY SPIES FOR KILLER HURRICANES

Hurricane hunters this year are relying on new aerospace technologies to help watch for a vicious killer that's statistically overdue.

by Marc Stern

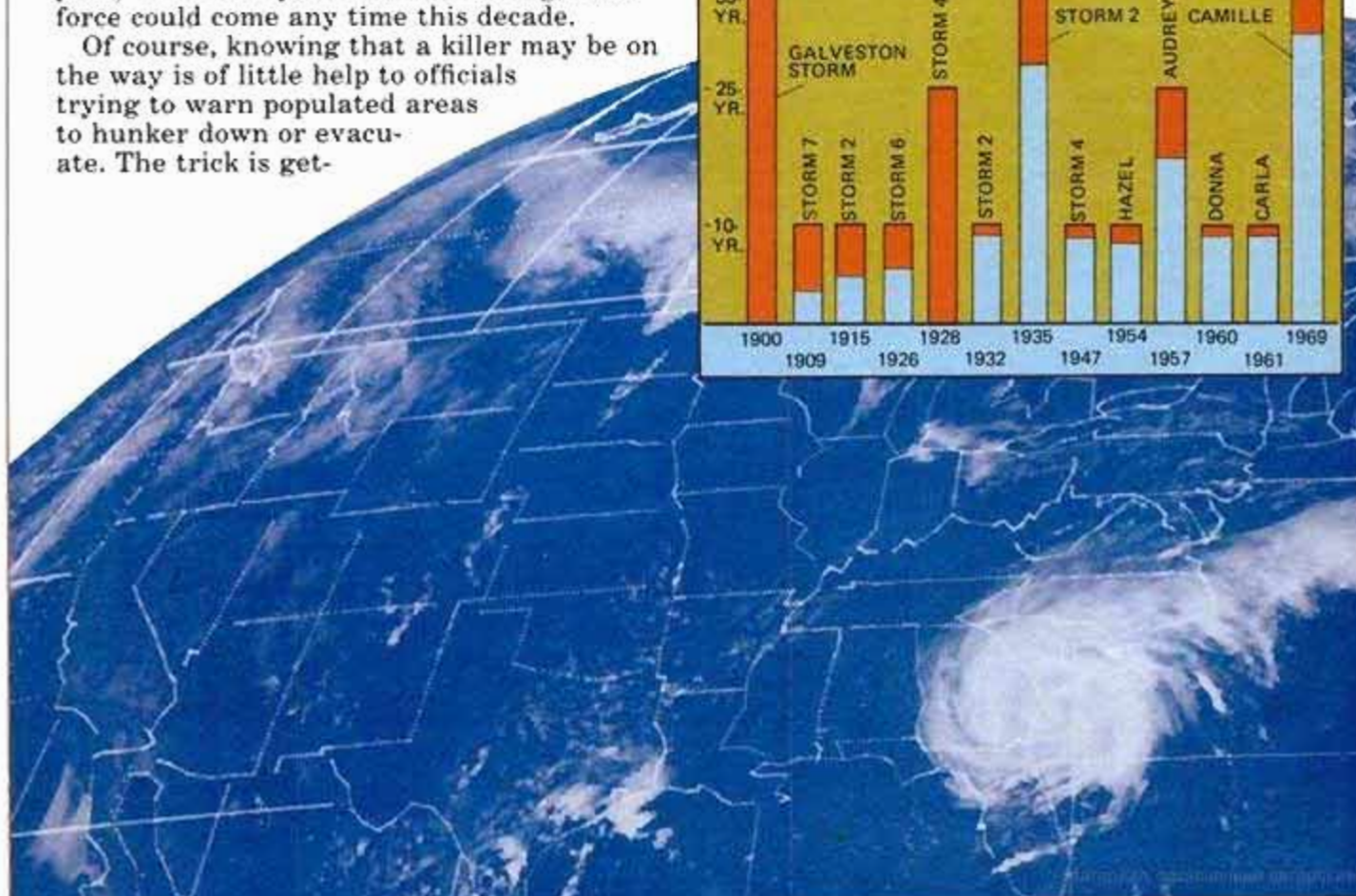
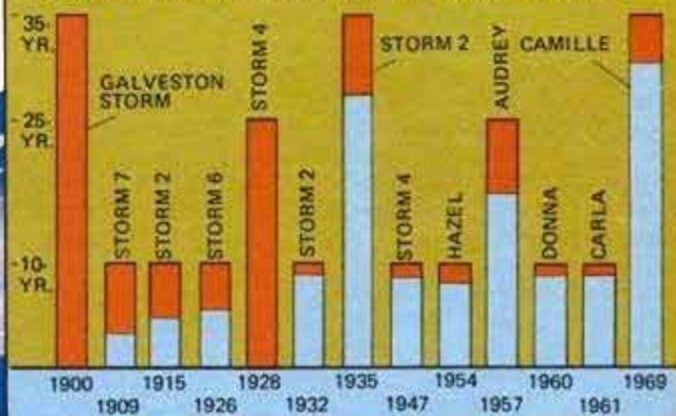
The trigger is cocked and there's tension in the air as America's meteorologists look down the barrel of a killer hurricane—the kind that strikes with murderous force approximately every 10 years. Even worse, there are the superkillers that touch down on land about every 25 and 35 years. No killer storm—of what meteorologists call “Force Four” or “Force Five” strength—has struck the continental United States since 1969, when Hurricane Camille cut a path from Mississippi to Virginia, leaving in her wake 255 dead and more than \$1 billion worth of destruction. Statistically, a 10-year storm of similar magnitude is overdue this year, while a 25-year storm of even greater force could come any time this decade.

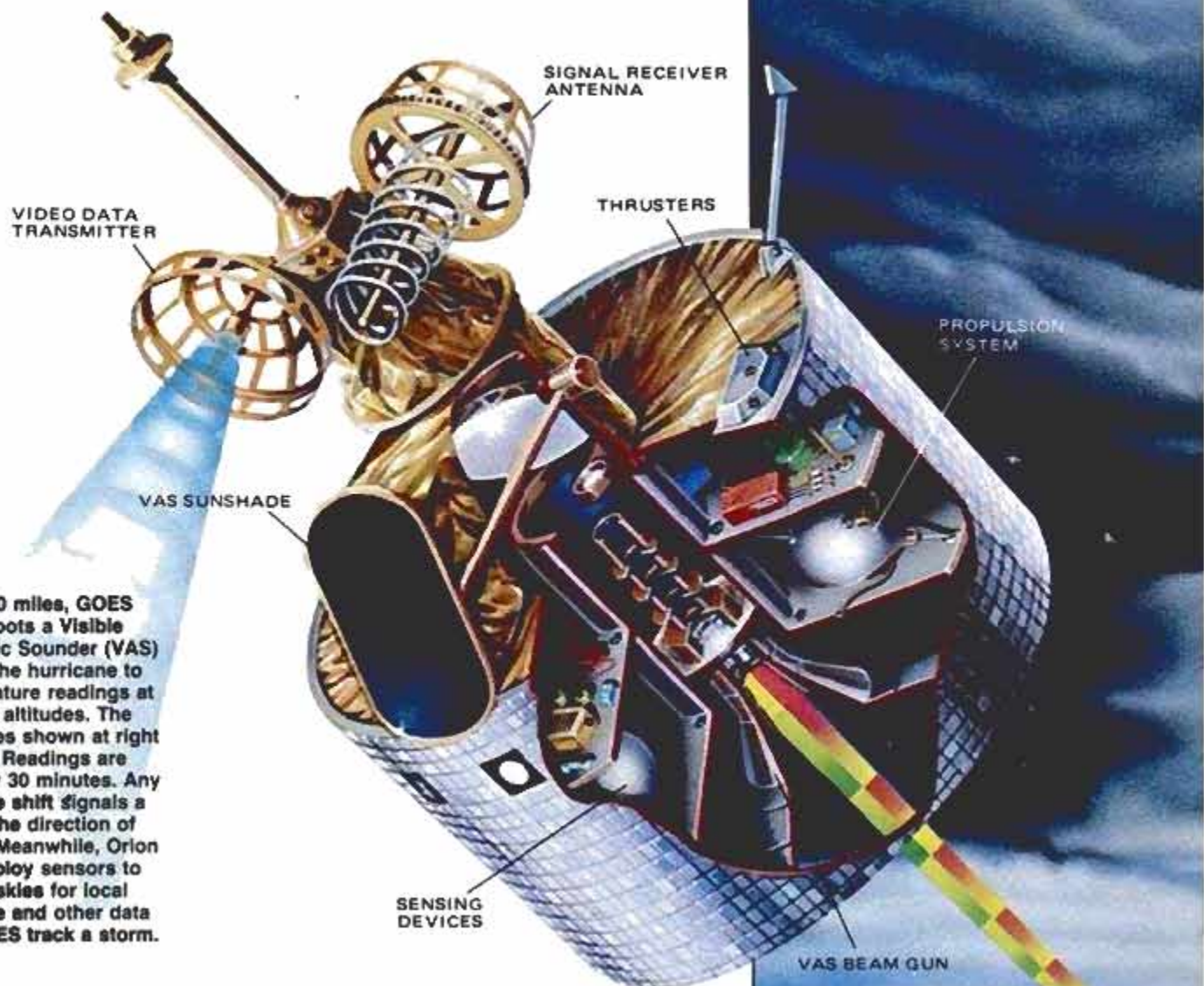
Of course, knowing that a killer may be on the way is of little help to officials trying to warn populated areas to hunker down or evacuate. The trick is get-



PHOTO: Robert C. Sheets

Hurricane Frederick, too weak to appear on storm graph (below), still wracked Louisiana (above) in 1979. Graph-bar heights show relative force and frequency: 10, 25 or 35 years. Red areas show relative number of deaths. In 1928 storm 4, there were 1,836 deaths; in Galveston, 6,000.





From 22,000 miles, GOES satellite shoots a Visible Atmospheric Sounder (VAS) beam into the hurricane to get temperature readings at a variety of altitudes. The temperatures shown at right are typical. Readings are taken every 30 minutes. Any temperature shift signals a change in the direction of the storm. Meanwhile, Orion aircraft employ sensors to sweep the skies for local temperature and other data to help GOES track a storm.

ting a fix on the hurricane at least a few hours before it strikes, giving people in its path a chance to clear out. With the latest additions to its satellite and computer arsenal, the National Oceanic and Atmospheric Administration (NOAA) feels better prepared this year than ever before.

Up in space, the NOAA Geo-Stationary Satellite GOES-E, launched in May 1981, has standard optical photographic equipment that creates the weather maps you see every night on TV. But it also packs a brand-new piece of hardware called a Visible Infrared Atmospheric Sounder, or VAS. Turned on and off a few times for tests in its first year of orbit, VAS has been put to work gathering data this hurricane season for the first time. VAS shoots an infrared beam from its earth-stationary orbit 22,000 miles aloft through the cloud bank below. The beam bounces back to GOES-E, and is analyzed by an on-board computer. Then GOES-E signals an earth station with the temperature and moisture content of the hurricane's body taken at various altitudes.

Temperature shift is the key to predicting the path of a big storm hours in advance. As thermometer readings move up and down at various heights, winds change direction and pick up or reduce speed. In the past, using a cloud photograph, meteorologists could deduce only general differences in temperature and moisture, based on areas of darkness (high moisture) on the weather map. But the VAS beam penetrates the cloud bank and gives accurate temperature readings for specific areas. The beam sweeps wide areas of the map as GOES-E rotates in orbit, providing a complete U.S. profile every 30 minutes. Federal officials are banking on just such data to save hundreds of lives.

In the early hours before a hurricane strikes with full force, it sends before it a "storm surge" that increases the height of coastal waves and churns up violent winds. A Force Four storm surge can convert 5-foot coastal waves into 18-foot giants. In a Force Five hurricane, such as the one that killed 408 people in Florida in 1935, the surge-powered waves rise to 25

(Please turn to page 102)



30,000' (-20° F.)

20,000' (23° F.)

10,000' (48° F.)

5,000' (62° F.)

SEA LEVEL (78° F.)

ORION
SENSORS

GROUND
COMMAND
RECEIVER
ANTENNA

PM art: Jeff Mangiat

Calculator Or Computer—Which Should You Pocket?

There are many programmable calculators on the market and new pocket computers, too. Here's how to decide which type is best for you—and then, what models are the ones to consider.

by Herb Friedman

Though we tend to think of microcomputers in terms of desk-top models, such as those from Apple, Commodore, IBM and Radio Shack, in actuality, we often don't need the tremendous computer power or memory built into such full-size computers. Many tasks we think of as requiring a personal computer can be handled, just as easily, at far less cost, with a programmable calculator—or one of the new pocket computers.

For the engineer calculating street grading while standing on a mountain of dirt, anything that will solve simple math problems will be satisfactory; he doesn't need a cassette or disc storage system. On the other hand, there's the salesman who, 20 times a day, must figure out the cost of cartons needed to ship a few million widgets or a hundred gizmos. His big need is for something that will remember, from one customer to the next, the program steps that calculate the cost of the cartons.

Radio Shack
TRS-80 Pocket Computer-1



How do you decide whether you need a programmable calculator or a pocket computer? To make that choice, you must first understand their differences.

The modern programmable calculator is actually a computer; the two differ mostly in the way the program is entered by the user. In the case of the programmable calculator, the programming is entered in keystrokes, just as if the problem were being solved directly for the first time. For the pocket computer, the programming is generally written in BASIC, the same language used for desk-top computers.

Programmable calculators and pocket computers come in all types and styles, providing everything from a convenient way to "remember" an ordinary arithmetic program to the nearest thing to a "full-blown," desk-top personal computer, complete with Microsoft BASIC.

Early models of the programmable calculator were simply "scientific" calculators that

could remember the key sequence used to enter the original formula or numerical data. Once the program was *learned* by the calculator, the user needed only to enter the new variables for each run—not the entire program. The early programmable calculators could also be programmed to test values, compare results and even branch to a different routine as a result of the tests and comparisons. If this sounds like a computer, that's just what it is—a small computer that happens to be programmed by mathematical function rather than by a BASIC program.

The pocket calculators

Many modern programmable calculators, such as the Hewlett-Packard HP-11C, have non-volatile *continuous* memory, meaning that even when the calculator is turned off, the programming is remembered until cleared by the user or written over by a new program. Continuous memory is maintained by providing continuous

Four units below and others cited in text represent the leading edge of technology made small. The Radio Shack TRS-80 Pocket Computer-1 (shown inserted into optional printer) speaks BASIC and is simple to program, with an alphanumeric display for words, as well as numbers. Hewlett-Packard's 41CV is a conventional programmable calculator which features a word-handling alphanumeric display and the ability to hook up to added memory and cassette-based data storage. The 11C, also from Hewlett-Packard, is one of latest, thinnest portables. Texas Instrument's 59 calculator is programmed by magnetic cards and it attaches to a variety of optional devices.

Texas Instruments 59 Calculator

Hewlett-Packard 11C Calculator



power to special memory cells that draw so little current there is essentially no effect on the life of the batteries.

While the programmable calculators are inexpensive and convenient, their use is somewhat limiting when it becomes necessary to change the program in memory, because the program must be keyed in one step at a time. (Though it's possible to store several small programs in a budget-priced programmable calculator, there isn't all that much memory available to begin with.)

For those who need more than just a calculator that will remember the user's program, there are programmable calculators that are really full-scale computers.

There are many options available with these models. Some have plug-in memory modules, so that you can enter very long and involved programs. The HP-41C and others in that line from Hewlett-Packard now feature this option.

All of the higher priced programmables, such as the TI-59 and HP-41C have printers that attach for hard-copy printouts of programs or data.

And, depending on the model of calculator, there are various ways to store a program so that you have to keyboard-enter it only once. A few such systems store data on magnetic cards, cassette tape or even in printed bar-code form (as on a grocery package) to be read by a light pen. Or prewritten programs are available on plug-in program modules.

Program memory

The program module provides the most convenient way to program a programmable calculator. All but the most basic models make provisions for the module, though it might be called by some other name. The program module is a small plastic "cube" that fits into a socket built into the calculator (see photo at the end of this story). It is a factory-programmed ROM (read only memory), containing many programs on the same general subject. Simply pressing a few calculator keys causes the program module to load the desired program automatically into the calculator's memory.

Program modules are available for many subjects, including general business, mathematics, financial planning, all engineering disciplines, aircraft navigation, real-estate management, home-construction estimation, heating and ventilation and even recreational

FEATURES OF THE POCKET MACHINES

	Programmable Calculator				Pocket Computers		
	HP-11	TI-58	TI-59	HP-41	PC-1	PC-2	HHC
Battery backup memory	•			•	•	•	•
Plug-in memory				•		•	•
Numeric display	•	•	•	•	•	•	•
Alphanumeric display				•	•	•	•
Keystroke programming	•	•	•	•			
BASIC programming					•	•	•
Plug-in programs (ROM)		•	•	•		•	•
Mag card storage			•				
Accessory mag cards				•			
Cassette storage				•	•	•	
Accessory printer		•	•	•	•	•	•
Price	\$135	\$115	\$250	\$250	\$160	\$280	\$595

games. Many users could probably rely solely on programs available in a program module.

For those who need to write their own programs, or who must store data developed through a module or a custom-written program, some of the programmable calculators feature storage on a small magnetic card. The *mag card* storage system can be built into the calculator, as in the Texas Instruments TI-59, or it can be an optional plug-in accessory, as it is for the Hewlett-Packard HP-41.

Programs are also available as "listings" that can be typed in by the user. Some of these programs are available in books, which are reviewed in this month's *Electronics Monitor*.

The HP-41 is one of the very latest of the programmable calculator designs. It features an alpha entry and display (letters, numerals or characters). The alpha mode allows the user to program English language "prompts," which are requests for information.

For example, if the user wanted to run a program to calculate compound bank interest, he could call up the program by entering the word INTEREST, rather than a series of numbers. Similarly, the prompts would ask for the desired information directly, and the display might indicate PRESENT VALUE when the program was asking for entry of the amount of the deposit. The answer might be labeled FUTURE VALUE.

Among other "computer" features of the HP-41 are four input/output "ports" on the rear that can be used for memory expansion modules, a magnetic card system, a light pen for reading bar codes or

a combination printer and plotter.

The precise features available in a programmable calculator depend on the price and the specific model.

The pocket computers

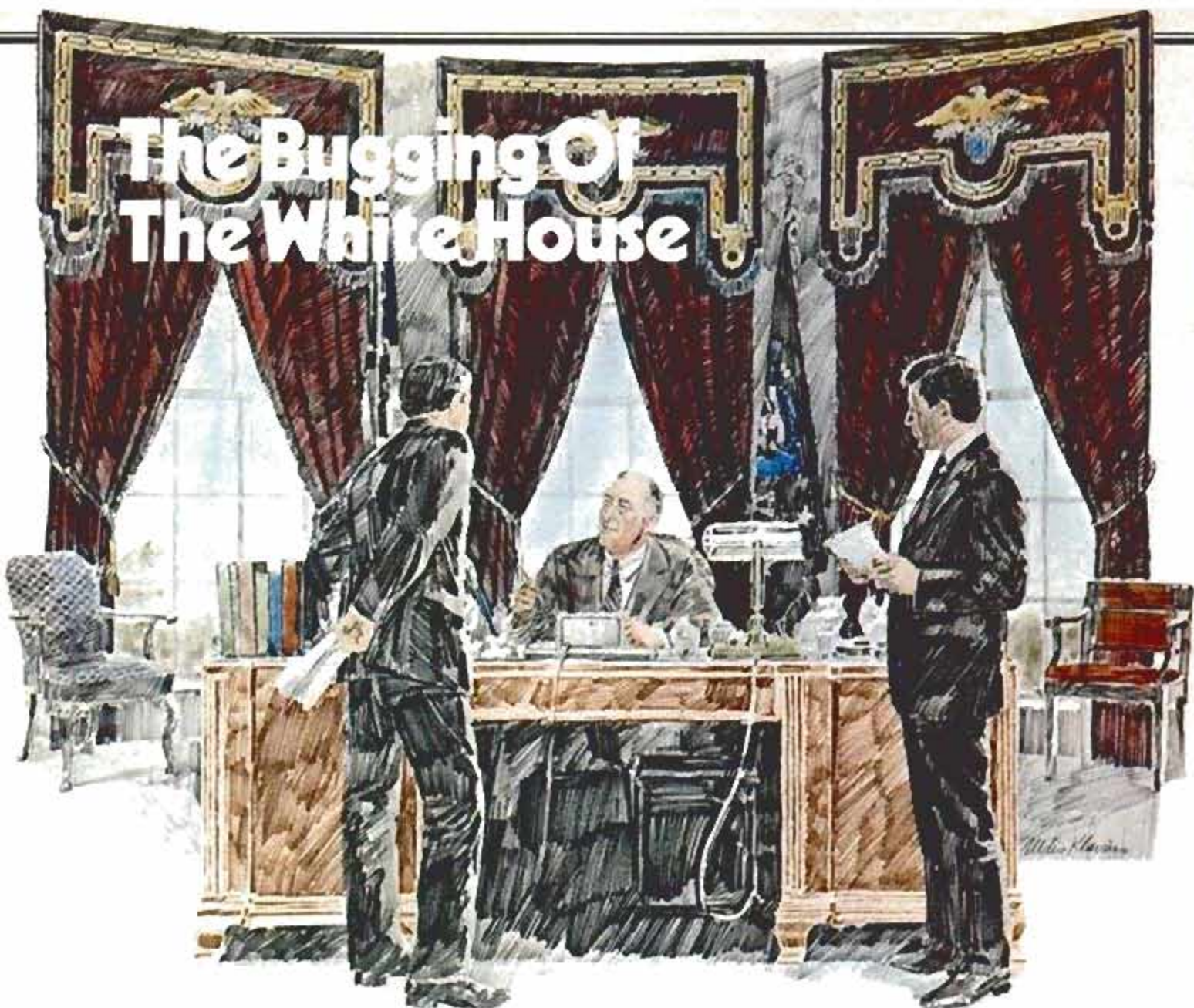
Unlike the programmable calculator, the pocket computer has a more-or-less standard, typewriter-style keyboard and is programmed in BASIC, the common language of personal computers. (To be more precise, the pocket computers *presently available* are programmed in BASIC; future pocket computers might provide for other languages.) The sophistication of the BASIC depends on the computer's model and price. The levels range from an elementary version of BASIC to an Extended Microsoft BASIC as powerful as you might expect to find in an advanced desk-top computer. The pocket computer also functions as an elementary scientific calculator, providing the four arithmetic functions of multiplication, division, addition, subtraction, and, perhaps, square root, powers and the value of pi. All the other scientific mathematical functions are provided through the BASIC, as they are for desk-top computers.

Depending on the model, a pocket computer can display a single line of up to 24 characters. The more advanced models can also display symbols and bar charts in addition to alphanumeric characters.

The original BASIC-programmed pocket computer was the Radio Shack PC-1, which is manufactured by Sharp. It's also sold as the Sharp PC-1211. Though the version of BASIC is somewhat limited—for

(Please turn to page 105)

The Bugging Of The White House



Every U.S. president since FDR has wired the Oval Office. Even a president's bedroom has been bugged.

by Jack Anderson and Bob Sherman

Early in 1968, Sen. Robert Kennedy asked President Lyndon Johnson for a private meeting to talk a little politics. It was before Johnson's poor showing in the New Hampshire primary, and the President was still planning to run for reelection. Kennedy hadn't announced his own candidacy, but it was no secret that he was thinking about a race for the White House. The two men were shrewd, passionately political animals; there was no personal love lost between them. It promised to be a lively exchange of views.

Jack Anderson, the syndicated columnist, does most of his investigative reporting from Washington, D.C. Bob Sherman is his associate.

Each in his own way, President and senator, prepared for the one-on-one encounter in the White House Cabinet Room.

LBJ issued a brief order to Jack A. Albright, head of the White House Communications Agency: "Let's record the meeting." Albright, now a retired major general, knew what to do. He told us: "We put in one microphone. It was hidden in the table. It should have worked beautifully, except it didn't." It was only later that he figured out why.

"He [Kennedy] brought in a briefcase, which he kept in his lap, and they talked for 30 to 40 minutes," Albright recalls. "We weren't listening, of course; all we could do

During intimate Oval Office press conferences, FDR made reporters stand close to a bugged lamp (above). A wire ran from the lamp to a basement room, where a marine (below), monitored the tape recording.



PM art: Uldis Klavins

'Bobby Kennedy, wise in the ways of White House bugging, had carried a jamming device in his briefcase.'



was record. When we tried to play it back, all we got was a bzzzeeettt." Bobby Kennedy, wise in the ways of White House recording, had carried a jamming device in his briefcase.

Ever the exacting taskmaster, Johnson ordered a transcript of the private meeting prepared immediately. When Albright broke the bad news, he recalls, LBJ drawled, in exasperation, possibly tinged with grudging admiration: "That son-of-a-bitch!"

Secret presidential eavesdropping predates Watergate by more than three decades. Oval Office bugging was done as early as the 1940 presidential campaign, if not earlier. Franklin Roosevelt worried about reporters misquoting him at his informal press conferences, so he ordered a recording system to back up his human stenographer.

FDR's setup was a fairly elaborate "Sound on Film" device, installed by the Secret Service in a special room almost directly beneath the Oval Office. Jack Romagna, the White House stenographic reporter from the final Roosevelt years through the early months of the Kennedy administration, remembers that the Secret Service built a special floor-to-

ceiling booth for the machine in the basement room.

We can identify the device for the first time: It was a recording system patented by John R. Kiel, an inventor then living in Evanston, Ill. It used 35-mm movie film, but was unique in that it recorded transversely, rather than longitudinally, along a sound-carrier strip. This meant that more conversation could be recorded on less film and it

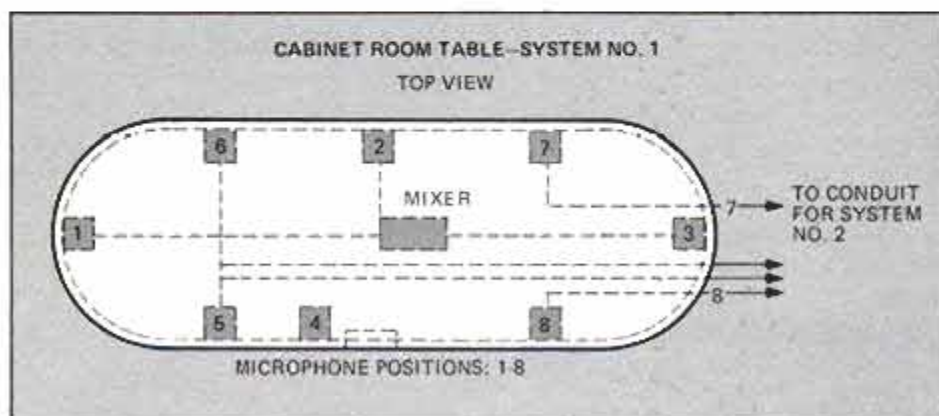
also made it easier to locate a particular point on the recording.

A microphone wire snaked up from the basement through the Oval Office floor and into President Roosevelt's desk, where it emerged in a small, shaded bronze lamp that sat in front of FDR and concealed the microphone. Unlike the televised extravaganzas of today, FDR's press conferences were intimate gatherings. At times, reporters were practically leaning over the mike.

Prof. R.J.C. Butow, a historian at the University of Washington at Seattle, has deduced that FDR used an RCA 88-d microphone. This 2½-inch-diameter device was tough to hide, and a far cry indeed from the mikes of hearing-aid size Richard Nixon used, to his regret, 30 years later. But it served its purpose well; the quality of FDR's voice is unusually clear. Kiel's invention gathered dust after the 1940 campaign, but was still in place when Roosevelt died. Though FDR's desk was removed, Harry Truman kept the recording system and even tested it on occasion. But he evidently disliked the recorder, though whether for ethical or practical grounds is unclear. Stenographer Romagna remembers the sound quality as being very poor.

Truman tapes made into discs

The Truman Library in Independence, Mo., contains about 10 hours of recordings. It is believed that all but about 30 minutes were made on



The eight microphones which Lyndon Johnson had ordered hidden around the Cabinet table fed into just two systems. This created wild distortions and was often unintelligible.

'In the last 16 months of his presidency, JFK recorded about 600 telephone conversations and White House meetings.'

the "Sound on Film" device in 1945, soon after FDR's death. Inexplicably, however, a 30-minute segment dates to 1947. In that year, the National Archives took the film and rerecorded it onto 16-inch discs that were eventually sent to the Roosevelt Library in Hyde Park, N.Y. A master tape was made in 1973.

The White House Communications Agency was created in the 1940s as an outgrowth of the Signal Corps operations at the White House. Jack Rubley, an agency staffer in the Eisenhower, Kennedy and Johnson years, says that one Agency task was to record "all the Presidents' utterances in public." These public recordings were transcribed and given to the press and others who required them. It was only natural, then, that the Agency



J. Edgar Hoover might have exaggerated LBJ's bugging capability. He told Nixon not to use the White House switchboard.

which did the public recording would later take charge of presidential eavesdropping.

Secret recording began on a grand, albeit primitive, scale when John F. Kennedy entered the White House. Evelyn Lincoln, JFK's personal secretary, was the operator of the recording equipment. In the last 16 months of his presidency, JFK recorded about 600 telephone conversations and White House meetings.

Kennedy taped his telephone conversations on a Dictabelt system located in Evelyn Lincoln's office. She

recalls that the President had two toggle switches directly in front of him, but out of view, on his desk. One was flipped to tell her to start the Dictabelt for phone calls. The second instructed her to initiate a taping system for personal meetings. She activated both systems with switches on a panel out of view on her own desk.

The Dictabelts were kept in a cabinet in the secretary's office. There were two that operated in sequence, providing only about 30 minutes of recording time. The tape machines were downstairs in the basement room that housed the audio-visual offices of the White House Communications Agency, Evelyn Lincoln said.

Memories are sketchy from that period, but Mrs. Lincoln believes that the President could also signal her to start recording by flipping a switch on his favorite rocking chair in front of the fireplace in his private office. He would often meet with small groups in that area. Mrs. Lincoln says a microphone was under an adjacent coffee table.

President Kennedy recorded in the Cabinet Room, as well. The Kennedy Library in Boston has 125 reels of tape from Oval Office or Cabinet Room meetings and 27 Dictabelts including 275 phone conversations. Mrs. Lincoln (the self-proclaimed "White House sound engineer") became the guardian of the Dictabelts and reel-to-reel tapes after JFK was assassinated.

How extensively did JFK bug his meetings and calls? Air Force Gen. Godfrey McHugh, a Kennedy military aide, assumed that most calls were recorded. He learned of the taping system when two FBI agents appeared at his White House office and accused him of breaching security over the telephone. They played a tape for McHugh in which he was discussing a flight Air Force One had made recently. "It had been in *The New York Times* that day," he recalls telling the G-men.

Robert Kennedy is believed to be the first person to make use of the Kennedy presidential tapes. He apparently used them in researching

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Cloning The Cobras

The originals may be extinct, but breeders are keeping the species alive.

by Rich Taylor



Great old cars never die—they just get replicated by the next generation of car nuts. Cobra (left) is from Contemporary Cobra Replicas; 427 SC models (center and right) are from E.R.A. Contemporary and E.R.A. are two of the firms making Cobra clones that look, smell and drive just like the originals.

PM photos: Taylor-Constantine

You come down the hill at Lime Rock right at the top of third gear, which is 100, 110 mph. You're arm-wrestling for control as you clip the apex of Diving Turn, the Cobra in a classic four-wheel drift. When you shift to fourth and nail it, the whole car sidesteps a foot or so, and you can feel the cartilage in your neck snap from the top-heavy weight of your full-face helmet.

Halfway down the front straight, which is only a matter of a couple hundred yards, the speedometer of the blue E.R.A. Cobra pegs itself at 160, though the tachometer continues to climb. Out of the corner of your left eye, you get just a hint of an angry red fender as Cobra enthusiast Randy Hartigan, in an E.R.A. 427 SC, edges up next to you, trying to slingshot past.

You rocket along side by side for what seems like forever, close enough to reach out and touch. But it's really less than a second before the signposts flash by . . . 3 . . . 2 . . . 1 . . . already you're standing on the brakes, that little rodent of uncertainty gnawing at your gut, as the trees leap out from the end of the straight.

Hartigan's red roadster, whose engine he built himself, is on the line, and there's nothing you can do as he sweeps across your bow and dives for the first apex in the Hook. But like every lap for the past two hours, he'll go wide into the zig-zag where you can pass him again—two shimmering dots of color caught in a crescendo of noise, vibration and heat on an unforgettable spring afternoon.

This isn't your normal road test. Everything about it is a little larger than life—the cars, the speeds, even the legends that have grown up around a wily Texan named Carroll Shelby and the cars he built. The last real Cobra came off the line a decade and a half ago, and there were only a handful, even then. Yet the cars have never been more popular. And this Cobra mania is spreading like wildfire.

Cobra mania assumes many forms. There's a Shelby American Automobile Club, some 5,000 members strong, most



The Cobra 289 (left) and the 427 (right) are both originals and are virtually priceless in today's market. In the 1960s, they sold for \$6,000.

of whom have been forced into collecting all sorts of Ford-powered performance cars because there is only one Cobra available for every six club members.

There is a booming industry in reproduction parts for Cobras, Mustang GT-350s, Sunbeam Tigers and other cars blessed by an association—however remote—with The Great Shelby.

But the most unusual signs of Cobra mania are the clones. Now, replicas of old cars are nothing

new. You can buy everything from a "Bugatti" with a Volkswagen chassis to a Mercedes 540K-ish Excalibur powered by a Chevy V8 to a Stutz Blackhawk built on a Ford truck chassis.

The difference is that while everyone knows an Excalibur isn't a 540K, even Carroll Shelby has trouble telling a real Cobra from a clone.

One thing sets a Cobra clone apart from a Shelby—the price. A genuine Cobra 427 in good shape is

worth upward of \$75,000 these days, and \$100,000 is not too much to pay for an exceptional example. By comparison, new Cobra clones sell for under \$40,000, ready to drive. Better yet, you can buy a do-it-yourself kit for just \$14,000 and finish it for a total investment of \$25,000.

What this means to you is that while a \$100,000 Cobra is an investment, a \$25,000 clone is a car. It's not a car the way a 6-year-old Valiant is a car, but you can get in



and drive it around without getting totally paranoid about every pothole, intersection and gawker coming the other way.

As far as we can tell, there are three reputable manufacturers of Cobra replicas, people from whom you can expect to receive what they promise. We brought samples of all three to Connecticut's Lime Rock Park.

We also invited Ken Eber, the president of the Shelby American Automobile Club, to bring both his original Cobra 427 and restored Cobra 289 so we could compare the new clones directly with two of the best Shelby Cobras in the country.

The three replicas were from Contemporary Classic Motor Car Co., E.R.A. Replica Automobiles and Aurora Cars Ltd.

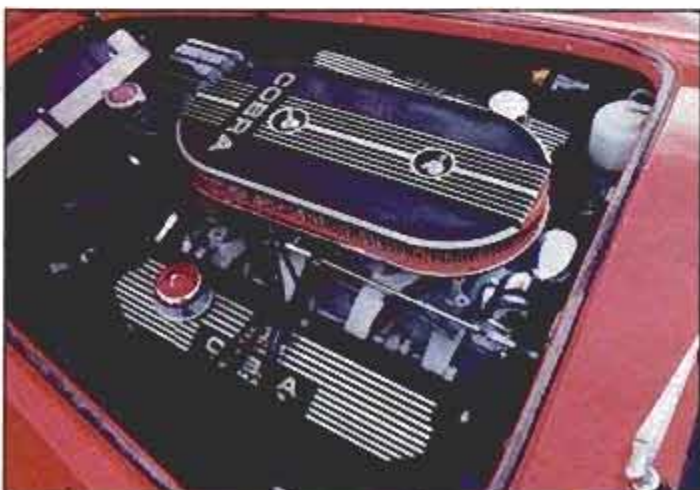
Contemporary Classic Replica

Contemporary sells two models: a Replica 289 and Replica 427 SC. They're both built on the same chassis. It starts with a pair of 4-inch-round tubes, tied together by 4-inch cross members; that's surprisingly close to the original Cobra frame. The suspension is Jaguar XKE at both front and rear—a convenient way of getting an all-independent suspension as well as four-wheel disc brakes.

Since each frame is custom-built, you get to specify your own drive

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Fiberglass body of Contemporary 427 kit is a lot tougher than aluminum body of original Cobras, and it won't rust. It's also a lot cheaper to fix in the event of an accident.



GRX Aurora copy of 289 (top) is available only fully assembled and sold as new car with 12-month warranty. Depending on tuning, its 427 engine (above) can do 300 to 500 hp. Replica interior (left) is spartan, but functional, just like original. Authenticity in detail is everywhere. Note the safety wire on knock-off hub spinner (bottom left) to prevent spinner from backing out during spirited motoring.

How To Pick A Perfect



Kershaw Camp and Field Model 1030, from Kershaw Knives, Lake Oswego, Ore., one of an extensive line, comes with a fitted leather sheath.



Schrade Old Timer Sharplinger is by Schrade Cutlery, Ellenville, N.Y., makers of Uncle Henry, Scrimshaw, and limited edition collector lines, as well.



Puma Hunter's Pal, Model 6397, a handmade imported by Gutmann Cutlery, Mount Vernon, N.Y., is from extensive line.



American Blade boot knife, new from American Blade Cutlery, Chattanooga, Tenn., has a 3 1/2-inch blade with concave back and buffalo horn handles.



Utica Kutmaster Stockmen's Model 3256, by Utica Cutlery, Utica, N.Y., is a classic pocketknife with clip, sheepfoot and spey blades.



Ibberson Extending Ruler folding knife of Sheffield steel, imported by Garrett Wade, New York, N.Y., shows scale size of knives above.

Until recently, only a few personal-knife types were popular. There was the pocketknife that could be used for whittling and the multi-blade camper's knife of the Boy Scout type. The hunter's sheath knife was related to the Army and Marine fighting and survival knives of several years ago. These, in turn, were modified varieties of Bowie

knives, with century-old heavy blade and clip-point designs.

But today's knives are different, and the finest are much more expensive. Models shown here range from under \$20 for the classic Utica Stockman, \$27.50 for the folding ruler or \$35 for the American Blade boot knife, on up to several hundred dollars for fancier engraved designs.

Knife

by Jim Woods

Imperial Frontier Model P-IV folder (far right) is from the extensive lines of Imperial Knife, New York, N.Y., one of the largest cutlery companies.

Case Shark Tooth Model P197ISSP (center) by W.R. Case & Sons Cutlery, Bradford, Pa., is part of a line whose old knives have become collectors' items.

Crosman Hunter 956 Lock-Back is a 5-inch, heavy-duty model from the new line of folders and fixed-blade knives from Crosman Airguns, Fairport, N.Y.

Buck Duke Model 500, a folder lock-back (far right), is from Buck Knives, El Cajon, Calif., considered the originators of popular big belt-pouch folders.

Rigid Navajo Pocket Folder (center), from Rigid Knives, Lake Hamilton, Ark., is a lock-back with engraved leaves embedded on 24-karat gold.

Ka-Bar Folder Model 02-2822, from the Ka-Bar Div. of Cole, Cleveland, Ohio, is a mini lock-back with colorful mother-of-pearl type handles.

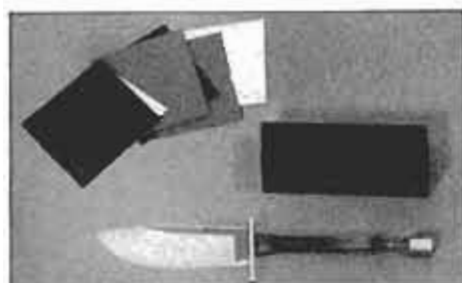
A material that has influenced considerable change is stainless steel. No longer is it a metal with unpredictable qualities that appeared shortly after World War II. Now, an increasing number of quality knives made worldwide are stainless. Generally, U.S. factory-made

BenchMark Diamondback Folder (below), from BenchMark Knives, Gastonia, N.C., has a Rolox System blade that slide-rolls forward and locks in place.



blades use 440 stainless, while the several hundred custom knifemakers employ 440C or 154CM.

The plastics of modern technology have also had considerable influence on knife construction. Natural handle materials—horn, bone and ivory—are still in demand for some expensive knives, but for various reasons are in short supply. To meet a growing demand, plastics such as



Morseth custom \$50 kit (above) from A. G. Russell and \$25 Rigid Knives kit (below) show models ready for finishing at home.

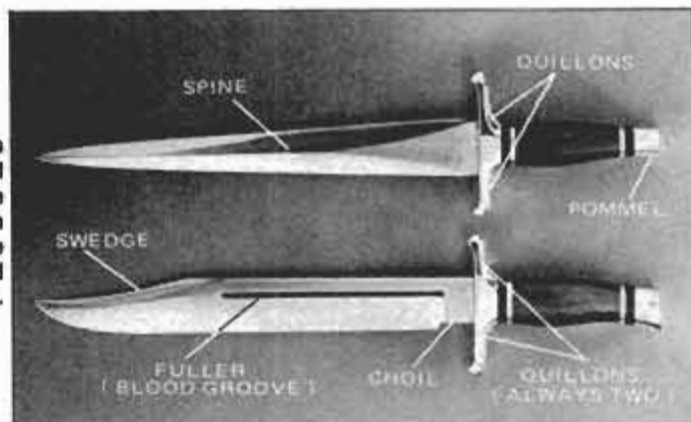


Lexan, Delrin and Micarta are the answer. None of these are new. Lexan is the practically bulletproof material that is sometimes used for cashiers' cages. Delrin has been cast and machined into high-strength aircraft components for years. Micarta, a phenolic resin developed by Westinghouse, has been in use for electric insulators since the 1930s. All of these machine relatively easily, take a smooth finish, are warm to the touch, and will outlast the steel in the blades.

Better locks

Perhaps the biggest design improvement has been the blade lock for the folders. It has put new safety into folding knives, and has helped personal knives become socially acceptable. This wasn't the case at the start. The first lock-back folders,

Double-edge Arkansas Bowie (above) and Classic Bowie knife (below) are both from Charles Hipp's Bone Knife Co., located in Lubbock, Tex.



generally considered to be the product of Buck Knives in California, were large knives with husky blades. For several years, "buck knife" was the generic description of a lock-back folder from any manufacturer. The big folders rode in equally big snap-flap pouches, frequently hanging from the belts of some members of our rougher social element. In time, the knives became smaller and more finely finished, disappeared into pockets rather than belt pouches, and then emerged in belt pouches once again as they became respectable. Now, a lock-back folding knife in a belt pouch is as common as a wristwatch in the everyday dress of many men, and a few women, in all manner of occupations.

There are a number of variations in lock locations and advertising names, but the folding-blade lock is usually a lever that runs the length of the handle back. When this lever is depressed, the forward end that engages a notch in the blade tang pivots up and releases the blade.

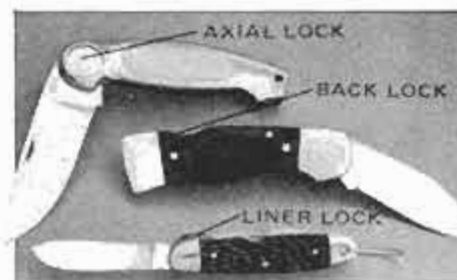
A simple and less expensive device is the liner lock, a springy brass divider between blades or handle scale and blade, that snaps into place behind the blade tang when the blade is fully extended. To close the blade, the liner is warped aside with the thumb. More complicated and expensive is the axial lock. This is primarily offered by custom knifemakers, but Gerber Blades and Kershaw Cutlery, both in Oregon, have axial lock models. Blade locks are not new, and some antique folders have clever ones.

Better shapes

While the latest popular blade designs aren't brand new, one that was rediscovered about 25 years ago and dubbed the "drop point" is a current favorite and a good compromise shape.

Knife blade shapes are identified by point style and location. Hold the knife horizontal with the edge down. If the blade back is straight to the point, the style is "straight point." It's a good skinning and slicing blade, and knives so equipped are classed as skinners, although there are specialized shapes that do a better job.

If the back of the blade curves up, the point is called a "sweeping" or "swept" point. If it angles down to a point below the blade back or is in a curve that resembles a ski jump, the blade has a "clip" or "clipped" point. If the downward curve is like that of a bullet trajectory and the point is more than midway down the blade, it is the "dropped" point. When the blade back and edge have identical curves, it can be a dagger shape if

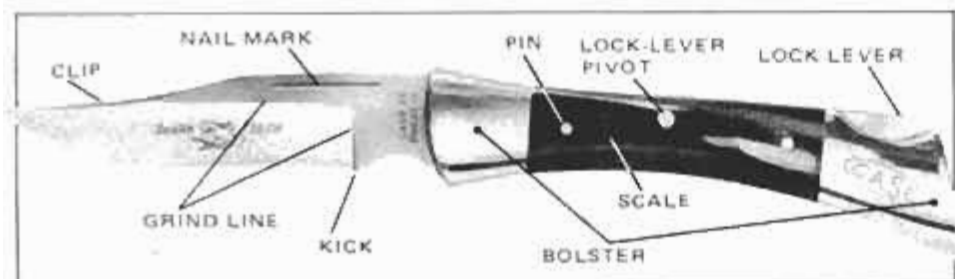


Locking folders are most popular. Axial Life-Lock (top) is about \$200; Western's Lockback S-534, \$40; Utica (bottom), \$15.

the back and edge are parallel, or a spear if the blade is widest where the point curve starts. There are numerous other blade shapes for your special needs, and variations include sheepsfoot and spey blades that see lots of use in pocket knives.

Almost every knife company produces most of the standard patterns. A pocketknife maker will supply a Stockman's knife with clip,

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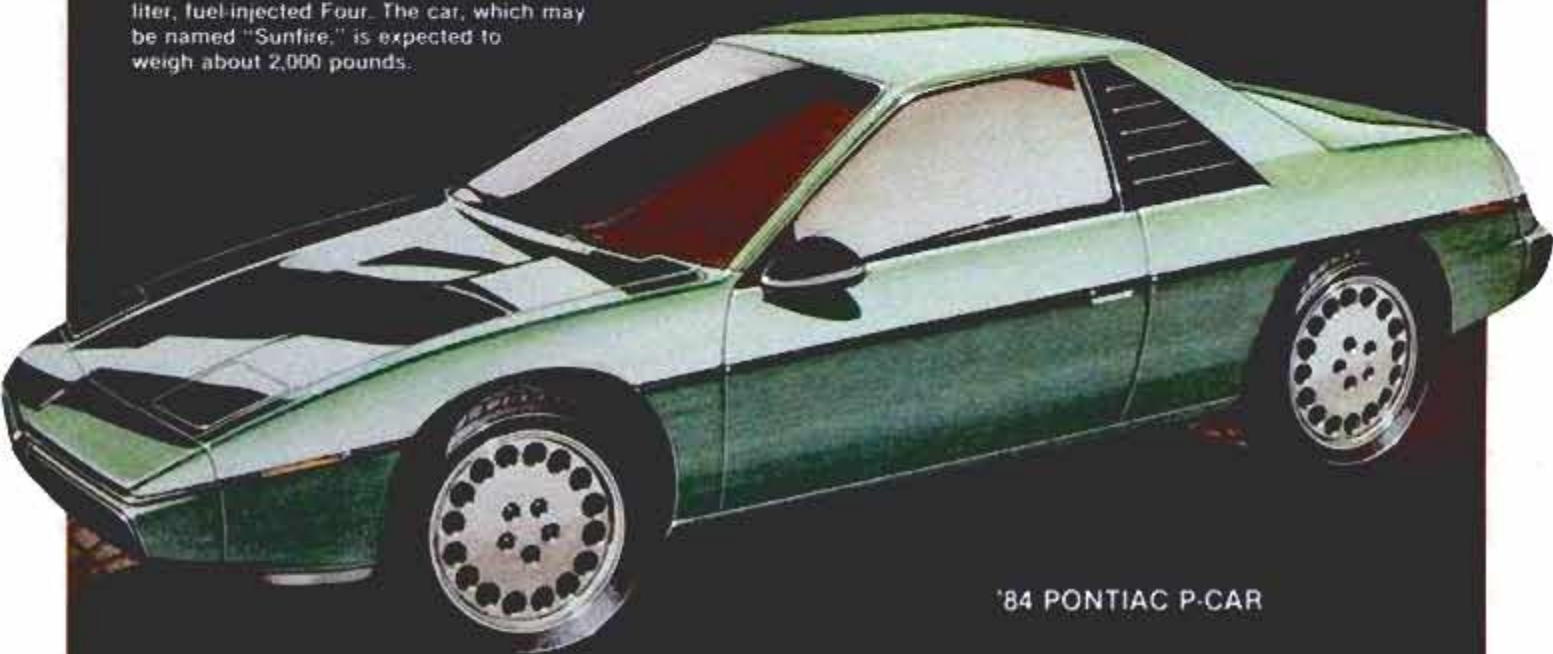


Shark Tooth Model P197 L SSP, from W. R. Case & Sons Cutlery, attracts collectors.

GM Pulls Into The Fast Lane

GM wants to cure its showroom blues and put some excitement back in the line. Here's a sneak look at how they plan to do it.

Pontiac P-car will make debut in early '83 and feature mid-engine, rear-drive configuration wrapped in a fiberglass body. Base engine will be a 2.5-liter, fuel-injected Four. The car, which may be named "Sunfire," is expected to weigh about 2,000 pounds.



'84 PONTIAC P-CAR

by Cliff Gromer

They're putting the sizzle back in at General Motors—just like it was in the old days. Let's face it, they had to do *something*. All that their lineup of boring, mundane cars was doing was generating boring, mundane sales figures.

So GM is trying something old. It's called performance. Outright sex appeal. Body by excitement.

GM is even talking different numbers. Gone are the amount of grocery bags or Little League baseball teams they can cram into the back of a car. Or how many inches of hip-to-ankle room there are to stretch out in. The numbers we're now hearing talk about acceleration times from zero to 60 mph. And we like what we hear.

Some of the razzle-dazzle cooked up by GM for its future models is evident in the 1982 Chevrolet Camaro

and Pontiac Firebird. These cars are turning heads and generating showroom traffic the likes of which General Motors hasn't seen for years.

Can GM maintain the beat of excitement created by the restyled F-body cars? Judge for yourself, with this sneak preview sample of models that will be coming down the pike over the next three years.

General Motors will continue its "incredible shrinking car" routine so that by 1985, all "full size" family cars will be reduced to wheelbase a mere 2.6 inches longer than that of the current X-models. Big cars such as the '85, Buick Electra, Cadillac DeVille and Fleetwood models all will be front-drive models based substantially on the X-car platform. The Chevrolet Caprice also will go to front-wheel drive in 1985 and have the same 104.9-inch wheelbase as the '82 Citation.

The Caprice has only two years remaining as a rear-wheel-drive

model. But starting in '83, the Impala Caprice will be in reality a re-skinned Malibu. While the Malibu nameplate will be retired next year, the existing mechanicals will be retained for the 1983-84 108.1-inch-wheelbase Caprice. Overall length of the car will be 184 inches.

Power for the '85 Caprice will come from a two-liter V4 base engine, with a hotter 3.0-liter V6 also available. Checking off the diesel option on your dealer's order form will get you a 3.1-liter V6. Chevy, at one point, was considering a supercharged version of the diesel, but that's no longer in the cards. Chevrolet also has shelved its plans to build a five-cylinder diesel for the Caprice.

Pontiac's P-car will debut as a mid-'83 or '84 model with the name "Sunfire." The mid-engine, rear-wheel-drive two-seater will serve as a mild-mannered commuter car or a pocket hot rod, depending on power-train options.

While unmistakably a 'Vette, the '83 model will lose those hulking fenders and gain a hatchback. The body will remain all fiberglass.

'83 CORVETTE

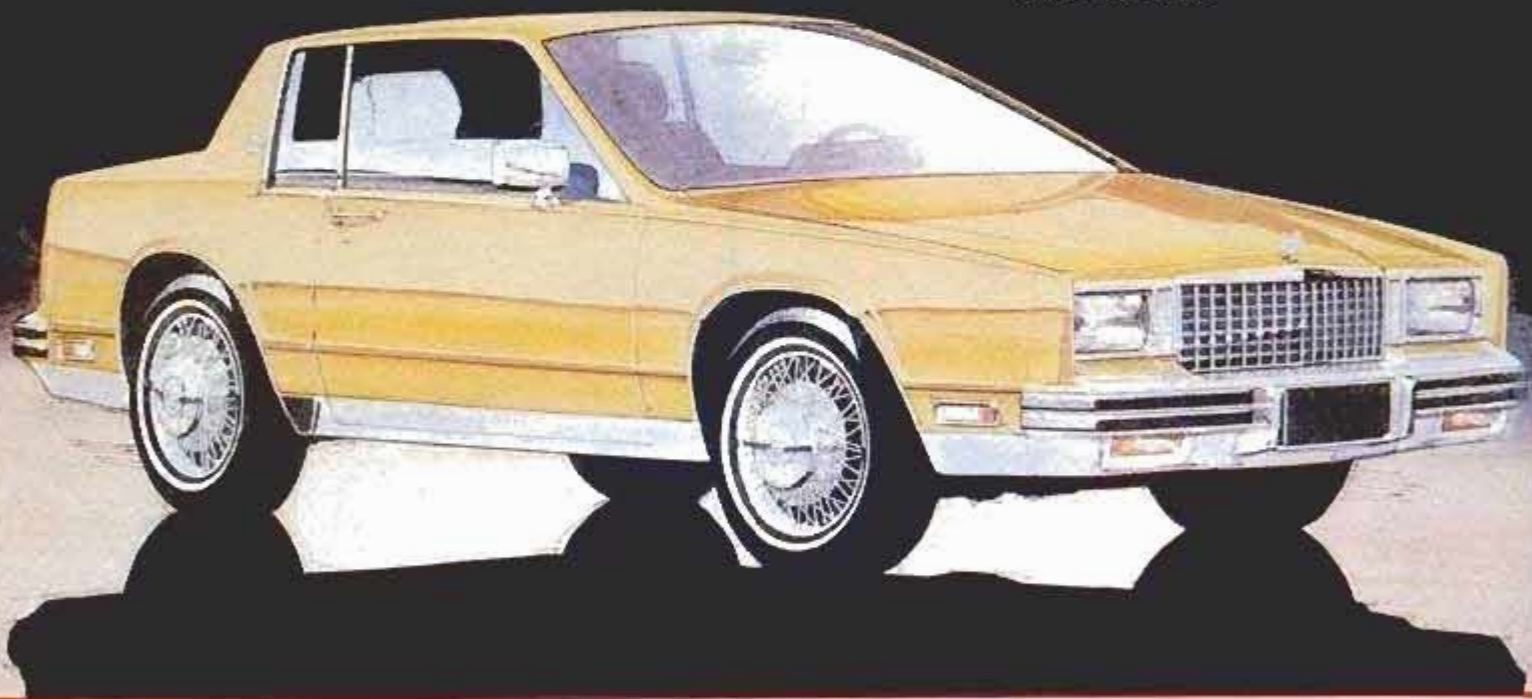


At the bottom of the power ladder will be Pontiac's 2.5-liter, throttle body injected, pushrod "Iron Duke" four-cylinder. Hard-core tire smokers would be wise to bide their time and wait for the Chevrolet-designed, turbocharged, 2.8-liter V6 that will come on the scene sometime after an initial run of cars.

The engine in the P-car will be mounted transversely behind the twin bucket seats, and will drive the rear wheels through a four- or five-speed overdrive transaxle.

The P will use a fiberglass body

'84 ELDORADO



bolted to a steel skeletal frame and a welded-steel underbody. Light parking taps should be shrugged off by the soft polyurethane bumpers integrated into both ends of the car.

Weighing in at about 2,000 pounds, the car, equipped with the turbo V6 option, should offer a level of performance that would put a Corvette on its best behavior.

Styling will be on the order of a Fiat X1/9 and only one body configuration will be offered—a notchback. All you fresh air fans will go for the targa-type removable roof section.

Size-wise, the P-car will be on a

par with a Mazda RX-7. Overall length will be 150 inches, and wheelbase will measure 90 inches.

Mechanical goodies will include four-wheel disc brakes and rack-and-pinion steering. The front suspension will be set up Chevette-style, with lower A-arms, coil springs, shock absorbers and stabilizer bar. MacPherson struts will suspend the rear.

Over at Oldsmobile Div., the '84-'85 Olds 98 will bear a close resemblance to the recently introduced A-cars, but will be about 2 feet shorter and some 1,000 pounds lighter.

Barely 2 inches longer than the current Cimarron, the '84 Eldorado will be styled in door-stop fashion—a large wedge to disturb the slipstream as little as possible. It will be front-wheel drive, with the base engine a 2.0-liter V4.

Styling will emphasize a sharply raked windshield, low and wide front end for good aerodynamics, and a high trunk. Cadillac and Buick will get similar versions. Sticker price at your local Good Olds Guy will be about 20 big ones.

Upscale at Cadillac Div., an un-

(Please turn to page 111)



PM art: Mark Stehrenberger



The Chevy Caprice will be built on GM's basic building-block platform, the X-car front-drive chassis. A 2.0-liter V4 will be the base engine, with a 3.0-liter gas V6 and 3.1-liter diesel V6 optional. Like other GM cars, it will be shaped along aerodynamic lines.

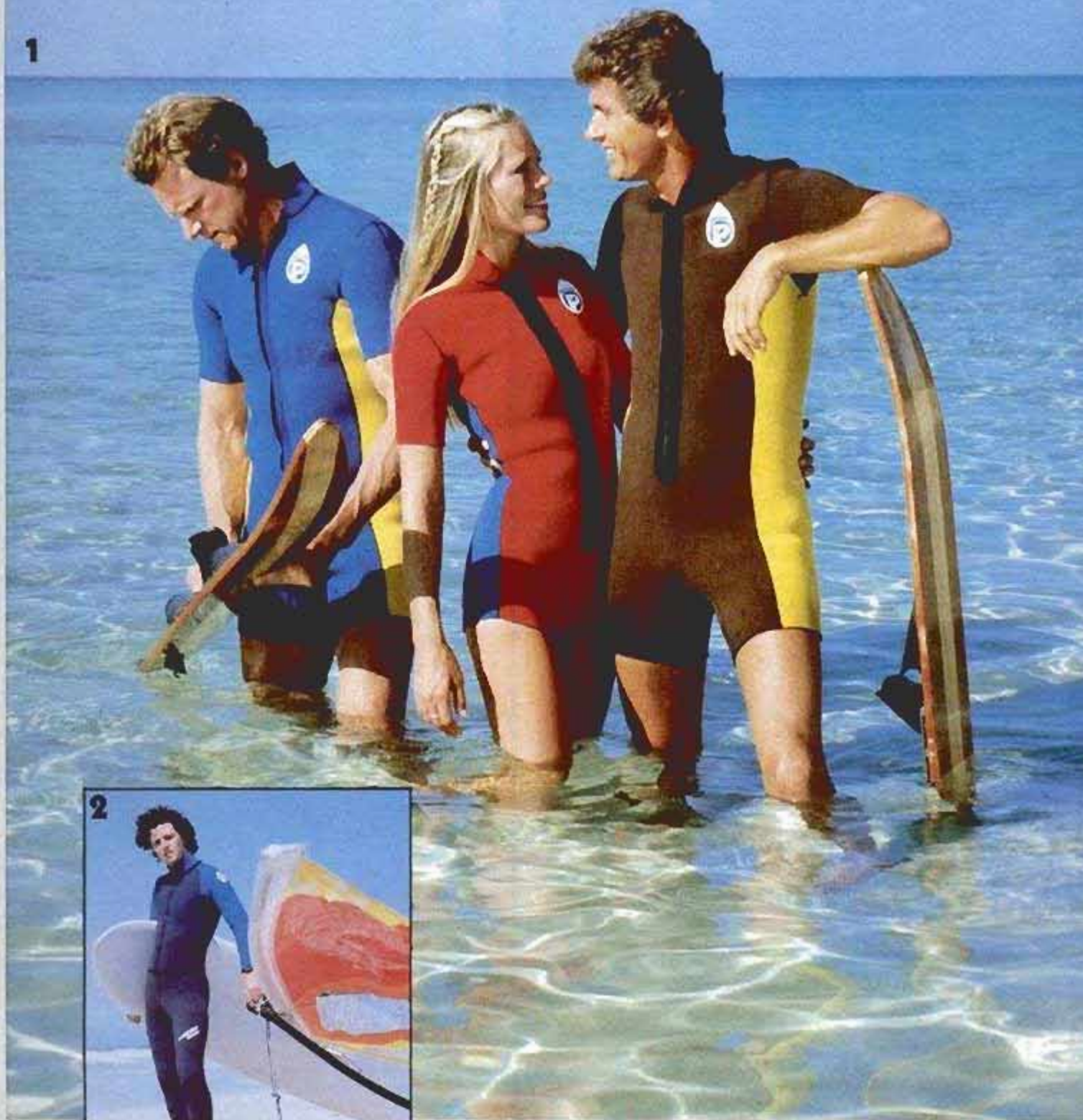
Bearing a close resemblance to the recently introduced A-cars, the Oldsmobile 98 will be 2 feet shorter and approximately 1,000 pounds lighter than the current 98s. Styling will be from the folded-paper school of design, with raked windshield and sharp angles.

Double-Duty Diving Gear

Underwater equipment is surfacing to be used for other water sports and even activities ashore.

by Bill McKeown
OUTDOORS EDITOR

1



2





1 Wet suits for diving have been updated. From Parkway Fabricators, South Amboy, N.J., are Reversible Shorties.

2 Also for cold-weather waterskiing or spray of sailboarding, Parkway has new Tempest coverall, a bolero jacket.

3 For O'Brien International Bullfrog knee-board riders and sailboarders, there are waterproof windbreakers and wet suits.

4 The Nikonos IV-A, with automatic exposure and flash, can surface for photography in rain, snow or blowing sand.

5 A waterproof, digital-reading depth/distance finder, Dive Ray from Morrow Electronics, Salem, Ore., also spots fish.

6 New flashlights by Tekna, Menlo Park, Calif., are rated for depths to 2,000 feet and 12,000 candlepower with four AA cells.



Like prehistoric fish that changed into amphibians and climbed ashore, a lot of diving accessories are surfacing this summer to take on additional uses. Anything that can keep you warmer, safer or better equipped for sport under water is likely to do a good job at water level or above, as well—sometimes, too much so.

Full wet suits that can retain body heat under cold water or even under ice may become unbearably hot in sunlight. Exercising in one can bathe you in sweat and make you

feel like you're wearing a straitjacket in a sauna. But aboard a spray-drenched sailboat on a cold and windy day, running white-water in a raft or kayak, or taking dunkings while sailboarding or water skiing, a rubber suit can be the answer to staying warm.

Choosing a shortie suit may be best. The full-length, one-piece wet suit, plus gloves, booties and helmet, keeps you warm while diving. But shorts and a vest of thinner neoprene or a jacket with nylon sleeves may be all that you'll need to ward

off cold spray at sea level. These allow much more freedom of motion, and are infinitely easier to put on and take off. Many dive-suit, board-sail and water-ski companies are now providing colorful models.

Because underwater accessories are made to survive salt water conditions, their rugged strength is an advantage ashore. What a diving light, for example, gives away in added weight (not of great importance in subsurface gear), it makes up for in durability for a camper who

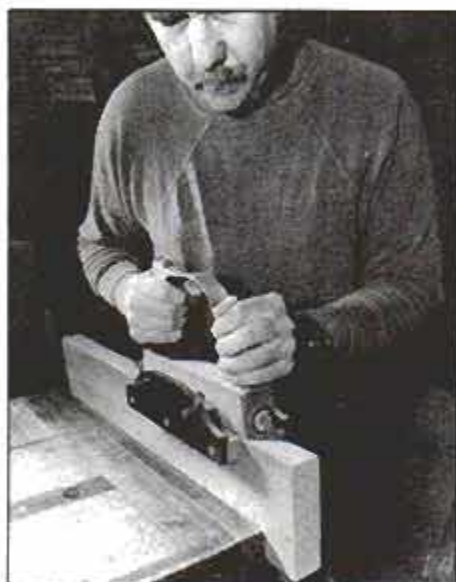
(Please turn to page 134)

Crafting your own tools is especially satisfying. Here are three hand tools and one power-tool accessory that are enjoyable to make and use.

1 Handsome Edge Sander

A rougher-than-desired edge is usually left on lumber after it's ripped with a saw. An experienced woodworker might choose to plane the edge, but there is an easier way. This edge sander, when used with care, helps you to do professional-quality work.

Use heavy hardwoods, bolts, rods and brass plates to bring your sander in at a hefty 4½ pounds or more. The heavier weight requires less muscle power for downward contact pressure. If it is necessary to "one-hand" the sander, the curved brass bar on top (besides adding some extra weight) directs some of the downward pressure from the back handgrip toward the front of the tool.



As you hold sander firmly by knob and handle, you'll find its beefy weight helps you do the work. This handsome tool will be the pride of your collection.

Cut the main body block from a well-seasoned piece of maple. The side plates are black phenolic plastic, but since this material is expensive, and hard to find, you can also use sheet acrylic or any sheet metal.

Cut the handle and front knob from mahogany. The hold-down bolts in the handle and front knob are carriage bolts with their shoulders filed off to allow flush tightening.

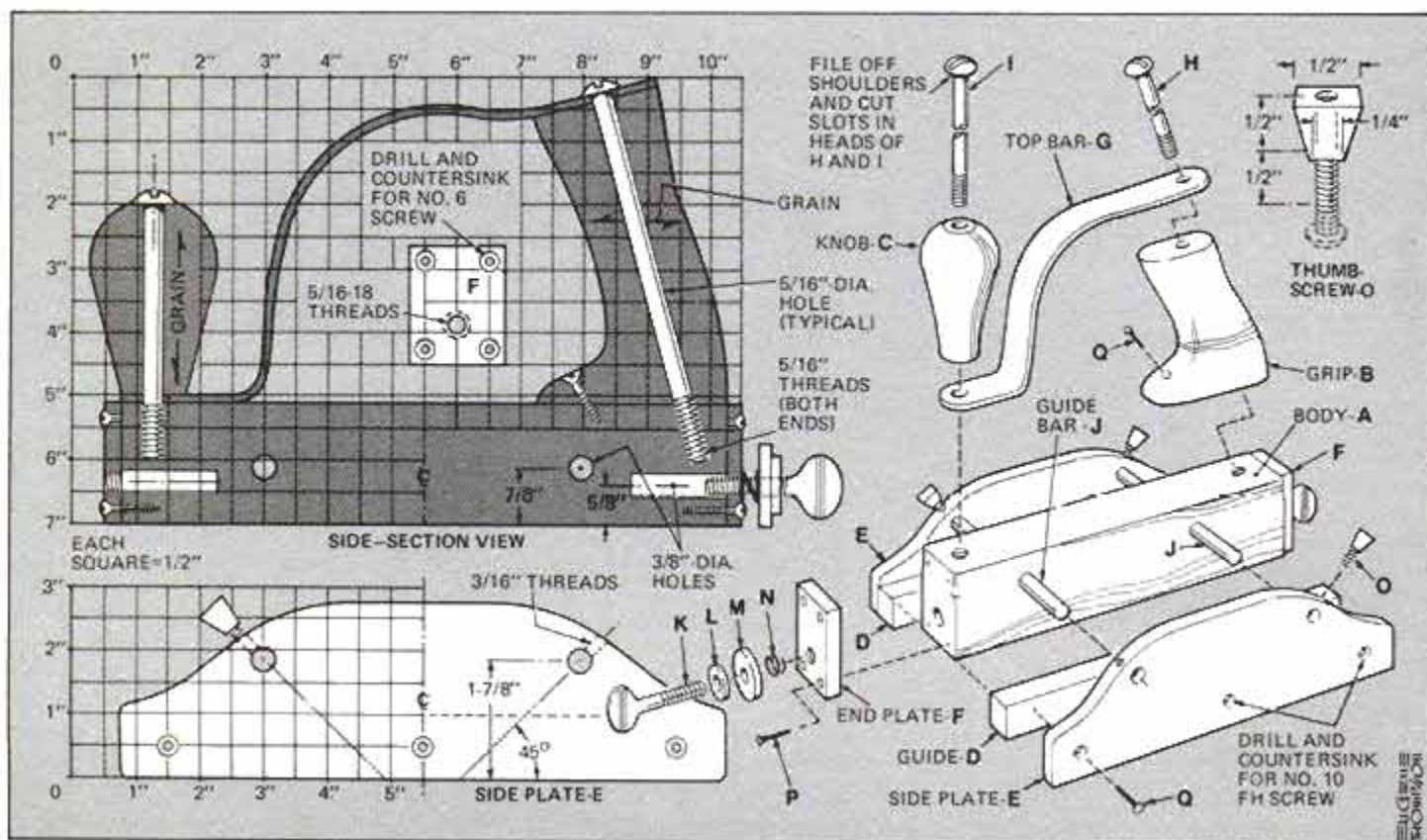
Cut a slot for a screwdriver in the top with a hacksaw. Carriage bolts are preferable because they have a larger head and a lower profile than most machine bolts. This makes them blend in more smoothly, especially on the front knob.

Assemble the side plates and birch edge guides and then clamp them to the main body. Now bore the holes for the 3/8-in.-dia. guide bars. This

MATERIALS LIST—EDGE SANDER

Key	No.	Size and description (use)
A	1	13/4 x 17 1/2 x 9 1/2" maple (body)
B	1	1 1/4 x 3 x 5" mahogany (grp)
C	1	2"-dia. x 3" mahogany (knob)
D	2	3/4 x 1 x 9 1/2" birch (edge guide)
E	2	5/8 x 2 3/4 x 9 1/2" sheet acrylic (side plate)
F	2	1/4 x 1 1/2 x 17 1/2" brass (end plate)
G	1	1/8 x 1 x 11 1/2" brass (top bar)
H	1	5/8"-dia. x 6" carriage bolt
I	1	5/8"-dia. x 4" carriage bolt
J	2	3/8"-dia. x 5" steel (guide bar)
K	2	5/8"-dia. x 2" thumbscrew
L	2	7/8"-dia. brass washer
M	2	1 1/4"-dia. leather washer
N	2	3/8"-dia. compression spring
O	2	1/4 x 1/2 x 1" (thumbscrew)
P	8	1" No. 6 oval-head brass screw
Q	7	1" No. 10 th steel screw

Misc.: Epoxy, wood finish, metal-buffing materials.



For Your Shop

step assures perfect alignment to binding during adjustments.

The oval screws in the end plates protrude slightly above the surface. This provides two distinct points for the leather washer to bear against so that it can grip the abrasive strips securely.

Because of the limited finger room when the side guides are brought in close to the body of the sander, the thumbscrews must be narrow, yet strong and easy to operate. Make them from 1/4-in.-thick brass bar stock and 1/16-in.-dia. bolts. Scribe the shape of the knobs on the bar stock. Then drill and tap before cutting knobs from the bar.



Loosen or remove side plates for easy installation of abrasive paper. Paper must be tightly secured with wingnuts. Any slack will cause paper to tear or wear quickly.

Use epoxy to glue the 1/16-in.-dia. screws into the knobs. Since metal does not have a porous surface to

absorb the epoxy, its bond depends on a tough mass that surrounds irregular shapes, and makes them immobile. So, the trick is to create pockets into which the epoxy can run. Grinding or filing irregular notches along the portion of the bolt that is to be threaded into the head creates these epoxy pockets. Polish and buff the knobs and then saw off the heads of the bolts.

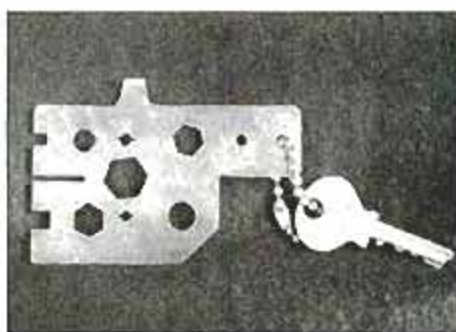
Be sure to use brass instead of steel to keep the 3/8-in.-dia. steel guide bars from becoming dimpled. This would allow them to skip out of adjustment and would also cause the travel of the guides to become ragged.—Robert F. Bessmer

2 Sheet Steel Tool

Ground flat stock is sheet steel ground on both sides to produce flatness and a specific thickness such as 0.0625 (1/16 in.) Use this stock to make the one-piece tool shown below. Carry it with you; it will come in handy.

This tool consists of a combination of holes, slots and other useful details: It includes a screwdriver, wrenches for small square and hexagon nuts, gauges for checking rods for 1/8-, 1/4- and 3/8-in. diameters;

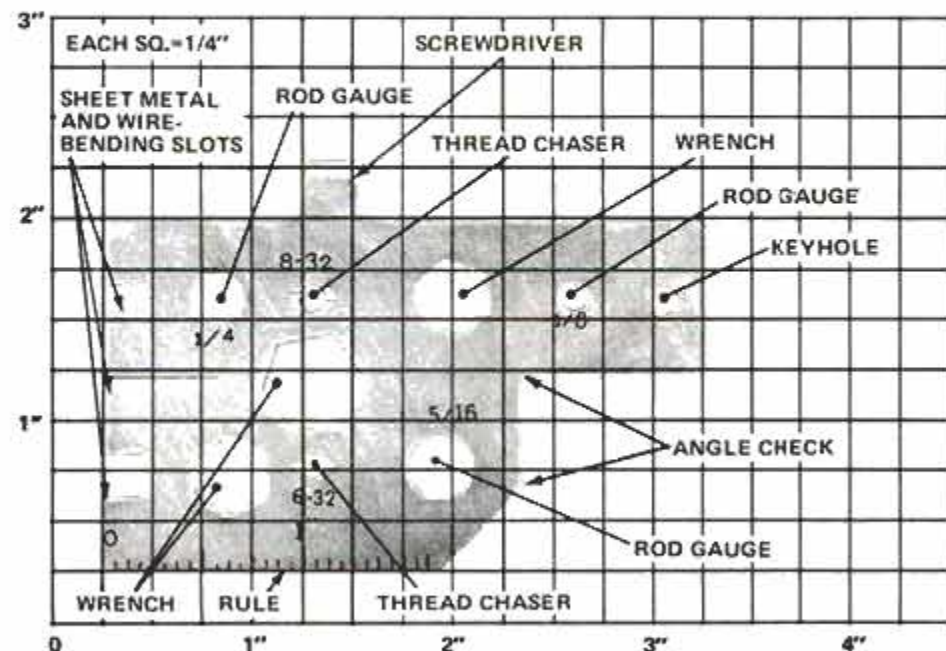
thread chasers for renewing and cleaning 6-32 and 8-32 threads, slots



Attach this tool to your key ring and you'll be surprised how often it comes in handy.

for bending sheet metal and wire, a modest ruler and an edge arrangement for checking 45°, 90° and 135° angles.

First, make a pattern drawing of the tool on self-sticking label paper and apply it to the cleaned surface of your steel blank. Shape the blank and make slots with a milling machine or with hand tools. Drill each hex hole to its bolt diameter and scribe a line around the outer nut for the hexagon shape. Then convert the round hole into a six-sided one with a jeweler's saw and file. Provide the threaded holes with clearance to catch dirt and chips by cut-



Duplicate this "tool" or use this drawing as a model. Then add "wrenches," holes, slots, and angle checks for dimensions and degrees that are suited to your particular needs.



Use a small hand grinder for smoothing the edge at base of screwdriver blade. Remove the self-sticking pattern when you're done.

ting two opposing notches in each hole with a jeweler's saw.

To make the rule divisions, clamp the blank flat on the compound rest of your lathe and position it to move parallel to the lathe centerline. Then clamp a boring bar in the

WEEKEND WORKSHOP:

lathe-headstock collet, with its cutter tip extending downward and pressing lightly against the surface of the tool blank. Space the graduations at $\frac{1}{16}$ -in. (0.0625 in.) intervals by using the scale on the compound feed screw, and engrave by operating the cross-feed screw.

File all tool edges and sand to make them smooth and bring measuring parts to the correct angles. Round corners for comfort in handling.

To harden the tool, heat uniformly to a "cherry red" and then plunge it edgewise into cool water. Polish a

small area on one surface to brightness, and then reheat the piece uniformly, over a gas burner, until a straw color appears on the polished spot.

Remove tool immediately from the heat, let it cool, and then polish all over.—Walter E. Burton

3 Accessory Sanding Table

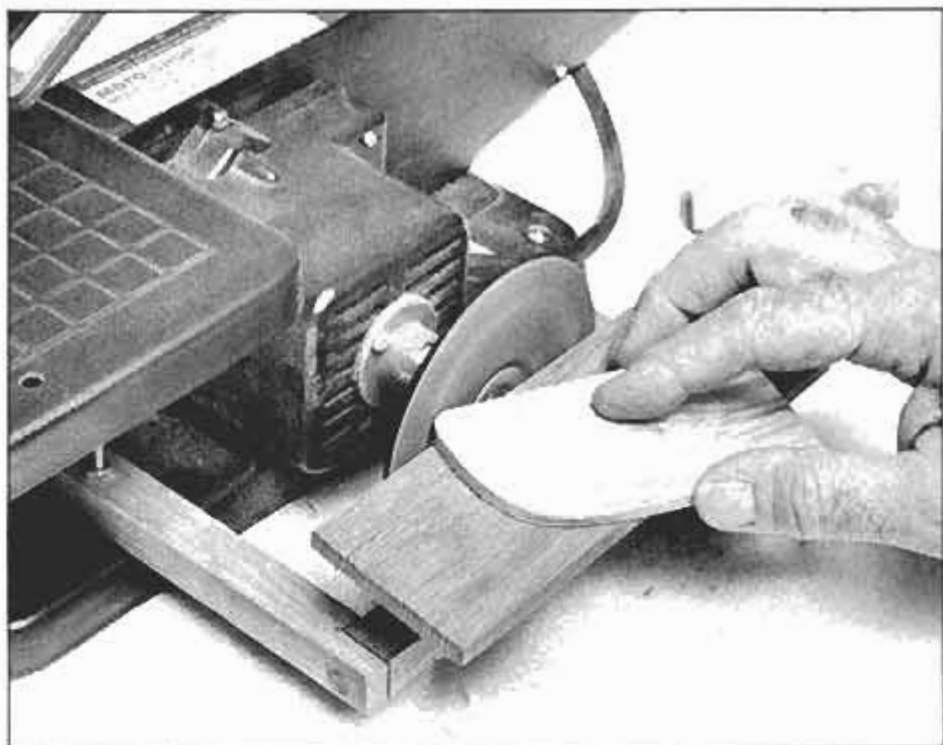
When you sand small parts such as dollhouse furniture or model fittings, a sanding table is often a necessity for accuracy. The table shown here can be easily made by the hobbyist. Most of the work can be done with the Dremel Moto Shop for which the table is an accessory to the sanding disc.

Use hardwood such as oak and note that all pieces can be cut from a single piece of stock $1 \times 6 \times 10$ in. long. The frame and wood pivots are constructed of pieces $\frac{1}{4}$ in. by $\frac{1}{4}$ in., and the table is $\frac{1}{4}$ in. thick.

Once the pieces are rough-ripped, you can make final cuts with your Moto Shop. Then cut the $\frac{3}{4} \times \frac{3}{4}$ -in. end notches in the frame sides to let in the frame front. The pivot blocks are let into the front frame member in dados $\frac{1}{8}$ in. deep. Bore holes and cut the slots in the pivot blocks before rounding the tops. Use your corner braces to determine the width of the slot (kerf). The braces should be fairly snug, yet free enough to move within the slot. Attach pivot blocks to front frame member with screws and glue.

Bore the side frame pieces for assembly and counterbore the underneath side to let in the hex nut and lock washer at the saw base. Assemble the frame with screws and glue.

Now, using the dimensions in the drawing, position and drill one of the holes in the saw base. Attach the frame and use the hole in the other

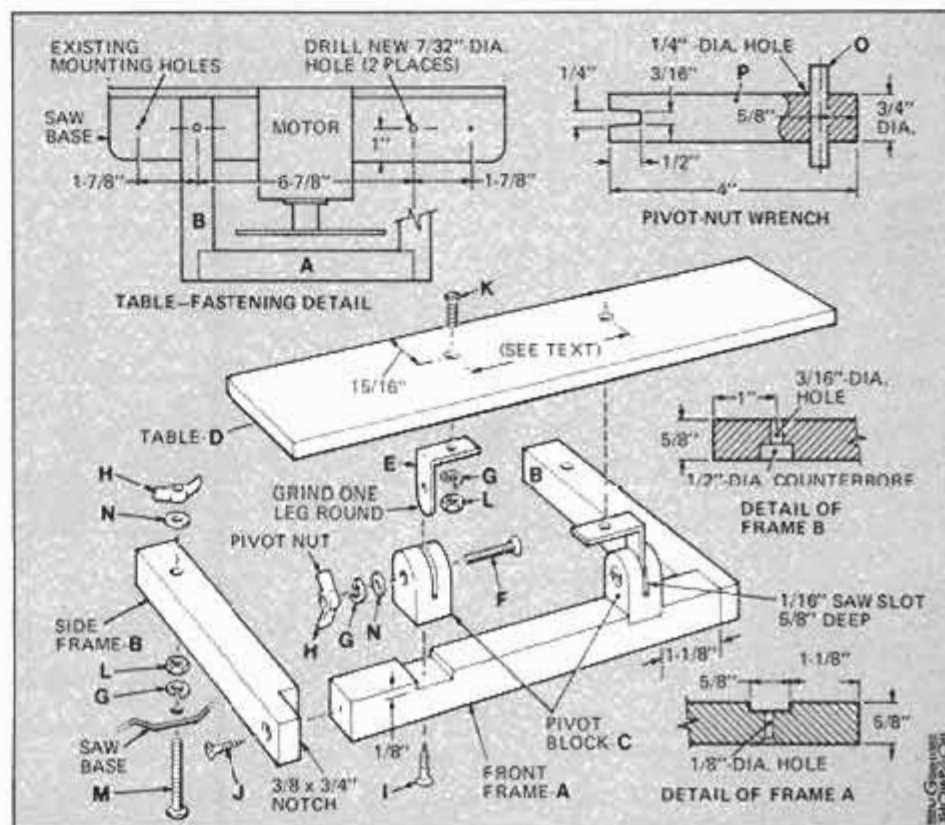


Here's an accessory sanding table for accurate and easy sanding on your Dremel Moto Shop. The Moto Shop itself can be used for most of the work after rough cuts.

MATERIALS LIST—SANDING TABLE

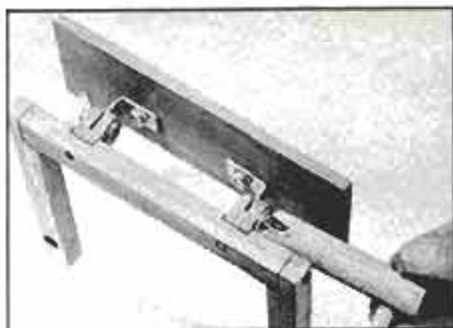
Key	No.	Size and description (use)
A	1	$\frac{5}{8} \times \frac{3}{4} \times 6\frac{7}{8}$ " oak (frame front)
B	2	$\frac{5}{8} \times \frac{3}{4} \times 5\frac{7}{8}$ " oak (frame side)
C	2	$\frac{5}{8} \times \frac{3}{4} \times 1$ " oak (pivot block)
D	1	$\frac{1}{4} \times 2\frac{3}{8} \times 7\frac{3}{8}$ " hardwood (table)
E	2	$\frac{1}{2} \times 1 \times 1$ " corner brace
F	2	10-24 $\times \frac{3}{4}$ " th machine screw
G	6	10-24 lockwasher
H	2	10-24 wingnut (pivot nut)
I	2	$\frac{3}{4}$ " No. 6 th screw
J	2	$\frac{5}{8}$ " No. 4 th screw
K	2	10-24 $\times \frac{1}{2}$ " th machine screw
L	4	10-24 hex nut
M	2	10-24 $\times 1$ " th screw
N	4	No. 10 flat washer
O	1	$\frac{1}{4}$ "-dia. $\times 1\frac{1}{2}$ " dowel
P	1	$\frac{3}{4}$ "-dia. $\times 4$ " dowel

Misc.: Epoxy.



leg to position and bore the second hole. Don't worry if the second hole doesn't fall exactly where it should according to the drawing. Just keep the front frame piece parallel to the sanding disc plane.

Install the corner braces after grinding one leg of each corner brace round. The pivot screws must be locked in place so they won't turn when the wingnuts are adjusted. You can do this by applying quick-setting epoxy cement over the head of the countersunk screw. To be effective, the holes in the wood pivot blocks should be counterbored sufficiently so the screwhead will be slightly recessed. This will allow the epoxy to grip some wood as well as the screwhead.



Adjust angle of the table with a pivot-nut wrench, as shown here. You make the wrench yourself from a 4-in. length of $\frac{1}{4}$ -in.-dia. dowel. Store it with the table.

Once braces are installed, position and bore the holes in the saw table. If you think that you haven't been too accurate, mount the table frame

on the saw base with the sanding disc in place. Then check to be sure you can tilt table as required without coming into contact with the disc.

To adjust the table's angle, you must make a pivot-nut wrench, as shown in the drawing on page 88. The wrench is made from a $\frac{1}{4}$ -in.-dia. length of dowel 4 in. long, and a short piece of $\frac{1}{4}$ -in.-dia. dowel that acts as a finger grip for extra torque. You may make a similar tool of your own design, but be sure you can apply enough pressure on the wingnuts to fix the table securely in place. Since you'll be using this table for precision work, a slight shift in the table's position could cause problems.

—John E. Gaynor

4 V-Block Clamp

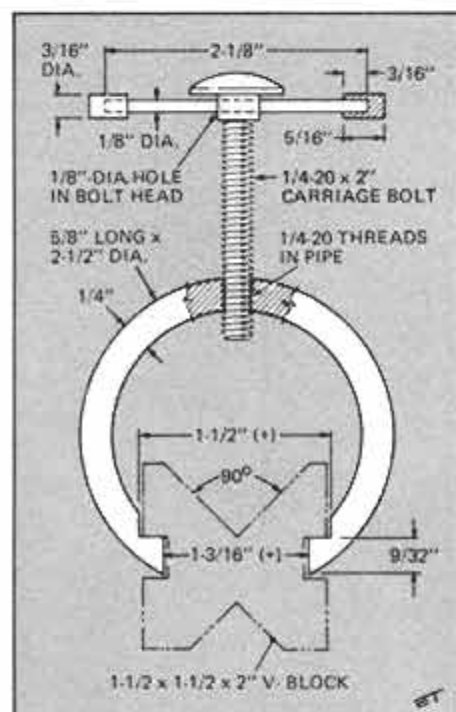
V-block clamps are simple tools, but they are indispensable for the jobs they do. By making your own, you can save money, as well as creating different-size clamps for the various sizes of V-blocks you use most often. I started making my own clamps when I lost the one I used with the No. 749 Brown & Sharpe block shown here. The clamp is made from $2\frac{1}{2}$ -in.-outside diameter aluminum pipe with a $\frac{1}{4}$ -in. wall.

Chuck one end of the stock piece in a lathe and support the other end

with a steady rest. Use a conventional cutting-off tool bit to cut a ring from the pipe; make it $\frac{1}{8}$ in. long. Then, make a C-segment by cutting a section from the ring to form a gap a few thousandths of an inch wider than the V-block width between its side grooves. This dimension is given as $1\frac{1}{16}$ in. plus in the drawing. Next, mill or file 90° notches at the ends of the C-segment so the ends will fit into the block grooves.

At the mid-point of the C-segment, drill a hole with a No. 7 bit and tap for a $\frac{1}{4}$ -20 carriage bolt.

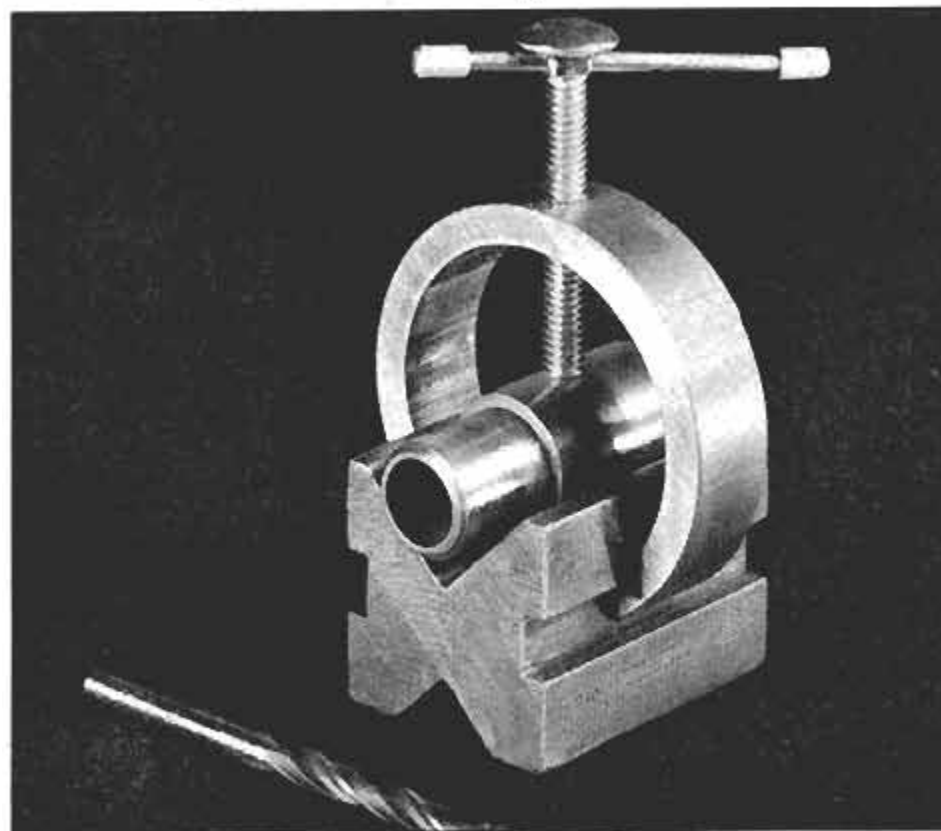
Use a 2-in. carriage bolt threaded its entire length. For ease in turning, drill a $\frac{1}{8}$ -in.-dia. hole in the



An ordinary V-block is shown with the parts of simple clamp. After a ring section is cut from a pipe (upper right), a C-segment is made by cutting a section from the ring.

square part of the bolt head and fit it with a $2\frac{1}{2}$ -in. length of steel rod. Cap the ends of the rod with sections cut from $\frac{1}{8}$ -in. aluminum rivets. Drill rivets so they can be press-fitted.

If you are concerned about marring your workpiece, fit a brass or aluminum cap over the clamp screw end.—Walter E. Burton



V-block clamps are indispensable for metal-working projects on tubes and rods. This clamp can be made in a short time and duplicated in various sizes to fit your needs.

P. M.
MASTER
CRAFTSMAN



Build This Colonial Pie Safe

The pie safe, variously called the pie cupboard, kitchen safe, tin safe, and even the meat safe, came into use in the 1700s and was made until about 1880. A large cabinet, made to hold pies, bread, and sometimes meat, it had pierced tin panels in the doors and usually on the ends. The tin panels were for ventilation and to keep out insects, but they also served a decorative purpose. Usually, the cabinets had one or two drawers, most often above, but sometimes below, the tin-paneled doors. The wood was often pine or poplar.

Pie safes are classified as American country furniture and are popular today, particularly among young people. Antique shop and auction prices begin at about \$200. You can buy everything needed to build a reproduction of this popular item at a cost of less than half that figure.

I chose No. 2 white pine for the cabinet shown because it is easy to work, attractive when finished, and materials can be found in nearly any lumberyard. No. 2 white pine is much less costly than clear pine and a few small knots enhance the appearance of authenticity. By planning saw cuts in advance, I was able to avoid using stock with large knots or other blemishes.

Start constructing the pie safe by making the doors and side panels. Cut frames from 1-in. stock (actually measuring $\frac{3}{4}$ -in.) Note that door stile K is $\frac{1}{4}$ in. wider than the other door stiles because the right door overlaps the left. The short horizontal side frame pieces are 4, 5, and 10 in. wide. All other frame parts are 2 in. wide. You can save time by rip-

Colonial pie safes no longer cool pies made by the dozen. Modern methods let you bake one pie at a time, so you can use this reproduction as a kitchen cupboard.

Craftsman Ralph Wilkes is an authority on antiques.

This pie safe is his third reproduction for PM. Inspired by the originals, Ralph picks models you can make easily in your shop.

by Ralph S. Wilkes



Knobbed right door overlaps left to hold it closed. Add a catch for right door.

ping, planing the edges, and sanding all framing stock before assembly.

Cut pieces to the proper length and prepare the joints for mortise and tenons. Cut the $\frac{1}{4}$ -in. rabbet on the door stiles. Test-assemble frames and mark the edges for the tin-panel slots.

To make this slot, use a fine-tooth plywood blade on your table or radial-arm saw. Set the saw for a cut just over $\frac{1}{2}$ in. deep.

You are now ready to make the pierced tin panels. You may find a brown protective coating on both sides of the tin when you buy it. This coating can be readily removed with paint thinner (mineral spirits) and No. 00 steel wool. Use the steel wool with lengthwise strokes in the final stages.

With standard 20-in.-width flashing tin available in hardware and building material stores, there is no waste, as 6 linear feet provide material for the 10 x 14-in. panels, leaving 2 in. for a practice strip.

To pierce the panels, you need a round punch, a tool for slotting, and a suitable backing. See the drawing at the end of the story for the shapes of punches you need. A chunk of hardwood, preferably 12 in. or more in diameter and sanded reasonably smooth on one end, makes an ideal backing.

Before you begin piercing the panels, make a few practice holes and slots in a piece of scrap in order to determine the force needed to make the perforations. A lightweight ball-peen hammer does a good job.

The pattern shown was one of the most common in the 19th century. After enlarging the pattern to the 10 x 14-in. panel size, make two or three extra copies in case you damage one while using it. Secure the pattern to the tin at the corners with masking tape and you are ready to begin the job of piercing.

The panel may tend to curl upward as you work. You can prevent this by tacking it down loosely with a

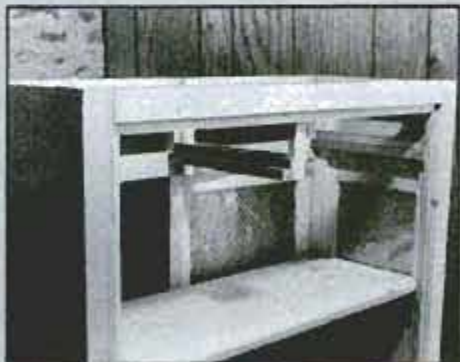
PM color photo: George Arconia; PM black and white photos and construction by the author



Begin construction with doors and sides that contain the tin panels. Test-assemble first for a good frame fit, then once again to center pattern of each tin panel.



Start construction by attaching cabinet frame to side panels with $\frac{3}{4}$ -in., No. 10 flat-head screws. Screws are countersunk in cabinet frame's vertical cleats.



After side panels, doors, shelves and bottom are installed, begin assembling drawer runners. You will find it easy if you work from the back and through the top.

couple of upholstery tacks through perforations already made. Break this job up into several sessions because it can become tedious.

Test-assemble frames again with tin panels before the final assembly with glue. Be sure the panel designs are centered.

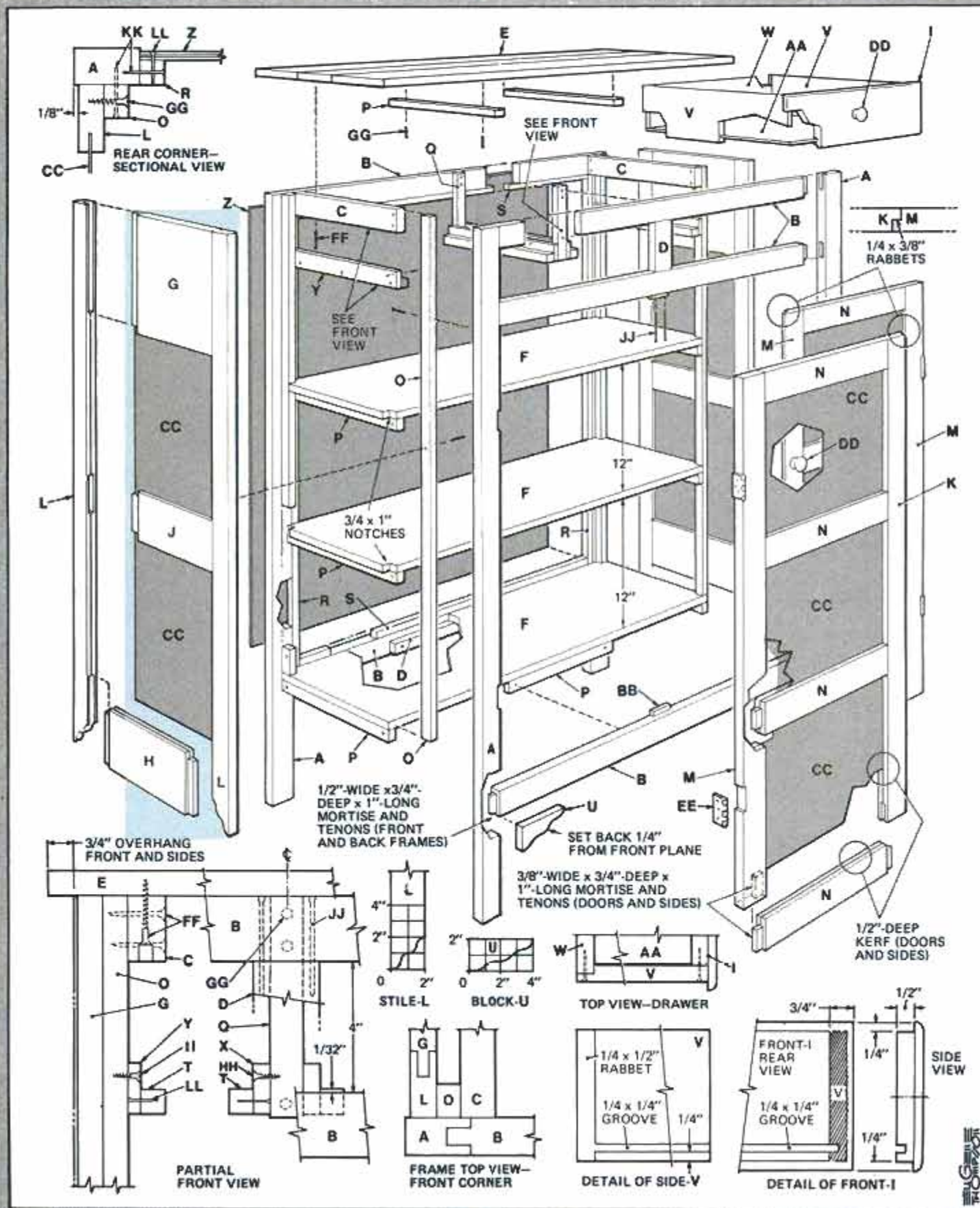
Build the front and back frames for the cabinet from $\frac{3}{4}$ stock (which actually measures about $1\frac{1}{8}$ in. thick). Glue the joints and check carefully to be sure the corners remain square when tightening the bar clamps.

Attach the two end panels with

flathead wood screws from the inside of the vertical frame cleats. Cut and install the floor of the cabinet by inverting the entire assembly, holding the bottom in place with cleats. Then install the shelves.

Mark the hinge locations on the

(Please turn to page 104)



WORKSHOP MINICOURSE

SHOP TRICKS FROM A CRAFTSMAN

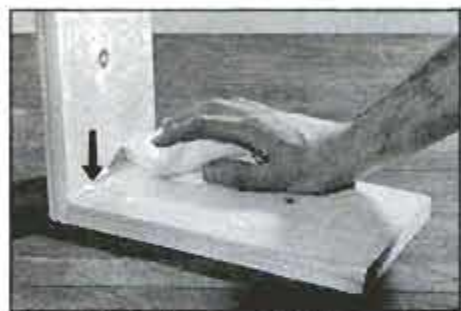
Often, when preparing an article about building a major piece of furniture, space prevents the writer from inserting many of the little shop tips that all craftsmen have in their bag of tricks. I find that in my woodworking class I am frequently asked questions regarding information that many how-to writers, I suspect, consider too basic to cover.

Since I build the projects that I write about, I am constantly reminded that certain tricks should be shared with PM readers. Thus, I plan to do just that in this space from time to time. This month, we will discuss two very basic aspects of woodworking—gluing and clamping—and some of the techniques for doing both successfully.

Gluing

It is safe to say that I, like many woodworkers, probably use either white or carpenter's glue 90 percent of the time. It sets quickly, yet allows adequate working time for getting parts aligned. Although it dries hard under ideal conditions in about four hours, I still allow all glued-up projects to rest undisturbed for 24 hours. The strength of these glues is evidenced by the fact that we can use them to laminate turning blocks for use on the wood lathe.

The single biggest glue problem



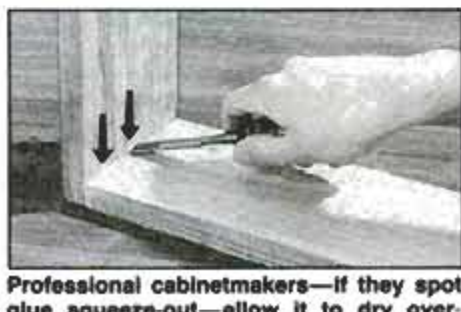
When this inside corner joint was closed tight, there was glue squeeze-out. Since surface will be painted, excess is simply wiped off with a water-dampened cloth.



The same holds true for outside joints. Your best bet is to first scrape off the excess glue using a wood spatula (piece of lattice), then wipe workpiece clean with a wet rag.



After the wiped surface has had time to dry completely, sand the surface smooth.



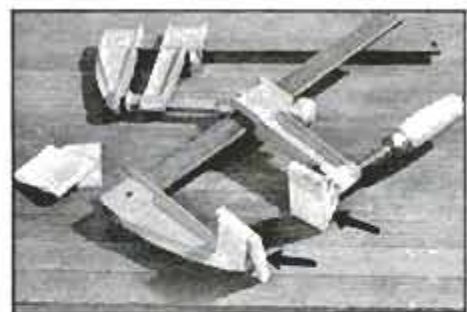
Professional cabinetmakers—if they spot glue squeeze-out—allow it to dry overnight. The next day, the hardened glue is easily removed with a razor-sharp chisel.

every attempt to avoid glue squeeze-out. Since the glue prevents a finish from penetrating, you will have ugly "white" spots wherever there is glue on the surface. Here are some professional hints for achieving pro gluing techniques:

can scrape off excess glue using a wooden spatula followed by a thorough wiping with a damp cloth. That's all there is to it, regardless of the type of joint.

■ On projects to be stained, it is

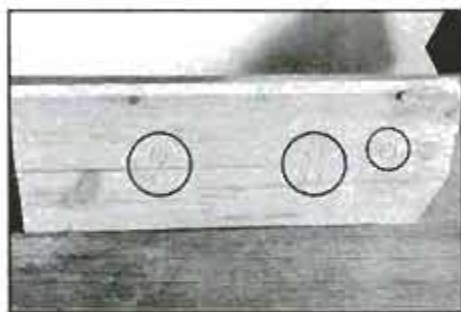
(Please turn to page 111)



To avoid fumbling and dropping clamp protective pads, temporarily affix them to the clamp, as shown, using masking tape.



For most furniture clamping tasks, however, author prefers to tape the wood scraps to the workpiece. Make certain they are opposite each other so that both clamp jaws are shielded from the work.



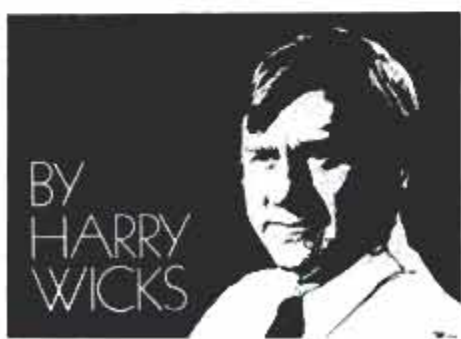
Failure to insert scrap stock between the clamp jaws and the work is sure to result in damage to the surface, as here (circles).

for beginning woodworkers that I have observed is that the average person simply uses too much of it. A professional will put on a scant amount of glue and still remove a great deal of it to minimize a chance of squeeze-out. The important thing is to apply the glue to both surfaces, then remove all excess before pressing the parts together.

If the work is to be stained and varnished, you should really make

■ It is just about impossible to avoid getting some glue on your hands as you handle the glue pot and parts. The best method to avoid transferring glue from hands to wood is to keep a small supply of sawdust handy (there's a treasure beneath your table saw). If you suspect that there is glue on your hands, rub sawdust between them. It's better than using a wet rag.

■ If the project is to be painted, you



Enjoy A Year-Round Harvest



Potatoes, popcorn, canned goods: They all have a safe wintering place in this handy root cellar.

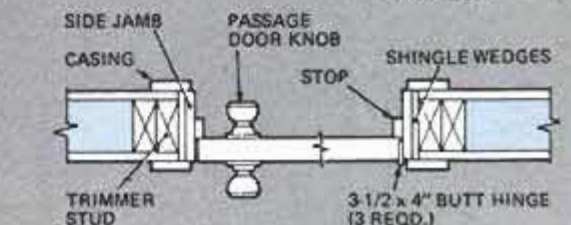
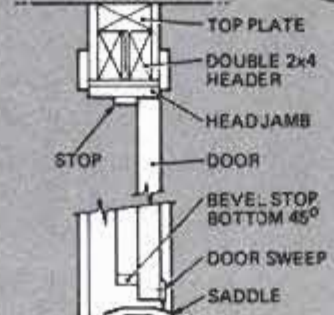
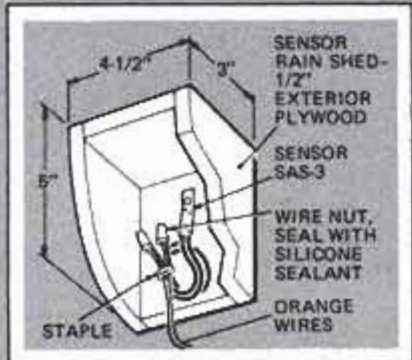
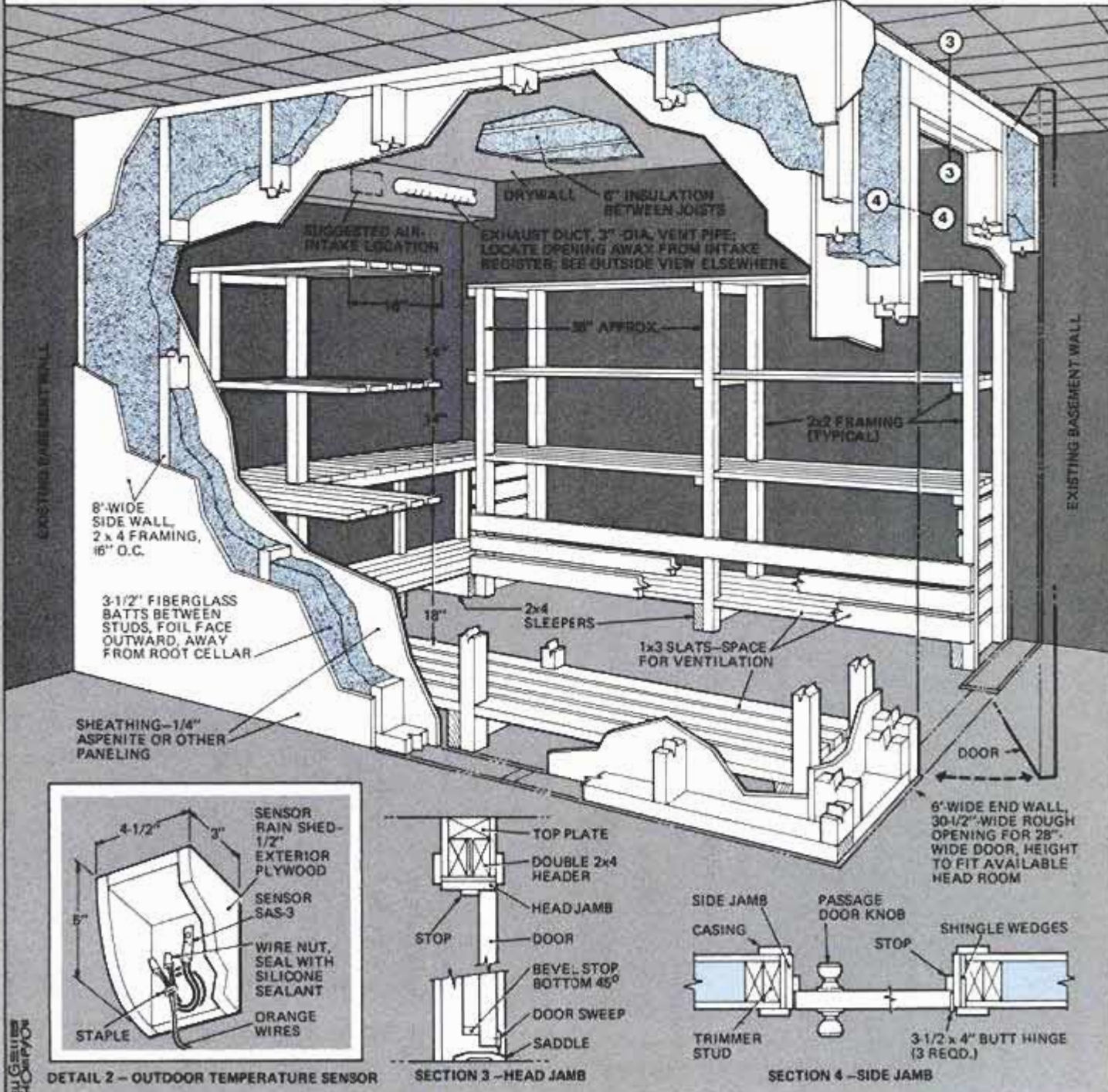
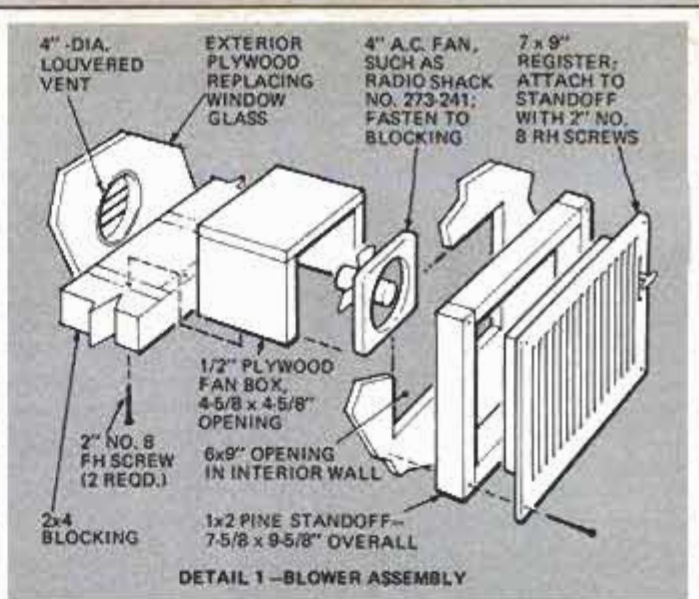
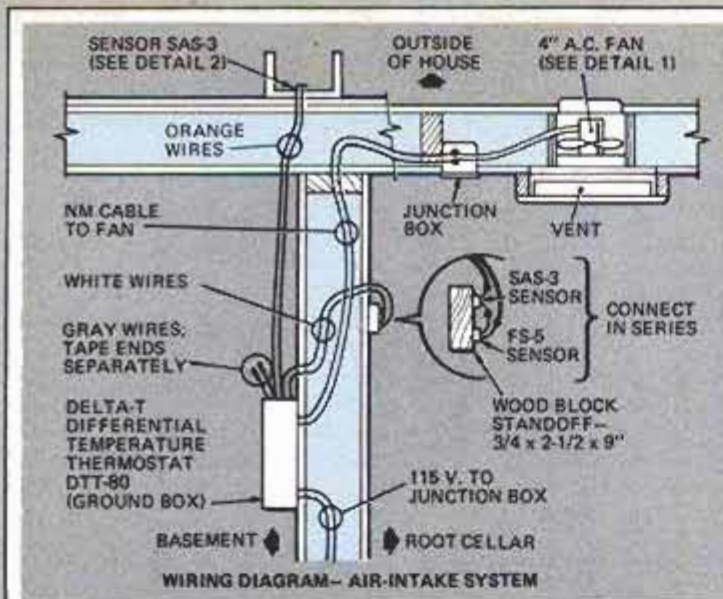
After you've harvested a blue-ribbon yield from your garden, the next step may be to provide storage for your bumper crop, so you'll have fresh vegetables throughout the winter. Master gardener Dick Raymond accomplished this with a root cellar that he built in a corner of his basement.

This cold cellar is a modern version of the traditional root cellar, an underground pit which was usually covered with earth. It can store root crops and other vegetables, as well as canned goods.

PM has further updated the root



- 1,2** The root cellar provides a place to store all your raw and canned vegetables.
3 Outdoor air enters through a register.
4 Differential thermostat outside cellar activates the fan when cold air is needed.
5 A temperature sensor is put outdoors.



McGraw-Hill

cellar by devising a means of cooling it when needed, using outside air. The controlling device in this cooling system is a differential temperature thermostat. By means of sensors, this thermostat keeps tabs on the temperature outdoors and the temperature in the root cellar.

You can set the thermostat to activate a fan when the temperature outdoors is 5° F. cooler than the temperature in the root cellar. The fan draws this cool air into the root cellar to cool the vegetables. The fan turns off automatically when the temperature in the root cellar is within 2½° F. of the outdoor temperature. (For supplier information on

the thermostat and other items, see the list at the end of the story.)

An additional freeze cutoff sensor mounted in the root cellar keeps the fan from running when the temperature in the root cellar falls below 42° F. Then the cellar is cooled by natural airflow.

Root crops are preserved best in colder temperatures, between 32° and 40° F. Although the cellar is largely below grade and, therefore, shielded from temperature extremes, in areas with severe winters, there is some danger of freezing temperatures in the cellar. In these areas, it is wise to keep a thermometer in the cellar; if the

temperature drops near 32° F., you can seal the intake vent. When you seal the intake vent, however, be sure to use the manual override on the thermostat, so the fan in the sealed vent isn't activated when the inside temperature rises.

Sufficient humidity keeps produce from shriveling. Humidity should generally be above 60 percent for most vegetables; many thrive in 90 percent humidity. Ideally, you should keep a hygrometer in the cellar to measure humidity. Or you can check the vegetables from time to time to see if moisture is needed.

Locate the root cellar on a north

(Please turn to page 135)

Stacking Boxes To Carry Your Garden Produce

To carry his harvest of vegetables from the garden to the root cellar, master gardener Dick Raymond uses these easy-to-build stacking boxes. They help keep vegetables from becoming bruised, damaged, or otherwise unfit for storage by the time they get to the root cellar.

The big handles make the boxes easy to carry and they let you haul a full week's supply from the root cellar to the kitchen, or carry freshly canned products from the kitchen back to the root cellar.

The boxes also come in handy for storing an odd squash or a handful of potatoes that won't fit into a bin or on a shelf. This overflow

of vegetables might otherwise end up on the floor, to be kicked or stepped on accidentally. You can also stack the boxes to save floor space. You can even use them for vegetable storage elsewhere—in a pantry, a cool closet or on a porch, for instance.

The boxes shown are made from the remains of an old packing crate, and assembled with 4d and 6d nails. You could also use pine, fir or other available stock to build them. Each box measures 11½ × 16½ × 24 in., and holds about a bushel of produce. However, you can modify these dimensions so the boxes will fit in a vacant spot in your root cellar.

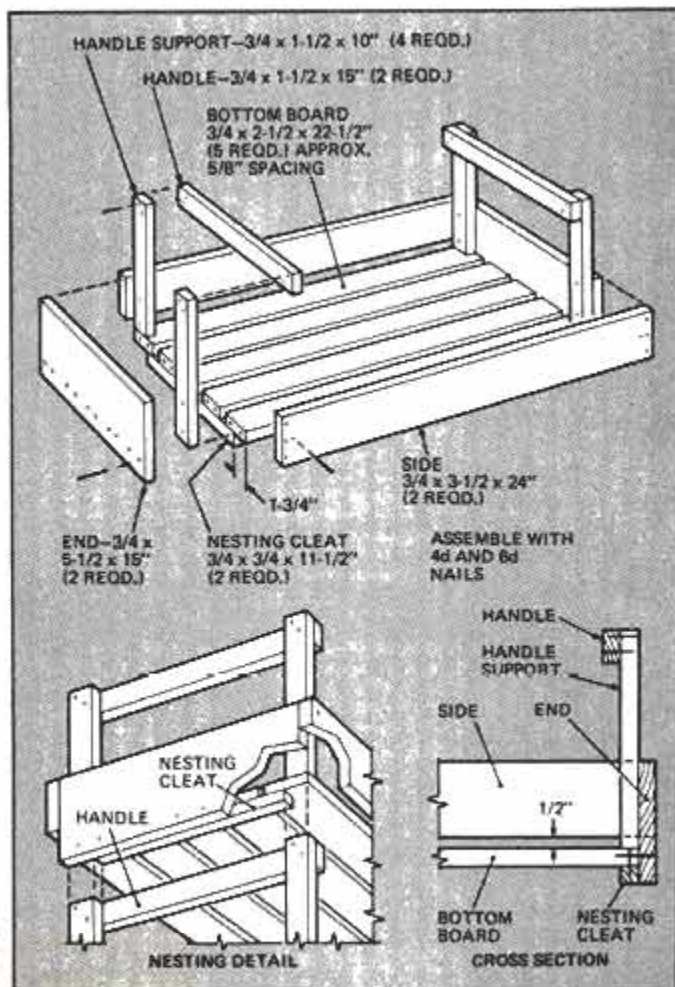
Begin work by cutting the six different types of parts to size. Center the nesting cleats on the end members and fasten them with 4d nails. Fasten the ends to the sides, using butt joints with 6d nails. Check that the corners are square.

Position the bottom boards, leaving about ½-in. spacing between them. Again, check the box carefully for square and then fasten the bottom boards to the endpieces with 6d nails.

Fasten the handles to the handle supports with 4d nails. Then position the handle supports in the box; fasten them to the box ends and to the sides with 4d nails.—P.S.



Easy to build and easy to carry, these convenient stacking boxes go from the garden, piled high with vegetables, to nest in neat stacks in an unused corner of the root cellar.



How To Keep Your Car From Being Stolen



You can't stop the break-in, but with one or more of the security systems available, you can hold onto your car.

by Joel Breault

If auto theft doesn't mean much to you right now, you've probably never been hit. Don't count your blessings, though; with 1.1 million auto-theft crimes last year, your turn is coming. In fact, your car may already be on someone's hit list.

Few thefts are ever solved, because the police have their hands full trying to prevent more serious crimes. New York City, for instance, has only two full-time detectives on its auto-theft squad—a situation tailor-made for thieves.

Although the majority of auto-related crimes are committed in large cities, any vehicle—any time, any place—is a potential target.

The majority of cars are hit simply because they're fair game. A few are stolen and soon abandoned by young

joy riders. But most are stolen for their body parts by the well-organized, nationwide chop-shop mills, where a car stolen in Cleveland on Monday can have its fenders, doors, hood, trunk lid and engine on a truck heading elsewhere by Tuesday morning.

The chances of recovery are nil; and the likelihood of getting the car's true value from your insurance company is equally bleak.

In a sense, insurance companies foster the growth of chop shops because they insist on used parts to repair damage on an insured car, since used parts are cheaper than new. But what happens frequently is that the local salvage-yard operator won't have the needed parts. As a result, he will call other salvage

yards, one of which may also run a chop shop. That operation will then steal the specific make and model car—often matching the needed color—dismantle it, and have the parts on a truck the next morning.

It looks neat enough. Everyone turns a fast profit, the insured car gets fixed, and the insurance company gets out from under the claim with a reasonable settlement.

So, who gets hurt? The person whose car was stolen—perhaps you. The depreciated value of your car might not even be enough for a down payment on a new car. That means having to finance the balance of the price tag, not to mention a rise in your insurance rates.

In the end, you could be out several thousand dollars. But even if



Theftguard Electronic Vehicle Alarm features automatic arming, variable entry delay, monitoring of all openings and emergency activation of the 115-dB siren.

you're not the victim, your premiums still finance the whole operation.

How thieves work

Most professional thieves are, or have been, in the legitimate car business. They work in garages, collision shops and dealerships, where they have access to every entry tool available and can even make duplicates of your keys when you bring your car in for service.

No matter, though; anyone can buy entry tools easily. I recently bought a set of "Slim Jim" door-opening tools from a garage attendant for \$10, including an instruction book. With them, I can get into any American car (and most foreign models) in less than 10 seconds.

Next to a whole car, thieves' most favorite targets are wheels, fancy seats and stereo systems. These unsophisticated car strippers will smash a window, open the door, slash away at the dash with a pick or a screwdriver and pop out the stereo in about 30 seconds. While they generally work the night shift, they will hit a vehicle parked in a desolate area in broad daylight.

Hardening the target

Ultimately, the burden of responsibility for vehicle security falls upon you, the car owner.

Short of a 24-hour armed guard, the only alternative you have to prevent theft is a good security system. Security pros call it "hardening the target," which means throwing as many curves as possible at the would-be thief in an effort to convince him that it isn't worth the time and trouble to steal your car. The harder you make it, the more likely he'll be to pass your car by.

Many of today's antitheft devices include highly sophisticated electronic circuitry; others are quite simple. They're divided into three basic categories:

- Alarm networks;
- Specialized locks for windows, doors, hood, trunk, wheels, ignition, or steering;
- Ignition- or fuel-system immobilizers.

Alarms

A basic alarm is valuable, but will only tell you when a theft is occurring; it won't cut out the ignition system or keep the hood locked. Your best bet is a vehicle-protection system incorporating a good alarm and devices from one or both other categories.

Most auto alarms use existing or added-on pushpin switches (like the ones that control your vehicle's courtesy lights) set in the door jams, trunk lid and hood. When a thief opens any of these, it triggers the alarm's siren or horn. Although these switches are common, they do have disadvantages. Smog and corrosion can contaminate their contacts, which should be checked and cleaned frequently.

Sonic systems detect intruder noise through minicrophones that can pick up the sounds of pry bars, jimmies, key blanks and breaking glass. Depending on their type and sensitivity, however, they may also react to kids playing nearby—or even the buzz of a trapped fly. The resulting false alarms may be annoying, but do verify that the system works.

Some alarms detect electrical-system voltage changes, such as occur during hot-wiring or when the doors, hood, or trunk are opened and the courtesy lights come on. This type can also be affected by voltage changes that occur when your electric clock rewinds or the electric engine-cooling fan switches on, for instance.

Motion detectors monitor many things—someone's posterior being parked on your fender, a tow truck lifting your bumper, or the wheel-and-tire crook putting your car up on blocks.

There are three types of motion switches:

- With the ball-bearing type, when the car is moved, the ball rolls and makes an electrical contact, setting off the alarm.
- The mercury switch does about the same thing, through the mercury flowing within its container, but is more resistant to dust, moisture, cold, heat and parking angles.
- The pendulum type swings when

your car is moved and sounds the alarm.

Alarms are either key-activated, digital-code-activated, or keyless.

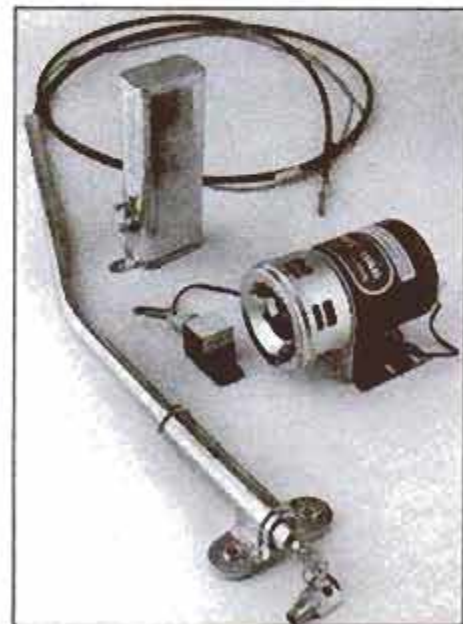
The key-activated ("active") types are usually less expensive and require a key-operated switch to be placed in a convenient exterior location on your car. Some people feel that just the sight of the key switch acts as a theft deterrent; others see it as a target. Unfortunately, a slap hammer can pull this type of switch in seconds—bending your sheet metal and cutting your defenses.

The digital-coded keyless types require you to punch in a series of numbers to arm or disarm the system. When you enter the car, you have a set amount of time to enter the code or the alarm automatically sounds. Most manufacturers offer this type of activation, which can also control ignition immobilizers and the like. Most digital systems also have a bypass switch or code to allow mechanics or valets to operate the car without the secret code.

Keyless ("passive") activation works on a time-delay principle, usually beginning when the ignition is switched off. Depending on the alarm, you may have from 10 seconds to 2 minutes to get out and secure the vehicle. When you re-enter, you have another interval in which to disarm the system.

What happens when the alarm is triggered? The thief may give up his assault and return when the battery goes dead, or he may take what he can right then. If he's really good, he'll break in, find and cut the alarm wiring and knock out the system. Or

Chapman Black Panther uses under-dash mounted hood deadbolt that also disables ignition. Alarm protects against tampering and can be activated in emergency.





Page Alert 4000 is a silent radio alarm that activates a remote pager (beeper) in the event of a break-in. The unit has an effective range of up to five miles.

he could simply cut the battery cables. While he may not be able to drive your car that way, he could strip it or tow it away. Some alarms feature auxiliary power systems designed specifically to beat this kind of theft.

Microprocessor units usually have a timer to control how long the alarm sounds, generally up to two minutes before the system shuts down and rearms itself. That's fine, but suppose the bad guys really want your car. They'll trip the alarm enough times to make you think it has a malfunction. If the scheme works, you'll shut down the system and—unless your vehicle is wired for sound, motion, intrusion, tilt, or voltage drops—you'll never see it again.

Specialized locks

About a decade ago, federal mandates required automakers to design antitheft features into every vehicle. But on pre-1970s cars, it isn't difficult to pop the hood and hot-wire the ignition, or to push in the vent window and open the door. Then, a screwdriver in the ignition and a sharp twist with a pair of Vise-Grips is all it takes to overpower the lock. Any kid worth his auto mechanics class can steal such a car.

On today's ignition locks, however, theft by hot-wiring is generally limited to all-out pros who have tools to deal with the toughest locks. And no matter what carmakers do to improve locks, locksmiths' toolmakers will make better entry tools and lock pullers.

Still, the most common way to get into a car is with a coat hanger or by putting a brick through the glass. Changing the mushroom-shaped door locks to tapered or flush types will slow a thief, as will wind-wing

locks for vans, locks for NASCAR-style hood pins, and cable/key-operated hood locks. (Other specialized locks can protect wheels and fancy accessories.)

Hardened-steel locks are available for most ignition switches. Installing them means disassembly of the steering column, but the peace of mind is worth it. There are also steel collars that wrap around the steering column and ignition switch, forcing thieves to defeat two locks before driving away.

Cane-type locks are double-hook devices that connect the steering wheel and brake pedal. A lock holds the steel hooks together. While this is an inexpensive way to keep the average crook at bay, the pro will cut the steering-wheel spoke and slip the unit off in seconds.

Ignition and fuel cutoffs

Another way to stop a thief is to have your car fail to start or stall out

after it does. The object is to make the thief think that your car is having heart trouble. Rather than sitting in a sick car, he'll search for another victim.

A remote-operated hood deadbolt is a very effective security device, especially when it is integrated into a system that also disables the vehicle's ignition. Not only can't the car be started and driven away (the most common method of car theft), but the lock also prevents the thief from getting under the hood and neutralizing the no-start device or an alarm system.

Secret switches are the simplest and most effective way to stop a thief. They usually interrupt current to the starter or distributor, and can be simple toggle switches or sophisticated digital-type units.

Fuel shutoffs are another defense. With the fuel line blocked, the thief may drive only a short distance before being stopped. However this might leave your car stranded in the middle of a six-lane highway and a danger to other motorists.

Regardless of whether you have a fuel interrupter or ignition immobilizer, you should be familiar with its workings. You might have to bypass it if it stops working.

Buy quality

Perhaps the most important thing you should look for when choosing an antitheft device is quality. Compare the components, not just the

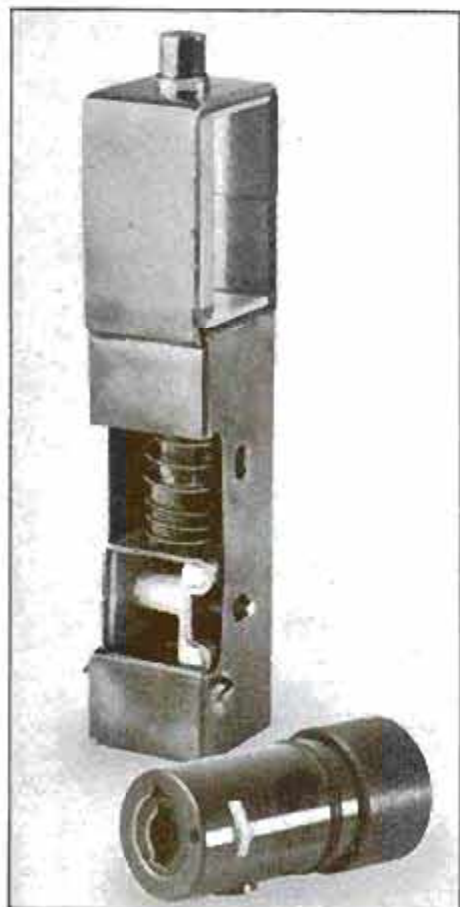
Clifford system is computer controlled and uses keypad to activate ignition cutoff, electronic hood lock, motion/vibration detector and dual air-horn alarm.



SECURITY SYSTEMS AND COMPONENTS—SOURCES

features. If the device looks like a piece of junk, it probably is. And you should be sure to buy only from a reputable company; the system should last the lifetime of the car and should have some sort of warranty against defect. You may think that you're getting a tremendous bargain by purchasing a less expensive system, but it won't seem like such a good deal if your car is stolen because you bought inferior merchandise.

Some alarms and systems can be installed by the average home me-



VasLock's solenoid-activated deadbolt prevents thief from entering car even if he penetrates car's existing lock. His only alternative is to smash the window and crawl in. Case-hardened key cylinder is pick-proof and resists slap hammers. It replaces existing ignition cylinder.

chanic in a few hours. But if you go to a commercial outlet, check with the police or customers to see if they do a good job. Then find out from your insurance company if you qualify for any discounts on your annual premium.

Above all, be certain to test your system frequently. Dirt, corrosion, general wear and tear, and many other day-to-day gremlins can combine to render your newly installed system ineffective. Without constant vigilance, you could easily end up as just one more statistic in the stolen-car file.

FM

Individual components or complete security systems are available from numerous sources. You can consult your local classified directory for listings of nearby dealers or contact one of the following manufacturers directly. Along with addresses and telephone numbers, we have described one major product from each company and listed other types of security devices they sell.

Anes Electronics Inc., 4112 Del Ray Ave., Venice, Calif. 90291. *Pro-7000 Sight/Sound* (\$165): a keyless, computerized alarm system with digital keyboard control; monitors current changes with switches at all entry points; has valet-parking override, high-low siren, headlight flasher, and ignition-kill features. Other products: key-armed alarm systems, motion detectors, kill switches, ignition-switch assemblies, and locks for batteries, fuel cans, and stereos.

Bearfinder Inc., 221 Crane St., Dayton, Ohio 45403. *Bearfinder Auto Alarm* (\$34.95): a passive alarm using the car's horn; monitors current changes through stock or add-on switches at doors, hood and trunk; ignition-switch controlled.

Cal Custom/Hawk, 23011 South Wilmington, Carson, Calif. 90745; (213) 775-8621. *Hawk Auto Alarm* (\$61.95): a keyboard-controlled alarm using the car's horn; monitors voltage changes through stock or add-on switches at doors, hood and trunk. Other products: cane-type steering locks, tapered door-lock knobs, and locking devices for mag wheels, hub caps, and hood pins. Free catalog.

Cambridge Technology Corp., Box 4130, Spokane, Wash. 99202; (509) 534-1953. *VPS-II* (about \$60): a keyboard-operated ignition immobilizer; the 2.5-ounce controller fits behind the sun visor and has valet-parking override feature. Other products: passive anti-intrusion alarms and fuel-protection systems. Free literature.

Chapman Industries Corp., 2638 United Lane, Elk Grove Village, Ill. 60007; (312) 595-8510. *Chapman Black*: a remote hood deadbolt lock with patented no-start ignition suppressor (\$190 installed). *Black Panther*: same as Black system plus additional alarm features and panic button, (\$250 installed). *Total Protection System*: includes Black Panther plus siren alarm, motion detector and detection module that senses opening of doors (\$400 installed). Optional *Air Alert*: pocket beeper that signals tampering with car. Glass sensor detects glass breakage, and other security options. Free information.

Clifford Electronics, 11750 Roscoe Blvd., Sun Valley, Calif. 91352; (213) 768-4810. *Clifford System* (\$850 to \$1,000, depending on vehicle): a computer-controlled vehicle protection system; monitors electrical and ignition systems, starter, motion/vibration sensor and fuel pump (diesels); has valet-parking override and includes hood-locking solenoid and dual air horns with compressor. Free brochure.

Crimestopper Security Products Inc., 9620 Topanga Canyon Pl., Chatsworth, Calif. 91311; (213) 700-8005. *Crimestopper CS-2002* (\$199.95): a keyboard-controlled alarm with automatic arming and warbler siren;

protects all entry points and monitors motion sensor; LED display indicates intrusion or mode selected; options include remote pager and standby battery. Other products: key-armed alarms, timers, floor-mat sensors, kill switches and ignition locks, plus sirens, whistles and bells. Free catalog.

Digequip Security Industries Inc., 220 Great Circle Rd., Nashville, Tenn. 37228; (615) 244-7016. *ARMED WA9X* (about \$90): a passive ignition immobilizer and alarm with 113-dB warbler, adjustable entry delay, miniature test light. Other products: alarm-control module, ignition immobilizer and add-on switches to guard doors, trunk, or hood. Free brochure.

Landia Inc., 450 Third St., Excelsior, Minn. 55331; (612) 474-4116. *Beartrap 2000* (about \$99): a passive alarm with 125-dB electronic siren; choice of entry time delays; "panic" button for personal protection while inside car; ignition-switch controlled. Free brochure.

McGard Inc., 852 Kensington Ave., Buffalo, N.Y. 14215; (716) 833-6120. *McGard Wheel Locks* (\$17 and up per set): hardened-steel locks that replace one lug nut per wheel; pick-proof undulating key groove; available for nearly all vehicles, including 18-wheelers. Other products: locks for spare tires and hub caps. Free catalog.

Micronics International Inc., Box 6319, Anaheim, Calif. 90806; (714) 832-5080. *Theftguard Electronic Vehicle Alarm* (about \$125): an automatic-arming alarm with 115-dB electronic siren; monitors hood, trunk, and doors, plus motion/vibration sensors; variable entry delay; options include starter disabling, remote pager and emergency activation while inside car. Free brochure also covers additional alarm systems.

Page Alert Systems Inc., 23842 Hawthorne Blvd., Torrance, Calif. 90505; (213) 378-8596. *Page Alert 4000* (\$150): a silent radio alarm that triggers a remote paging unit (beeper) as much as two to five miles away; monitors all vehicle openings with sound-activated sensors; can also operate with audible alarms. Free information.

Rocket Automotive Products, 9935 Beverly Blvd., Pico Rivera, Calif. 90660; (213) 699-0311. *Car-Taker AS-100* (about \$120): a computer-controlled combination security system and musical horn; monitors current changes through stock and add-on switches at doors, hood and trunk; 110-dB electronic siren; horn is programmable for different tunes. Other products: forged-steel wheel locks, door-lock knobs and wire-wheel locks. Catalog of security and other automotive products is \$2.50.

Techne Electronics Limited, 916 Commercial St., Palo Alto, Calif. 94303; (800) 227-8875; within Calif., (415) 856-8646. *Ungo Box TL 3000* (\$289): a computer-controlled alarm with passive and manual arming; monitors impact/motion sensor with adjustable sensitivity; has ignition-kill feature and can protect hood, doors, trunk, stereo units and CBs. Free brochure.

Walling Industries Inc., 23485 Industrial Park Dr., Box 9, Farmington Hills, Mich. 48024; (313) 476-6684. *Vent Locks* (about \$6 per pair): metal-and-plastic locks for vent windows on vans, pickups and older cars; tool-free installation. Free information.

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SKY SPIES FOR HURRICANES

(Continued from page 66)

feet or higher, and flat terrain 10 feet or less above sea level gets flooded as far inland as 25 miles.

The killer turns suddenly

In 1935, forecasters watched helplessly as the so-called "Labor Day Storm" (officially dubbed Storm 2—hurricanes didn't have names until 1950) ravaged Florida. It had been hugging the west coast of Florida for two days, when it took a sudden eastward turn. In a matter of hours, it destroyed scores of buildings and killed hundreds in populated areas not expecting a full-blown hurricane. The forecasters couldn't know that above-ground temperatures were shifting by tens of degrees in areas just a few thousand feet apart.

Such sudden shifts in temperature and wind have produced some of the most bizarre phenomena in meteorological history. The 1935 storm produced the lowest barometric reading in the history of the Western Hemisphere: 26.35 inches of mercury on Long Key, Fla.

Hurricane Camille, a Force Five storm, was the last killer to strike American soil. When it hit, in 1969, it

dumped 27 inches of rain during an eight-hour deluge over Virginia. More than 100 of Camille's 255 victims drowned in Virginia, because the sudden downpour caught forecasters by surprise.

While Force Four and Five storms practically guarantee death and destruction, storms of lower magnitude can kill when they arrive unexpectedly or in places where no one would have guessed they'd do damage. Such was the case of the juggernaut of 1938, a Force Three storm that killed 600 along the east coast of New England. That storm arrived in southern New England a day ahead of schedule and went farther north and farther inland than forecasters had predicted. In cases such as these, VAS is expected to do some of its most important lifesaving work.

But the new satellite still leaves forecasters blind in certain aspects of hurricane watching. Thus, they continue to rely on the famous "hurricane hunters" of the Air Force and their own tracker aircraft.

"We now get a picture every 30 minutes, but there's still uncertainty about where the center of the storm is. We still need reconnaissance planes, especially when the hurricane is a threat to land," says

Dr. Joe Pellessier, a Hurricane Center meteorologist.

The daredevil hurricane hunters fly their C-130 aircraft into the storm to get a close-up view of the eye. These experienced trackers can give forecasters vivid descriptions of the shape of the eye all the way from the top of the storm at 40,000 feet, down to the weakest parts a few thousand feet above the surface.

Still, it's up to two NOAA WP-3B Orion aircraft—newly equipped this season with special instrumentation—to provide the detailed mass of data needed for in-depth analysis of a hurricane. Carrying new minicomputers, the Orion craft use barometers, thermometers, radar and other sensing equipment to keep a constant record of the storm's speed and barometric reading changes aloft, as well as the overall physics of the hurricane, says Dr. Frank Merceret, an NOAA researcher. The computer-equipped craft, unlike the Air Force hurricane hunters, record and analyze the data for later research use. The Orions even measure the surface water temperature, crucial to the strength of a hurricane. And they carry sophisticated *dropsondes*, sounding devices dropped by parachute into the storm's body.

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These packages perform a service no daredevil pilot would try—riding the storm itself from thousands of feet aloft down to the Earth. With its sensors broadcasting to nearby weather stations, the dropsonde gives yet another major dynamic picture of the storm's direction, shape and strength.

While the science of "weather modification" has come a long way in recent years, scientists don't even dare dream of a day when a man will be able to tame one of nature's wildest beasts. So the primary effort is going into research to provide better warning of storms.

Ultimately, these new tools will allow weather researchers to create models to study killer hurricanes under wind-tunnel and laboratory conditions. Such information will give meteorologists the ability "to do a better job of forecasting and provide more information to the public to save lives," says Dr. Albert W. Friday of NOAA.

Technology and science are taking some of the punch out of the killer storm. When the Galveston Storm of 1900—a 35-year hurricane—swept the Gulf of Mexico, taking 6,000 lives, there were no airborne forecasting devices and communications were poor. When Storm 4 of 1928—a

Amateurs Give Hurricane Forecasters Extra Eyes

Every day during the severe weather season—tornado, thunderstorm or hurricane—thousands of men and women spend hours of unpaid time providing the National Weather Service with eyes and ears in various localities. These are the amateur weather spotters who serve as part of Operation Skywarn. The network is composed mostly of amateur radio operators, but it also includes those willing to telephone local weather information to the National Weather Service.

Having a thermometer, wind meter, barometer or other simple device is of help. But some trackers just call in naked-eye reports—of blown-down trees, sudden, local flooding and the like. Other members of this network act as relay stations for spotters.

Volunteers often take their lives in their hands to stay behind in a disaster area and radio changing conditions, even as their neighbors flee. Once you

get started working the net, it's tough to break away. When a freak blizzard struck the East Coast this past April, for example, I was at my home radio station for the better part of nine hours, relaying New England weather reports.

If you've never tried tracking a major storm, PM invites you to use NOAA's storm-tracking chart. It's a map of the United States, with grids and points for plotting a storm's path as you hear news of it on the radio—be it a ham station or an ordinary, household receiver. To get one of these 8 x 11-inch charts, send a self-addressed, stamped, business-size envelope to Science Dept., Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. If you want to join the net and are a radio amateur, contact a local emergency coordinator or the National Weather Service for information. Other prospective storm spotters should contact the weather service directly.—M.S.

25-year storm—cut a path from Florida to South Carolina, killing 1,836, there were some rudimentary sensing devices and many homes had radios. Today, many meteorologists believe that Camille, a 35-year storm, would have killed many more

than 255 victims had there been no satellites or airborne sensing devices in 1969.

If the next killer hurricane strikes this year, as is likely, the chances of reducing death and destruction seem better than ever. **PM**



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COLONIAL PIE SAFE

(Continued from page 92)

doors and front frames, mortise, and mount the doors.

Make the runners for the two drawers of maple, cherry, or other close-grained hardwood. Construct the drawers and try them for proper fit before gluing. Turn knobs for the drawers and right door on the lathe or, if you wish, purchase them at a



Brush on a stain/sealer after sanding edges lightly and taping around tin panels. Alternately, you may apply polyurethane varnish alone to preserve natural color.



Make your piercing tools from a nailset and an 8-in. file. An upright log makes a good work block. The piercing job for the 10 panels should take about five hours.

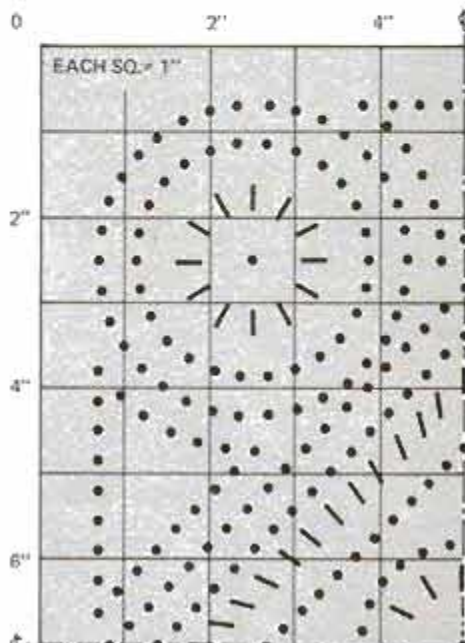
hardware or building supply store.

Make the top of the pie safe by edge-gluing two or more pieces. The plywood back is a piece of plain 1/4-in. mahogany wall paneling. Use a piece of the same 4 x 8-ft. panel for the drawer bottoms.

Now that you have it all together, go around the panel edges with

masking tape. Then go over all edges once, not to round them, but to knock off sharpness with No. 180-grit abrasive paper on a sanding block. Dust and tack off.

Select a stain which is appropriate for the wood, such as Minwax No. 230 Early American stain/sealer. After allowing a day for drying, sand lightly with the same grade of paper, clean, apply white shellac to the end grain, and apply polyurethane. **PM**



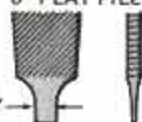
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GRIND END TO 25° ANGLE

8" FLAT FILE



BREAK OFF END AND GRIND AS SHOWN

PIERCING TOOLS

MATERIALS LIST—PIE SAFE

Key	No.	Size and description (use)
A	4	1 1/8 x 2 x 55" (frame legs)
B	5	1 1/8 x 2 x 35 1/2" (frame rails)
C	2	1 1/8 x 2 x 13" (top cleat)
D	1	1 1/8 x 2 x 4" (frame stile)
E	1	3/4 x 16 x 39 1/2" (top)
F	3	3/4 x 13 x 36" (bottom shelf)
G	2	3/4 x 10 x 10 1/2" (top side rail)
H	2	3/4 x 5 x 10 1/2" (bottom side rail)
I	2	3/4 x 4 1/2 x 16 1/2" (drawer front)
J	2	3/4 x 4 x 10 1/2" (center side rail)
K	1	3/4 x 2 1/4 x 35" (left door stile)
L	4	3/4 x 2 x 47" (side stile)
M	3	3/4 x 2 x 35" (door stile)
N	8	3/4 x 2 x 14 1/2" (door rails)
O	4	3/4 x 1 x 43" (corner cleats)
P	10	3/4 x 1 x 13" (cleats)
Q	2	3/4 x 1 x 6 3/4" (runner support)
R	2	3/4 x 3/4 x 41" (vertical back cleat)
S	2	3/4 x 3/4 x 30 1/2" (horizontal back cleat)
T	4	3/4 x 3/4 x 13" (runners)
U	4	3/4 x 2 x 4" (corner block)
V	4	1/2 x 4 x 13 1/2" (drawer side)
W	2	1/2 x 3 1/2 x 15 1/2" (drawer back)
X	2	1/2 x 1 1/2 x 13" (inner runner guide)
Y	2	3/8 x 1 1/2 x 13" (outer runner guide)
Z	2	1/4 x 3/4 x 41" (back)
AA	2	1/4 x 13 1/4 x 15 1/2" (drawer bottom)
BB	2	1/4 x 1/4 x 2" (door stop)
CC	10	10 x 14" No. 28 gauge flashing (tin panel)
DD	3	1 1/2" dia. wood knob
EE	4	1 1/2" butt hinge
FF	12	2" No. 10 th screw
GG	*	1 1/4" No. 10 th screw
HH	*	3/4" No. 10 th screw
II	*	5/8" No. 5 th screw
JJ	4	10d finishing nail
KK	*	6d finishing nail
LL	*	1" wire brads

Misc.: Finish, paint thinner, steel wool, carpenter's glue, masking tape. *As required.

CALCULATOR OR COMPUTER

(Continued from page 70)

example, there are no READ and DATA statements—it does permit extensive user programming. In addition, programs for the pocket computer can be developed on any desk-top computer using BASIC, just as the pocket computer can be used to develop BASIC programs to run on the office desk-top computer.

Two battery-powered peripherals are available for the Radio Shack and Sharp pocket computers: a cassette interface that permits the computer to write or read programs and data to a cassette recorder (supplied by the user), and a combination cassette interface and miniature matrix printer. To use either, all you do is slide the computer into a recess on top of the interface. A built-in connector on the computer mates with a matching plug on the interface.

the Hewlett-Packard and Texas Instrument programmable units.

For those who need even greater power and flexibility in printouts, Radio Shack has the PC-2 pocket computer system, which is a twin of the Sharp PC-1500. Though it resembles the original PC-1, the PC-2 features: an Extended BASIC; an operating speed competitive with desk-top models; a port for plug-in memory modules for up to 16K of RAM, ROM or RAM/ROM combination; and provision for an RS-232 interface that permits the computer to function as a remote terminal. The matching combination cassette interface/printer can accommodate two cassette recorders, while the printer can turn out four-color graphics: green, red, blue or black, one color at a time. It will also print characters in nine sizes, 4 to 36 characters per line, with automatic wraparound.

Full-blown computer power, virtu-



Plug-in attachments for the Quasar handheld computer (HHC) are shown in the inset. They will turn the HHC into a powerful computer system that will fit in your briefcase.

Though the printer is miniature and prints 16 rows across with automatic end-of-line wraparound, the characters are about the size of those from a desk-top printer.

While the low priced BASIC-oriented pocket computers don't accept ROM software, an extensive selection of programs is available on cassette tape. These include business and real estate, personal finance, math, engineering, and even horse-race handicapping, though these programs are less sophisticated than the ROM program modules for

ally the equal of any desk-top computer, is available with the Quasar and Panasonic HHC (handheld computer), which differ from each other primarily in appearance. Both feature two programming languages, Microsoft BASIC and SNAP through plug-in program modules; a real-time clock with a resolution of 1/256 second; a calendar modified for leap years that accommodates text messages; and a text file with editor, cursor controls, search and copy functions. The HHCs are really

(Please turn to page 106)

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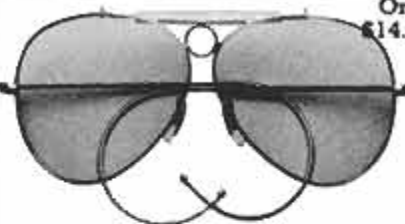
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CALCULATOR OR COMPUTER

(Continued from page 105)

"full-blown" computers with a single-line display in place of a video display. They can, however, be connected to a TV receiver for a conventional 16-line/32-character display.

The HHCs, though handheld, are too large to fit in a pocket. They're part of a complete system which fits inside a special attaché case that accommodates up to six peripherals through an I/O expander.

The HHCs are powered by rechargeable NiCad batteries or 120 volts. The batteries within the computer also power all the other peripherals through the buss expan-



Program modules can plug into calculators, such as HP-41 (left) or the TI-59 (right).

der. The basic computer unit can be equipped with either 2K or 4K of nonvolatile RAM, and up to 48K of outboard additional continuous memory can be added through the buss expander. Standard software includes a powerful calculator mode, a clock calendar and a file system.

With an optional input/output adaptor and peripherals that fit within the attaché case, the HHCs can connect directly into a TV receiver for full screen and color graphics displays; connect with other computers and data bases through an acoustic modem (a device that couples the computer to a telephone handset); or connect to a thermal printer, additional memory, or any RS-232-C compatible device. The computer is about \$525. The attaché case system is about \$2,500.

Which one for you?

Is the programmable calculator the better buy? Or is the pocket computer for you? For straight business, financial and engineering calculations, a programmable calculator will generally be easier to use, and most of the commonly needed programs will be available in a program module. On the other hand, programs that require letters and words, or which might be developed for use on a personal computer, must be written in BASIC, and are best done with a pocket computer. **PM**

his book on the Cuban missile crisis, *Thirteen Days*, published in 1968. So there's no doubt that he knew all about White House recording capability when he showed up for that private meeting with LBJ.

Lyndon Johnson was fascinated by electronics. He had televisions installed all over the White House, three in a row, so he could watch all the networks at once. He was intrigued by small, handheld recorders and radios, and he'd pass out expensive equipment as gifts to Congressmen and special visitors.

Johnson used the Kennedy-installed Dictabelts briefly, but replaced them with a special reel-to-reel system designed by the National Aeronautics and Space Administration. Gen. Albright explained: "We went to a wide tape, a 24-hour recorder, a very slow-moving tape. It would play 24 hours continuously and it recorded back and forth across the tape as opposed to along the edge of it."

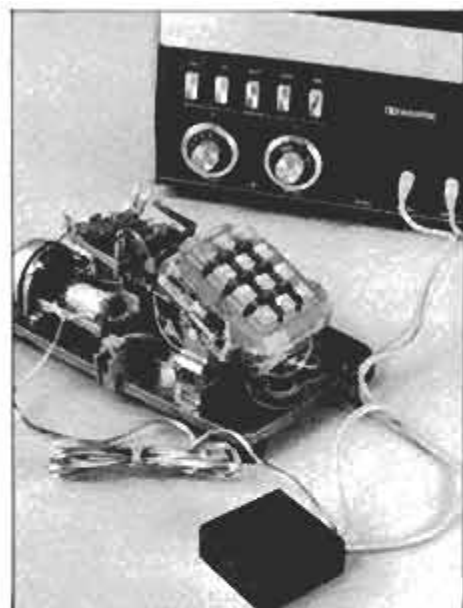
The equipment was not actuated by voice or receiver. Juanita Roberts, Johnson's personal secretary, had to turn the system on and she usually did so on a signal from the

President. Johnson did have the capability to activate the system himself, but usually signaled his secretary when he wanted to record. This equipment was also located in the basement hideaway beneath the Oval Office.

Johnson bugged Cabinet Room

Albright recalls that Johnson set up special equipment to tape White House meetings. W. Marvin Watson, special assistant to the President, requested that bugs be installed in the Cabinet Room and the President's lounge. Telephone taps, or "Charlie Browns" as they were called, were eventually installed in the President's bedroom, the situation room, Watson's office and the LBJ ranch office.

They didn't always work well. In the Cabinet Room, Albright says, "we put mikes in about eight locations around the table." The result was a nightmare. There was no way to choose the strongest signal. So "every time someone sat down at one end of the table and coughed, and a guy pounded his pipe on the table and another guy scraped an ashtray and another rubbed his



A "bug box" (above) like the one used by JFK, available at any electronics store, connects a phone to a concealed recorder.

beard, every one of those sounds came through," Albright said. The result was often unintelligible.

FBI Director J. Edgar Hoover had perhaps an exaggerated view of Johnson's taping capability. Shortly after the election in 1968, Hoover

(Please turn to page 108)

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shuttled up to New York for a meeting with President-elect Nixon. He warned Nixon not to use the White House switchboard during the transition, a perquisite granted the President-elect, because every call in and out was recorded. Nixon, through H.R. Haldeman, summoned Gen. Albright to New York and they sent their own expert on a five-hour tour of the White House communications system.

Albright says the aide reported back, "I don't see any way it could be done." Haldeman apologized. Albright told Haldeman it was "a god-damn lie" that all the calls through the White House were being recorded.

The soon-to-be White House chief-of-staff never once asked if Johnson had the capability, which of course he did, to record Nixon's calls. The Nixon aide sent into Johnson's domain to discover the taping system was described by Albright as a "political hack who couldn't have tracked an elephant through six feet of snow," let alone identify a bug in a complex communications system.

Johnson ordered all the equipment removed by Jan. 10, 1969.

Immediately after Nixon's inaugural, Haldeman had the building checked again, this time by a group of experts, but it was clean. Haldeman learned subsequently that Johnson had the capability to record Nixon and, according to Albright, never again trusted the Communications Agency staff. Consequently, when Nixon installed his equipment, the Secret Service was made responsible for it.

New equipment

Nixon installed taping equipment in the Oval Office and his office in the Executive Office Building. He had at least three systems and as many as eight high-quality Sony 800 B reel-to-reel recorders. There were between six and eight microphones in the Oval Office, installed in the desk and the walls. The tiny hearing-aid-size microphones were not amplified, and fed for as much as 50 feet into a single mixer, where they were recorded on a single track. This caused problems, because there was no way to choose the strongest signal. Consequently, there was considerable reverberation and hum on the tapes.

Nixon's machines were voice-actuated and his telephone conversations were receiver-actuated. The Secret Service monitored the machines and the tapes.

The infamous 18½-minute gap was most likely done on a Uher 5000 that was used by Nixon's personal secretary, Rose Mary Woods, to transcribe the tapes, according to a panel of experts who examined the recordings at the request of Judge John Sirica.

President Dwight D. Eisenhower evidently tried his hand at bugging on several occasions. Summaries of secretly recorded conversations are on file at the Eisenhower library in Abilene, Kan. Apparently, Ike bugged approximately two dozen meetings, including at least one with then Vice-Pres. Richard Nixon.

Presidential eavesdropping has become a touchy business since the Watergate tapes helped topple Nixon. The three Presidents since Nixon have all denied that they ever record surreptitiously. Still, the White House communications people are, in fact, recording all the President's public utterances. It would be a relatively simple matter to start recording his private conversations, as well.

PM

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train. Contemporary will install mounts for a Ford or Chevrolet small block or big block, but most of its cars have been built with Ford 351-cubic-inch "Cleveland" small blocks, tied to a four-speed "top-loader" Ford gearbox.

An outside fiberglass firm supplies Contemporary's bodies.

Just the body and frame will cost you \$6,595. The Deluxe kit is \$13,220, and still you must add the suspension, engine/transmission, tires and wheels, plus assorted bits and pieces.

In other words, you should figure on spending at least \$17,000 for parts, including an inexpensive 351 Cleveland.

If you've got more money than time, there are eight Contemporary Classic dealers who will be happy to sell you a finished car for \$38,000, depending on engine, transmission and paint scheme.

We had the opportunity to drive a pair of Contemporary replicas, one built by a dealer called Supercars in Cold Spring, N.Y., the other by Contemporary. Both cars were virtually flawless in quality and performance.

Contemporary Classic Motor Car Co. is at 5-7 Tecumseh Ave., Mount Vernon, N.Y. 10553. The man to talk to is vice-president Monty Gatti, who's in charge of day-to-day affairs.

E.R.A. Replica automobiles

The E.R.A. Replica comes only one way—as a copy of the Cobra 427 SC competition model. The frame is similar to that on the Contemporary Classic—and on a real Cobra—except that the frame rails are rectangular tubing rather than round, and E.R.A. fabricates its own front suspension.

You can use a small-block Ford, but as E.R.A. partners Peter Portante and Phil Gaudette point out, a big-block Ford V8 is not only more authentic, but much more powerful. Early Cobra 427 models came with a 427 side-oiler; later 427s came with a less expensive 428 Cobra Jet.

Unlike Contemporary, E.R.A. has no dealers, and the firm won't sell you a partial kit. The one and only deal is a \$14,800 "standard assembly," which contains everything but the engine, transmission, rear suspension, brakes, steering, shocks, tires and wheels. Theoretically, if you have every part ready to go, you can assemble an E.R.A. kit in 125 hours.

E.R.A. Replica Automobiles is at 608-612 East Main St., New Britain,

Conn. 06051. They're building kits at the rate of one per week, and Peter Portante is the man to ask for if you would like one of these beauties to be yours.

GRX Aurora

The Aurora is very different. First, it's not a kit. You can buy it only as a complete car. The base price is \$36,000, though that can easily grow to \$40,000 if you add every option. And, it's completely legal. It meets all the federal safety and

emissions regulations, including the old 5-mph bumper standard. And like any new car, the Aurora even comes with a 12-month/12,000-mile warranty.

The Cobra 289-copy body hides a real multitubular space frame designed to absorb impact front and rear. It's much more elaborate than either of the kits. The front suspension uses stamped A-arms, the rear has fabricated upper and lower trailing arms with inboard discs and coil-over shock absorbers.

Aurora buys 169-hp, 302 V8s from

(Please turn to page 110)

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Ford, complete with two-barrel carb and four-speed transmission. In a 2,050-pound car, this gives sprightly performance by 1982 standards, but nowhere near the awesome speeds of either a genuine Cobra or a kit. While the E.R.A. cars were hitting 160-plus mph on Lime Rock's short straight, the Aurora was good for only 90 to 95.

Otherwise, the car was all of a piece. The fiberglass bodywork is excellent and most body cavities are filled with foam for added strength.

The interior isn't authentic Cobra at all, but it's probably pretty much the way a Cobra would have ended up if Ford Motor Co. had tried to update it to 1982 specs.

Aurora Cars Ltd. of Richmond Hill, Ont., Canada, is building 125 cars a year. Harvey Morrow is the president of Aurora-Cobra-East, Circular House, Suite One, 88 Circular St., in Saratoga Springs, N.Y. 12866. This is the U.S. distributor, and we used Harvey's personal car for flogging around Lime Rock.

Shelby Cobra 289 and 427

It's not every day you get to pound a \$50,000 Cobra 289 around a race track, let alone a \$100,000 Cobra 427. How did they measure up? Well, honestly, a man would have to be a masochist to own a Shelby Cobra. Not because there's anything wrong with the cars, mind you, but because they're so rare, valuable and delicate that it's a shame to drive one and risk damaging it.

That aside, how did they go? Well, a street Cobra 289 is a surprisingly pleasant little thing. The handling is dead predictable, the engine responds as only a presmog V8 in a one-ton car can, and the controls are light and precise to the touch. It's a genuine pleasure to drive fast.

The 289's cornering limits are pretty low by modern standards and the suspension doesn't work too well, but you have to remember we're talking about a 1953 A.C. Ace chassis that was originally designed to survive 102 hp and a top speed of less than 100 mph.

Ken Eber's Cobra 427 is another kettle of fish. Ford Motor Co. spent millions of dollars designing a chassis for the 427, and it pretty much represents the state-of-the-art circa 1965. And it's good. There must be street cars which will outdo it on a skidpad—a BMW M1, a Porsche 928, maybe, the new Z-28—but Eber's 427 has the nicest high-speed handling feel you've ever experienced.

It's also quick as a flash, of course, but the controls are light and surprisingly easy to use, considering it has a 500-hp motor.

If you want to know anything at all about Ford-powered performance cars—and that includes Shelby Mustangs, Tigers, Panteras, Mark IIs, Mark IVs and even Boss Mustangs in addition to Cobras—you need the Shelby American Automobile Club. Directed by Ken Eber and Rick Kopec, it's the best run car club in the country. Just the bi-monthly magazine is worth the dues. The Shelby American Automobile Club is at 22 Olmstead Road, West Redding, Conn. 06896.

Everything you always hoped about Cobras is true. That the cars are stunningly beautiful from every angle is so obvious it doesn't bear discussion. The styling is not just timeless, it simply IS. That they will outperform any street-legal car ever built has become a cliché from the repetition. And thanks to the Cobra clones, you don't even have to spend \$100,000 in order to share the Shelby experience. It's not often you get a shot at automotive heaven... even if you have to build it yourself.

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WORKSHOP MINICOURSE

(Continued from page 93)

generally better to let any glue squeeze-out dry hard overnight. The next day, use a razor-sharp chisel to remove glue from the wood.

■ A stunt that I use to make spotting glue squeeze-out easier—especially after it has dried clear—is to mix a small amount of chalkline powder with it. The “blue glue” is then very obvious.

■ No matter which method is used to remove squeeze-out, always sand the surface after the glue has been removed.

About clamping

The biggest bugaboo about setting up a clamped arrangement is that you never have enough hands to handle the workpiece, clamp weight and clamp's adjustable jaws at the same time. That's why craftsmen create holding jigs, whenever possible, for cradling the bar clamps so the work can be set in between the jaws. But in many cases you must bring the clamps to the work. And if the surface being clamped will be visible on the finished project, it is imperative that you protect the workpiece from the clamp jaws. Failure to do so will result in a damaged work surface. To do it, you must insert scrap pieces of wood between clamp and work.

To simplify this task, use masking tape to hold the protective pads in place while you set up and secure the clamps. You can use either method shown, but on large workpieces the method of taping the pads to the work is the better system. Protective pads on the clamps work perfectly well for small benchtop assembly projects. In a future issue, we will discuss more clamping techniques, including a suggested simple clamp cradle (jig). **PM**

GM PULLS INTO FAST LANE

(Continued from page 82)

Sanforized, but totally redone Eldorado will bow for '85 on a 103.5-inch wheelbase—only 2.2 inches longer than the current J-car (Cimarron). Overall length of the Eldo will be 175 inches, while the car's weight will have been pared down to a fighting trim of 2,750 pounds—which is a mere shadow of the Cadillacs of former days.

The Eldorado will share the same fwd platform with GM's other luxury E-body models—Olds Toronado, Buick Riviera and Cadillac Seville.

Power options will include a base engine 2.0-liter V4, 3.0-liter V6 and a

(Please turn to page 125)

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In summer, use the variable speed feature (from 60 to 150 rpm.) to increase the fan speed. The cooling breezes allow you to cut down on air conditioning. You can save up to 56% in energy costs! The large 52" diameter sweep of the blades provides movement of air for an entire room . . . up to 14,000 cubic feet per minute of air delivery!

In winter, you can lower your thermostat all season long! Save on fuel bills and stay warm and comfortable. Here's how: As the heated air rises to the ceiling, the slow-moving fan gently recirculates the warm air downward again. As a result, you get more "mileage" and comfort out of that heated air. It's wonderful!

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FIRSTHAND REPORT



Flagship four-door, Volvo's first all-new car in 15 years, replaces current 260 GLE.

Driving The New Volvo 760 GLE

The prestige- and performance-packed turbodiesel will challenge the Mercedes 300D.

by Bill Hartford MANAGING EDITOR

Before we ever heard of Volvo, Swedes were comparing their home-grown car—born in Gothenburg in 1927—to a tractor: unexciting, but solidly built, a serf on wheels. When I first saw a black 544 in 1955, I found it a curious automobile that resembled a lowly '47 Ford. Now, it's Volvo that's often chosen by discriminating buyers who can't, or won't, pay the price of a three-pointed star.

That's how far Volvo has come in its assault on the fine-car market. It was Volvo, in fact, that was first with a status station wagon, Mercedes jumped in long after half the spots in the country club lot were filled with 245s. With the introduction of its 1983 760 GLE four-door sedan, Volvo will make a lot more buyers think twice before paying megabucks for a car.

A couple of months ago, while the world was seeing this new car on display at the Geneva Motor Show, I

was in that neighborhood "running in" a European-market 760 GLE turbodiesel, the model in the line that will suffer least when federalized for sale here: While the gasoline-engine cars are stopped at customs for their emissions-control visas, turbodiesels will be waved right on through.

A diesel delight

Performance of the turbodiesel will be exactly the same here as I experienced it. You may not get the

chance to run for long stretches at 185 kilometers per hour as I did in northern Italy, but you'll know that the GLE will give you that 115-mph equivalent here; you may not nail it all the time and enjoy the hearty growl of the turbodiesel getting you

up to 60 mph in 13 seconds, but you'll know those six cylinders are ready when you want them; and you may not always be in a fuel-saving frame of mind, but when you do want 30

mpg, the electric overdrive on the four-speed manual will pop in with the push of a button. This is a diesel-fueled car that will thumb its tailpipe at any other oil burner on the road.

It's the right weight, for one thing, just 3,000 pounds, so the 2.4-liter straight Six, with its Garrett Air Research T03 turbo, and good for 106 hp, lets you throw it around with great fuel-efficient fun.

When the GLE goes on sale in November, you'll have the choice of the turbodiesel with either four-speed manual and electric o.d., or three-speed automatic. The other engine choice is the fuel-injected, gas B28F, Volvo's familiar 2.8-liter, 130-hp V6; it's teamed with the automatic overdrive transmission only. Smooth, but not a scorcher. That's it. Two solid powerplants. If you're wondering where the hot, turbo gas Four is, it's still in the other Volvo models, but not in the 760—yet.

All-new body

At last, a hood line that races down to meet the road! Gone is the Flat Earth Society hood that drops off somewhere out there in infinity. There's a hint of Aston Martin Lagonda, perhaps, but, for sure, the styling is more Latin than Lapp.

Interior room benefits from a longer wheelbase: It's 109.1 in., which is 5 in. more than the old GLE. Hard to believe is that overall length

(Please turn to page 114)

Comfort and luxury of leather seats and numerous power-operated accessories don't detract from the control and feel that make the 760 very much a "driver's car."





Wide doors ease interior access; the central locking system includes the trunk lid.

is shorter, 188.4 in. vs. 192.4, but the new lines make it look longer. Driver and front-seat passenger share most of the pleasures of the new layout; it's superb. Seating comfort in the rear, however, is less than it should be in a four-door prestige sedan. A too-high seating position can be blamed on a combination of factors: the new rear-axle suspension system, the fuel tank under the rear floor and the shape of the floor under the seat, which is raised at the front edge to keep passengers from submarining under their belts in a frontal collision.

Front seats, too, are designed to prevent submarining, but they're perfectly positioned and infinitely adjustable. And the belts are attached to seat rails so they move when you move the seat. The center console—where you'll find the automatic climate controls and sound system—is angled toward the driver



Hood opens 90° to the vertical position to allow for easy care of the 2.8-liter V6 (here) or the turbodiesel Four engine.

and the dash is nicely laid out. The steering wheel looks good, but the bottom two spokes of the four meet the rim at an acute angle that catches your thumbs; it's extremely awkward. Center armrests front and rear open to reveal storage compartments, and there are many other catch-all pockets and cubbies.

The interior is wired from top to bottom: Between the electric sunroof and the electrically heated front seats are power windows, electric rear-view mirrors, cruise control and intermittent wipers. Top it off with the all-leather seats that color-key magnificently with the carpeting and interior panels and you feel that, in no way, have you been shortchanged on the price, which should be in the neighborhood of \$19,000.

Under the skin

If you could take a 760 up to speed and see through the all-steel unit body, Zincrometal and hot-dipped galvanized panels and full undercoating, you'd be treated to Volvo engineering in action. Rear-axle movement during acceleration and braking is transmitted via torque rods to a wishbone-shaped subframe, the heart of a new live-axle mounting system. Centered over the differential, the subframe eases shocks and vibrations that are transmitted to the body. And, as we found out in high-speed and mountain driving, this patent-pending system deserves its name: Constant Track.

Front suspension is MacPherson struts with coil springs. Gas-filled shocks are used all around, with automatic self-leveling at the rear. A 19-mm sway bar completes the arrangement up front.

Brakes are four-wheel, power-assisted discs with triangular split and proportional application on the hydraulics, the supersafe setup we

now take for granted. Finned, sliding-type calipers are used in front, and the 760 also gets a set of new light-alloy wheels that mount Pirelli P8 185/65R15 steel-belted radials. Good road feel is retained with the aid of power-assisted, rack-and-pinion steering, which gives a tight turning circle of 32.2 feet, excellent considering the 760's long wheelbase.

If you want to go exploring under the hood, you'll find that it opens 90°. The turbodiesel gets a heavy-duty, 90-ampere-hour battery, vs. 55 for the V6, and the crankcases of both engines are wired to signal a low-oil reading.

Speedometer is electrically operated and fuses are in the driver's center console. Engine-temperature



The 15.8-gal. fuel tank has unique built-in reservoir. It's mounted forward and has break-away-type filler pipe for safety.



Wishbone-shaped subframe (light color) is centered over differential. It improves ride and handling of live rear axle.

and battery-voltage gauges and other warning lights make sure there's no mystery as to what's happening under the hood.

The only thing you might find mysterious about the new GLE is the "760" designation. Unlike numbers for earlier models, it's not shorthand for series, engine cylinders and doors, which would make it "7-series, 6-cylinder, no doors!" It's just an internal code number that Volvo carried over from blueprint to nameplate.

Soon, though, even without any significance, "760" will be as familiar to those who appreciate fine cars as the numbers 240, 300, 380... **PM**

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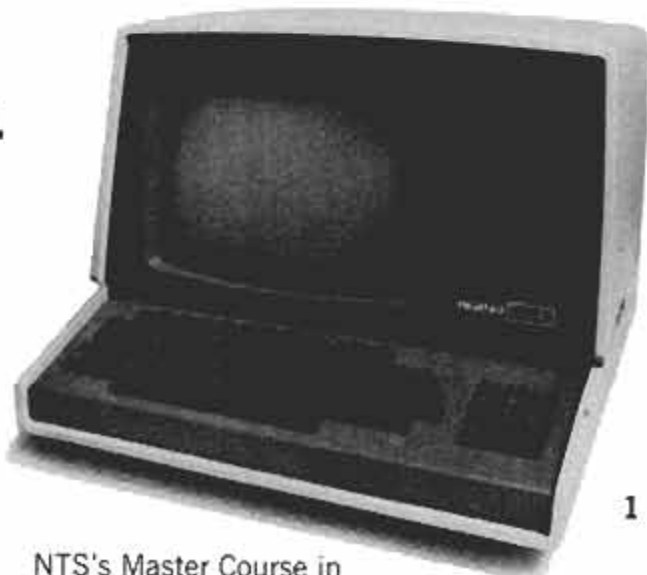
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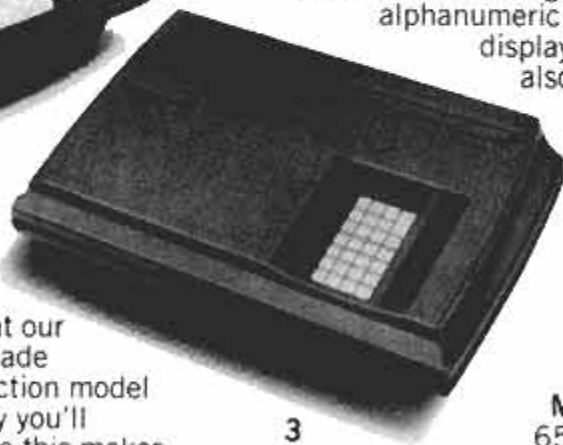
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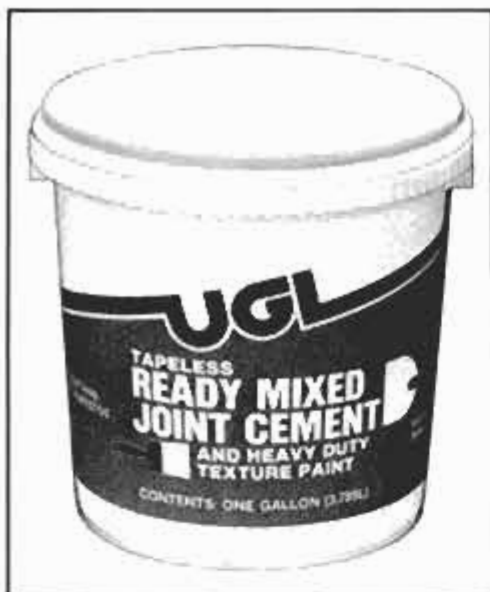
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A



B



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D

A Ready Mixed Joint Compound is a water-based dry-wall joint compound that can double as a texture paint. It can be tinted with latex paint colors if used as a texture paint. It adheres to dry wall, plaster, brick, stone, cinder block and concrete. Drying time is two to four hours. It's available in 1-gal. containers that cover 75 linear feet of wallboard joint, or texture 100 sq. ft. About \$7.90 per gallon at home centers, it's made by United Gilsonite Labs, Box 70, Scranton, Pa. 18501.

B The Big Dipper is a new 4-in.-wide paintbrush with a cellulose core surrounded by tipped and flagged polyester filaments. According to the maker, this lets the core soak up and hold a large amount of paint, which is released evenly while brushing. The brush has a durable plastic handle and brass holding plate. The Big Dipper is \$10.95 at paint and hardware stores; it's from the Lucas Group, Box 6709, Cleveland, Ohio 44101.

C Masonite recently introduced two new roof-shingle products, made of compressed wood fiber, for both new roofing and reroofing. Called Woodruf Traditional and Woodruf Rustic, the shingles' heavily textured surfaces weather to a light gray. The Traditional line has 32 pieces per square, while the Rustic has 36. Available in lumberyards and home centers, both are \$65 to \$75 per square (100 sq. ft.). They're made by Masonite Corp., 29 North Wacker Dr., Chicago, Ill. 60606.

D Jenn-Air's oven model No. W221 is a new double oven that features a microwave oven on the top and a convection/radiant oven on the bottom. Both ovens are regulated with a timer or an automatic temperature probe. Made for combined installation, the unit is $23\frac{1}{4} \times 25\frac{1}{4} \times 48\frac{7}{8}$ in. and requires 220 volts. The oven is about \$1,750 at appliance stores. It's from Jenn-Air Corp., 3035 Shadeland, Indianapolis, Ind. 46226. **PM**

Cache recently located...

Obverse



Reverse



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The equipment needed to make the stained-glass panel includes (from back to front): dishcloth, sponge, square, carbon paper, detergent, glass for flux, flux brush, 60 to 100-w. soldering iron, scissors, glass pliers or parallel-jaw pliers, orange stick, fine-point waterproof marker, glass cutter and fine-grade half-round file.

STAINED-GLASS LIGHT BOX

(Continued from page 54)

all of the equipment and materials shown in the first two photos above. Check your classified directory under "Glass—Stained and Leaded" for a supplier near you, or see the supplier list for mail-order sources at the end of this story.

Carefully draw the 1-in. grid and



Glass-panel materials are: opalescent glass (transparent glass will reveal the box innards), 3/16-in.-wide copper foil tape, tinner's fluid (flux), kerosene, 60/40 solder, Manila folder, pushpins, copper sulfate solution (1 oz. copper sulfate to 4 oz. water) with four drops vinegar.

sketch in the pattern. A Manila folder makes a sturdy pattern. Besides this pattern, which you'll cut into pieces and use as a template to cut individual pieces of glass, you'll need an additional copy to use as a guide in soldering parts together. Use carbon paper to make a duplicate on paper. Carefully cut out the pattern; trim 1/16 in. within the border of the pattern to allow for the thickness of the copper foil.

Select the glass, starting with the largest pattern piece. Place the pattern on the glass and trace around it with a marker. Dip the glass cutter in kerosene and cut out the pieces, cutting on the inside of the line.



After drawing the pattern and duplicating it, cut out parts 1/16 in. undersize to allow for copper tape. (Numbering parts merely helps distinguish them from scraps.)

Cutting glass

The inside curves are the most difficult cuts to make on glass; make these cuts first. Don't try to remove all of the waste from these cuts in one pass. Make a series of cuts, each one closer to the line than the last cut. Remove the waste as you work.

The outside curved cuts are next in degree of difficulty. Make these cuts next. Finally, make the straight cuts.

The appropriate cutting pressure will vary from one sheet of glass to another. It will take practice before you learn the proper amount of pressure to apply. If you apply too much pressure, the glass will chip along the score line, which will result in an uneven cut. If you apply too little pressure, the break won't follow the cut. The correct amount of pressure will cause the cutter to make a slight hissing sound as it rolls across the glass, resulting in a clean cut.

To make the break, grasp the glass with your thumbs on top and the knuckles of your index fingers under the glass on either side of the cut, serving as a fulcrum. Break the glass with a firm downward and outward motion.

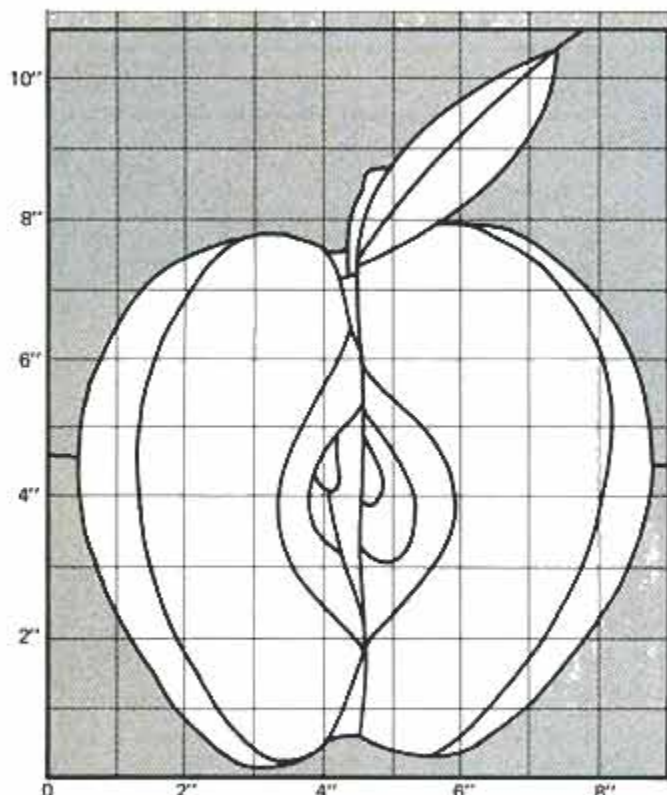
Use pliers to break out smaller pieces. Use a file to smooth any sharp edges. Do not breathe the glass dust. You may wish to wear a respiratory mask.

Soldering parts together

Clean the cut pieces with detergent and water to remove the kerosene, then wrap their edges with copper-foil tape. Center the edge of the glass on the foil and form a U-channel on the edges of each piece. Burnish the foil carefully, pressing the edges down firmly with a small stick.

Place the duplicate pattern on a scrap of plywood and put the foiled glass on it. Check for square and size, and secure the parts with pushpins around the perimeter.

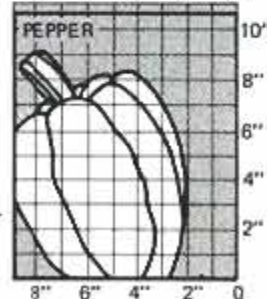
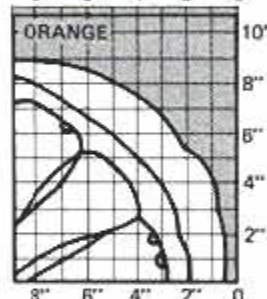
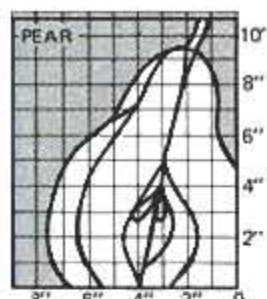
While you're soldering the parts



APPLE PATTERN EACH SQ. = 1"

To duplicate a pattern, accurately draw a grid of 1-in. squares on a Manila folder. Then sketch in the pattern on the grid.

ALTERNATE PATTERNS EACH SQ. = 1"



together, make sure the room is adequately ventilated. Brush tinner's fluid sparingly on the copper. Apply smooth beads of solder to the copper lines. Solder all of the exposed copper, then turn the piece over and solder the back. Wash the piece in soapy water. Copperplate the solder so it will darken and assume a patina with age. To do this, dissolve copper sulfate (1 oz.) in water (4 oz.) to make a concentrated solution. Add four drops of vinegar. Rub the solution generously over the solder lines. Wash and dry the panel and put it aside.

Building the light box

Begin work on the light box by cutting the parts to size as specified in the materials list (page 124). Although I used ash, you may prefer another hardwood that is compatible with the furnishings in your home.

You can make most of the cuts on a table saw. Set up the saw to make $\frac{1}{8}$ -in.-deep cuts and test on scrap wood. Cut $\frac{1}{16} \times \frac{1}{8}$ -in.-deep grooves to receive the glass panel in the top, bottom and sides of the box. The sides and bottom of the box have $\frac{1}{8} \times \frac{1}{8}$ -in.-deep grooves to receive the hardboard back. The top is chamfered along the edge that joins the back of the box.

The box sides are rabbeted to receive the top; the sides are dadoed to receive the bottom. Cut rabbets in the box bottom to join it to the sides. Cut the bottom ventilation hole with a coping saw. Also use a coping saw to notch the back and bottom to accept the electrical cord.

Test-assemble the box without glue; test-fit the glass panel, removing excess solder with a file or widening the slots as necessary to ensure a smooth fit.

Prebore holes and attach the lamp

socket with screws to the box side as shown. Glue and clamp the box together. Remove excess glue with a damp cloth.

Bore and countersink holes for the screws that secure the lid. Fit and screw the lid in place, making sure that it opens smoothly to provide access to the light bulb.

Sand the wood smooth with successive grades of 80-, 150- and 220-grit abrasive, dusting and wiping with a tack cloth between operations. I opted for a natural look and simply applied several coats of satin finish varnish, rubbing lightly between coats with 4/0 steel wool and tacking off. When the final coat is dry, rub the wood with 4/0 steel wool to achieve a luster.

Secure the aluminum reflector to the top with epoxy glue. Wire the lamp cord to the two terminals on the socket. Cover exposed wires with

(Please turn to page 139)



You should begin with the largest pattern piece. Place it on the glass and trace it.



Dip the glass cutter in kerosene; cut the glass, cutting inside the line. On inside curves, remove glass in a series of cuts. Here, the last inside cut is made.



Pliers break away small pieces of glass.



To snap off a large piece, grasp the glass with your thumbs on top and with the knuckles of your index fingers under the glass, serving as fulcrums. Make a firm downward, outward motion for clean cut.



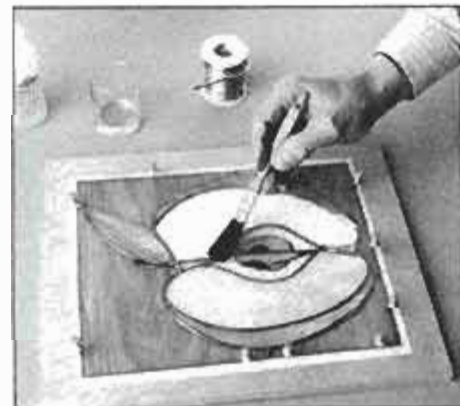
After pieces have been cleaned with detergent and water, and dried, wrap them with copper foil. Center the edge of the glass on the foil and form a U-channel with foil.



Burnish the foil, pressing the edges down firmly with either a small stick or pencil.



Place a pattern on scrap plywood and position the foiled glass on top of it. Check for square and size; secure with pushpins.



Brush flux sparingly on the copper foil.



Solder the exposed copper, applying smooth beads of solder. Turn over the panel and repeat the soldering process on the back. After washing the work in soapy water, sponge copper sulfate solution over the solder, so it will acquire a patina in time. Immediately wash off any residue.

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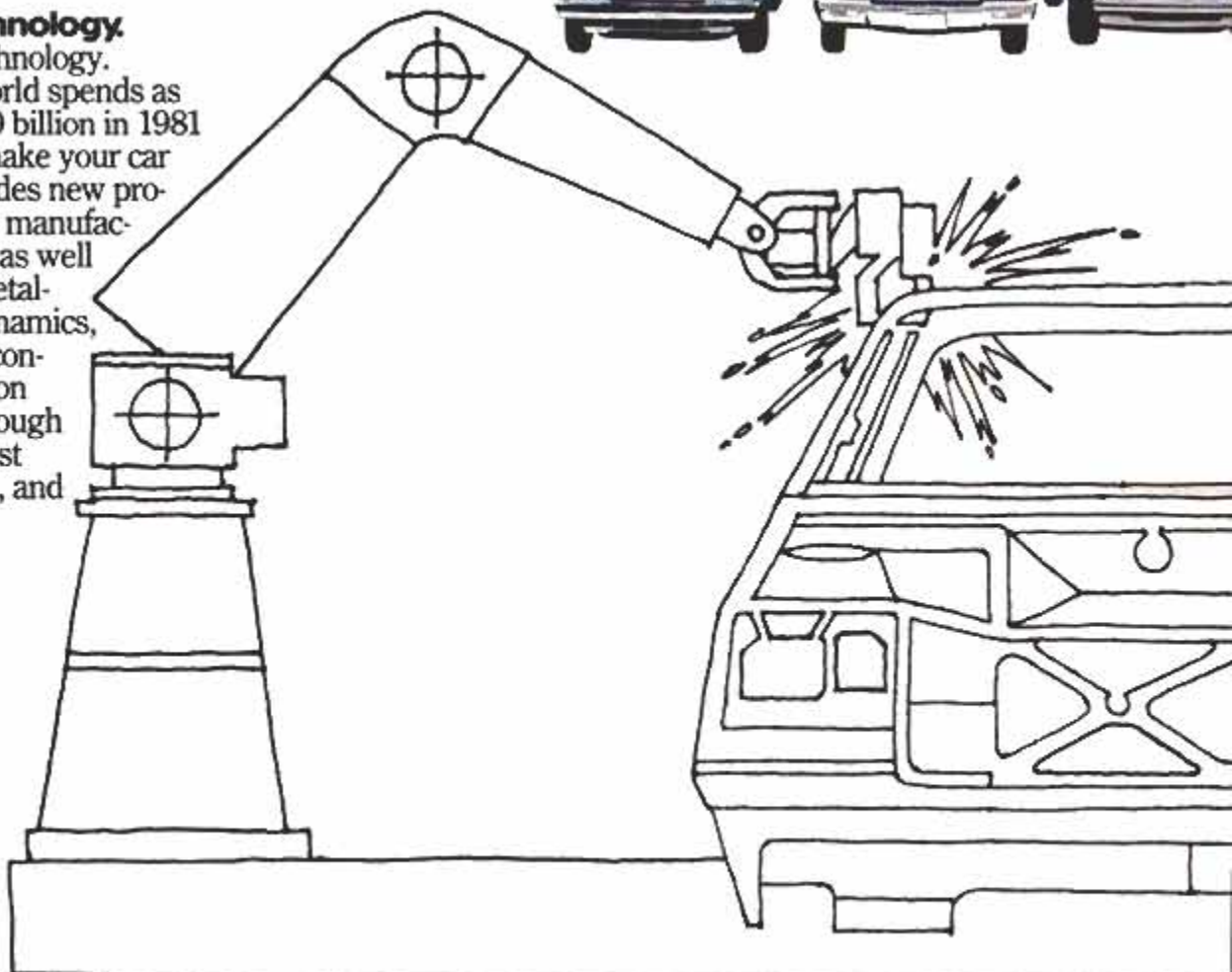
Robert D. Sexton
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GM PULLS INTO FAST LANE

(Continued from page 111)

3.1-liter V6 that stands a good chance of being offered in super-charged trim.

The Chevrolet Corvette has been totally restyled for 1983—the car's first major body surgery in 20 years. Gone are the high crown front and rear fenders. In their stead is a long, sleek, more wind-cheating shape.

Helping to accent the new wedge-shaped look is a more highly raked windshield and rear hatch window. Yes, you read that correctly; the '83 will be a three-door, with a large, one-piece, all-glass hatch that is supported in the open position by gas-pressurized struts.

The hood has been shortened, while the entire front end tilts forward for easy engine access, much like the old Triumph Spitfire.

The roof section also is new. The entire roof panel lifts off in one piece, targa style, eliminating the former T-top design. The body-colored roof panel can be stowed easily in the hatch area.

The body still will be fiberglass bolted to a steel chassis, but there is more use of aluminum alloy in suspension, steering and brake parts.

Changes in the suspension are designed to cut weight and provide much-needed help in the handling department. Springs at both ends of the car will be made of fiberglass-reinforced plastic. The front suspension layout utilizes a monoleaf spring, while the rear uses a new setup of two trailing links per side, a multileaf spring and a transverse link that will cure the rear toe-steer effect plaguing current models. Wheels and tires are very special, and exclusive to Corvette. Wheels are 8½ and 9½ inches wide, front and rear, with 255/55 VR16 Goodyear Eagle GT tires at both ends.

Muscular mill

It's all muscle under the tilt-nose hood. One of the strongest domestic engines available—a carryover of the 1982 crossfire dual throttle body injection 350-cu.-in. V8—pumps out 200 hp at 4,400 rpm. The mill will be mated to either the new-for-'82 700-R4 four-speed overdrive automatic, or a new Doug Nash-built manual four-speed with automatic electric overdrive.

This kind of power, bolted into a slightly less than 3,000-pound, 96-inch wheelbase sports car, is an invitation to some entertaining sub-7-second, zero-to-60-mph blasts. Fuel economy, approaching the 20-mpg mark, isn't too shabby either. **PM**

TECHNOLOGY UPDATE

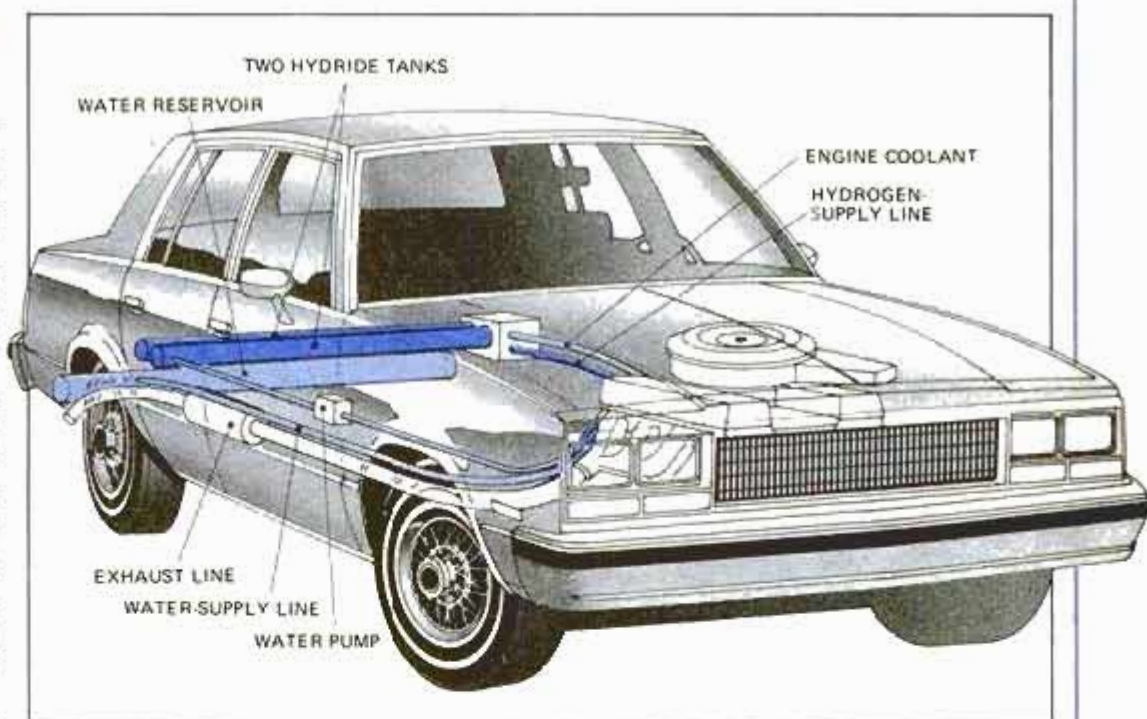
Making hydrogen safe for the highway

Transportation

It was an impressive demonstration: Trained marksmen (see photo) put a rifle bullet through the fuel tank of an automotive hydrogen system—and nothing happened. The next shot went into a conventional gas tank and the expected fireball bloomed menacingly.

Can hydrogen overcome the so-called "Hindenburg syndrome" to emerge as a prime alternate fuel candidate? Billings Energy Research, which grabbed headlines a few years ago by providing hydrogen-fueled limousines for the Carter inauguration, says that the answer is "yes." And the Independence, Mo., company has the experimental vehicles to prove its point.

The raw material in the Billings systems' tanks is an iron-titanium hydride (salts), which contains the combustible element in chemical combination. Hydrogen gas is released slowly by a controlled application of heat. Either ex-



Heat, which is obtained from exhaust gases, engine coolant, or both, warms water to provide a controlled release of hydrogen gas from metallic salts (hydride) in automobile's fuel tank.

haust gases or engine cooling can be used as the heat exchange medium. In net, there is a minimal amount of free hydrogen circulating in the engine; therefore, the threat of explosion is eliminated.

Though there is a nearly inexhaustible supply of flammable hydrogen, it has enjoyed only limited automotive applications so far. The weight of the pressurized tank in conventional systems cut the

range and performance; fuel-injection difficulties were common. But under a contract to Peugeot, the French automobile concern, Billings has developed a microcomputer to control a new, high-pressure (200-p.s.i.) fuel-injection system which has overcome many of these problems.

At idle, the computer damps the injection to provide the leanest possible mixture. It then senses any load placed on the engine, and more hydrogen, air and water (to regulate exhaust emissions) are injected simultaneously.

There's still a long way to go before a full-scale distribution system for "safe" hydrogen fuels is a reality. But the feasibility of running a car on one of the most abundant natural fuels has been proved.



Law-enforcement personnel attempt to induce an explosion by firing rifle bullets into a tank which has been filled with hydrogen-bearing salts; the bullet passes through without any effect.

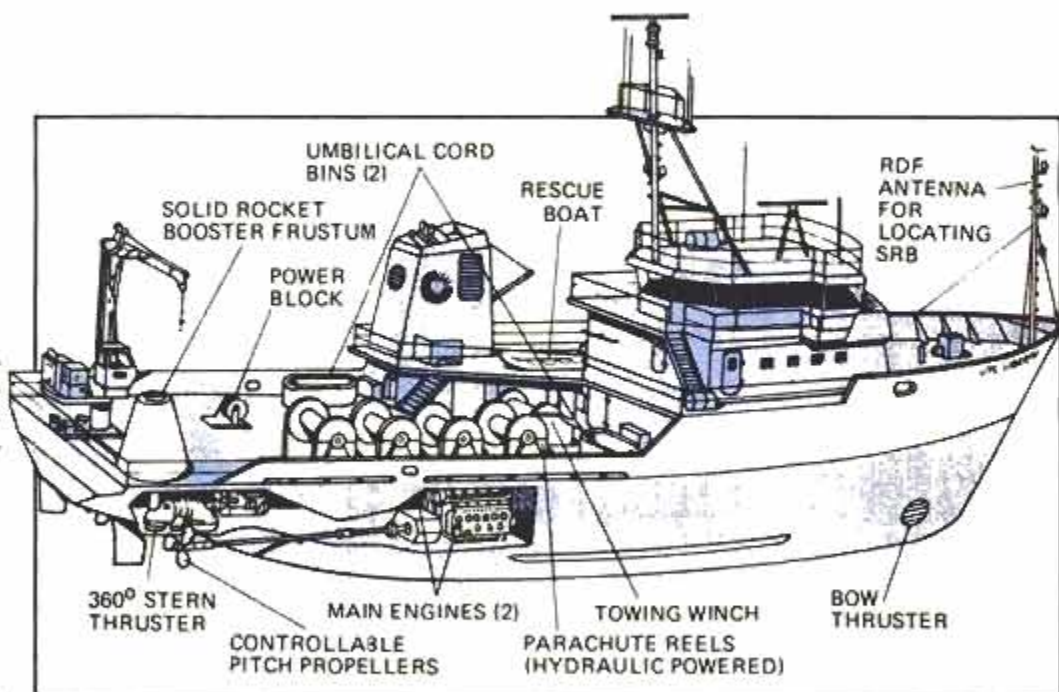
Marine

They haven't lost one yet

Almost everything about America's space shuttle is reusable—right down to the twin booster rockets that separate from the ship about two minutes after launch. The 150-foot, 80-ton fuel tubes parachute back to earth, splashing down more than 150 miles off the Florida coast.

To reuse the boosters, you must fish them out of the sea first. This job has been accomplished admirably so far by two special vessels, manned and operated by United Space Boosters. The *UTC Liberty* and *UTC Freedom* serve as research ships in between launchings. But when a Space Shuttle goes up, they're part of the countdown.

It all starts at T-minus-24 hours, when the 176-foot twins slip their moorings



The two identical booster recovery vessels double as research ships between the shuttle shots.

and cruise a few miles into Port Canaveral for premission checkout. At T-minus-8 hours, a 12-hour built-in hold in the shuttle countdown begins. This allows the ships to cruise at 12.5 knots (14 mph) to the projected impact area.

But the vessels really start cooking at T-plus-6 minutes, 44 seconds, when

the casings splash down—hopefully at the predicted coordinates. That's when diving crews get into inflatable boats to approach the casings, which are bobbing vertically in the water.

Three divers help lower a 20-foot boom about 90 feet beneath the surface. They insert the boom, con-

nected to a pumping device on the retrieval ship, into the nozzle throat at the aft end of the booster; then compressed air is pumped in. That trims the boosters so they can be towed back to Canaveral with relative ease.

As the ships near land, they switch power from their propeller shafts to shrouded thrusters. These can stabilize the research ships when they're on a delicate mission, as well as preserve the lives of manatees, the endangered mammals that live along Florida's shores. Propellers have killed many of these sea creatures that Christopher Columbus described once as "mermaids."



Towing the air-filled booster cylinder back to Florida: The rendezvous occurs 170 miles offshore.

Electronics

When in Washington

As most U.S. Presidents since F.D.R. have known (see page 71), hidden recorders have a certain utility. Up until recently, they have also been extremely difficult to detect with portable equipment. However, it is now possible to protect yourself against secret recorders with a device no larger than a cigaret pack.

The TRD 009 unit, from CCS Communications Control Inc. (633 Third Ave., New York, N.Y. 10017), lights up in the presence of a magnetic recording device.

By moving around, the user extinguishes a row of lights in sequence as he gets closer to the hidden tape unit. Various inconspicuous "terminals," such as a watch that vibrates against the wearer's skin without alerting others, are available as accessories to this clever little detection device.



Pocket-sized unit spots tape recorders.

Military

Ship killers

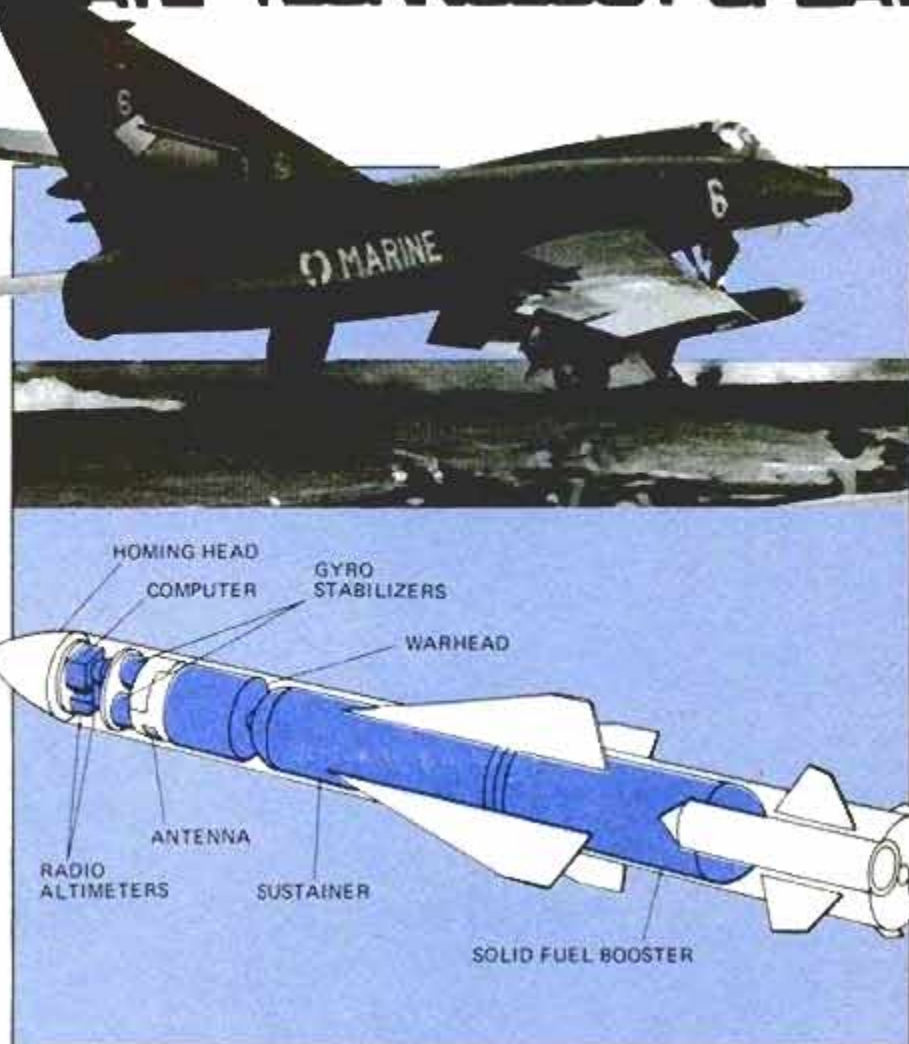
The loss of the British destroyer *H.M.S. Sheffield* early in the fighting for the Falkland Islands marked another step in the advancement of technological warfare. The ship was downed by a single air-to-surface missile, fired by an Argentine Super Etendard aircraft. The missile, a French-built (Aerospatiale) Exocet AM-39, is part of a family that has been in development since 1968. However, it is considered to be a "second-generation" weapon.

Early antiship missiles, such as those which sank the Israeli ship *Eilat* in the 1967 Mideast War, followed a straightforward flight path. The Exocet, however, is what is known as a "sea-skimmer," approaching its target at no more than 25 feet above the surface, while flying upwards of Mach .9. This makes it difficult to acquire on radar or knock out with gunfire.

Launched from an aircraft as far as 70 kilometers (depending on altitude) from its target, the Exocet, like similar ship- or ground-launched versions, is aimed only roughly at the target's coordinates. An inertial platform flies it to the target area, while its radio altimeters adjust the cruise level to travel near the sea surface. At a predetermined time, depending on the initial range of the target ship, an active radar begins to search. When the radar locks on, it takes the missile in—usually impacting near the superstructure or other prominence

The reliability of its systems has made the Exocet the most widely deployed missile (in its various versions) in the Western world. There are currently more than 1,600 of them known to be in use in various navies. (Ironically, the Royal Navy has far more Exocets than the Argentine forces and they are even manufactured in Britain under license.)

Far more sophisticated and costly antiship missiles are available, some combining infrared homing and jam-signal homing, with active radar. The U.S. Navy's Harpoon and



French Etendard strike fighter (top) with Exocet AM-39 on wing (detail, bottom).

other new missiles, fly an automated final climb/dive maneuver to make close-in defense even tougher. Or, if enemy defenses adjust, the program can be altered so that the missile sea-skims all the way to its intended target.

The ranges are also being extended: The farthest antiship missile hit recorded to date was from 125 kilometers away. The strike was registered by a live Otomat (French-Italian design) fired at a practice target in the Pacific by the Peruvian Navy.

Missiles launched by submarines pose another modern threat. The Soviet underwater-launched SS-N-7 "Siren" missile is believed to be effective against ships from 50 kilometers. A test Tomahawk cruise missile (land-attack version) that was fired recently from a surfaced U.S. submarine hit the center of its target, a banner on poles, 300 miles away in the Nevada desert.

About the only drawbacks that antiship missiles have is a lack of discrimination: They can't tell a rust-bucket from an aircraft carrier. In

addition, they don't always sink their targets, because they hit them above the waterline.

In the case of the destroyer *Sheffield*, a high percentage of aluminum used in constructing the superstructure, a feature of certain British ships built under tight-economy ground rules, may have contributed to the superhot fires that doomed the destroyer.

Further analysis of the Falklands actions will undoubtedly be revealing. Example: The Argentines reportedly fired two Exocets at *Sheffield*. Did the first one malfunction, overfly its target, or get knocked down by the most sophisticated antimissile missile now in service, the British Sea Wolf?

It is questions such as these that will bear heavily on the future planning of all modern navies, including ours. If, in the words of one U.S. congressman, "million-dollar missiles can kill billion-dollar ships," defense budgets will ultimately have to be adjusted to reflect the technological realities.

Aviation

Don't quite flap

Birds do it. Bees do it. Pterodactyls in the trees did it. Naturally endowed flying creatures all have some ability to change the shape—the camber—of their wings in flight. Now man is getting around to trying it.

The Boeing Co., under an Air Force contract, is modifying an F-111 aircraft by equipping it with a "mission-adaptive wing" (MAW). The wing has a smooth, uninterrupted upper surface during all phases of flight; it doesn't make use of conventional flaps, spoilers, slots or other known lift-enhancing devices.

Instead, the camber of the wing is varied by mechanisms that bend its flexible leading and trailing edges to achieve the most efficient airflow. The first actual flight, expected sometime early in 1983, will be the culmination of nearly a decade of study involving the National



Artist's conception of an F-111 fitted with mission-adaptive wing. It's scheduled to fly in '83.

Aeronautics and Space Administration, as well as Boeing and various military branches. The military hopes that the MAW could enhance perfor-

mance of several types of military aircraft.

In addition to increased payload and range increments, and enhanced maneuverability, the new wing could improve the ride quality of airplanes and give wings a longer structural fatigue life.

Flaps on the MAW have flexible fiberglass skins; their shape is controlled by internal power linkages connected to hinges. The first aim of the test program, to be conducted at NASA's Dryden Flight Research Center on Edwards Air Force Base, is to demonstrate cruise camber control.

This refers to the precise shaping of the wing in flight for maximum cruise efficiency. As the tests progress, a digital flight control system that allows for high-speed, automatic movements of the variable

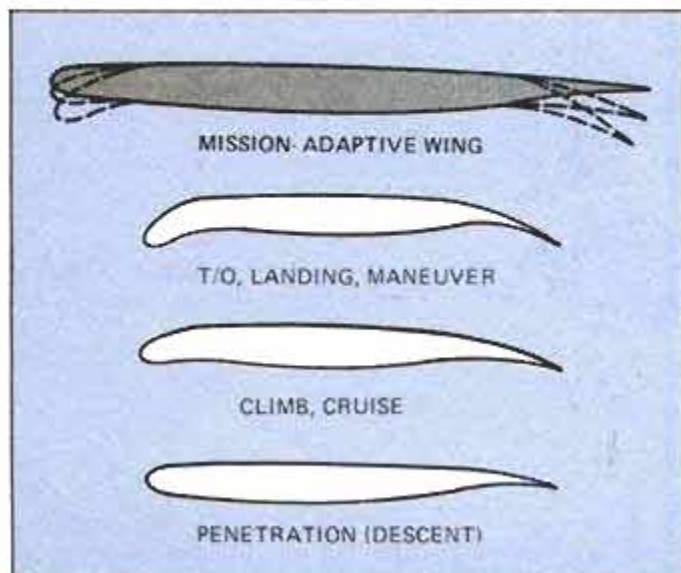
surfaces will be incorporated. This will allow demonstration of three additional flight techniques:

■ **Maneuver load control:** Rapid changes to permit fast dogfight maneuvers, while preventing over-stress from high-G loads.

■ **Direct lift:** Changing the plane's altitude by hundreds of feet without pointing the nose up or down. Conversely, the longitudinal orientation could be altered—to aim weapons, for instance—without a gain or loss of the craft's altitude.

■ **Gust load alleviation:** Automatic load reduction of the aircraft structure in turbulent air.

If the advantages of the MAW are significant, the switch to continuous, flexible surfaces for aircraft wings will have a profound effect on design and manufacturing.



The use of fiberglass and other composite materials permits continuous, internally driven camber changes for all regimes.

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

by Eugene Griffin

Read how one man freed himself from this crippling pain.

It happened aboard a Lufthansa flight to Frankfurt, Germany where I was going for a business meeting. The plane hit an air pocket and suddenly my back "went out."

If you've ever suffered from lower back pain, you know what this can mean. In my case, the stewardess had to lead me off the plane when we landed. "This is the first time this has happened?" she asked. When I told her no, she said:

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

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

Couldn't get out of bed

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

Lunch Included, Too!

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

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

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

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

The Most Amazing Walk Of My Life

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

Tested & Proved In Hospitals

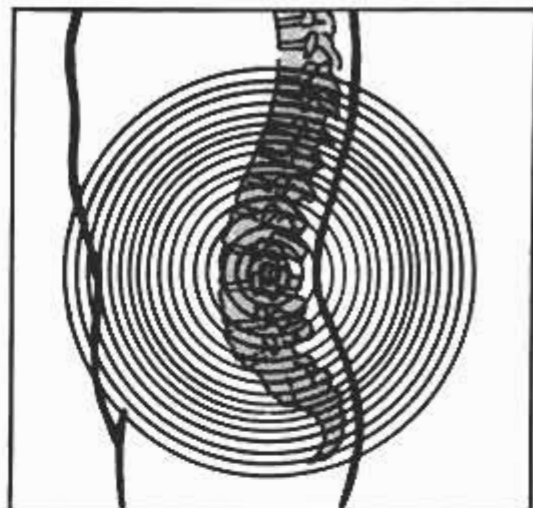
Over lunch my friend proceeded to tell me about the Prosana Belt. How it was invented by a doctor, tested and proved in hospitals and clinics; even on people so crippled with lower back pain, they had to wear steel braces! How it was, and is, used throughout Europe by tennis champions, Olympic bobsled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

Save \$14.00! Special Free Trial Offer!

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

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

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



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

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

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Mr. H. Kilian, Olympic Medalist & 3-Time World Bobsled Champion

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

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

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PICK A PERFECT KNIFE

(Continued from page 89)

sheepsfoot and spey blades. The camper's model will have a large spear and shorter clip blade, along with a can opener, combination cap lifter and screwdriver, and an awl or punch—like those issued to members of the Swiss Army. The commercial versions of the Swiss Army



Browning South Pass is in presentation box. Cam III assortment (below) has three-bladed belt buckle.



knife go a lot further, and on some you can count a couple of dozen tools and gadgets.

Owners find constant use for such fold-out items as scissors, screwdriver (including a Phillips-head), saw, file, fishhook disgorger, inch and metric rules, can opener, miniature marlinespike and magnifying glass. More elaborate models also have tweezers and toothpick. There are lots of poor-imitation Swiss Army knives, but only two that have been made for over 80 years and are "official": the Victorinox, imported by Swiss Army Knives Inc., and Wenger, from Precise International.

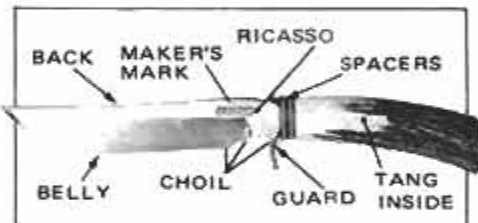
Custom models

In spite of all the knives available, a lot of owners want one that's unique. Custom knifemakers fill this need, often at high prices and most of the time with superior quality. If a factory produces a pocketknife for \$25, a lock-back for \$50 and a straight blade hunter for \$75, you usually can multiply those numbers by five or six for the price at custom makers.

You can also create your own custom knife with the help of knife parts suppliers. The do-it-yourself

way to get started is to buy pre-ground blades and put most of your effort into the handle. Shaping blades from raw bar stock and then properly hardening, tempering and polishing the steel takes a good deal of metalworking ability and access to advanced shop equipment.

You will learn that there's more to a knife than a blade and handle. A blade may have a back, belly and



Staghandle No. 3 Hunter is famous Randall.

sometimes a spine. The handle may be comprised of a guard, bolsters or pommel, along with scales. Underneath the handle of a fixed-blade knife is a tang. All these could be held together with solder, epoxy, cyanoacrylate adhesives, pins or cutlery rivets.

Assessing value

You can probably produce an acceptable home-shop knife for about \$20 or less, if you are buying supplies in quantity. Your knife is not likely to increase in value, but you will have the satisfaction of a hand-finished project. Nor do store-bought, factory-produced knives often increase in value. In spite of a few that have become collector's pieces, most are headed for useful work rather than a glass cabinet. There are companies like W.R. Case and Sons



Gerber's new folder has Bolt-Action lock.

whose knives have a collector following, perhaps because Case is well into its second century of production.

It's common for knife companies to produce commemorative models in limited quantities—instant collectors' pieces. Unfortunately for investors, it may take a couple of lifetimes for such knives to become more valuable. With hundreds of knife styles and millions of knives in annual production, it takes many years for a make or model to disappear so that a few can become rare. A limited edition knife may reach that rarity earlier, but most "limited

editions" don't get used at all. If it's a 500-unit edition, there will be 500 around for a long time.

Knives are competitively priced—the market is too big to be otherwise—so the price of U.S. knives is usually a good indicator of quality in the knife you choose. As with most tools, buy the best you can afford for the job at hand. Look for top workmanship, or the lack of it, in the fit



Precise's Swiss Army knife has lock.



Westmark 702 is from Western Cutlery.



New folder is in Camillus Wildlife Series.

and finish. If an inspection of two similar knives doesn't show the difference, rely on price to indicate some hidden qualities or shortcuts. A high-priced knife *may* be cheaply made, but a cheap knife is *sure* to be.

With a couple of dozen domestic knife manufacturers and an equal number of importers offering millions of new knives every year, there is no shortage of choices for an ideal knife to carry.

SUPPLIERS—KITS AND PARTS

- Angus-Campbell Inc., 4917 South Soto St., Los Angeles, Calif. 90058. (Bulk materials, Micarta.)
 Atlanta Cutlery Corp., Box 839, Conyers, Ga. 30207. (Blades, kits, fittings.)
 CAM III, 243 Millbrook Way, Vacaville, Calif. 95688. (Lock-back folder kit.)
 Christopher Firearms, State & Ferry Sts., Miamitown, Ohio 45041. (Blades and fittings.)
 Dixie Gun Works, Union City, Tenn. 38261. (Finished and raw blades, fittings, handles. Catalog: \$3.)
 The House of Muzzleloading, Box 6217, Glendale, Calif. 91205. (Modern and old-style blades, fittings, handles.)
 Indian Ridge Traders, Box 869, Royal Oak, Mich. 48068. (Modern and old-style blades, fittings, hardware.)
 Koval Knives, Box 14130, Columbus, Ohio 43214. (Bulk and unfinished materials, hardware.)
 A.G. Russell, 1705 Highway 71, Springdale, Ark. 72764. (Kits and materials.)
 Schrimsher's Custom Knifemaker's Supply, Box 308, Emory, Tex. 75440. (Bulk steel and materials. Catalog: \$1.)

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Lawrence Stevenson
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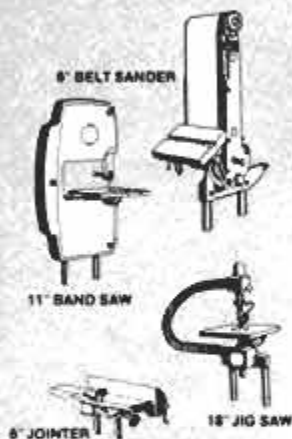
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(Continued from page 85)

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Tekna Survival Knife is bright or black 431 stainless in either belt or boot sheath.

use. An underwater range-and-depth finder handheld sonar, from Morrow Electronics, shows a diver the distance down or back to the surface. Boatmen can lean overboard with it to take digital readings of bottom depth or fish. Nikon's newest dive-camera, the Nikonos IV-A, has built-in electric-eye exposure and optional, electronic, self-adjusting flash. Ashore, it can go on shooting through rain or dust storms without slowing down. To clean off salt spray or sand, rinse it under a faucet instead of sending it out for repair.

Today, outdoorsmen can learn and borrow a lot from frogmen.

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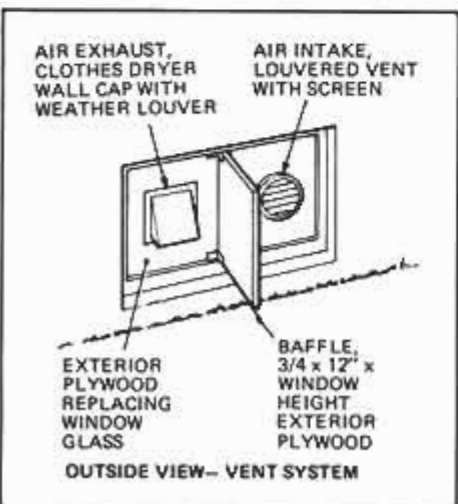
(Continued from page 95)

wall, if possible, away from heat pipes. You can replace the glass of a cellar window with 1/2-in. plywood and install a ventilation system for the root cellar in the plywood. Cover any other window panes in the space to keep out light.

If there are no windows at the location, you must break through the foundation, or cut through at or



Cellar ventilation system is set up in a basement window. In top photo, plywood replaces glass, louvered vent is ready for installation and junction box is ready for fan hookup. Horizontal blocking supports fan. Above, the fan hookup is complete.



above the sill, to install the air-intake and exhaust system. Use a cold chisel and a hammer to break through concrete block. A hammer drill and a cold chisel will help you cut through concrete.

Study the drawing of the root cellar on page 95. Conventional fram-

(Please turn to page 136)

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(Continued from page 135)

ing is constructed of 2x4 studs spaced 16 in. on center (O.C.) and assembled with 8d nails to the sole and top plates. The top plate is toenailed to the joists of the floor above. (See Sections 3 and 4 for framing the door.) Use a level to check that the framing is square.

Fasten paneling to the framing on the basement side of the walls before wiring the differential temperature thermostat. Mark all stud locations on the floor and ceiling before you install the panels, so you'll know where to nail.

Use 1/2-in. casing or finishing nails every 6 in. along the edges and every 12 in. on intermediate studs. Or attach the paneling with panel adhesive and use fewer nails. Squeeze a bead of adhesive onto each stud face; nail the panel along the top edge only. Press the panel in place, swing the bottom out and prop the panel away from the adhesive for five minutes before nailing the panel to the stud. Finally, apply corner guard.

If you use Aspenite wall panels, attach them with nails. Before applying, bevel the vertical edges or round them off with a rasp plane to make a neat V-joint; or cover the panel joints with moldings.

The venting system

Install the blower assembly and exhaust duct, and wire for the differential thermostat and sensors before insulating and sheathing the interior of the root cellar. Use the wiring diagram for the air-intake system on page 95 as a guide.

Mount the differential thermostat on the newly sheathed basement wall. Ground the box by fastening the green wire to the inside of the box. The thermostat is wired to the air-intake fan with No. 16 nonmetallic (NM) cable joined in a junction box located near the intake vent. You can use conduit if you prefer to surface-wire the connection. Bore a hole through the paneling for the cable. Seal around the cable with silicone sealant.

Cut a hole in the plywood covering the window for the louvered vent and attach it in place (see Detail 1—Blower Assembly). The fan frame is secured to blocking attached in the window. A box encloses the fan, and a 1x2 pine frame standoff allows clearance for the register louvers.

Join the fan and thermostat wiring at the junction box. Hook the thermostat at 115-v. power via another junction box.

The air from the cellar is exhaust-

ed via a 3-in.-dia. flexible clothes dryer exhaust duct, which ends outside at a clothes dryer wall cap. The air intake and exhaust are separated outdoors by a plywood baffle (see outside view drawing of vent system on page 135). Inside the root cellar, locate the opening of the exhaust duct away from the air-intake vent and near the ceiling to vent the warmer air.

Use 18- to 24-ga. zip or bell wire to connect the sensor leads to the thermostat. Orange wires from the thermostat go to the SAS-3 temperature sensor located outdoors (see Detail 2). Both the outdoor sensor and the connection to it should be shielded from the elements. It may be easier in some homes to snake these wires out through the first floor.

The gray-wired sensors on the thermostat aren't used in this application. Tape their ends separately to prevent their coming in contact and causing a short.

The indoor temperature SAS-3 sensor located in the root cellar is connected to the thermostat with white wires. An additional sensor (FS-5 freeze cutoff sensor) is also located in the cellar. Both should be located well away from the cold air intake vent. Staple them to a wood block or a block of rigid foam insulation which won't conduct heat, after the interior sheathing is applied. Seal the holes in the wall and the wire nuts with silicone sealant.

The root cellar must be well insulated from the basement to retain its cool air. Use 3½-in. fiberglass batt insulation between studs. Face the foil vapor barrier to the warm (basement) side of the wall.

Installing the racks

For the most part, the storage racks in this root cellar are 2x2 framing (posts) nailed to sleepers with 1x3 slats spaced for ventilation. However, you can also use lumber from your scrap pile.

Since it's coolest nearest the floor, store crops that need the coldest temperatures there. Store canned items nearer the ceiling. **PM**

SOURCE LIST—ROOT CELLAR

Differential temperature thermostat: The unit shown is model DTT-80 (about \$50) which has two SAS-3 sensors included. An additional FS-5 freeze cutoff sensor (about \$7) is an added purchase. They are available at solar-product suppliers or from the manufacturer: Heliotrope General, 3733 Kenora Dr., Spring Valley, Calif. 92077.

Vent register: 7x9-in. vent register is made by American Metal Products, Masco Corp., 6100 Bandini Blvd., Los Angeles, Calif. 90040.

Vegetable storage information: For additional information on storing vegetables, send for: *Storing Vegetables and Fruits in Basements, Cellars, Outbuildings and Pits*, bulletin No. 119, U.S. Dept. of Agriculture; it is \$2.25 from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Hygrometer: These instruments are used to measure the absolute or relative amount of moisture in the air. They are available by mail for approximately \$100 from Edmund Scientific, 101 East Gloucester Pike, Barrington, N.J. 08007.

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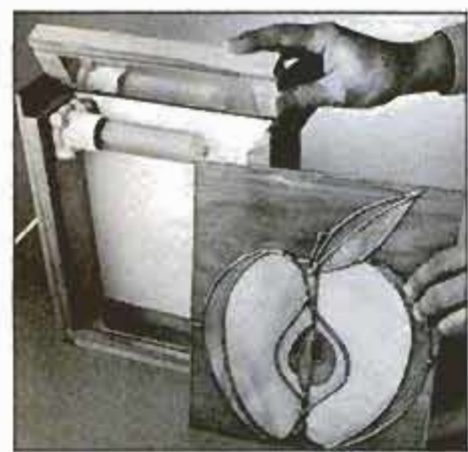
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STAINED-GLASS LIGHT BOX

(Continued from page 123)

silicone sealant. Attach the cord switch.

Finally, insert the bulb and slide in your stained-glass panel. **PM**



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Glassmasters Guild, 621 Avenue of the Americas, New York, N.Y. 10011; free catalog.

Jennifer's Glassworks Inc., Box 20447, Atlanta, Ga. 30325; free catalog.

The Light Through Yonder Window, 4209 Lankershim Blvd., North Hollywood, Calif. 91602; free catalog (stained glass paint).

New Renaissance Glass Works, 5151 Broadway, Oakland, Calif. 94611; free catalog.

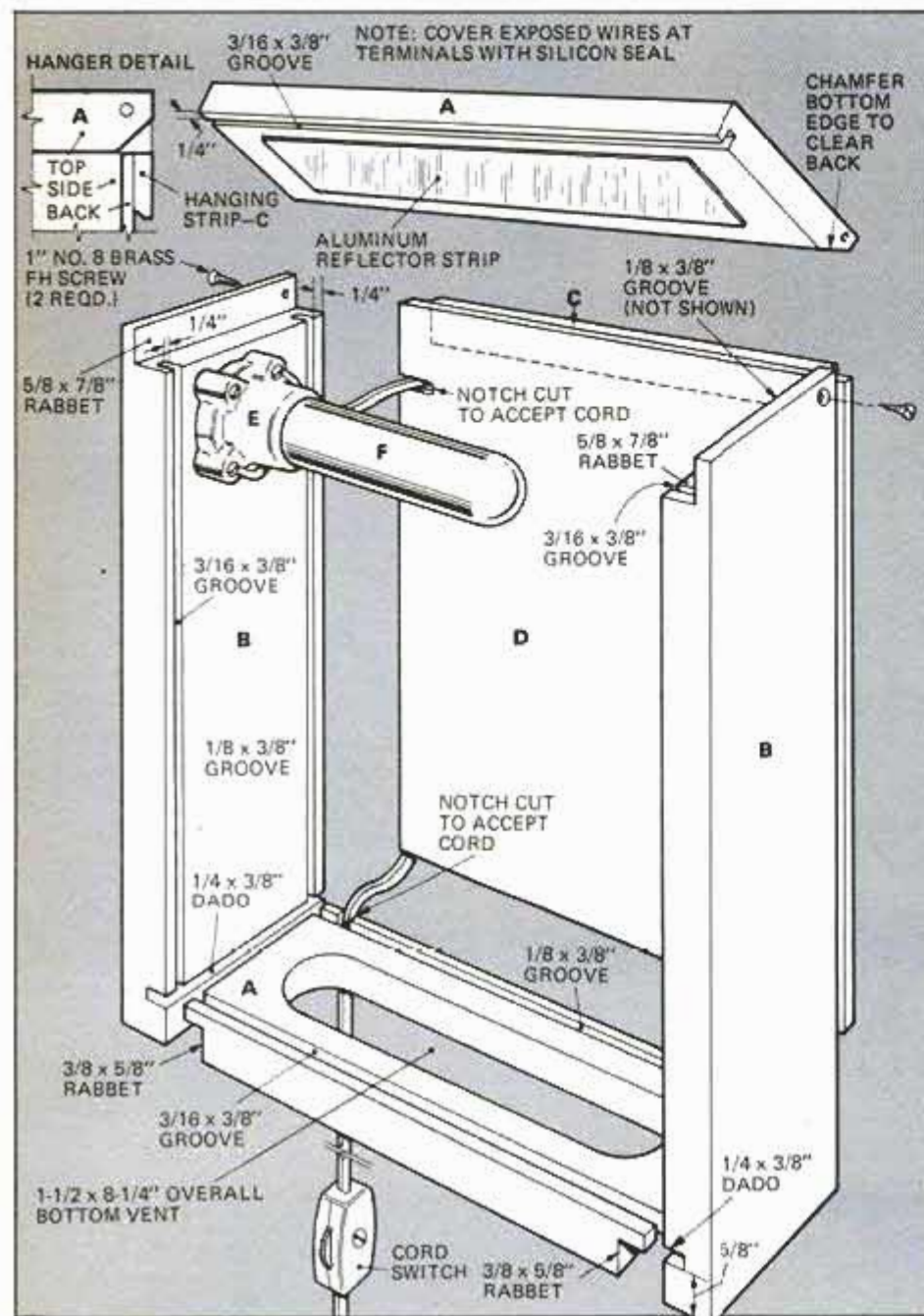
Oklahoma Stained Glass, 2606 North Moore Ave., Moore, Okla. 73160; catalog, \$1.

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How much money?

Recently I telephoned some of the people we helped get started in the chimney cleaning business. I wanted to find out — first hand — just how well they were doing. With their permission, I recorded our conversations. We then had a record made which you can play on your record player when you receive our information. Here's what a couple of them said . . .

Dave Richison, Ohio

"The 3rd quarter of this year I did \$23,000, the 4th quarter I did \$24,000. We should hit somewhere between 55 and 60 thousand this year."

Fran Watts, Virginia

"If we need \$200 at the end of the week, it's simply a matter of making a couple of phone calls. The repeats are just fantastic!"

John Moszulski, Canada

"Last month I worked 18 days, and I made 2,600 bucks."

Ed & Mo Simonson, Texas

"We're very pleased with it. We're making a dream come true. We've always wanted some land and thanks to chimney sweeping we now own 30 acres."

"In October of '78 we made \$1,530. That was our first October. OK, now in October of '79, which was last year, we made \$3,245. Now in October of '80 we grossed \$6,593. In one month. We're making two grand a week."

Just what do these people do to earn that kind of money? Sweep chimneys. Six to eight a day if they're fulltime. Two or three an evening plus ten to sixteen on the weekends in the case of part-timers who keep their present jobs. Since the average charge is \$45 for the first and \$35 for each additional in the same house, it's easy

to see how Ed and his wife Mo are making two grand a week.

But Why?

Why would anyone pay \$45 to have his or her chimney cleaned? That can be answered in one word — SAFETY!

When solid fuels such as coal and wood are burned in a fireplace or woodstove, they give off a flammable by-product called soot. What is soot? Soot is a combination of fly ash and creosote. Creosote is the flammable unburned residue left over when wood doesn't burn completely. The creosote combines with the fly ash and the smoke carries it into the chimney flue. This soot then sticks to the flue. When a quarter inch or more of this stuff builds up on the chimney walls, it can cause a dangerous chimney fire.

A Chimney Fire

Imagine this tall stack coated inside with a quarter or half inch of flammable soot. When the right amount of heat and oxygen get this stuff burning, you have yourself a real fireworks show. As the creosote burns, the heat causes the natural draft of the chimney to increase ten fold. What you now have is a blast furnace that looks and sounds like a rocket taking off. The temperature of the chimney fire, 2000-3000 degrees, is enough to disintegrate the mortar holding the chimney together. The flaming balls of soot shooting out the chimney's top can land on the roof and the dry leaves surrounding the house. Needless to say — this situation is undesirable and the people who've lived through it get their chimneys cleaned regularly.

According to the National Fire Commission there were 60,000 chimney fires in the U.S. in 1980 causing \$300,000,000 of damage. 75% of all fatal residential fires in Vermont, for instance, were caused by faulty installation and maintenance of woodstoves. Tens of millions of people are using wood to supplement the high cost of oil. There are over 40 million woodburning chimneys in the U.S. These people need you to clean their chimneys.

The Height of Technology

How do you clean a chimney? You do it as quickly and efficiently as possible. The more chimneys you can clean in a day the more lives and loss of property you'll save. And how do you do a good job in record time? You use the most advanced system available — The August West System.

One of the key elements in the August West System is the SootSweeper. This machine is a high-powered, high-volume dust collection unit that was designed specifically for cleaning chimneys. When I first started cleaning chimneys I used a large vacuum truck. It worked well, but they cost over \$20,000 now. I also had a prob-

lem with the 100 feet of hose. It didn't always reach the fireplace from outside. The powerful but portable SootSweeper has the same kind of air-moving muscle as a vacuum truck, but you can bring it right in the house. New filter technology is the key to its efficiency and dependability.

Other key elements of our system are an assortment of high carbon steel brushes, specially designed fiberglass cleaning rods, roof safety equipment, an easy-to-follow handbook with everything from advertising to chimney design, a bi-monthly newsletter, telephone consultation and much, much more. I don't have room to go into all the details right now. Our information kit will explain everything to you.

I'd just like to say that many years and a tremendous amount of devotion have gone into the development of the August West System. We are a strong company with over 5,000 sweeps in our network! You can join us and count on us to help you build a business you can be proud of. We are proud of what we do and the quality of our equipment and service to you reflects our pride.

To sum up, then . . .

Sweeping chimneys may not exactly be a "Lazy man's way to riches" . . . you'll work hard . . . but the pay is exceptional, the demand is steadily growing and new equipment and methods make the job far easier, faster and safer than ever before. Perhaps best of all, this is one of those "dream" businesses that so many of us are always looking for: a business with flexible hours and very low overhead.

Find out more about what it's like to be a chimney sweep cleaning 25 chimneys or more a week. Just call **TOLL FREE 800-243-5166** and ask for extension 217. I'll rush you a detailed information kit with the complete August West Story and your 33 1/3 RPM record entitled, "Now, Hear It From The Sweeps." We urge you to call us at no obligation, TODAY.

August West Systems, Inc.
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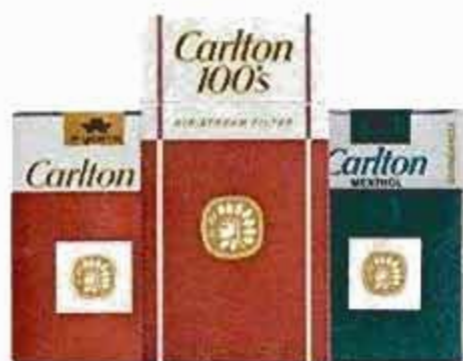
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SMOKERS

U.S. GOV'T LATEST REPORT:

King, Menthol or Box 100's:

**A whole carton of Carlton has
less tar than a single pack of...**



...KINGS			...100's		
	TAR mg./cig.	NICOTINE mg./cig.		TAR mg./cig.	NICOTINE mg./cig.
Kent	12	1.0	Kent 100's	14	1.2
Winston Lights	11	0.9	Winston Lights 100's	12	0.9
Marlboro	16	1.0	Benson & Hedges 100's	16	1.1
Salem	14	1.1	Parliament Lights 100's	12	0.9
Kool Mids	11	0.9	Salem 100's	15	1.1
Newport	16	1.2	Marlboro 100's	16	1.1

TAR & NICOTINE NUMBERS AS REPORTED IN LATEST FTC REPORT

Carlton Kings	Less than 0.5	0.1	Carlton Box 100's	Less than 0.5	0.1
Carlton Menthol	Less than 0.5	0.1			

Box—lowest of all brands—less than 0.01 mg. tar, 0.002 mg. nicotine.

Carlton is lowest.

U.S. Government laboratory tests confirm no cigarette lower in tar than Carlton.

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

Box: Less than 0.5 mg. "tar", 0.05 mg. nicotine, Soft Pack, Menthol and 100's Box:
Less than 0.5 mg. "tar", 0.1 mg. nicotine av. per cigarette, FTC Report Dec. '81.