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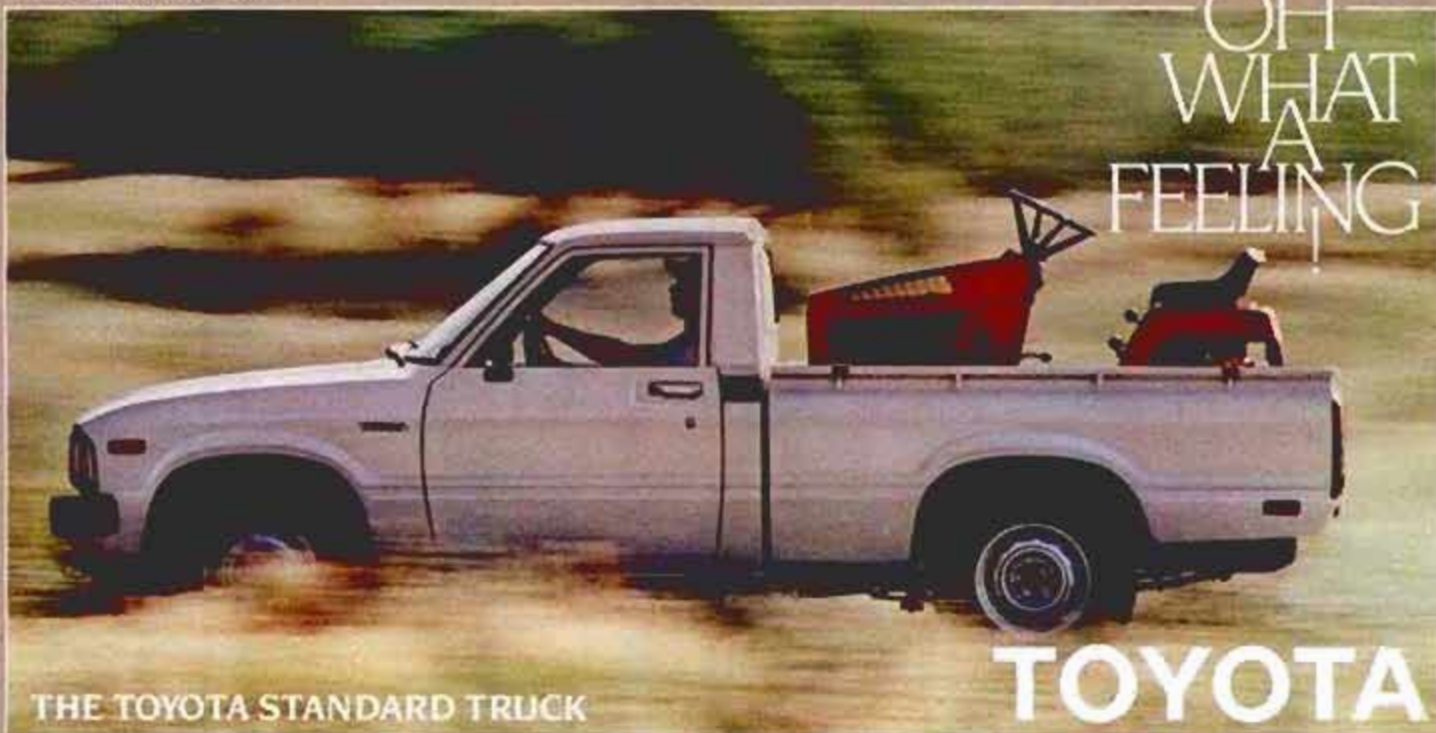
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This One



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\$5998



On the cover

PM's new woodworking bench and tool center were designed as a complete master craftsman's facility. You can build them for total mobility—via heavy-duty casters—from plans beginning on page 104 in this issue.
—PM photo by Mark Kozlowski

Popular Mechanics

NOVEMBER 1982

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LETTERS TO THE EDITOR



Aluminum warships: It was a bum rap

It's an unfortunate but understandable fact that the fast-paced action of war often leads to erroneous reports. In commenting on the sinking of British ships at the Falklands (*Technology Update*, page 129, Aug. '82), you asserted: "In the case of the *Sheffield*, a high percentage of aluminum used in the superstructure may have contributed to the superhot fires that doomed the destroyer."

The fact is that the HMS *Sheffield* was an all-steel Type 42 vessel. In addition, aluminum as it is used in ships cannot, under any circumstances, burn. Reports that falsely blame aluminum for the loss of ships in the South Atlantic can only have a deleterious effect on the aluminum

industry and its thousands of employees.

JOHN E. BLOMQUIST
PRESIDENT, REYNOLDS ALUMINUM
RICHMOND, VA.

Our account was based on early reports from the Falklands that were widely circulated in the press at the time. Also, the fact that the Sheffield did contain aluminum in her superstructure was later confirmed by her commanding officer James Salt, although he admittedly did not feel it had contributed to the vessel's sinking. We are glad to learn that the presence of aluminum is no longer thought to have been a factor in the tragedy.

A difference of opinion

For years I've enjoyed your magazine, but lately I find most of your articles about automobiles are in favor of Japanese models. Seldom do I see a good word for American cars. If Japanese products are as good as you claim, I suggest you go live there.

ROBERT MEISMAN
CINCINNATI

I'd like to know who paid for your article on American pickups (*PM Road Test: Detroit Pickups Vanquish The Imports*, page 82, Sept. '82). Did Detroit? What hot air! I've owned many American-made cars and none can come close to the three Toyota SR-5 pickups I've had. Bah, humbug!

THOMAS L. SHANKLIN
BRATTLEBORO, VT.

We know we can't please everyone all the time, but we're thankful for honest, healthy disagreement—and the freedom to express it. This is one American "product" that no one in the world can beat.

Hot debate on fusion

As an engineer with 12 years of experience with the radiochemistry of nuclear waste disposal, I am writing to correct an erroneous statement made in your article on atomic fusion

(*Fusion—We're Harnessing The Power Of The H-Bomb*, page 86, Sept. '82). Contrary to what you say—that fusion produces no "hot" waste—the truth is that both fission and fusion produce energetic neutrons.

In our toying with nuclear energy, we have already generated enough waste to contaminate our entire planet forever. I am astonished that we don't give up on nuclear power and concentrate on solar energy instead.

WILLIAM J. VAN SLYKE
WALLA WALLA, WASH.

Science Editor Dennis Eskow replies: When we refer to "hot" waste, we mean nuclear fuel that remains radioactive so long that any container used to store it will decompose before the waste becomes harmless. This is a problem with fission, but not with fusion.

In fusion, the radioactivity lasts for far shorter periods—a few hundred years compared to thousands for fission products. Thus, fusion products will be able to be stored safely for as long as necessary.

No scam intended

We appreciate your use of our thermogram to illustrate your *Home Energy Guide* (page 109, Sept. '82).

Now for the bad news. The credit

line referred to our product as VAN-SCAM instead of the correct VAN-SCAN. This not only creates a trademark identification problem, but the term VANSCAM has a bad connotation. It degrades our product name and could affect our marketing effort.

GEORGE ENGLAND
DAEDALUS ENTERPRISES INC.
ANN ARBOR, MICH.

We very much regret this unfortunate slip of the typewriter.

Little girls like it, too

Here's a picture (below) of the "Boy-Powered Digger" I made for my granddaughter from your plans (4



PM's Boy-Powered Digger made by reader Richard Williams for granddaughter.

Great Playthings To Make For Youngsters, page 118, May '81). What fun to work on! I was almost sorry to see the project completed, but was well rewarded by the joy of my granddaughter. Thanks to your excellently detailed plans. I am now a hero.

RICHARD W. WILLIAMS
RENTON, WASH.

Thanks for the kind words. For others who may be interested, photocopies of the article, which also includes plans for making a model racer, doll cradle and preschooler's play center, are available for \$4.50 post-paid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

PM

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PM ELECTRONICS MONITOR



Videotex: Here comes the future

The whole world will soon have a brand-new way to store and retrieve information of all kinds—from schoolwork to commodity exchanges, from meeting friends to selling cars. This new videotex revolution (see *Videotex: Instant Info From Your TV*, page 102) will soon be available to anyone who has a TV and telephone and can afford a moderately priced decoder. But for now, most videotex services require a personal computer or a terminal. To taste the future, we used some exciting new devices.

Pocketable wonder

Robert and Holly Doyle live in a large, old-fashioned house that's jammed to the rafters with computers. The Doyles made their mark when they invented the first hand-held electronic game, *Merlin*. *Merlin* launched an avalanche of games, but their latest invention, the IXO terminal, may change our society even more than *Merlin* did.

This new IXO terminal is the smallest, full-featured terminal on the market, and you don't need a computer science degree to plug the IXO unit into your telephone and begin accessing videotex databases.

The unit (pictured on page 103) features color-coded keys and easy-to-follow operating instructions.

When you turn on the unit, it greets you by name. (Mine says "Hi Neil," on its one-line LCD display.) Then, you enter your secret password and the unit is operable.

Scrolling across the display are the services you can call. If you press the YES key when one of these services is displayed, the unit will dial the number for you. Or, you can skip them all with the NO key and dial a number yourself.

The one-line display can be scrolled at any speed. You can pause it, and even go back and reread the last few hundred characters.

Even if you've never used a computer or terminal, the IXO's human engineering will have you on-line in a matter of moments. The IXO is available through computer stores or from IXO, G041 Bristol Parkway, Culver

City, Calif. 90230. Accessories include a device to use a TV for multi-line display and a coupler so you can use a pay phone.

A genius program

Not all terminals are created equal. There are "dumb" terminals and "smart" terminals. A dumb terminal is simply a typewriter keyboard and a modem that lets you talk to a database. A smart terminal offers many other functions.

We tested a new program for the Apple II computer called *ASCII Express—the Professional* which turns that computer (and accessory modem) into not just a smart terminal, but the Albert Einstein of computer terminals.

The features of the program are incredible. You can set AE-Pro, as it's called, to dial your favorite database automatically when you activate the computer. Then it will give the database your name or account number and your password, and enter whatever commands it takes to get you where you want to be.

A feature called "macros" eliminates typing repetitive commands from one database area to another. Macros lets you redefine keys on the

keyboard to mean a whole string of commands. Pressing CONTROL-W 1, for example, could mean the same as typing R DISPLA; GO PCS-51.

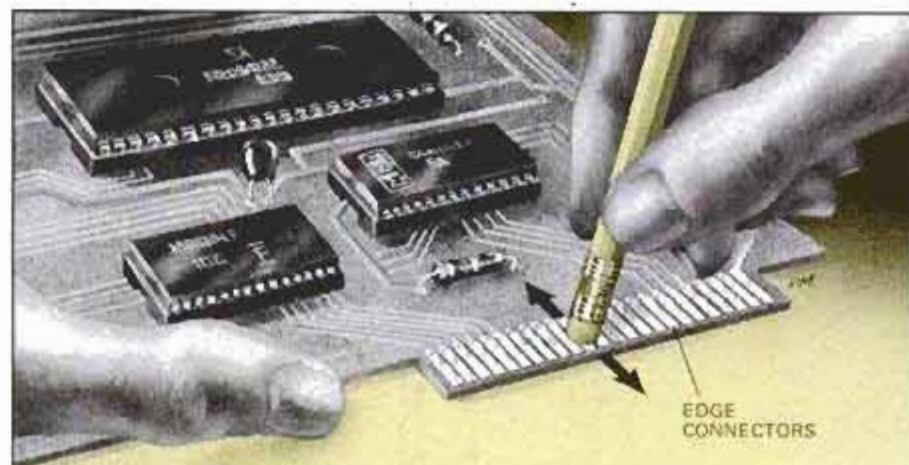
The "editor" feature allows you to edit such things as letters and comments off-line (while you're not paying for time connected to the videotex service).

The documentation is the most complete and usable I've seen for any computer program. AE-Pro is available from Southwestern Data Services through computer stores.

Telidon Apples

As Telidon databases come into more homes and onto TV sets, what will happen to computers? Most aren't capable of the bright, colorful graphics that characterize the Telidon standards. But they have more versatility than decoders do.

Apple recently unveiled a new Telidon graphics system, a printed-circuit card that plugs into the computer. This card gives the Apple Telidon capability. And it lets the Apple owner design graphics and Telidon screens. These screens can then be sent over the phone, from Apple to Apple. Developed with Norpak Inc., this Telidon card seems to be the wave of the future for all telecommunicating computers capable of color graphics. **PM**



Cleaning contacts

Personal computers, video games and other electronic equipment take many forms of plug-in cards or cartridges. Dirty

contacts on these can cause malfunctions. Use a soft, clean pencil eraser to shine contacts. Don't press too hard.

Even the person who has everything
occasionally runs out.



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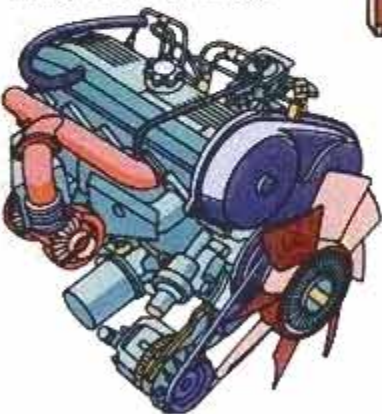
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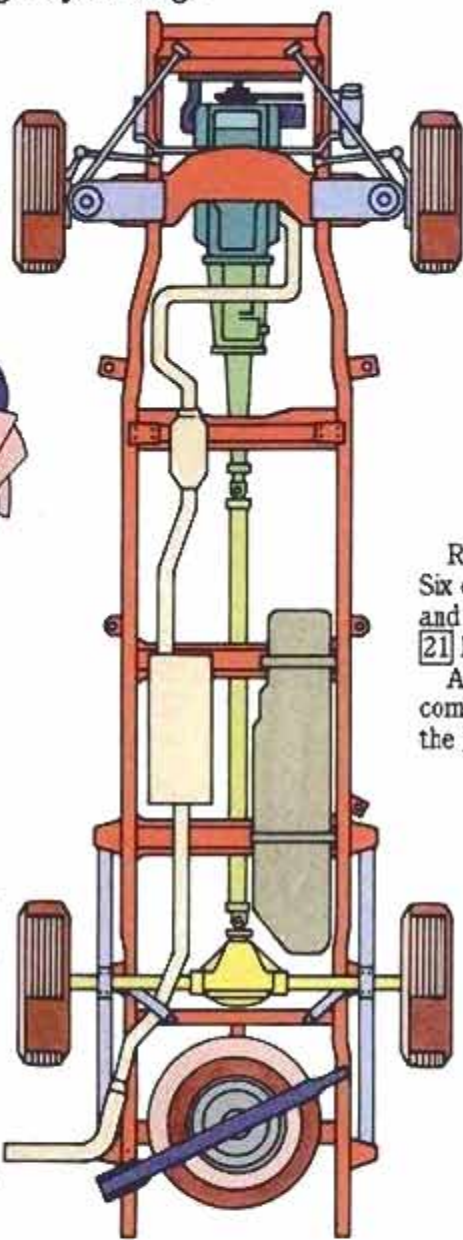
There's a new power in trucks. Turbo Diesel power. You get it from Dodge Ram 50 and it's 4x4 running mate, Power Ram 50.



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And turbocharging helps this fuel-injected diesel run with fuel economy that belies its power: 45 est. hwy. **34** EPA est. mpg in 4x2.**



7 STEEL CROSSMEMBERS IN THE FRAME

Like all full-size Dodge pickups, the long wheelbase Ram Miser has a frame of high tensile (36,000 PSI) carbon steel reinforced by 7 steel frame crossmembers for torsional rigidity and all-terrain stability.

RAM MISER: \$5999* EQUIPPED, NOT STRIPPED

Ram Miser is Dodge's lowest priced full-size pickup. And as you can see from the chart, it gives you standard features you can't get from Ford or Chevy without added cost.



TWO STEEL WALLS

Gas-powered Ram 50 packs a standard payload of 1630 lbs.; for the 4WD Power Ram 50 it's 1680 lbs. Royal and Sport models have all-steel double-walled cargo boxes to protect the exterior from cargo-caused dents.

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	Dodge Ram Miser	Ford F100	Chevy C-10
Est. Hwy/EPA est. MPG**	30 21	27 20	26 19
Standard Tank	20 gals	16.5 gals	16 gals
Range	600 est. hwy. 420 EPA est.**	446 est. hwy. 330 EPA est.**	416 est. hwy. 304 EPA est.**
Manual overdrive transmission	Standard	Extra Cost	Extra Cost
Ade Ratio	3.21	2.47	2.56
Standard Payload	1465 lbs.	1460 lbs.	1430 lbs.
Bright wheel covers	Standard	Extra Cost	Extra Cost
Bright front bumpers	Standard	Standard	Extra Cost
Cigar lighter	Standard	Extra Cost	Extra Cost
Dual horns	Standard	Extra Cost	N/A
Day/Night mirror	Standard	N/A	N/A

*Base sticker price for 2WD excluding title, taxes and destination charges.
**Use EPA est. mpg number for comparison. Your mileage and range may vary depending on speed, distance and weather. Actual hwy. mileage and range probably less. CA est. lower Range = EPA est. tank capacity. *R. L. Polk & Co. registrations thru 7-1-81

Ram Miser's proven Slant Six engine offers performance and economy: 30 est. hwy. **21** EPA est. mpg.**

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Dodge Rams: we're building our trucks like we never did before.

**DODGE
310
SQ. FT.**

**CHEVY
263
SQ. FT.**

**FORD
217
SQ. FT.**



**RAM
TOUGH**

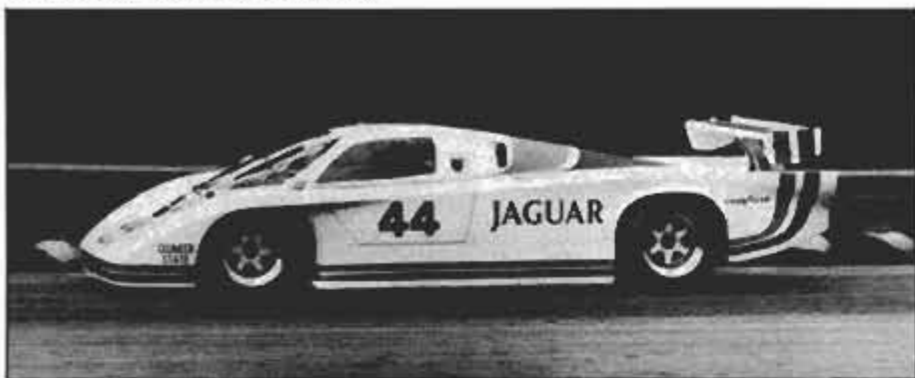


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IMPORTS & MOTORSPORTS



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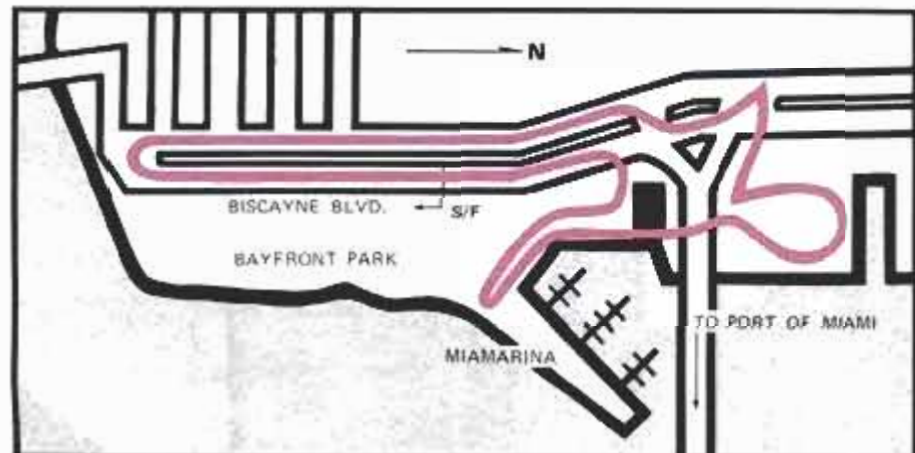
Jaguar XJR5 racer is geared up for the Daytona and Sebring endurance classics.

No snow-belt motorsports fan worth his crankshaft risks cabin fever cleaning carburetors all winter—not when he can follow the racers South. This winter there's enough action in sunny Florida to get you a suntan that'll last 'til the Indy 500. New on the International Motor Sports Assn. (IMSA) calendar for '83 is a Miami Grand Prix to be run through the city streets. Part of the Camel GT series for sports cars, it will be 160 laps around a 1.94-mile circuit, using portions of Biscayne Blvd. and the Miamarina. The 310-mile (500-kilometer) race for the GT class will be the main event and two 100-km races for GTO and GTU cars will round out the Feb. 26-27 weekend. At \$175,000, it's the richest purse in sports car racing, with \$50,000 minimum going to Sunday's GP winner. For ticket information, write to Miami Motorsports,

10113 Southwest 72nd St., Miami, Fla. 33171.

The Miami GP will be sandwiched between the two traditional endurance races in Florida, the 24 Hours of Daytona, Feb. 5-6, and the Sebring 12-Hours, March 19-20. That gives you plenty of opportunity to catch the new Jaguar XJR5 in action. The V12-powered, Grand Touring Prototype (GTP) racer made its long-awaited competition debut at Road America in Elkhart Lake, Wis., late last August. Its third-place finish, just behind the Porsche Turbos, was so outstanding that drivers Bob Tullius and Bill Adam were looking to end Porsche dominance before '82 is over.

So, mark your calendar now: With the IMSA races and the good ol' boys and bikers at Daytona during Speed Weeks, you'll be starting off the 1983 motor racing season with a bang.



Miami Grand Prix for sports cars will take this route during weekend of Feb. 26-27.

Hiking around Hiroshima

It was the morning of Aug. 6, 1982, and I had a few free hours before re-joining my hosts from Toyo Kogyo for a tour of the all-new Hofu plant near Mazda's main headquarters in Hiroshima. It's Hofu where the second-generation, 1983 Mazda 626 will be built. After attending the 37th annual commemoration of the atomic bombing of Hiroshima at the impressive Peace Park, I was back on the streets of the city noting how many Japanese cars we don't see here, because they're not exported. Among the basic transportation modules, the Honda City is the newest and most unusual minicar. It's extremely popular in resort areas of Japan and sports a definite reverse snobbery image. It's a

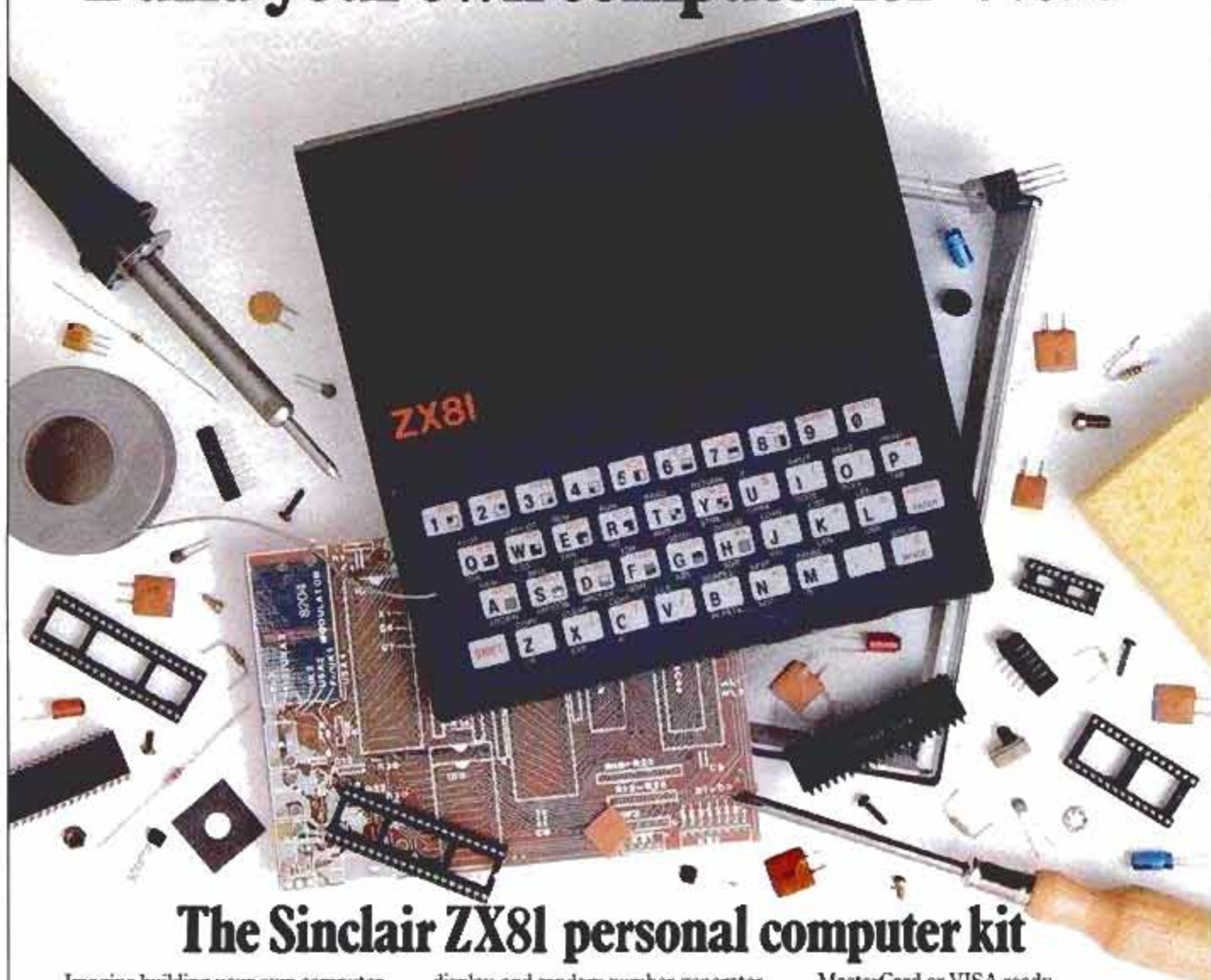


Nissan Leopard four-door hardtop, not sold here, has 145-hp turbo Six option.

handy runabout (as is the VW Rabbit convertible here) for people who could afford to own a lot more car, like the Mazda Cosmo and Luce models I had a chance to drive. These are beautiful machines with high-class accommodations for driver and passengers. If they were on the market, they'd give the domestics even more competition than they're getting now. Some other eye-catchers are Toyota's new Soarer Coupe, Nissan's Leopard and Isuzu's Piazza. Also on the list is the new 626, a car we will get here (in January). We drove the wedge-shaped coupe, sedan and hatchback, the three models that make up the line, and will have a drive report next month.

FM

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IG-700

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EDITOR'S NOTES

John A. Salletter

The leaves are raked. You've buttoned up your house for winter. Now it's the season to get back into your workshop. And, just in time, we have some exciting woodworking projects for you. Any reader who has ever assembled even as much as a birdhouse will want to own our clamping and assembly bench (page 106) and our roll-around tool center (page 109).

You can build the two handsome pieces with assurance that you'll soon be working in a setup that professionals would envy. The ideas that went into the designs came from craftsmen who have years of woodworking experience. Seth Stem of the Rhode Island School of Design, long-time contributors Ro Capotosto and Dave Warren, and our own Harry Wicks combined their best ideas for this month's woodworking center. It's the kind of arrangement they actually use—though they admit their own may not look quite as elegant. You can start now and build your own Christmas present!

To us, he's just plain Neil Shapiro. But to thousands of computer owners, PM's electronics editor is "70003.273 Wiz-Sysop of MAUG." It means he's head system operator of Compuserve's Micronet Apple Users' Group (MAUG).

Characteristically, Neil gets that deeply involved in new electronics systems long before most of us begin to understand them. Videotex is the latest one. You'll find it particularly interesting—you don't even need a computer. With just your TV, a decoder and Neil's article on page 102, you'll be able to tap vast stores of information right on your home screen.

On four wheels, PM Auto Editor Tony Assenza is formidable. As a matter of fact, he was one of a team of four drivers who won the Longest Day of Nelson Ledges, a 24-hour endurance contest (page 92).

But put him on three wheels and he has the same problem that you or I might have. He falls off.

Tony claims that he was hit broadside (or "T-boned" as the jargon has it) just as the photo above was snapped. No matter, it was fun, he says.



A T-bone can be hazardous, Auto Editor Assenza discovers. Hit broadside, he contemplates a landing spot here.

All of this bone-jarring activity was by way of bringing you a report on the growing sport of riding ATCs—fat-tired, powered tricycles (page 100). Try it in good health—but skip the T-bones.

Even as their navy fought in the south Atlantic, the unflappable British carried out plans to salvage a centuries-old relic of earlier seapower. It's the *Mary Rose*, a warship that sank in 1545. Raising the fragile hull is a huge task (page 96). The *Mary Rose* should surface about the time you read this.

PM photo: Eberhard Lotzke

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CAR CLINIC

Diesel keeps running—and running

No one can tell me what to do about the strange actions of my 1978 Oldsmobile diesel engine. When I turn off the ignition switch, the engine continues to run, and it keeps running until I disconnect a battery cable. Do you have an explanation for this odd problem?—Joseph M. Howard, Fort Knox, Ky.

Yep. Battery voltage is applied to the ignition switch of the 5.7-liter diesel engine at all times, with and without the ignition switch turned on. When the switch is in the "run" position, current flows to a solenoid in the fuel-injection pump that allows the metering valve to open. Fuel flows through this valve to the pumping chamber and, subsequently, to the eight cylinders. When you turn the switch off, current to the fuel-injection-pump solenoid is supposed to be interrupted.

To find what's causing your trouble, determine whether there's a

short between battery and ignition switch which allows current to energize the fuel-injection-pump solenoid even with the switch off. Start the engine and then turn off the switch. The engine, so you say, will keep running.

Pull the wire from the fuel-injection-pump solenoid. This is a slip-fit connection, so it's easy to do. Now if the engine stops running, there's a short between the battery and ignition switch. If the engine continues to run, there is no short and the trouble is a sticking solenoid in the fuel-injection pump.

Suppose there's a short. To find the circuit to which it's confined, again get the engine running with the ignition switch off. Now, pull fuses one by one until the engine stops running. You've now isolated the troublesome circuit.

If a fuel-injection-pump solenoid is faulty, replace it.

ing jerk in third gear at 30 mph, in second gear at 17 mph and in first gear at 7 mph. The Chrysler zone representative said Horizons and Omni Misers have this problem, because they're set to run lean. He says, "learn to live with it." Must I?—Merrill Roberts, Winton, Minn.

The Chrysler rep told you the truth. This decel-bucking, as it's called, is characteristic. In some cases, drivers also experience hesitation upon acceleration from a dead stop.

Decel-bucking usually happens to cars operating under low-speed conditions. The 1.7-liter engine is set up to provide a 50° to 54° spark timing when operated at low speed. Setting timing this way helps the car get maximum fuel economy. If timing were adjusted to occur later, decel-bucking would probably disappear, but you would lose about a mile to a gallon of gas.

Chrysler is studying a new engine computer to correct decel-bucking. It would have to be approved by the EPA, however, so I suggest you get in touch with your dealer to see if this repair has been authorized since we investigated the matter last summer. If not, there are two things you can have your dealer do to try mini-

(Please turn to page 22)

Rx for eye trouble

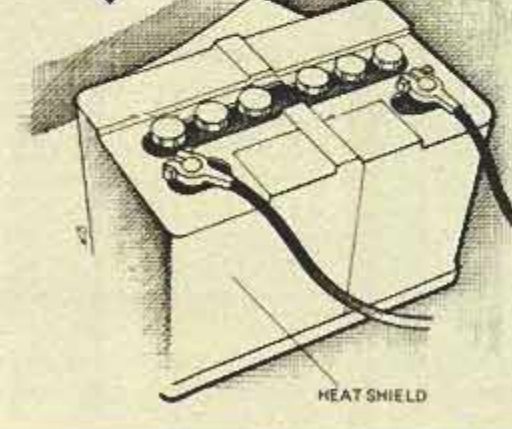
My 1974 Ford Gran Torino has eye trouble. When the headlights are off, the directional signals blink fine. When the headlights are on, the directional signals go on but stay wide-eyed. They won't flash. What's wrong?—John Pavelec, Wisconsin Rapids, Wis.

The common denominator is the starter relay, which is the terminal point for voltage which feeds off to the directional signals and other accessories. The relay terminals are probably oxidized, which creates resistance. When headlights are off and resistance isn't that great, current gets through unimpeded to the directional signal flasher, and signals can flash. When headlights are on, resistance is too much, and there's a voltage drop in the directional signal circuit. Ergo—no flashing.

Polish up the contacts on the starter relay, and your GT's eyes will probably wink as good as ever, with and without the headlights on. If that doesn't work, you'll have to replace the flasher.

A bit too miserly

I have a 1982 Plymouth Horizon Miser equipped with a 1.7-liter engine. Since the day I drove it from the showroom, this car has had an irritat-



Shield's Achilles' heel

A battery heat shield effectively protects a battery from high engine compartment temperature, but it could be

detrimental in another way. A heat shield hides the battery so you can't see dirt and electrolyte salts that build up on the top. This accumulation conducts electricity stored in the battery and can cause the battery to discharge by itself. Therefore, twice a year or so, it's a good idea to disconnect battery cables, remove the heat shield and scrub the battery with a baking soda and water solution. Rinse with clear water and dry with a cloth before reinstalling the shield.

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CAR CLINIC

(Continued from page 20)

mizing the problem of decel-bucking:

1. Make sure the idle-stop solenoid switch is properly grounded. Loss of idle-switch ground could cause the oxygen-feedback emission system to malfunction and an overly lean fuel condition to result. This problem is discussed in technical service bulletin 14-07-82 (2/8/82).

2. See to it that the propane-assisted idle-adjustment method described on page 14-25 of the service manual is applied. A flaw in this adjustment would lead to an overly lean fuel setting.

The true GM cat con story

You may have read about a dual-bed catalytic converter problem with 1981 and early 1982 General Motor cars equipped with 3.8-liter V6, and 4.4- and 5.0-liter V8 engines. There's truth to this, but GM denies that there will be a sudden loss of power and stalling as was first reported.

Although the reason for failure is not fully understood it's believed that pellets in the upper bed of the converter disintegrate and plug the lower

bed, causing high exhaust back pressure. But this is a gradual process and will occur over a period of time. If it happens to you, you'll notice a gradual loss of acceleration performance and failure of the engine to run at high speeds. Before the condition gets bad enough for "sudden" stalls to occur, you'll be screaming

bloody murder about lousy performance.

If you begin to notice the signs, take the car to a GM dealer. Dealers are obligated to replace faulty converters at no cost to customers under the provisions of the mandated, five-year, 50,000-mile, emission-control parts warranty. But let me make it

Weights and measures

When you're stuck trying to find the reason for a GM car's hesitation and lack of power, think weights—centrifugal advance, that is.

Worn or corroded advance weights, axis holes or pins can affect the operation of the centrifugal advance mechanism. This prevents centrifugal ignition advance. If the weights jam in the fully advanced position, hot cranking problems can result.

Weight and corrosion wear seem to occur because of a lack of lubricant between pins and sides of holes. Smearing a light coat of high-temperature silicone grease around the pins and under the weights prevents the problem.



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PM11

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A&C GRENADIERS—THE TASTE LEADER

clear that GM will not indiscriminately replace a converter. It has to be bad.

Starlet for sublet

My 1981 Toyota Starlet has such a vibration from under the hood when the engine hits about 2,400 rpm, that I'm ready to get rid of it. You can feel it throughout the whole car. It happens with or without the air conditioner running, yet the air-conditioning unit seems to be the cause. The service manager tells me I have a vibrating compressor belt, and he's tightened it as much as he can.

One more fact: My friend's '81 Starlet drives beautifully, but it has a Nippondenso compressor. The one in my car is a Sankyo. Is this significant?—Robert Lane, Lafayette, La.

Maybe. The Nippondenso is the Toyota factory-authorized unit. The Sankyo is from an aftermarket air-conditioning kit. But before I get to this, let's put first things first, which is making sure the compressor is causing the vibration. Take off the compressor belt and run the car without it. If there is no vibration, then the compressor is to blame. If the vibration is still there, then the compressor isn't to blame.

Suppose the compressor is at fault. Replace the belt, which may have a mold-lump, and adjust it to specification. A belt that's too tight can contribute to vibration and also put stress on compressor bearings that may cause them to fail prematurely.

If the problem stays with you, make sure the compressor is securely mounted. Here's where the Sankyo unit may be letting you down. A car with a factory-authorized Nippondenso compressor has a brace between the engine and transmission (on the bell housing) to stiffen things up and prevent vibration. If your air conditioning is not a Nippondenso system, this brace may not be installed. To stop the vibration, see if you can brace the compressor similarly.

If the vibration is not being caused by the compressor, several possibilities present themselves, among which are clutch imbalance, drive-shaft imbalance or ignition-system breakdown at one or more cylinders at about 2,400 rpm.

DO YOU HAVE A CAR PROBLEM?

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 discussed in the column.

SERVICE TIPS

■ Ford says that if all else fails to eliminate a bad spark knock in the 3.8-liter engines of 1982 Granadas and Cougars, try a new distributor (part No. E2SZ-12127-E) and vacuum regulator valve (part No. D9DZ-9F490-A). Article 82-11-3 of TSB 82-11 gives details.

■ Brake pulsation and abnormal front-brake-pad wear in 1980-1982 Omegas and 1982 Cieras and Firenzas can result when caliper bolts corrode, keeping calipers from sliding freely. Olds recommends inspecting mounting bolts when calipers are removed. Replace corroded bolts. To prevent corrosion, fill the cavity around bolt bushings with silicone grease.

■ Don't be talked into new MacPherson-strut assemblies if you get a chucking noise from the front suspension of a 1981-82 Dodge Aries or Plymouth Reliant, or 1982 Dodge 400 or Chrysler LeBaron. The car may just need a front-suspension strut damper weight assembly (part No. 4052685). So says TSB 02-08-82. **PM**

HOMEOWNERS' CLINIC



Installing mirror tiles

I can't seem to locate any information on how to install mirror tiles. I have an 8x15 ft. wall, and would like to cover it, floor to ceiling, with these tiles. I'd appreciate your help.—Louis Taveras, Miami

Mirror tiles are attached to the wall with 1-in.-square, double-adhesive pads. Place one pad in each corner (none in the center), and push the tile

gently into place. Start at the top with a full tile, and work your way across and then down the wall. Don't leave any clearance between the tiles, but make sure that the bottom row clears the floor by at least 1/4 in.

Do not use other adhesives, since chemical reaction may harm the silver plating, resulting in poor adhesion or damage to the mirror.

these unsightly stains. Any suggestions that you could offer would be greatly appreciated.—R.E. Ogle, Sonoma, Calif.

Universal-Rundle was one of the pioneers in fiberglass plumbing fixtures over 20 years ago; that company still enjoys the reputation of being one of the leading manufacturers. It sounds like you've tried everything except an item carried both by Universal-Rundle distributors and Sears: a fiberglass cleaner! It's an isopropyl alcohol-based tub and shower cleaner, which comes in its own pint-size container with a pump-action spray top. All you need to do is follow the directions on the container to "lift" out stains.

Universal-Rundle's quality control department informs us that its gel-coat is thick enough that many stains may be removed by using a buffing cloth chucked in a drill motor. Use a white buffing compound, which is available in most hardware stores. Quite often, this will remove the stain and restore the finish in one operation—on thick gel coats only.

The company also maintains a list of authorized repair agencies located throughout the United States. These are factory-trained, independent repair technicians. For the name of the repair facility nearest you, write: Fiberglass Repair, Universal-Rundle Corp., Box 960, New Castle, Pa. 16103. **PM**

Drifting door

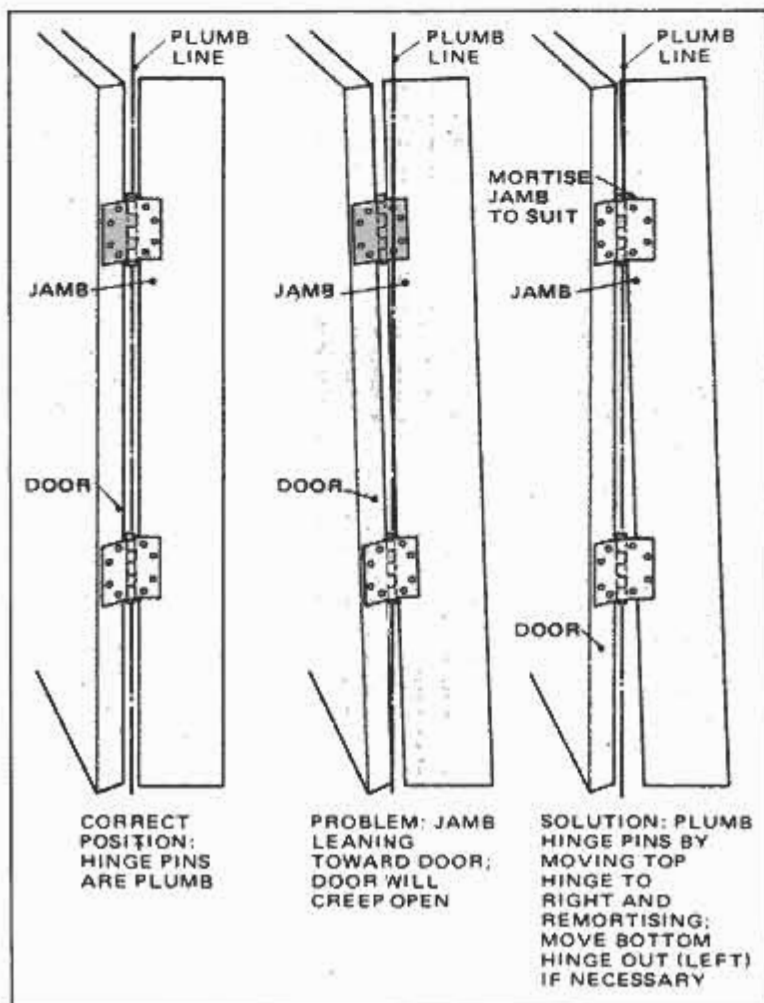
Our door had always worked properly until we had new carpeting installed. At that time, the men who did the installation had to cut 1/2 in. off the bottom of the door to clear the carpet. Since then, the door will not stay open, but slowly closes by itself. This is most troublesome. Can you tell us what we could do to correct this situation?—Mrs. Dave Jaksic, Pittsburgh

It appears that your jamb is not plumb. If this happened while the carpet was being installed, have the installer return and plumb the jamb. If your entire wall is not plumb (due to settlement), the easiest way to correct the door leveling is to either relocate the top hinge closer to the stop (remortise), or slide the bottom hinge out of its mortise until the pins are directly in line (plumb); see drawing. The stop and striker plate will probably have to be moved.

Stained fiberglass shower floor

We have a severe staining problem with the floor of our fiberglass shower. It's molded with a scalelike finish to re-

duce slippage. Dirt and other stains collect in these small design lines and are impossible to remove. We've tried commercial cleaners, bleach, toilet bowl cleaner, even steel wool and sandpaper, but nothing seems to faze



Pins in a pair of door hinges must be plumb, that is, one directly over the other—in both planes. If not, door will swing open (or closed).

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 to PM, Box 1014, Radio City Station, New York, N.Y. 10101.

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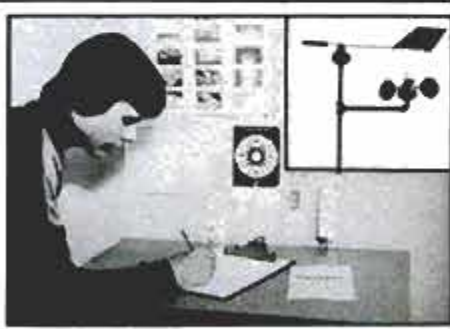
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DETROIT
LISTENING POST

First Look: '84 Chrysler Turbo



Chrysler's plan for its '84 turbocharged sports car: It will produce 147 hp at 5,600 rpm, 160 pounds of torque at 3,600 and will do 0 to 60 mph in 8.9 seconds. The wheelbase will be 96.9 inches and it will weigh about 2,300 pounds. It will give fits to everything from Mustang HOs to Porsches. That's Chrysler's plan; here's our sneak photo of the prototype.

Inside the General's bunker

Each summer brings the annual automotive orgy known as the "Long Lead" (magazine) press previews. That's when folks like Executive Editor Joe Oldham, Auto Editor Tony Assenza, yours truly and our counterparts from other publications are invited inside the General's bunker to see, drive and photograph his coming products for the following fall—so we can produce the stories and get them to you in time.

The other companies do it, too, of course, but no one does it quite like the General. With five car divisions, one per day, the GM Long Leads typically take an entire working week. A week of meetings, technical briefings, driving and more driving, mostly on

the enormous, sweltering Michigan Proving Ground skidpad known as "Black Lake." A week of buffet lunches under a tent, receptions and dinners at the headquarters hotel, hospitality suite gatherings every night.

A week of total immersion in automobiles, almost constant conversation about cars and the industry that produces them. Conversation with the general managers of each division, the chief engineers, the vehicle chief engineers and dozens of other engineers, designers, product planners, sales and marketing people and the public relations staffs that make the previews happen.

Keep your ears open and you can learn a lot in a week like that, not

only about the products but about the General himself and his intensely competitive divisions, each trying to outdo the other.

You can learn, for example, that: ■ Oldsmobile is pretty smug and self-satisfied in its third place (behind Chevrolet and Ford) in industry sales, calling most of its cars Cutlasses of one sort or another and operating as if nothing ever changes. And that fourth-place Buick wants nothing more than to knock Olds off its chrome and vinyl tower and is doing everything it can think of to further that ambition.

■ Pontiac, once a muscular third itself, is struggling mightily to regain the youthful, exciting, engineering-oriented image that kept it there for so many years not so long ago. Regaining third is the long-range goal; simply reversing its sales slide is the immediate priority.

■ Mighty Chevrolet, too, has been suffering badly through this lengthy recession that has so many of its traditional buyers either out of work or worried that they might be. It is approaching the problem largely by "de-contenting" (stripping standard equipment off) its cars to widen the price gap between them and the others and concentrating on fuel economy while its corporate rivals stress excitement.

■ Cadillac, its customers mostly unaffected by the recession, is doing just fine while gas prices and availability stay fairly stable.

You learn that Pontiac is not at all pleased with the Chevrolet-supplied 5.0-liter V8 engines that power its new Firebird Trans Am. In 145-hp four-barrel or 165-hp fuel-injected form, they're neither fuel-efficient nor powerful enough in the fairly heavy Firebirds (and Chevy's Camaros) to compete effectively against Ford's very strong Mustang/Capri 5.0-liter V8.

At the Chevrolet meeting, you ask why, if Oldsmobile engineers can get 180 emissions-certified horsepower from a same-size four-barrel engine in the much heavier '83 Hurst/Olds, can't the talented Chevrolet engineers come up with competitive Camaro/

(Please turn to page 31)



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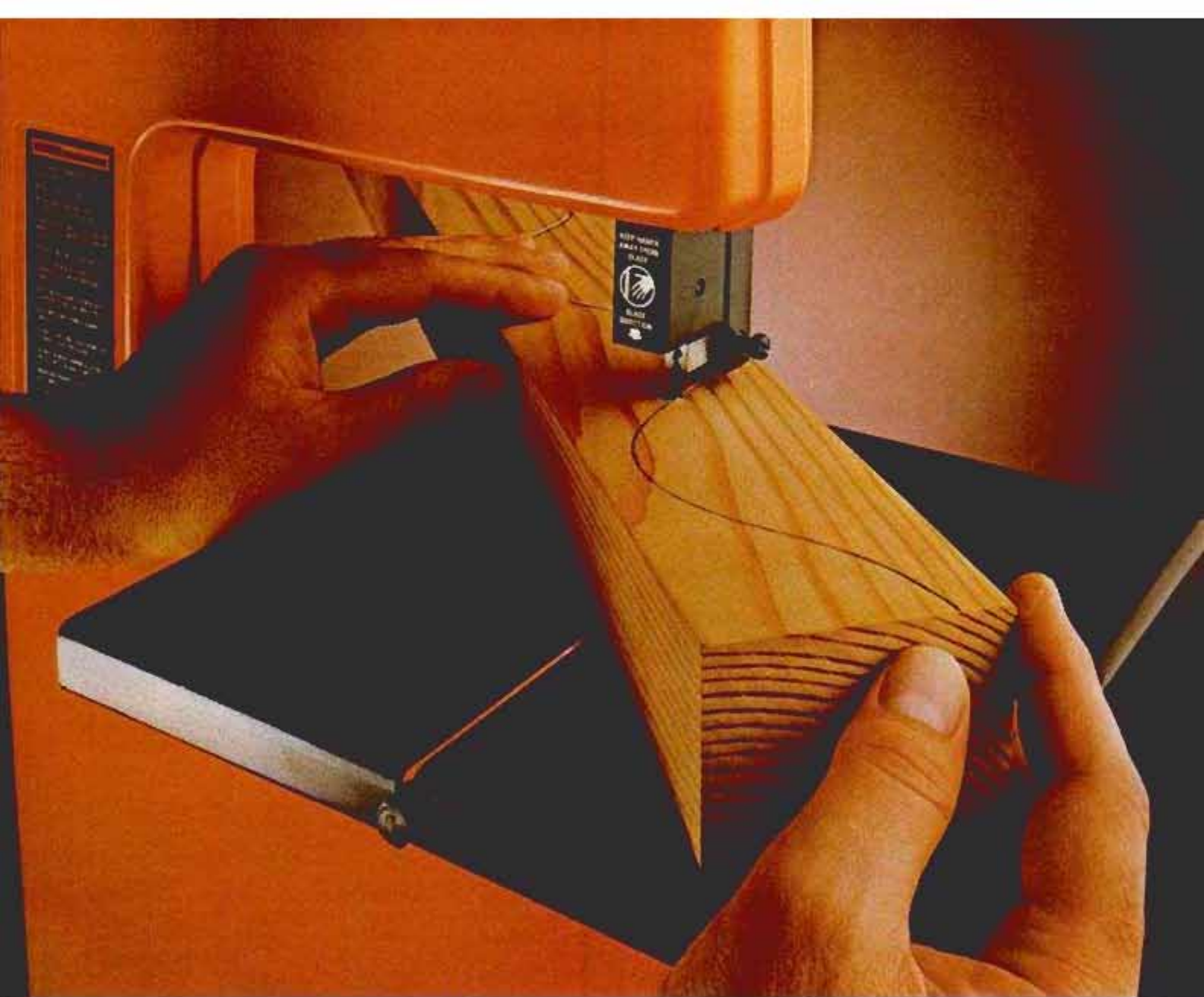
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DETROIT LISTENING POST

(Continued from page 28)

Firebird power? And you're told that Chevy *could* get more V8 horses but feels (they say) that the current calibrations are the right power/economy compromise in such "totally balanced" performance cars.

GM in racing?

Not for many, many years has the presence of motorsports been so evident at the GM previews. Some days you could almost smell the hot oil and rubber. It's no secret in Detroit that the general managers of at least three GM divisions have been trying to bump GM's corporate management off the fence toward the side of selling through racing. These are Chevy's Bob Stempel, Pontiac's Bill Hoglund and Buick's Lloyd Reuss—smart, dynamic, aggressive young executives who understand the value of, indeed the *need* for pumping competitive excitement into their products.

Though GM has long permitted absolutely no open involvement in motorsports, from time to time some of its divisions have kept the competitive fires alive by developing and marketing heavy-duty "off-road"

parts to keep their respective independent racers in the winner's circles. Chevrolet is the master of this technique. As a result, the Chevy small-block V8 engine has been dominant in many forms of the sport for a good many years—including NASCAR stock-car racing, where virtually all GM-based cars use it.

Buick Div., GM's V6 expert, has built up a similar program for V6 heavy-duty parts over the last few years. Now Pontiac, which supplies all of GM's 2.5-liter Fours, has joined the fray with a Super-Duty parts program for four-cylinder classes.

While Chevy Corvettes and Camaros have enjoyed tremendous success on the country's road racing circuits for as long as most of us can remember, Buick Regal-bodied stock cars have cleaned up in NASCAR for the past two seasons. And this year Pontiac's aerodynamic Firebird Trans Am quickly became the car to beat in the Trans Am road-racing series it was named for 14 years ago.

Though still under the corporate thumb at Long-Lead time, two of these eager but frustrated divisional managers were not shy about flaunting their top racers for the assembled magazine editors and writers. Chevrolet's dinner was essentially a retire-

ment party for Vince Piggins, long-time head of the "Product Promotion Engineering" Group responsible for developing and distributing these heavy-duty parts.

For its part, Pontiac had Richard Petty and his NASCAR Grand Prix, Don Prudhomme and his NHRA funny-car Firebird, and former World Driving Champion Phil Hill on hand; plus the SCCA Trans Am series-leading Mecham Racing Firebird and its owner, Dennis Mecham.

It's taken three dismal sales years and two seasons of open Ford Motor Co. participation to bring these GM divisions' healthy new interest in motorsports to the surface, and in a way that's a shame. Competition does "improve the breed," and we think there should be some level of consistent involvement by the U.S. manufacturers every year, good times and bad. Most of the imports do it continuously, and it certainly helps their sales and images.

We can only hope that the world's largest automaker—which competes virtually everywhere else on the planet where its cars are sold—leans toward *more* involvement, not less, here at home where it matters most as the long-awaited auto recovery begins. **FM**



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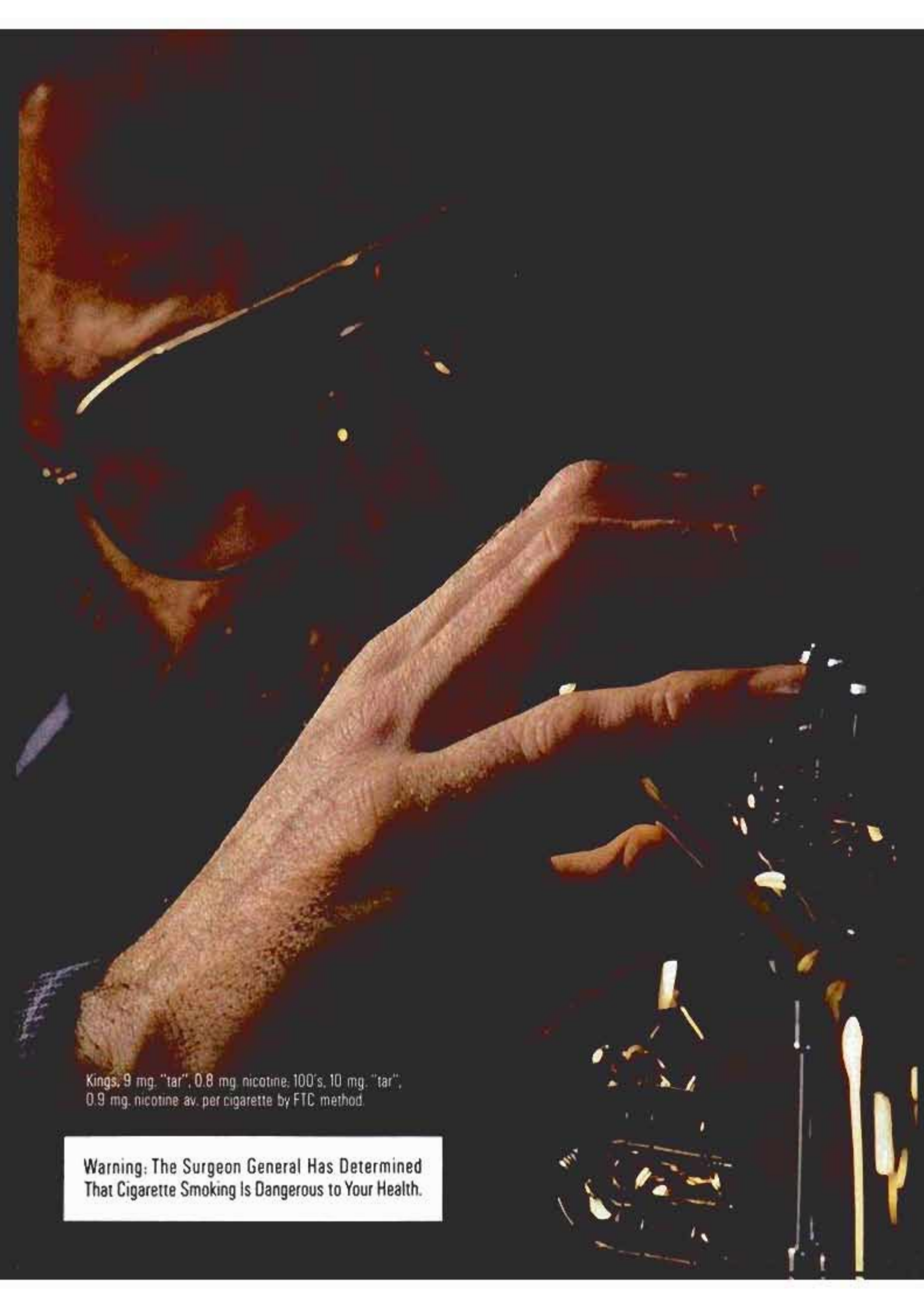
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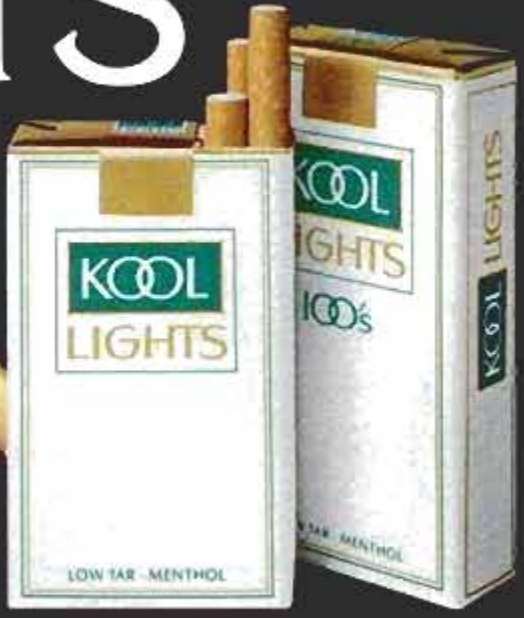
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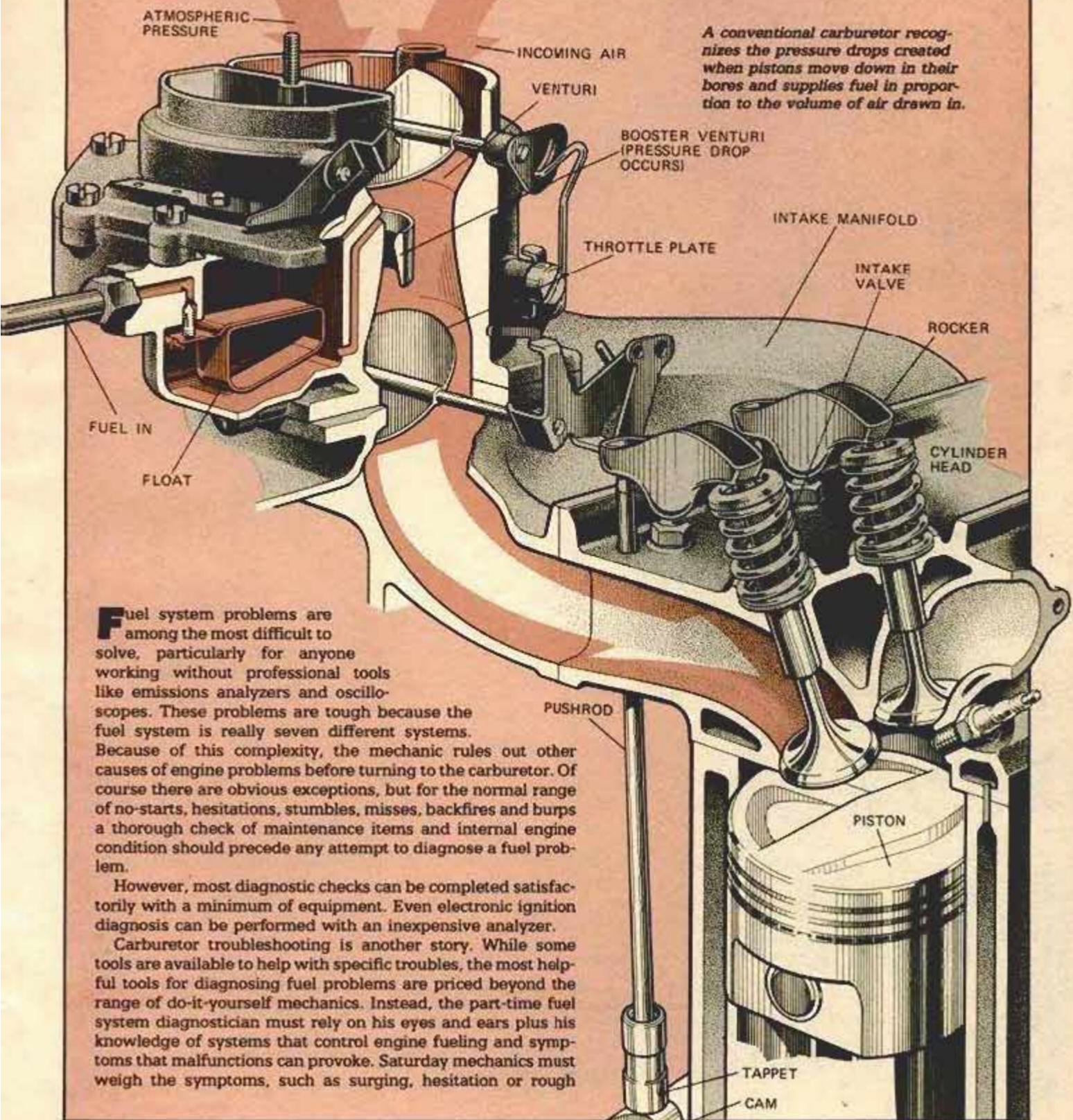
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FORD DIVISION

Troubleshooting Fuel System Problems



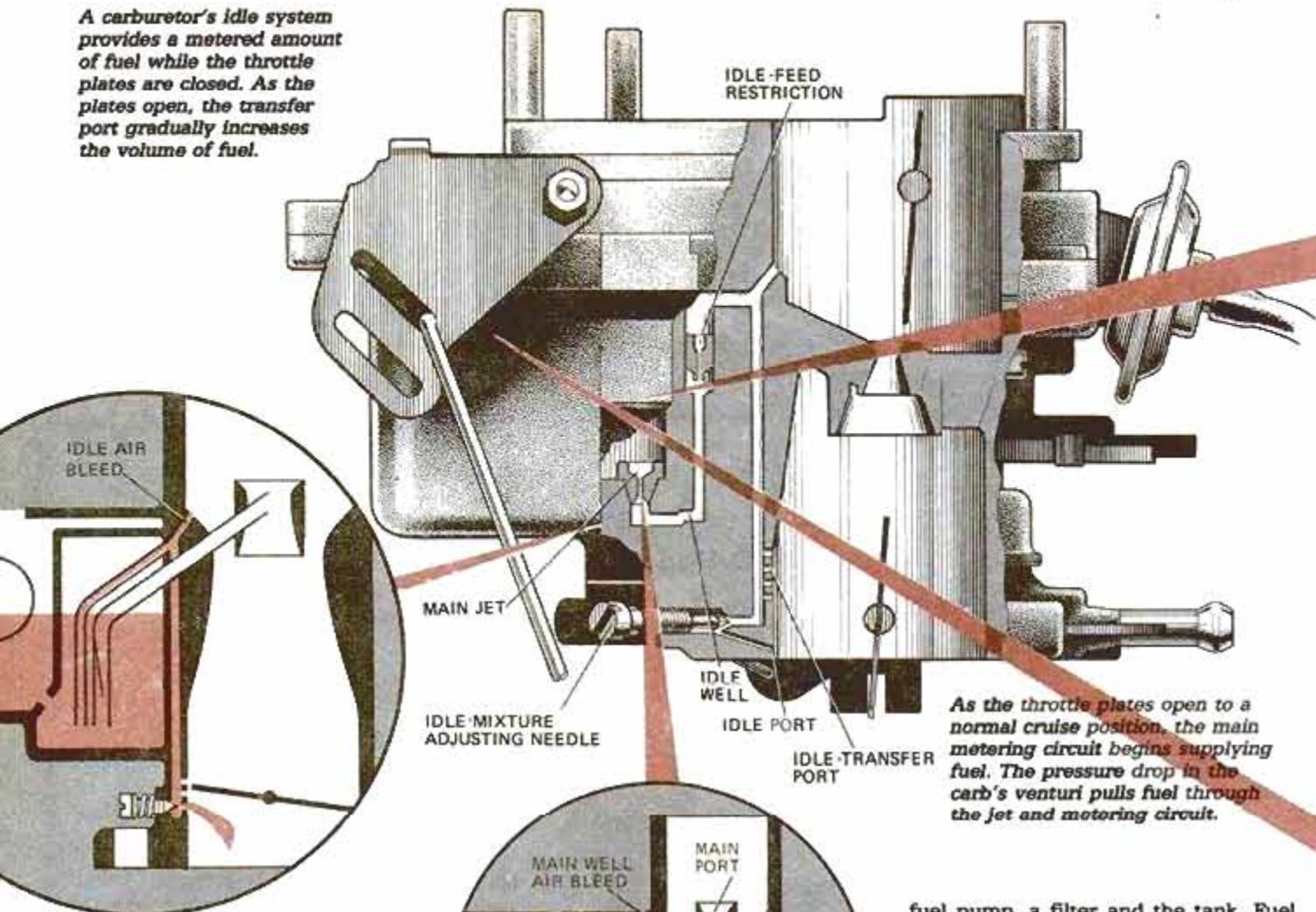
A conventional carburetor recognizes the pressure drops created when pistons move down in their bores and supplies fuel in proportion to the volume of air drawn in.

Fuel system problems are among the most difficult to solve, particularly for anyone working without professional tools like emissions analyzers and oscilloscopes. These problems are tough because the fuel system is really seven different systems. Because of this complexity, the mechanic rules out other causes of engine problems before turning to the carburetor. Of course there are obvious exceptions, but for the normal range of no-starts, hesitations, stumbles, misses, backfires and burps a thorough check of maintenance items and internal engine condition should precede any attempt to diagnose a fuel problem.

However, most diagnostic checks can be completed satisfactorily with a minimum of equipment. Even electronic ignition diagnosis can be performed with an inexpensive analyzer.

Carburetor troubleshooting is another story. While some tools are available to help with specific troubles, the most helpful tools for diagnosing fuel problems are priced beyond the range of do-it-yourself mechanics. Instead, the part-time fuel system diagnostician must rely on his eyes and ears plus his knowledge of systems that control engine fueling and symptoms that malfunctions can provoke. Saturday mechanics must weigh the symptoms, such as surging, hesitation or rough

A carburetor's idle system provides a metered amount of fuel while the throttle plates are closed. As the plates open, the transfer port gradually increases the volume of fuel.



As the throttle plates open to a normal cruise position, the main metering circuit begins supplying fuel. The pressure drop in the carb's venturi pulls fuel through the jet and metering circuit.

idling, and logically determine which of the carburetor or fuel-supply components is the likely cause.

Most cars on the road today use a conventional carburetor to control fuel and air intake. For fuel to burn well, this ingenious device must maintain an air/fuel ratio of about 15 to 1. Connected to the engine cylinders by intake manifold runners, it provides fuel and air in response to pressure drops created when the pistons move down on intake stroke. It also responds to the driver's control, maintaining that relatively accurate air/fuel ratio as the throttle plates open and close. To do this efficiently under various conditions, a typical carburetor depends on at least six different systems: fuel reservoir, main metering, idle, enrichment, accelerator pump and cold start.

While most carburetors employ variations of the same systems, they come in many sizes and shapes, and fall within three classes: one-, two- and four-barrel. Barrel refers to throttle bores in the carburetor, so these classes are based on the number of throttle bores the carburetor has.

Four-barrel carburetors are designed to open the secondary barrels—the two

rear ones—only when the pedal is pushed past the ¾ mark or so. This type of carburetor is called a two-stage design. There are also two-stage, two-barrels in use. All two-stage carbs have a choke flap on the primary side only.

Before the carburetor can do its job, fuel must be delivered by the pump and tank system. If you understand how that system and the six systems within the carburetor function, you will be well on your way to a working knowledge of conventional fuel systems. In the following subsections we'll discuss each system and explain what happens when it fails.

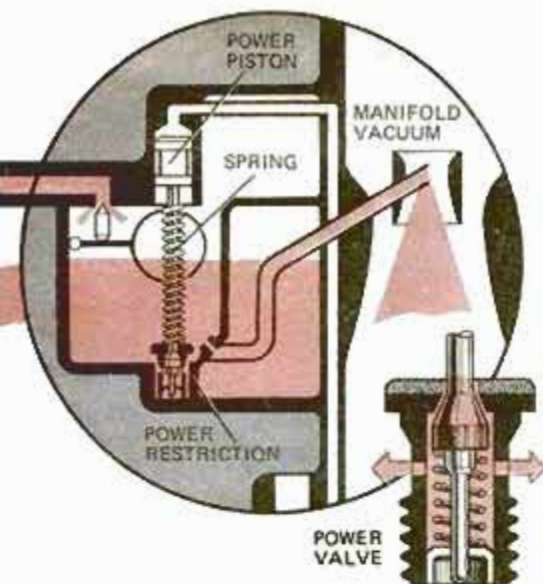
Fuel delivery system

The fuel delivery system of a carbureted engine consists of a mechanical

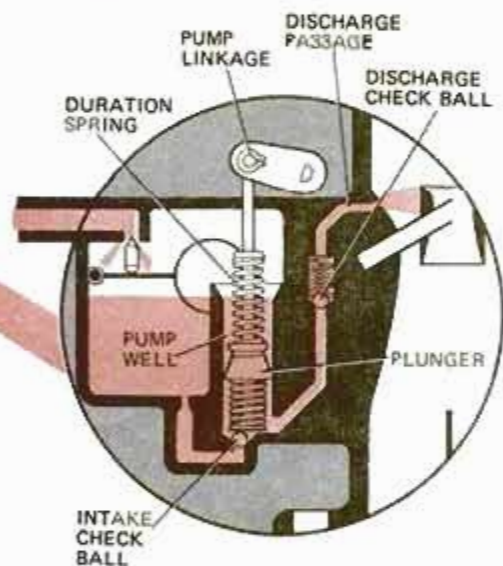
fuel pump, a filter and the tank. Fuel delivery problems are easy to recognize because they produce a very clear symptom: The car behaves as though it has run out of fuel. Usually the engine dies at high speed. Sometimes it will restart when you ease off the throttle. If not, it can usually be started with the key, but may die again. This will occur primarily under heavy load conditions, such as hill-climbing.

The first thing to consider when you have a delivery problem is the filter. If it isn't new, replace it. On many cars, it's behind the carburetor inlet nut. Before loosening the nut, be sure the engine is cold and lay a rag under the inlet. Then remove the nut and pull the filter out. Note any difference between the front and rear of the filter. Many have a check valve on one side. Other cars have in-line fuel filters. Canister-shaped with a nipple on each end, these are spliced into a fuel line.

If the new filter doesn't solve a fuel delivery problem, the pump pressure should be tested. Disconnect the fuel line at the carburetor and attach a fuel-pressure gauge. Run the engine at idle on the fuel in the carburetor float bowl and read the pressure. Generally, it should be between 4 and 7 pounds per square inch (p.s.i.), but it would be best to check the exact figure. If pressure is too low, replace the pump.



A carburetor's power valve or enrichment circuit (above) enriches the fuel mixture under heavy load (low vacuum) conditions. The accelerator pump system (below) provides extra fuel when driver moves throttle toward floor.



If pressure is okay, check for pumping capacity. Disconnect the fuel line at the carburetor and hold it in a graduated container. Look at the second hand of your watch, while an assistant runs the engine until it pumps one pint into the container. At idle speed, it should produce a pint in about 30 seconds. If there are lots of air bubbles in the fuel and capacity is low, there may be a small hole in the line between tank and pump.

If the pump is producing full pressure but will not deliver enough fuel, suspect a restricted fuel line, clogged tank or clogged purge canister or tank vent. If the tank is full of dirt, you should see some when you disconnect lines. Restrictions are usually caused by kinks in fuel lines. A clogged canister or vent will produce a sound of air being drawn into the tank when the gas cap is

removed, the car also should perform satisfactorily without the gas cap. If the system appears okay but the pump will still not meet capacity specs, have it replaced.

Fuel reservoir system

When the fuel arrives at the carburetor, the fuel pressure forces the needle valve open. Then the float bowl within the carb begins to fill. As it fills, a plastic or brass float inside rises and pushes the valve closed. When fuel reaches the proper level, the needle closes to prevent the bowl from overflowing.

If the needle doesn't close, the engine will run rich, because the fuel level will continue to rise and fuel will be forced through the metering system and float-bowl vent tube. This condition is typified by roughness, chugging and black smoke. A rich condition will sometimes clear up under load at wide-open throttle, because the engine is using so much fuel the float bowl doesn't overflow.

Several things can cause the needle not to close. One is simply a worn needle or seat. Another is dirt wedged between the needle and seat. This can occur if a car is run without a filter, or if care is not taken to maintain cleanliness when the fuel system is apart. A third cause is an improperly adjusted float system. A very common cause is a plastic float becoming saturated with fuel, and sinking in the bowl. A brass float with a hole in it will also sink.

That brings us right back to the fuel pump. If fuel pressure is excessive, it can hold the needle valve open.

Main metering system

The main metering system provides fuel under all open throttle conditions. Under heavy load and acceleration, it is supplemented by other systems. This system depends on vacuum developed by the pistons moving down in their bores to draw in fuel.

If you look down the throat of a carburetor, you'll see that each barrel has a throttle plate at the bottom and a narrow section or venturi somewhere near the top. There is usually a second barrel, a booster venturi, within the main venturis. When throttle plates are opened, pressure drop created by the pistons causes air to be drawn through the barrels. When air moves through the narrow venturi of the carburetor, the vacuum signal is amplified. The booster venturi amplifies it further.

In the center of the booster venturi, you'll find a tube with a hole in it. This tube leads to a metering passage that is joined to the bottom of the float bowl. Where it meets the float bowl, there is a metering jet. When air passes through the booster venturi, it literally sucks fuel out of the float bowl in much the

same way you can draw liquid through a straw.

If the metering circuit becomes clogged with dirt, the engine will run extremely lean, causing misfire, roughness and stumble at partial throttle/cruising conditions. Idle will probably be okay unless the idle circuit is dirty too. Since it is nearly impossible to tell the difference between an ignition misfire and a lean misfire without an oscilloscope and emission analyzer, it is important that ignition problems are ruled out first.

Many two-stage carburetors meter fuel for the secondary barrel(s) by a valve linked to a secondary air flap. As air rushes through these barrel(s), it pushes the flap open, which opens the metering valve. As air volume increases, so does fuel supply in correct proportion. A two-stage carburetor that performs well on the primary barrels, but causes hesitation, bucking or surging when the throttle is floorboarded, may have a secondary metering system problem.

Idle system

With the throttle at idle the idle adjustment screw or idle solenoid prevents the throttle plates from closing completely. Since air volume passing around the nearly closed throttle plates is not sufficient to draw fuel from the main metering circuit, an idle fuel circuit is provided to connect the fuel reservoir to a small hole in the carb barrel just below the throttle plates. With the engine running, air rushing around the edge of the nearly closed throttle plate causes a pressure drop. This vacuum draws fuel from the idle circuit.

Just above the idle port and bridging the edge of the throttle plate is the idle transfer port. This port, also connected to the idle circuit, provides a transition from idle position to open throttle.

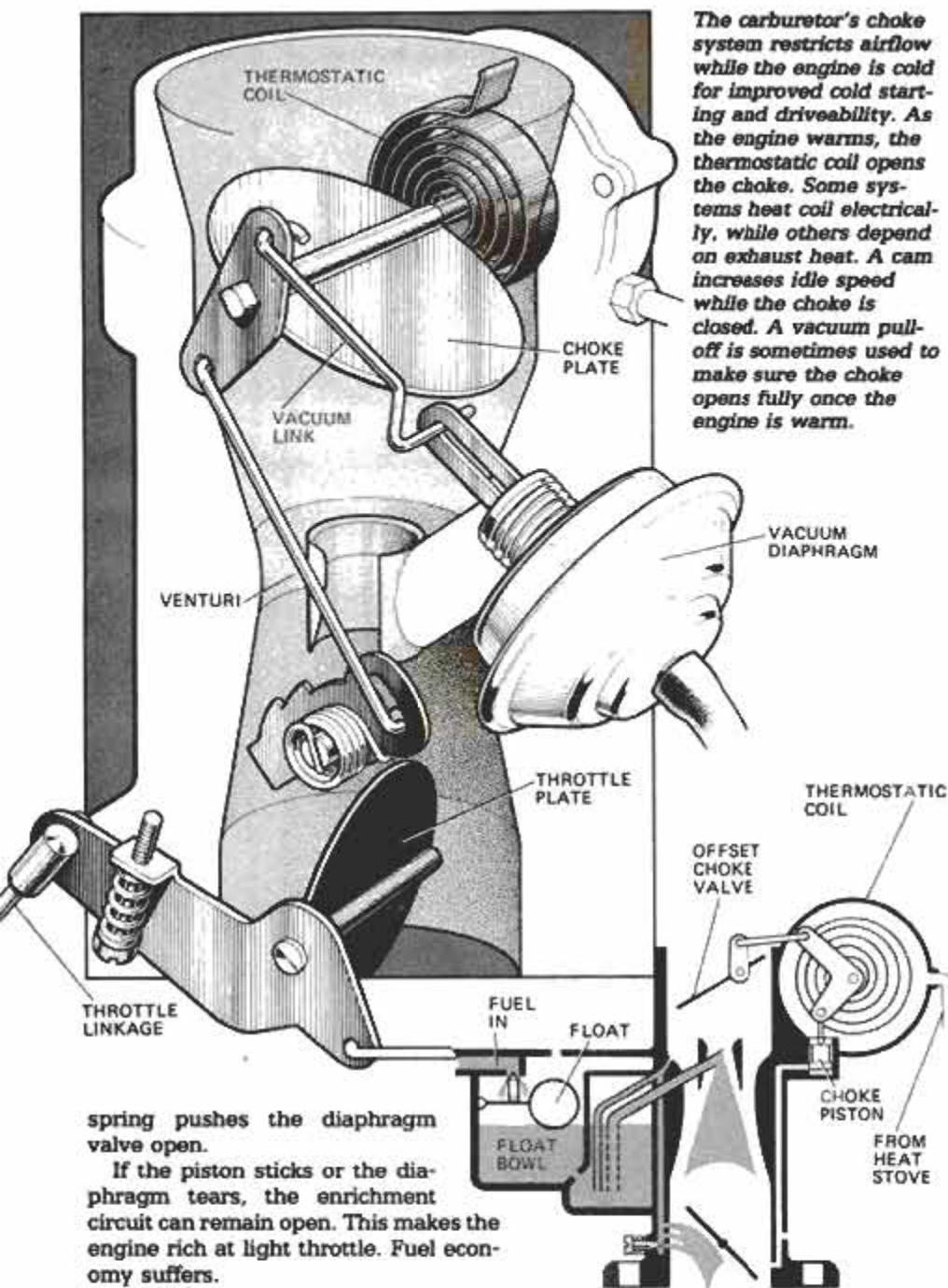
An incorrect idle mixture causes rough running, high emissions and poor fuel economy. A clogged transfer port can cause hesitation, surging or stumble at off-idle throttle positions.

Enrichment system

During open-throttle, high load conditions, the carburetor's metering circuit can't provide enough fuel for a suitable air/fuel ratio, so an enrichment or power valve system is provided.

Most enrichment systems consist of a piston and metering rod or a diaphragm-controlled valve. High manifold vacuum keeps the diaphragm closed or the piston down in its bore, preventing fuel from entering the system. As vacuum falls, the spring-loaded piston rises in its bore, pulling the rod out of the metering jet that it restricts, increasing the amount of fuel supplied. With diaphragm-controlled valves, a

The carburetor's choke system restricts airflow while the engine is cold for improved cold starting and driveability. As the engine warms, the thermostatic coil opens the choke. Some systems heat coil electrically, while others depend on exhaust heat. A cam increases idle speed while the choke is closed. A vacuum pull-off is sometimes used to make sure the choke opens fully once the engine is warm.



spring pushes the diaphragm valve open.

If the piston sticks or the diaphragm tears, the enrichment circuit can remain open. This makes the engine rich at light throttle. Fuel economy suffers.

The enrichment valve can also cause a lean condition if it jams in the high vacuum position, or if its fuel inlet port becomes clogged. A nonfunctioning enrichment system will cause loss of power, stumble and surging under heavy load/open throttle conditions. Absolute confirmation of an enrichment problem calls for tear-down and inspection. However, a service facility that's equipped with a chassis dyno and emissions analyzer can confirm a faulty power valve without opening up the carburetor. Detonation—spark knock—can also result from an excessively lean condition.

Accelerator pump system

In addition to the main metering and enrichment systems, controlled by engine vacuum, a carburetor needs an accelerator pump system that responds

to throttle movement. Without it the carburetor can't supply enough fuel when throttle plates open suddenly.

Two types of accelerator pump systems are in use—diaphragm pumps and piston pumps. Diaphragm systems have a spring-loaded neoprene diaphragm that, when compressed by the throttle linkage, delivers fuel to a nozzle or nozzles in the carburetor barrel. Piston-type accelerator pumps use a spring-loaded rawhide piston. A check ball near the discharge nozzle stops the flow when the accelerator pedal is held steady. When the pedal is released, the returning piston or diaphragm draws fuel from the float bowl. A second check valve keeps the charge from leaking back.

If your car hesitates severely when

you tromp on the accelerator, your carburetor may have a worn or damaged accelerator pump or a clogged discharge nozzle. By manually operating the throttle while you look into the carburetor, you'll be able to determine whether the pump system is delivering fuel.

Cold-start system

The most important cold-start components—the choke and fast-idle mechanism—are controlled by the carburetor.

The choke is an air flap that partially covers the carburetor barrel(s) when the engine is cold. The restriction created speeds up airflow. Resulting turbulence helps vaporize the fuel injected by the accelerator pump when the throttle is floored for a cold start.

Once the engine is running, the choke continues to limit the air intake, ensuring that the air/fuel mixture will be richer with fuel than under normal conditions and that the increased turbulence will help improve the cold-engine combustion.

The choke flap is usually controlled by a metal coil that expands as it warms. The coil is usually located within a housing on the side of the carburetor. Sometimes it is on the intake manifold.

On the throttle side of the carburetor a bellcrank is connected by linkage to the choke flap. Called the fast-idle cam, it has a series of graduated steps. Resting against the fast-idle cam is a fast-idle adjustment screw attached to the throttle-plate shaft. When the engine is cold and the throttle is floorboarded for a cold start, the choke coil closes the choke flap that pushes the linkage which rotates the fast-idle cam. When the throttle is returned to idle, the fast-idle screw contacts the high spot on the cam.

Choke problems show up most often in the form of difficult cold starting. Generally, this is the result of the choke being set too lean or simply not working. A lean choke adjustment will also make the car hesitate during cold driving. A rich choke adjustment will cause high idle emissions, poor fuel economy and poor driveability. An extremely rich choke adjustment can cause hot-start problems. An improper fast-idle adjustment will also cause cold driveability difficulties.

Whenever such problems occur, all choke-system adjustments should be checked. Most general auto repair manuals provide specifications and adjustment techniques for the more common carburetors. Some can be adjusted using only a steel rule. For others, a choke-valve angle gauge may be necessary.

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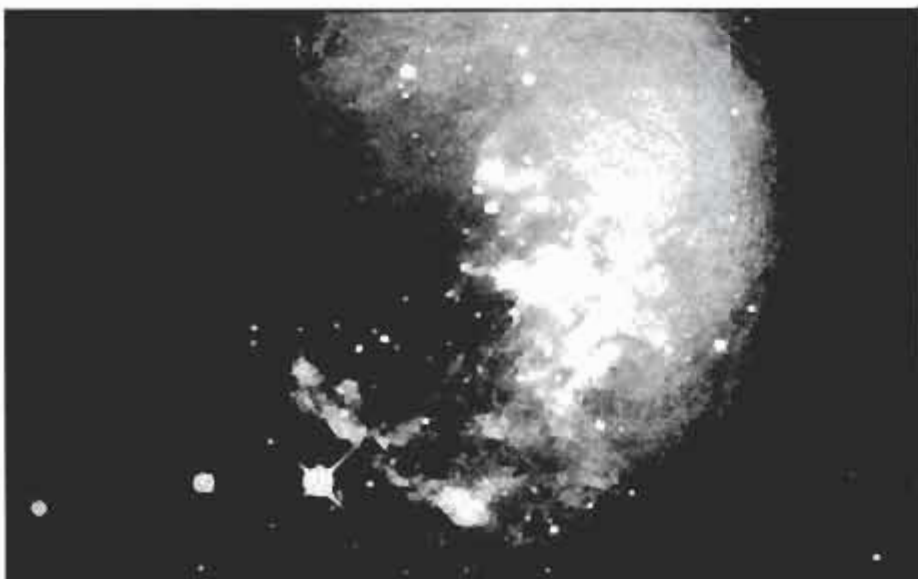


Airborne observatory maps Orion

Travel 60 miles from the nearest city lights and point an ordinary set of binoculars just below the three stars in Orion's belt and you'll see much of the Orion Nebula—a vast cloud of stars, stardust and gases. But, because of atmospheric interference, you have to climb 40,000 feet or more above the earth to get detailed photos of Orion.

ated a new kind of map that shows "brand new" star formation.

The three bright objects near the bottom of the map are called the Trapezium Cluster. These are not quite one million years old. They're about 30 times more massive than our sun, but they look even bigger in the photo because of its long exposure time. Toward the center of the map is a re-



NASA's new map of the Orion Nebula shows the older three stars (lower left) of the Trapezium against the swirl of dust, gas and regions of "brand-new" stars.

That's why a team of scientists led by NASA's Michael Werner recently went up in a C-141 Starlifter dubbed the Kuiper Airborne Observatory.

The craft's 36-in. telescope captured terrific infrared photos of the nebula. They weren't the first such photos, but by later imposing the infrared images on a black and white Orion photo, the NASA scientists cre-

ated a region of densely packed stardust. Here stars are not much older than 100,000 years—very young in astronomical terms. These superenergetic stars are expected to explode as supernovae far into the future. How far? "It can be expressed in tens of thousands of years, but any prediction will be very imprecise," says Werner.

Jet lag diet

There always seems to be room for one more diet. The latest comes from Argonne National Laboratory biologist Charles Ehret, who developed a feast-and-famine plan for those who travel across three or more time zones.

Say you're traveling to Paris from New York, crossing three time zones.

The diet calls for extra helpings of food three days before the flight; very light meals two days before; another feast the day before; light eating on the day of the journey, and a final feast on the day after the trip. You return to your normal eating habits the next day. The diet is designed to maintain your natural bio-

logical "clock," Argonne officials say.

If you'd like a wallet-sized rundown on how the diet works, send a self-addressed stamped envelope to: Science Dept., Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

Fly (ash) in the ointment

So many people are worried about the dangers associated with nuclear power plants that a number of utilities are turning their attention to coal-fired power plants to help ease the impact of petroleum shortages. Now it seems possible that the coal-burning plants also pose a radiation danger.

Biologist Paul Ziemer and his colleagues at Purdue University have begun experiments to determine how much radioactive radon gas is released into the environment by fly ash exposed to various conditions. Fly ash is a by-product of coal burning. The gas is nonpoisonous, but it also is inert—it doesn't break down after entering the human body. In the lungs, that factor may pose serious threats.

Fly ash is also used as a binder in concrete blocks for homebuilding. Thus, the Purdue scientists are also trying to determine whether well-insulated homes built with such blocks pose a radiation threat to residents.

Which is the experimenter?

It's eerie, but true, that a school of dolphins being studied by a Living Ocean Society team off the Bahamas went far beyond anything the experimenters dreamed of in mimicking humans. Writing in a National Wildlife Federation journal, team leader Hardy Jones says the spotted dolphins mimicked 10 different sounds generated by a computer and based upon recordings of dolphin calls. But the team was really surprised when, while filming the experiment, it observed the dolphins diving into the water tail-first—the way their human observers had dived earlier.

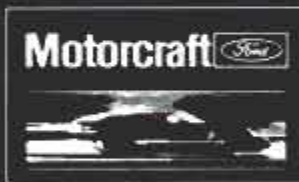
"Clearly we are only beginning to unravel the world of the dolphin," Jones wrote. He says the dolphins were probably checking to see how it felt to act like the experimenters. **PM**



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New Outboards For '83



Smaller, more efficient motors are arriving, and higher performance muscle models are in the works.

BY BILL MCKEOWN BOATING EDITOR

Any skipper looking for more, or less, motor to match a hull will find a wider choice than ever this coming spring. Prices have not jumped much. However, durability, performance at high and low speeds, plus convenience of operation are all upgraded.

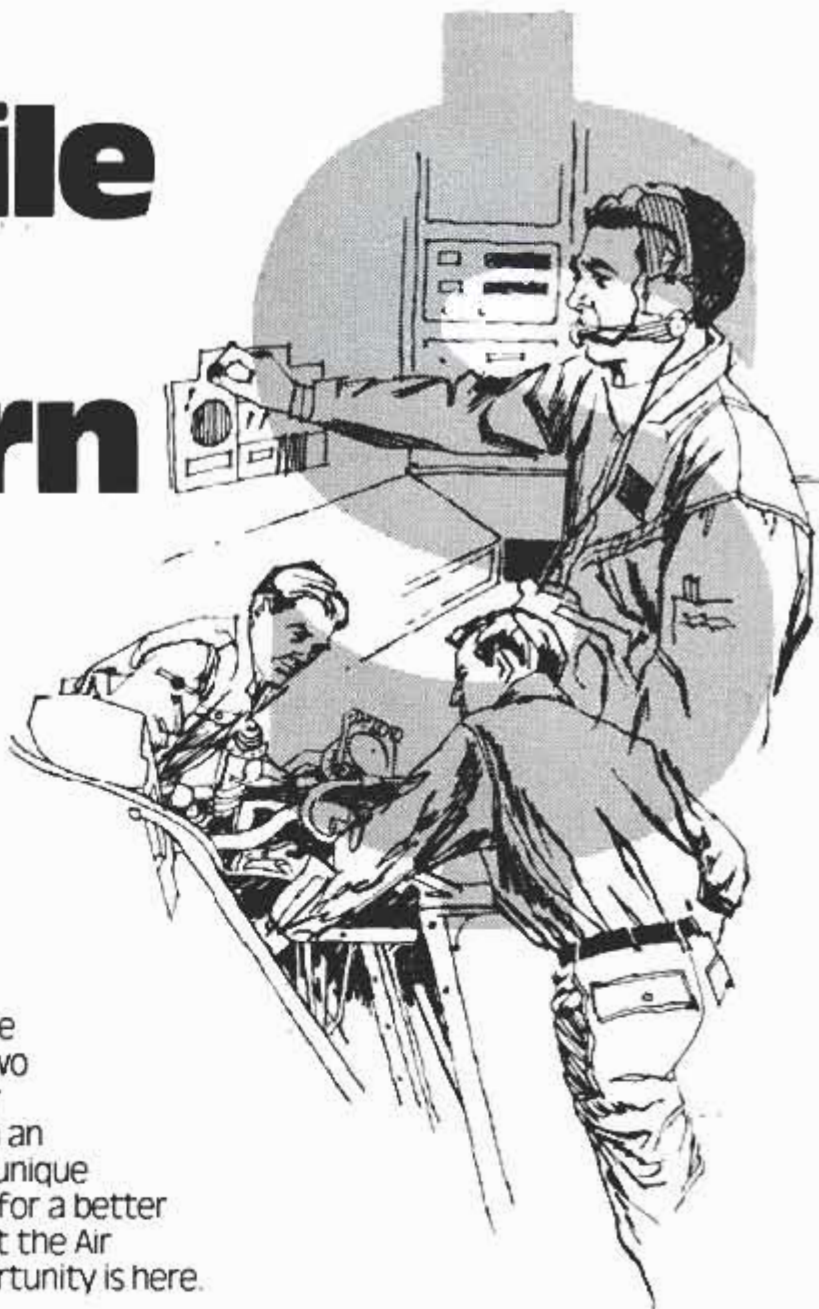
And waiting in the wings, as well as proving themselves afloat, are racing motors with more horses hidden inside than manufacturers have been willing to admit. Though 300 hp from Mercury is the largest stock production mill on the market, there are guesses that the *(Please turn to page 46)*

- 1** Refinements to add offshore dependability and smooth, slow-speed trolling are among Evinrude's changes.
- 2** All new in Chrysler outboard lineup is 90-hp, four-cylinder Charger, designed for bass and ski-boat use.
- 3** Power to speed pontoon and deck boats for water skiing is one goal of Johnson's new mid-range models.
- 4** Cruisers like Angler-22 with walk-around cabin can plane out with a Mercury 200. All Mercs are updated.
- 5** Noted as durable outboards, Mariners add higher performance in 17 power ranges from 2- to 200-hp models.

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Chrysler Sailor 180 outboard is rated in pounds of thrust and designed with optional long shaft, cockpit controls and vertical-pull starter for sailboat use.

NEW OUTBOARDS

(Continued from page 44)

Johnson and Evinrude V8 machines (PM Tests *The Biggest Outboard Ever*, page 68, July '82) and Mercury's new V6 with electronic fuel injection may be approaching 500 horses. Speeds that shave the official—and unofficial—world's records of 136.3 mph (137.9 in Europe) are rumored to have been reached already on closed-course racing straightaways.

The official record-book speeds have probably not been pushed up recently for two good reasons: Record runs are dangerous and accidents can give the sport and a manufacturer a bad name. And, to set a new record, it's worthwhile to push speeds up by a considerable jump so that the competition can't go out and top it a couple weeks later. Instead, the factory teams seem to prefer competition these days on a race course.

One of Mercury Marine's changes this coming year is to drop the power of its smallest motor from 3.6 to 3.5, but to improve convenience substantially by adding a gear shift. No longer is it necessary to start up in gear. Shift it from neutral to forward, and 360°

steering allows for reverse. Mercury will have its usual complete line of power options from 3.5 hp up to 300 in 15 different engines. Carburetor modifications for smoother trolling, corrosion-resistance improvements and added fuel filters are changes to smaller models. Power-boosting refinements have been added to the big Merc models.

Mariner outboards, starting at 2 hp, go up to 200 hp for '83 through 17 power categories. New for their mid-range, four-cylinder, 50-hp model is Mariner Power Trim to adjust the thrust angle to match throttle settings. The 50 comes with manual or electric start.

Chrysler has 18 hp ranges, with the newest a 90-hp, four-cylinder Chal-



The Merc 25, planing off a Fisher Marine SV-2, is equipped with a stainless exhaust to resist salt and brackish water.



Mariner, with its reputation for durable performance, is choice of these commercial fishermen for installation in the forward outboard well of a Hatteras-style skiff.

lenger designed specially for water ski and bass boat performance. Models for auxiliary sailboat use are rated as the Sailor 180, a 7.5-hp, manual-start motor geared down for 180 pounds of thrust, and a 9.9-hp Sailor 250. Long lower units, dual cavitation plates and large props on these models help prevent cavitation when backing up, and aid in controlling a big sailboat hull.

Evinrudes and Johnsons will have 19 standard models, in 2 to 235 hp, plus three more two-cylinder motors, called Worktwins by Evinrude and WorkHorses by Johnson. Coming in 25, 40 and 55 hp, these are for commercial use and have several improvements. One is an rpm limiter on the 25 and 55 that



Smaller outboards do more chores, and Evinrude's 9.9 can handle a variety of hulls where there are 10-hp limits.



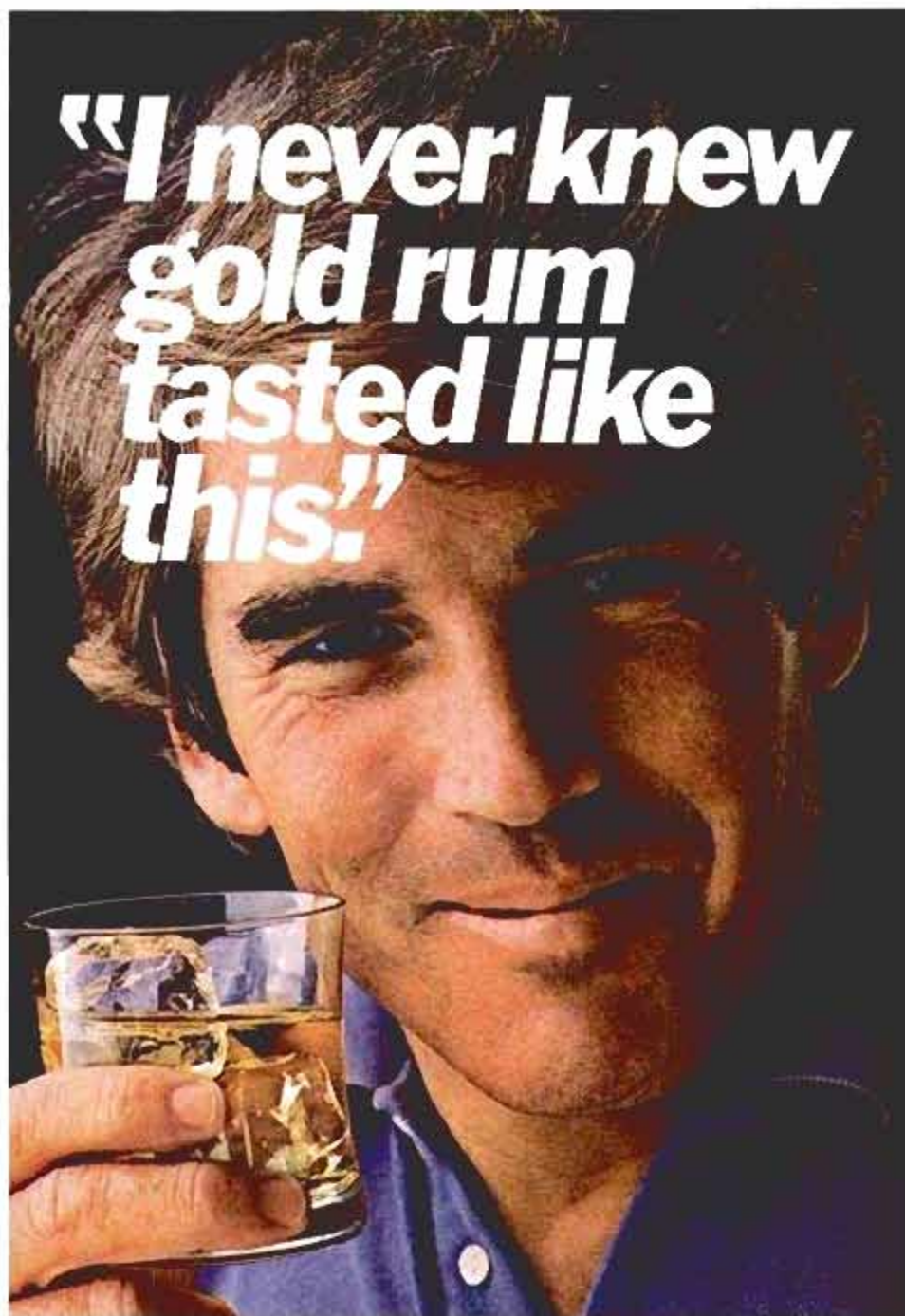
Mercury's new 3.5 now has neutral/forward gearshift, rather than starting in gear, and is quieter with inlet silencer.

will prevent engine overspeed due to lighter loads or worn propellers.

Johnson Sailmasters and Evinrude Yachtwins of 4 and 7.5 will be joined by an electric start 9.9-hp model with an extra-long, 25-inch lower unit and increased reverse thrust for sailboat maneuvering. A new 50-hp electric with tiller steering for back trolling in fishing boats is also available.

Suzuki will again have 14 hp choices, ranging from 2- to 140-hp models for 1983, with automatic oil injection on the big engines. Sears Gamefisher engines will number seven, from 1.2 to 15 hp.

Additional motors, mostly in the smaller power ranges, will be announced next spring. Meanwhile, you can think about getting your boat in shape for the spring. **PM**



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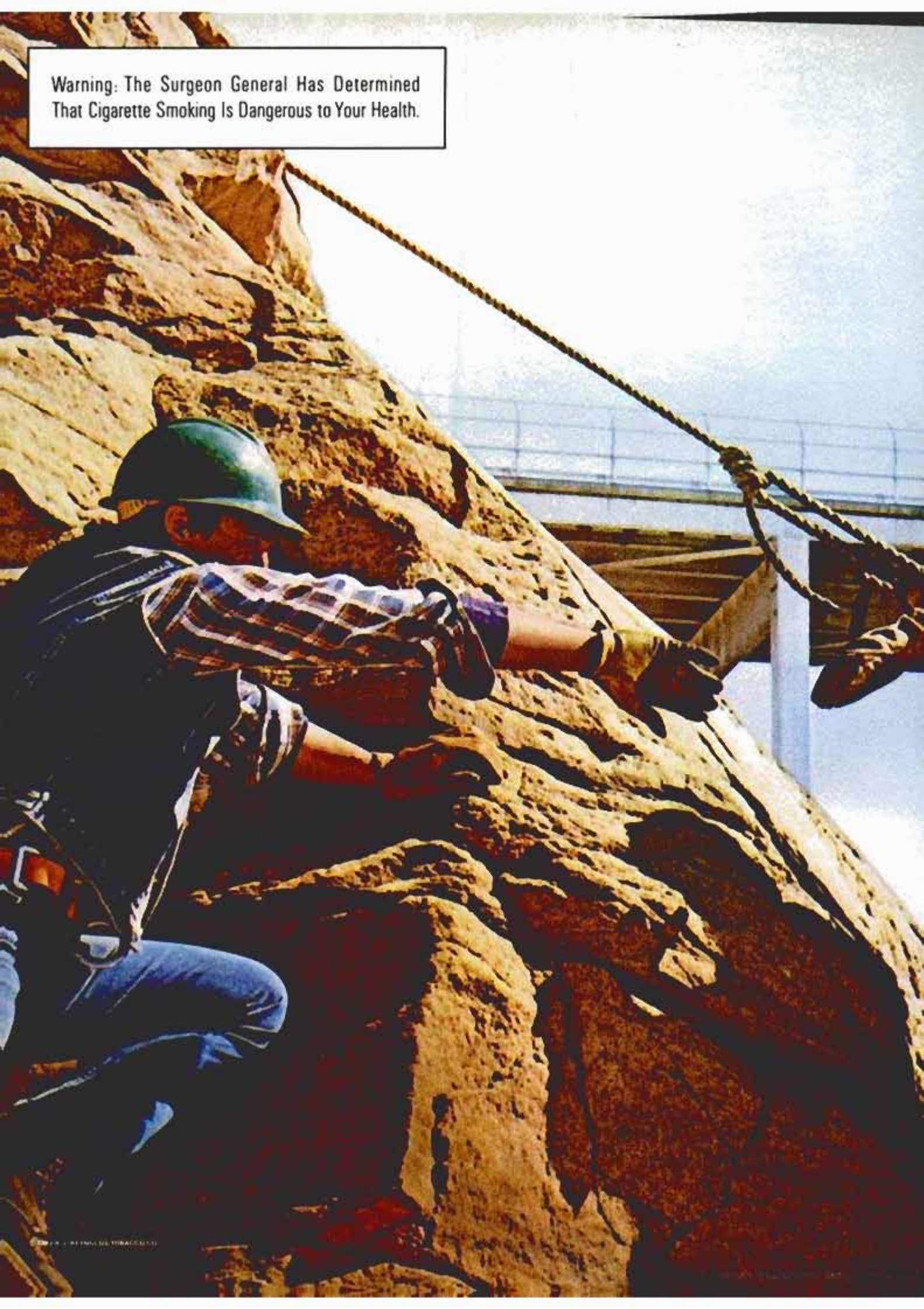
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APPLIANCE CLINIC



Refrigerator is a noisy dynamo

My new 1980 Admiral frostless refrigerator, Model NT2196, runs as noisily as a dynamo. The dealer claims this is normal for this model. Is there anything that I can do to have it run silently?

—Donald Wightman, Waltham, Mass.

New refrigerators use a high-speed compressor and two fans which run almost all the time, compared to the older types which used a slow-speed compressor and no fans, so noise level may be higher than what you're

used to. Other contributors may be tubing that vibrates, a drain pan that rattles, a cabinet which is not level or compressor mounting bolts that may be loose.

My advice would be to check all of these possibilities and if the refrigerator doesn't quiet down, have an Admiral authorized service agency in your area check it. If still dissatisfied, you may want to call Admiral. The toll-free number is 800-447-8371. Ask for customer service.

you help?—William H. McSheehy, Sudbury, Mass.

It sounds as if your problem may be hard to pinpoint. If I were a betting man, I would put my money on the hot-wire relay. From what you say, the control may be sticking due to temperature change and thus causing your problem. There is also the possibility of an erratic contact in the oven sensor.

To get a copy of the circuit diagram write: General Electric Co., Distribution Center, 35 Rix Mills Rd., New Concord, Ohio 43762. Be sure that you send the model and serial number of your electric range and ask for Tech Data Manual, publication No. 30-8400-A. I certainly hope that it helps!

Burned-out fan switch

I have a Montgomery Ward refrigerator model HMG-2272-25E. The fan switch No. 69307418 continuously burns out. This problem could be caused by either a defective switch being supplied by the switch manufacturer or a switch not rated properly to handle the start current of the fan motor. Can you suggest a better switch that I might purchase or an alternative solution to correct the problem?—Loren D. Carlson, Waipahu, Hawaii

I have checked with Montgomery Ward. The switch part number is correct for your model refrigerator, and the company's records indicate no previous problems with this switch. The switch supplier will be sending you a new tested replacement switch free of charge. When removing the old switch, check for water in the insulation. A remote possibility, which will cause premature switch failure, is water leakage into the switch during the defrost cycle. This might be due to a leaking drain, a cracked liner or a cracked breaker trim. **PM**

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

Dryer doldrums

I have a Kenmore electric dryer model No. 110-62101, serial No. F-14803362. Most of the time, when starting the dryer, all I get is a hum with no drum movement. If I move the drum by hand one-quarter turn, then start the dryer, I get normal tub movement. I can find nothing binding the drum. I've replaced the pulley and belt. Do you have any idea what's wrong with the dryer?—Thomas W. Schulte, Homestead, Fla.

The externally mounted centrifugal switch (black box on front of motor) is most likely sticking, or otherwise faulty, and preventing the motor from starting properly. You might try disconnecting the power to the dryer and blowing out the motor using an air compressor or a shop vacuum that blows air. Sometimes dust and lint get into the moving parts of the switch, causing the sticking (see drawing, right).

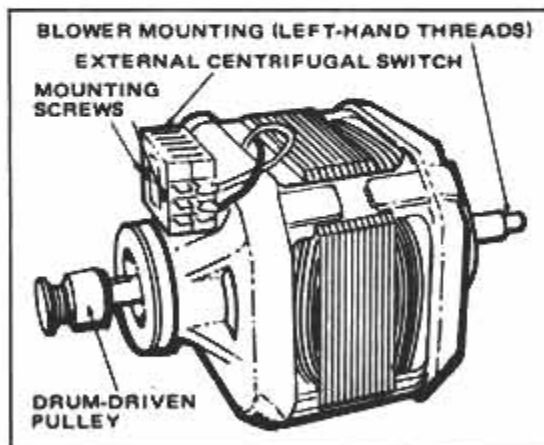
If the air doesn't work and you still have the humming noise, I suggest you replace the centrifugal switch. This is attached to the motor with two screws and a number of wires. Be careful to mark each wire as you remove it from the switch or you'll have trouble later.

You can order a new centrifugal switch from Sears. You will have to supply the company with the model number of the dryer along with all the numbers that are on the motor so you'll be sure to get the right switch.

Surprise performance

I own a Hotpoint electric range Model No. RB766-01. My problem is with an intermittent operation of the oven and broiler. Often, neither the oven nor broiler will go on when either is turned on; sometimes they will go off spontaneously after being on for a brief period.

Hotpoint has sent servicemen over twice only to have the unit operate perfectly when they arrive (100 to 1 odds so far). I already purchased a new functional switch for \$30 which didn't solve the problem. I noted that there was a printed circuit board with solid-state components mounted behind the oven rheostat, and I'd like to get a circuit diagram for the range. I am an electrical engineer, and would like to service the range myself. Can



The centrifugal switch of the dryer may be dusty and sticking, or otherwise faulty. Disconnect the power and blow air through the entire motor.

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WORKSHOP MINICOURSE

More about squares

Frequently in woodworking you must copy an angle accurately. A T-bevel square is the tool that lets you do it with a minimum of effort. One example that pops into my mind is a job on which we were installing exposed "rafters" on a cathedral ceiling. These were purely decorative "ceiling beams." Since they were supposed to simulate the rafters found in old barns, the joints at the ridge beam had to be neat and tight. To make sure they were, we held the T-bevel against the beam, obtained the angle, locked the tongue and transferred the mark. That's one example; making multiple-sided boxes in the shop is another. If you are a serious woodworker, you should have this square in your toolbox.

An important point about using a T-bevel square: No matter what type of square you buy—the one that locks using a thumbscrew or the one with a knurled nut—you'll find that the locked position is not a positive one. Thus, once you have the angle on the tool, hold it securely without disturbing the blade while you tighten the nut.

Even after the nut has been turned home, you'll find that the blade can be moved with a reasonably small amount of force. For that reason, *always* recheck the angle after you have secured it on the tool. And, check it again on the angle being copied, *after* you have transferred it to the new piece to be cut.

The steel square

You can lay out any angle on a board using a steel square simply by measuring the graduations on body and tongue as they cross parallel lines.

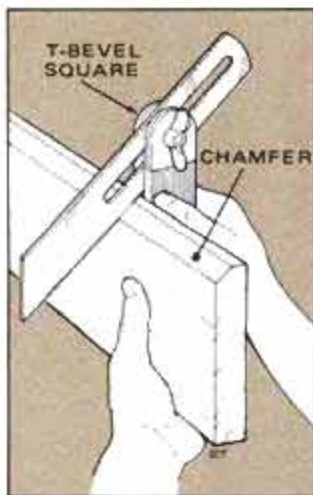
The angles in the chart are



1 Typical use for a bevel square—laying off a miter. You can make a perfect match with an existing angle, too.



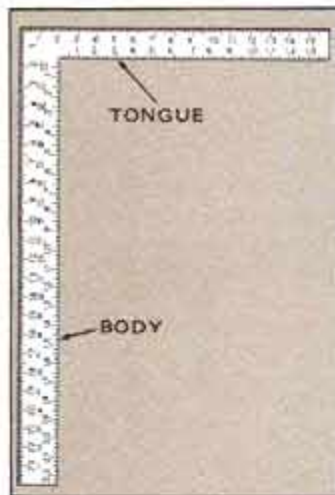
2 The T-bevel square is the tool to use when you have to check a beveled edge. Here stock fits tool angle tightly.



3 T-bevel's movable blade makes it easy to check chamfered edge, as here.



4 Use T-bevel to lay off duplicate lines at same angle, as when laying out sloped sides of dovetail joint.



5 Steel square is carpenter's calculator for laying off angles quickly (see chart).

those you'll use 90 percent of the time, so save the chart for future reference.

Most steel squares have graduations of measurements on both sides of the tool—one in sixteenths of an inch, the other in tenths, twelfths, sixteenths, and twentieths. To use the square, grasp the body in your left hand and the tongue in your right. The square's face is the side that is toward you when the blade is held in the left hand with the heel pointed away from you. When using the square, the tongue should be across the face of the work.

TYPICAL CARPENTRY ANGLES

Angle	Tongue	Body
30°	12"	20 ³ / ₄ "
45°	12"	12"
60°	12"	6 ³ / ₄ "
70°	12"	4 ³ / ₄ "
75°	12"	3 ¹ / ₂ "
80°	12"	2 ¹ / ₄ "

To create an angle using a steel square, you simply measure the graduations on the body and tongue as they cross parallel lines. When the graduation lines are equal, you form a 45° angle. Above are the typical angles used in carpentry and the tongue and body graduations to achieve them.



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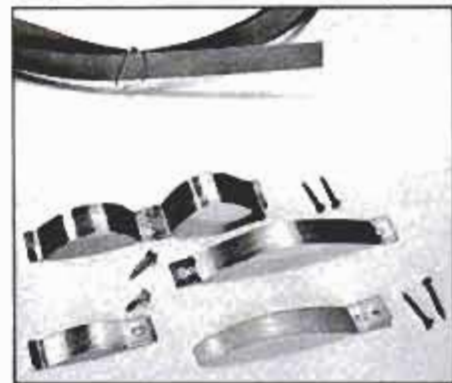


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HINTS FROM READERS

Clips from metal strapping



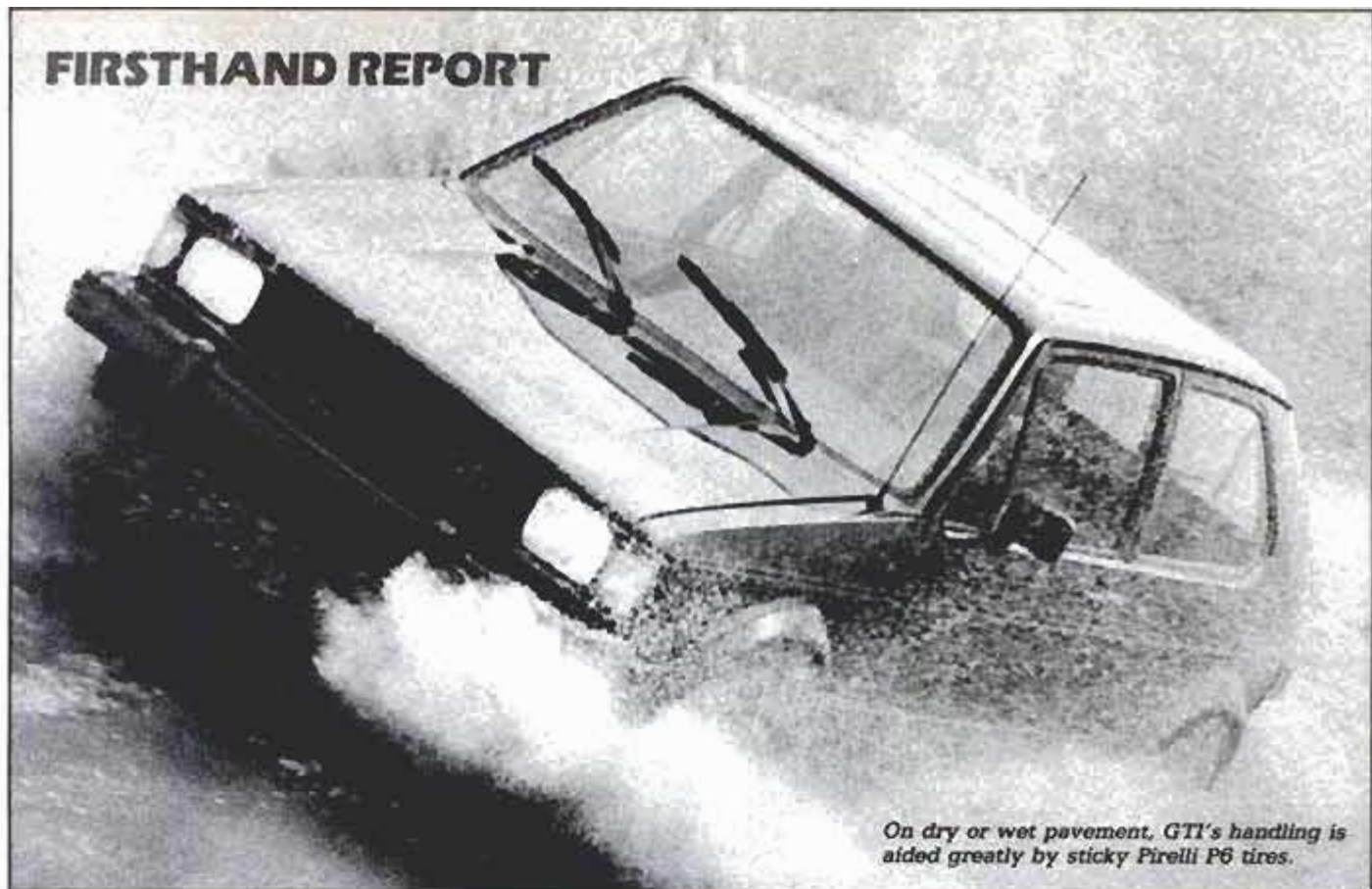
You can make spring clips (to hold paper on bulletin boards) or other flat-spring items from pieces of the metal strapping used to bind shipping crates. The material is generally springy enough for many purposes, yet it isn't too hard to cut or punch holes in. Make holes for mounting material by boring through the strip, or by punching it and filing off the burrs, if needed. —Walter E. Burton

Workbench trough



Every workbench user knows how annoying it is to search for small parts that have fallen to the floor. Installing a removable trough along the front of the bench, to catch parts that roll off, saves time and energy. The photo shows an open-end trough that was bent from galvanized sheet metal. It is supported by two roundhead screws extending through keyhole slots cut in the trough's back. This setup lets you lift the trough off the screws in seconds to clear the way for bench vises or other accessories. You can replace the trough instantly. —B.W. Ervin

FIRSTHAND REPORT



On dry or wet pavement, GTI's handling is aided greatly by sticky Pirelli P6 tires.

Driving The VW Rabbit GTI

A Wolfsburg bunny becomes a predator Rabbit.

BY MICHAEL LAMM
WEST COAST EDITOR

Over in Europe, Volkswagen has been marketing a high performance Golf GTI for about four years now. The GTI is so hot in sales, as well as performance, that buyers sometimes wait half a year for delivery. And when a Porsche driver sees a Golf GTI coming up in his rear-view mirror, he politely moves into the right lane. That's the respect this car has in Germany.

Noting the Golf GTI's runaway success overseas, the brass at Volkswagen of America decided the U.S. Rabbit, basically the same car as the Golf, needed a similar shot in the image. After all, VW's recent emphasis on fuel economy, diesels and E-Lights, has overshadowed the Pennsylvania-built Rabbit's reputation for zip. Not that Rabbits lack zip, but VW wants the public to know that the Rabbit will scoot. So, they've created an American GTI.

I recently drove a preproduction prototype. I must say, it's a very spunky, satisfying car in exactly the ways Volks-



wagen intends it to be. I like it better, in fact, than the Scirocco, which has been carrying VW's performance banner up to now. The GTI gets you out in front of the pack quickly thanks to its strong engine and the well-spaced gear ratios. Throttle response is immediate, and if



The 1.8-liter GTI motor pumps out 90 hp. Blackout exterior treatment is part of the standard GTI package. The interior gets well-bolstered sports seats.

you want to chirp the front tires in low and second, there's power to do it.

In acceleration, factory figures show 0 to 60 mph in 9.7 seconds (vs. 12.0 seconds for the tame Rabbit), with 40 to 60 mph in 6.0 seconds and the quarter-

(Please turn to page 56)

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DRIVING THE GTI

(Continued from page 55)

mile in 17.9 seconds. I felt a little torque steer to the right, but not nearly so much as in other, less powerful front-wheel-drive cars. Top speed is said to be 108 mph.

From the way VW's engineers talked, I expected fairly stiff suspension settings and a rough ride. It turns out, though, that the GTI is very gentle and



The roaring Rabbit's suspension is beefed up considerably by the use of stiffer shocks and springs, along with front and rear sway bars and Pirelli P6 tires.

easy riding, with no harshness. The GTI rolls little in hard turns and corners with great confidence and predictability. I didn't get a chance to drive this car on a race course, but on the street I never did get the car to exhibit any understeer. I'm sure, though, that at higher cornering speeds there must be some. Actually, the only fault I found with handling was a slight lag in on-center steering. Otherwise, the car is extremely precise and controlled.

According to VW, the fuel penalty with the 1.8-liter engine and the added horsepower is two to three miles per gallon, which means 27 mpg city and 37 mpg on the highway.

The GTI is built from the two-door Rabbit's body shell, but with a 1.8-liter version of the Rabbit's 1.7 ohc Four. The 90-hp GTI engine has an 81-mm bore instead of the Rabbit's 79.5 mm to get the extra displacement. The GTI's pistons are lighter, its valves larger, and its aluminum cylinder head redesigned for an 8.5 to 1 compression ratio. The GTI's exhaust system is totally different, giving 35 percent less back pressure and a very pleasant growl.

Other mechanical modifications include a five-speed gearbox borrowed from the European GTI, a slightly larger clutch disc and a considerably

beefed-up suspension system. Not that the Rabbit is any slouch when it comes to cornering, but the GTI suspension takes the stock Rabbit from a cornering coefficient of 0.73 g into the range of 0.81 g. This is done by a combination of revalved struts and shocks, stiffer rear coil springs, plus front and rear sway bars. The stock Rabbit uses no stabilizers at all. Also, the GTI borrows the Quantum's 6x14 wheels and mounts wide, sticky Pirelli P6s on them.

For stopping, the GTI uses 9.4-inch, vented, front disc rotors instead of the Rabbit's solid rotors.

Inside the GTI, you get very comfortable, well-designed sport seats, custom upholstery, a Scirocco-type steering wheel, full gauges, tach, passenger grab handle, map pockets and a hefty shift knob. The GTI comes in four colors—black, red, silver, and white—all with contrasting blackout trim, pin-striping and a urethane front air dam. The windshield fits flush, as do those of all 1983 Rabbits.

So how does the GTI stack up against the current VW Scirocco? In acceleration and handling, I think the GTI holds a slight edge—faster acceleration and quicker through the slalom. That says quite a lot, because the Scirocco handles awfully well—not so well, though, as when first introduced, because its suspension was softened a bit for '82.

In carrying capacity, the GTI has more room for rear passengers and luggage than the Scirocco. And finally, in terms of price, the GTI costs a few hundred dollars less than the Scirocco.

The bottom line then, when making a choice between the Scirocco and Rabbit GTI, is how much more you're willing to pay for the Scirocco's slick styling. We'll take the GTI. **PM**



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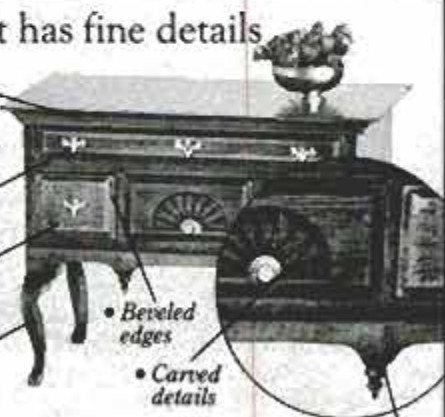
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It doesn't look like an air gun, but new Crosman 357 Magnum has the feel and heft of original, comes with four- or six-inch barrel, breaks for easy loading.

Some of the new replica guns try to be exact copies of the old originals. Others are copies of new originals. And some try to add something extra to the original design.

Latest example is a handsome Colt 357 Magnum Python that isn't from Colt and doesn't fire .357 caliber blockbusters. Instead, it's a .177-pellet air gun that uses a CO₂ Powerlet to push the pellets but has the look and the heft of the real thing. What's missing is the mule-like kick, the flashing muzzle blast and the deafening roar that a .357 can generate. Crosman Airguns, 980 Trunk Hill Rd., Fairport, N.Y. 14450 is the manufacturer.

The gun is just coming on the market and is available in 357-Four and 357-Six models with four- and six-inch barrels. The Four has a reported muzzle velocity of 340 to 390 feet per second. The Six goes from 380 up to 430 f.p.s. and rifled steel barrels give target groups of less than one inch at 25 feet. Weight is 27 or 32 ounces, a few ounces less than the gunpowder Pythons but enough for excellent practice. Trigger pull is 10.5 pounds for double action but 2.25 for single. The smooth Teflon-coated action felt less heavy than the early production model we tried out last summer.

Loading is particularly easy. The break-open design allows a six-pellet cylinder disc to be dropped right in.



Two of these Speed Loaders come with each gun and extras are available. Holster, case and Belt Paks for copperhead pellets are additional accessories.

Why an air pistol to resemble a full-sized revolver?

The weight and size make it ideal for practice, and the reduced velocity and noise allow a shooter to set up a basement target range safely. Cost of pellets is minimal. Yet, the look and feel of Crosman's 357 at \$45 compares favorably with \$500-plus for the original Colt. It's no wonder that adult air guns are starting to rival youngsters' BB guns in popularity.

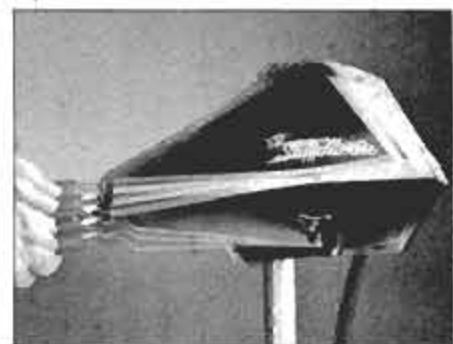
Old-timer replicas are also in the Crosman pistol line, if they're more to your liking.

An authentic-looking model of an 1861 cap-and-ball Shiloh revolver of the Civil War fires pellets or BBs. And Mark I and II have a classic Luger look.

For fishermen

How do you improve on a hook, line and sinker? At the latest American Fishing Tackle Manufacturers Assn. show, ingenuity kept showing up in new widgets to outwit fish. More reels using magnets to control revolving spool overspeed, backlash and bad language were introduced. Larger saltwater models are in the works. Du Pont is reported to have researched and developed a notable new Prime cofilament fishing line.

For the fisherman with his hands full, who tries to steer the trolling motor at the same time (and doesn't find a foot control very convenient),



Sigma Supra 280 from Shakespeare nods its head only when you push the Touch 'N Go to turn it on and off for trolling.

Shakespeare has introduced the Sigma Supra 280 electric that reacts to a nudge. Push the steering tiller lightly with a hand, elbow, knee, or foot if you cast and steer standing up like Toledo Bend ace Tommy Martin. Push the handle more firmly and the motor stays on until you click it off again with a quick lift. They call it the Touch 'N Go Speed Control.

Looking for action

Outdoorsmen who want to combine travel, adventure and a possible contribution to science should know about organizations like Earthwatch, 10 Juniper Rd., Box 127, Belmont, Mass. 02178. Name a remote corner of the world and it's likely they have mounted a research expedition there. Costs are shared so are kept moderate, and for someone who has the time and ambition, the expeditions can be a challenge.



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Cover of new 1983 MOTOR Manual differs from this cover.

THE PM GARAGE



Pliers speed up brake work



Disc brake dust-boot pliers spread dust boot for easy installation of brake piston. Pliers come in two sizes.

If you do your own brake work, you know how the dust boot gets in the way when you try to install the pistons back into the calipers,

The VIM Dust Boot Pliers makes this operation a snap.

All that I had to do was insert the tool through the dust boot into the disc brake cylinder opening and squeeze the handle. The special curved ends of the pliers spread the boot so I could easily install the piston.

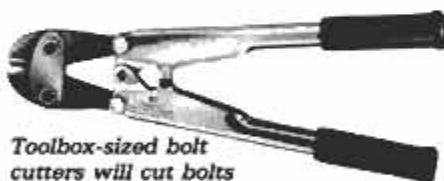
The pliers come in two sizes. Model B15 fits pistons 1½ to 2½" and Model B16 fits pistons 2½ to 3½".

You'll find the pliers at automotive jobbers for \$9.75 and \$9.95, respec-

tively.

The manufacturer is Durston Mfg. Co., Box 340, La Verne, Calif. 91750.—Cliff Gromer

jaws willingly attach objects up to ¼ inch (6 mm in diameter), and cut through bolts and rivets up to Brinell 300 and Rockwell C31 hardness. The



Toolbox-sized bolt cutters will cut bolts and rivets up to ¼ inch in diameter.

cutter, which weighs under two pounds, costs \$36 at hardware stores and is made by H. K. Porter Inc., Cambridge, Mass. 02142.

—Cliff Gromer

Wheel brush

The next time that you're cleaning your custom wheels and you happen to jam your fingers into the tight spots, don't get annoyed. Pick up Rally Mag's new Turbine Slot & Wire Wheel Brush, instead.



Wheel brush can clean tight areas on custom wheels and engine-cylinder fins.

This product uses nylon bristles over a flexible wire frame and a sturdy plastic handle that will stand up to long and rough use.

I found the brush to be particularly effective in cleaning between the fins

on my bike's cylinder head, as well as for getting into those inaccessible nooks and crannies around deep-dish mag wheels.

You can order the Turbine Slot & Wire Wheel Brush by sending \$4.95 plus 50¢ to cover shipping to Rally Mag Car Products, Dept. PM, Box 1274, Newport Beach, Calif. 92663.

We tried several other chores and the brush worked well in inaccessible corners of plastic grilles. Using it on chrome or bright plastic can cause minute scratches, however.

—Joel Breault

Jaws

A bolt cutter is a handy tool to have around: It supplies maximum power for a variety of cutting jobs. The problem is that most cutters are too large for your toolbox.

Porter's Model 2590C bolt cutter, however, does fit into your toolbox since it's only 14 inches long. I found this rugged, two-handed cutter ideal for chomping through soft and medium-hard materials such as wire, screws, nails and cotter pins. The

Spray wax

If you like taking the quick way out when it comes to doing things like waxing your car or motorcycle, then you'll go for Eagle 1 spray wax. All I had to do was shake the can and fire off a short burst. Then I spread the wax around, let it dry to a haze and wiped it off. It's much faster and easier than paste wax and it buffs easily. I found the large 14.5-ounce can of Eagle 1 in my local car care products section.

Each can should be sufficient for about five applications, depending on the size of your car. The cost is \$5. You can contact Eagle 1 at 1591 Sunland Lane, Costa Mesa, Calif. 92626.—Joel Breault



Spray wax applies faster than paste. One can holds enough wax for about five cars.

**CHEVY 5-10
BLOWS THEM
AWAY. AGAIN.**



WITH THE MOST LINEUP OF NEW-

Chevy S-10. Last year, it was the new-size truck that redefined the pickup—and became the hottest-selling new truck in Chevy history. And now for 1983, the great American success story just got greater with the exciting new-size S-10 Blazer, S-10 Maxi-Cab and the revolutionary new Insta-Trac 4X4 System.

CHEVY S-10 BLAZER 4X4.

The biggest news in 4-wheel drive since 4-wheel drive. Another Chevy first! Nobody else has a vehicle like this revolutionary, new-size

off-roader.* And nobody else has anything like its new Insta-Trac* 4-wheel-drive system with a newly patented central disconnect that lets you shift from freewheeling 2-wheel drive to 4-wheel-drive high and back while driving at any speed.

Massive 15-inch wheels are standard. Ground clearance with optional off-road tires is 9.1 inches in front and 7.9 inches in the rear. That's more than Ford's standard-equipped big-size Bronco. With optional rear seat folded down, it also has more load length than any full-size sport utility vehicle. A two-wheel-drive Chevy S-10 Blazer is also available.

CHEVY S-10 MAXI-CAB.

First ever in a new-size pickup.*

A 14.6-inch cab extension on an extra-long, 123-inch wheelbase gives you up to 40% more in-cab load space than Datsun's extended cab. That's a whopping 18.4 cu. ft. of storage space. The Maxi-Cab offers even more leg room than many full-size pickups. And available folding jump seats with front bucket seats let you carry two more adults.

CHEVY S-10 PICKUP.

Hottest-selling new-size truck in America. S-10 offers optional V6 power Ford Ranger and the import pickups don't. With heavy-duty payload option and V6, S-10



CHEVY S-10 4X4 PICKUP



CHEVY S-10 MAXI-CAB

TOUGH CHEVY TRUCKS ARE

ADVANCED SIZE TRUCKS EVER*

has a payload rating of 1625 lbs., including people and cargo. That's bigger than some full-size pickups. And now for '83, an S-10 with V6 power and optional heavy-duty trailering package can haul up to 5000 lbs., including trailer and cargo... more than twice as much as the import pickups.

REVOLUTIONARY INSTA-TRAC 4X4 SYSTEM.

Available in all '83 Chevy S-10 models. Get freewheeling fuel efficiency in 2-wheel drive or ground-grabbing traction in 4-wheel drive

without leaving the driver's seat. For the first time, you can shift from free-



Lighted action-display console shows the gear you're in, wheeling 2-wheel drive to 4-wheel-drive high and back while driving at any speed. There are no hubs to lock. The all-new patented central disconnect handles the locking and unlocking on the front axle where it's protected from the elements.

10 MODELS. ALL WITH AVAILABLE V6 POWER.

With S-10 Pickups, Maxi-Cabs and Blazers—2- and 4-wheel drive, 4-cyl. and available V6 power—you can get the new-size truck that's right for you. Chevy S-10 blows them away. Again. With the most advanced lineup of new-size trucks ever.*

*Excludes other GM products.

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



CHEVY S-10 BLAZER

TAKING CHARGE



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NTS HOME TRAINING INVITES YOU TO EXPLORE MICROCOMPUTERS, DIGITAL SYSTEMS AND MORE WITH STATE-OF-THE-ART EQUIPMENT YOU ASSEMBLE AND KEEP!

When it comes to electronics home study, no school matches the training you get from NTS.

For example, three microcomputer/microprocessor courses are available to the Electronics Beginner—Tech Writer—Analog Technician & Engineer. For your "hands-on" training, each course includes its associated microcomputer for you to assemble and keep. You will not only become acquainted with the fundamentals of troubleshooting, but also learn to communicate with a computer using



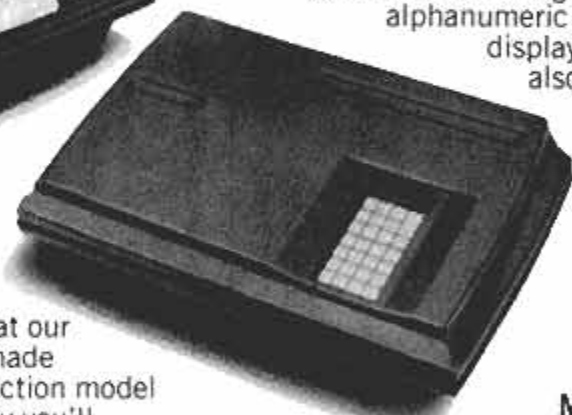
high-level BASIC programming language and Disc Operating Systems (DOS) software.

It's also important to note that our microcomputers are not home-made training devices. They are production model micro-systems, identical to many you'll encounter in the field. We believe this makes your training a lot more exciting and relevant.



NTS's Master Course in Microcomputers includes the **NTS/HEATH HN89A Microcomputer (#1 above)**. It features floppy disc storage, "smart" video terminal, two Z80 microprocessors, 32K RAM memory expandable to 64K. Choice of HDOS or CPM operating system.

The **NTS/Rockwell AIM 65 Dedicated Microcomputer (#2)** is included in our Microcomputer Technology Course. It is a single board unit featuring an on-board 20 column alphanumeric printer with 20-character display. This 6502-based unit also has 4K RAM memory, (expandable,) 8K monitor ROM and 8K advanced BASIC interpreter on ROM. Application Functions: Central Processor—Controller/Monitor—Development System.



The **NTS/SYM-1 Microcomputer (#3)** is a 6502-based CPU-4K bytes ROM (expandable)—1K RAM (expandable) 51 active I/O lines for versatile interfacing disk drives, ASC II keyboards, cassette tape, etc. It is featured in the Master Course in Electronics and Industrial Technology.

CONSUMER ELECTRONICS—VIDEO SYSTEMS

From the latest state-of-the-art Video Systems Technology, NTS offers its popular Color TV Servicing program. You build and keep the NTS/HEATH 25-inch (diagonal) Digital Color TV receiver as part of your "hands-on" training. Choose Communications and you'll train on an NTS/HEATH 2-meter FM Transceiver which you also build and keep. Most programs also include state-of-the-art test equipment as well as a digital multimeter.



Simulated TV Reception



AUTO MECHANICS Few technical fields offer the challenges and opportunities to equal that of the auto industry. To train for it with NTS you'll utilize "shop tested" instruction plus an impressive array of professional equipment, including a solid-state automotive oscilloscope. You'll learn engine diagnosis, motor overhaul, transmissions, and much, much more.



AIR CONDITIONING/HEATING. Equip yourself for opportunities in one of the most essential industries in the world. Learn servicing of commercial, industrial, and residential heating and cooling equipment. Your course includes such equipment as a hermetic unit analyzer, leak detector, and charging-testing-purging manifold set.



HOME APPLIANCES Here's an excellent full, or part-time opportunity with real potential. Saves you money on your own repairs, too! Course covers repair and servicing of washers, dryers, ranges and small appliances. Your equipment includes NTS's amazing circuit trainer, plus a multimeter for testing purposes.

For 77 years NTS has provided quality home training for thousands of students around the world. We look forward to helping you develop important new skills the proven NTS way. Take advantage of this opportunity now. Send the card or coupon today for a free color catalog in the field of your choice. We'll send complete details by return mail.

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THE PM WORKBENCH

Books for do-it-yourselfers

It seems that more how-to books than ever are being written these days and, judging by the review copies coming across my desk, many of them aren't worth buying. For example, I recently received an "all about home building" book that did not have an entry for building permits in its index. Such books are aimed at

the circular file. On the other hand, here is a pair that you might want to buy:

Splitting Firewood by David Tresemer; publisher: By Hand and Foot Ltd., Green River Rd., Box 611, Brattleboro, Vt. 05301. My guess is that Tresemer has split a log or two in his day. This book is packed with wood splitting and burning information. It costs \$6.95.

American Shelter. An Encyclopedia Of The American Home, by Lester Walker, published by Overlook Press, 625 Madison Ave., New York, NY 10022. PM readers will recognize the author's name because, over the years, we have called upon architect Les Walker to design a great many projects. His latest book focuses on every major American architectural style. Excellent for anyone interested in home architecture, it is filled with more than 100 of Les's drawings. It's \$27.95—H.W.

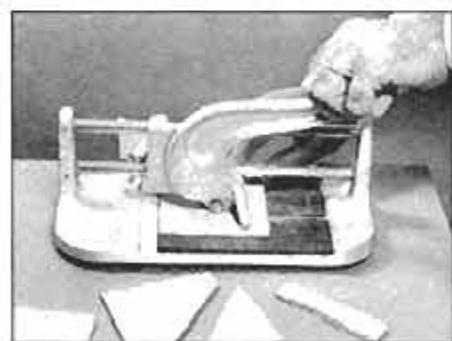


These two books are extremely readable and chock-full of illustrations and reliable information.

Snappy tile cutter

This ceramic tile cutter will enable you to cut tiles precisely with a minimum of breakage and waste.

To score a tile, which is cushioned on rubber pads, you push forward on the comfortable handle. At the end of the pass, you press down on the handle—a breaking shoe snaps the tile.



Stinn-Co's tile cutter coddles your tiles with rubber cushions to minimize any breakage. Some gentle pressure on the handle snaps the tile once it has been scored.

The tool is available with a standard or carbide scoring wheel. Scoring wheels are turret-mounted and the capacity is 6 in. The tile cutter is priced at \$49 plus \$5 shipping and handling. Additional wheels are \$2.95 each; a carbide wheel costs \$9.95.

For orders and more information write: Stinn-Co Tool Co., 1507 Peterson Place, Longmont, Colo. 80501.—Rosario Capotosta



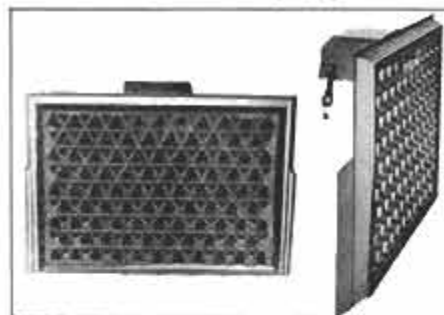
Precise crosscut guide



Mount Portalign's guide to your portable saw by drilling two holes in latter's shoe.

This crosscut saw guide mounts directly to the saw base for precise control of square, angle and bevel cuts. It has a sliding, bearing-guided track that can be adjusted up to 45° and has a reach capacity of 18-1/2 in. About \$30, it's from Portalign Tool Corp., Box A-80547, San Diego, Calif. 92138—Rosario Capotosta

Window solar collector



Just slip the Economizer into a window and secure the sash with corner braces.

Looking for an inexpensive way to add heat to my studio-work area, I installed the unit shown, dubbed Economizer, in a bathroom window. The collector panel is 3 x 4 ft. and uses a patented array of 99 tetrahedral honeycombs to increase surface area. About \$400, it's eligible for Federal Energy Tax Credit. From Solar Micro Inc., 110 East Industry Ct., Deer Park, N.Y. 11729.—H.W.

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



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Start your own money

BEAT INFLATION!

Cash in on the huge demand for small engine repair.

Work part time, full time right at home - we help you every step of the way.

making business!



In just a short time, you can be ready to join one of the fastest growing industries in America...an industry where qualified men are making from \$10.00 to \$15.00 per hour...and that's just for labor. Parts, engines and accessories add even more to the profits.



Because the small engine industry has grown so quickly, an acute shortage of qualified Small Engine Professionals exists throughout the country. In fact, it's not unusual for a good small engine man to be three to four weeks behind in the summer and at least a week behind in the winter. When you see how many small engines are in use today, it's easy to understand why qualified men command such high prices—as much as \$17.50 for a simple tune-up that takes less than an hour!

65-million small engines are in service today!

That's right — there are over sixty-five million 2-cycle and 4-cycle small engines in service across the U.S.A. That's the official count from the Engine Service Assn., and new engines are being built at a rate of one-million per month! With fully accredited and approved Foley-Belsaw training, you can soon have the skill and knowledge to make top money servicing these engines. Home-owners and businessmen will seek you out and pay you well to service and repair their lawnmowers, tillers, edgers, power rakes, garden tractors, chain saws, mini-bikes, go-carts, snowmobiles, generators, snowblowers, paint sprayers... the list is almost endless.



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You don't need to be a 'born mechanic' or have prior experience. If you can read, you can master this profitable trade right at home, in your sparetime, without missing a single paycheck. Lessons are fully illustrated—so clear you can't go wrong.

You receive trade secrets and business plans.

We guide you every step of the way, including tested and proven instructions on how to get business, what to charge, how to get free advertising, where to get supplies wholesale...all the "tricks of the trade"... all the inside facts you need to assure success right from the start.

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"I've had about 8 years experience repairing small engines... but repairs were only minor... until I started the Foley-Belsaw Course."



Walter H. Strick Campbell, California

With our famous 'learn-by-doing' training method, you get practical 'hands-on' experience with specialized tools and equipment that you'll receive with your training plus a brand-new 4 HP engine—all yours to keep!

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YES, please send me the FREE booklet that gives full details about starting my own business in Small Engine Repair. I understand there is no obligation and that no salesman will call.

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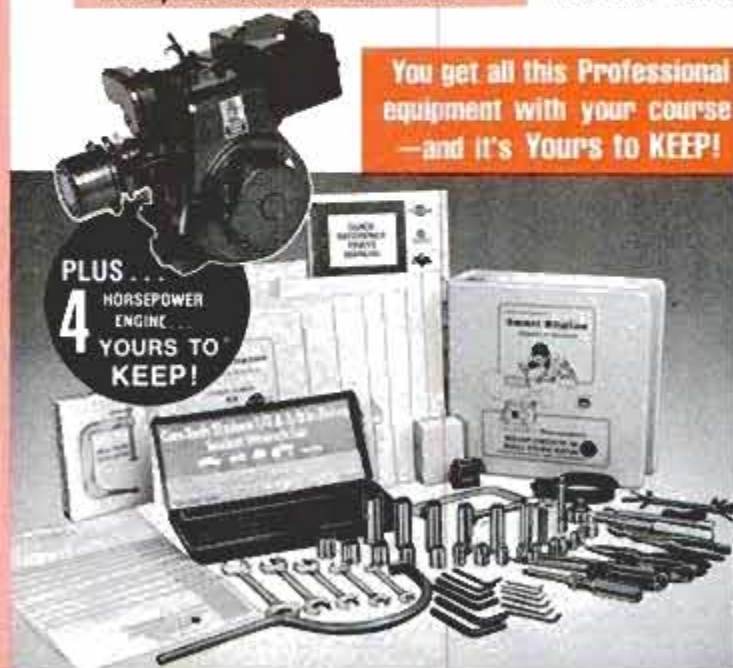
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PLUS... 4 HORSEPOWER ENGINE YOURS TO KEEP!

A Master Sawyer's Tips For Safe Chain Sawing



Dave Geer—a champion lumberjack—demonstrates safe techniques for limbing a tree. He's careful to cut in a spot that won't cause a sudden shift in the log's position.



Oil and gas are blended to make chain-saw (two-cycle) mixture. Fuel should always be mixed in a separate safety container at least 10 feet from the spot where the saw will be used.



When you start a chain saw, hold down its back end with your foot or knee so that the chain and bar will be elevated clear of the ground. You should never lean over the bar past the chain line.



Always grip a chain saw with both hands—the throttle control with your right and the handlebar with your left. Stand to one side of bar to avoid chance of injury in the event of a kickback.



As the chain saw becomes a key power tool in energy-conscious households, chain-saw safety is a matter of prime concern. PM asked Dave Geer—a professional logger and lumberjack competition champion—for some tips on handling a chain saw safely. Just as he did in giving us tips on maintenance (*11 Chain-Saw Maintenance Tips From A Master Sawyer*, page 108, Oct. '81), Dave got right to the point:

Fueling

Chain-saw fuel is a mixture of oil and gasoline. Check your owner's manual for the correct ratio. Always mix fuel in a safety-type container, never in the tool's fuel tank. Be sure to label fuel clearly and store it safely.

Fill the chain saw's tank at least 10 feet from the spot where you'll be cutting. Wipe off all fuel spills on your saw, garage floor or pavement; store wipe-up rags safely.

Allow a chain saw to cool before you fill its tank. Turn off the engine and wait about 15 minutes.

Starting

Inspect the tool to see that teeth are sharp and in good condition. Be sure that chain tension is correct; slack can cause kickback. Before starting a chain saw, latch the throttle safety. When starting it, wear nonslip gloves for maximum grip and protection. Hold the saw firmly on a clear, level surface with chain and bar in the clear. Position yourself on the motor side. When starting a smaller chain saw, hold down the rear with your knee as you pull on the starter cord; to start a larger model, use your foot as shown. *Never straddle the saw chain.*

Stance and grip

Always keep your weight balanced on both feet when cutting. Stand to one side, never directly behind the tool where it could kick back and hit you.

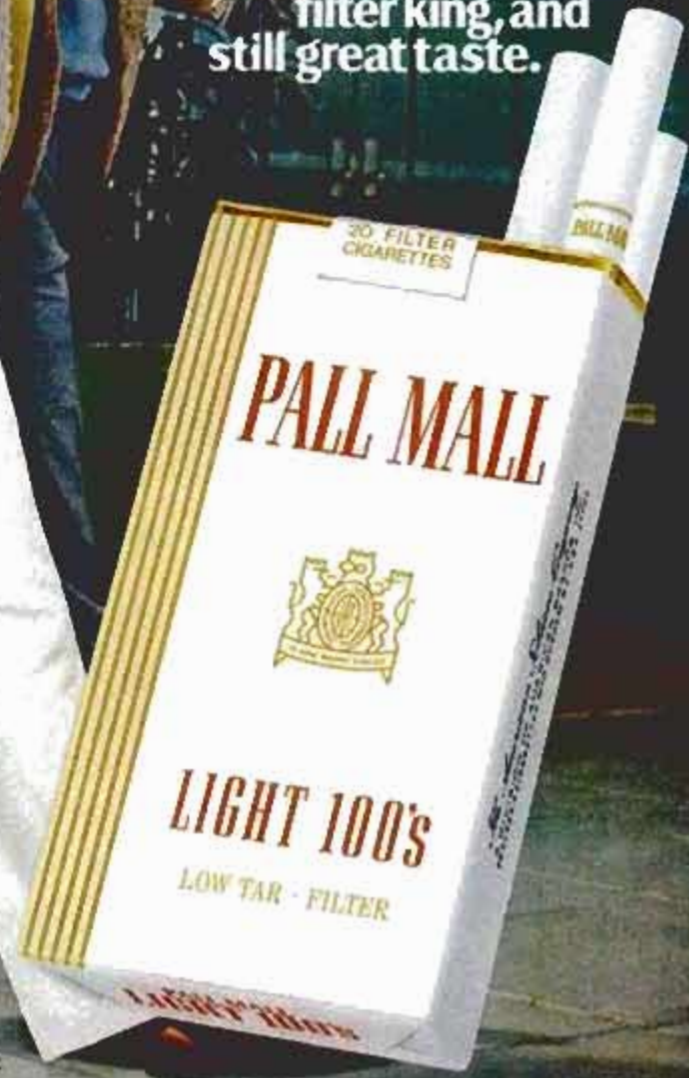
When you cut using the bottom of the chain-saw bar, the rotation of the chain will tend to pull you and the saw toward the work. When cutting with the top of the bar, you will be pushed away. Be prepared to counteract the

(Please turn to page 73)

Never cut all the way through the trunk when you make a back or felling cut. As the tree begins to lean, this operator will set the saw down in the clear and retreat following a preplanned path.

Did you say $\frac{1}{3}$ less tar?

Pall Mall Light 100's.
A third less tar
than the leading
filter king, and
still great taste.



Pall Mall	
Light 100's	9mg. tar 0.8mg. nic
Leading filter king	15mg. tar 11mg. nic
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less than	0.001mg. tar 0.0002mg. nic

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

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



When you want more than just a kerosene heater.

Comfort Glow. The kerosene heater with something more. Push-button starting. Lift-out fuel tank. A built-in fan that circulates heat better. And self-cleaning.

porous ceramic wick that lasts and lasts. If you want more than just a kerosene heater, there's a glowing alternative.

Comfort Glow
A great idea made even better.

UL listed Model GRF9B
© 1982 AMCA III / ATOMASTER, Bowling Green, KY

PM PHOTO HINTS

Bottle cap gasket



Cardboard-lined caps aren't watertight. But if you cut a gasket from a plastic coffee can cover and slip it into the lid, you'll get a tight seal.

—A. Weber

Big blowups



If your enlarger's lens can't make large blowups from small negatives, try this. Shorten the lens's focal length by slipping a portrait attachment over it. Try various powers until you find the one you need.

—Louis Hochman

Better battery life



Nickel-cadmium batteries last longer if you mark them as pairs, and rotate the pairs regularly between the flash gun and the charger. This increases their life.

—Robert Hertzberg

ExSil™ The Extra Distance Lubricant.

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WE BRING GOOD THINGS TO LIFE.
GENERAL ELECTRIC

CHAIN-SAWING TIPS

(Continued from page 70)

momentum of these forces. When you finish a cut, inertia will cause the saw to move more rapidly.

Always grip the tool with both hands when cutting. Even if you're left-handed, grip the throttle-control handle with your right hand and the handlebar with your left. The grip you maintain on the handlebar prevents the saw from kicking back toward you. Wrap your fingers over and around the handlebar and keep your thumb tucked under. Cradle it against your hand, tight in the crotch between your thumb and your index finger.

Felling

When felling a tree, consider factors such as wind, natural lean and balance of the tree, and location of large limbs. Check beforehand for power lines and other obstructions, and determine whether the trunk is sound; a rotted trunk can be unpredictable. Watch for dead limbs overhead. Survey the area and plan two safe paths of retreat.

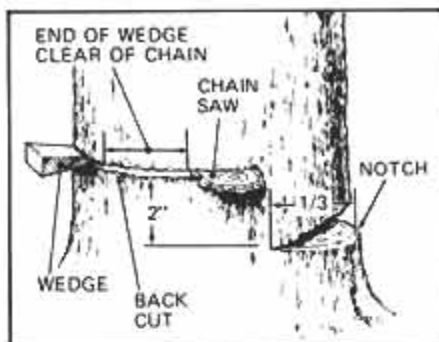
Let the chain reach full speed before starting the cut. First, cut a notch in the direction of the desired line of fall, about one-third the depth of the tree's diameter. Then, make a *back cut* about 2 in. higher than the notch. Leave an uncut *hinge* of wood to guide the tree over. *Never* cut all the way through the tree trunk.

To ensure that the tree falls in the right direction, insert a wooden or plastic (never metal) wedge in the back cut. The wedge may be driven in little by little as the cut progresses but its tip should never come in contact with the saw chain.

When the tree begins to lean toward the notch, set the saw down on clear ground. If you must retreat quickly while cutting, leave the saw and save yourself. *Never run with a chain saw.*



Wear trim-fitting, protective clothing that won't catch on underbrush. Your eyes should be guarded against flying chips by goggles and your ears shielded from noise by plugs. Always wear a hard hat when felling large trees.



Here's right way to wedge felling cuts.

Limbing and bucking

When limbing, snuggle the saw bumper against the wood. You may cut through small limbs using either the bottom or top of the bar. Never use the nose; it will cause kickback.

Cut limbs on the side of the trunk away from where you're standing to keep them from falling on you. If a branch is trapped under the trunk, cut partway through the underside of the limb and then finish the cut from the top. Watch out for *spring poles* or other dangerous conditions that may cause sudden shifts when stress is relieved by cutting.

Bucking is the term loggers use to describe cutting the trunk into sections. If bucking on a slope, always stand uphill from the work to prevent logs from rolling toward you if they should shift. Make sure the trunk beneath the cut is supported, so the sides won't pinch in, cause binding and kickback. Use the saw bumper as a pivot point when cutting large logs. Keep the moving chain clear of the ground.

Proper dress

Wear trim-fitting garments that won't catch in the chain or be drawn into air intakes. Cuffless pants should be worn to avoid catching on underbrush. Shoes should be sturdy with nonslip soles while nonslip gloves improve your grip and protect your hands. Ear and eye protection should always be worn as should a hard hat when you fell large trees.

To operate your chain saw like a pro does—safely—observe Dave Geer's safety fundamentals:

- Keep saw chains in good working condition (properly lubricated).
- Mix fuel in separate safety containers and wipe up spills.
- Keep chain and bar in the clear when starting.
- Never stand directly behind a working chain saw.
- Grip the tool with both hands and maintain balance on both feet.
- Wear protective equipment.
- Plan for the unexpected.
- Consider buying a tool with built-in safety features such as automatic chain-brake and safety tip. **PM**

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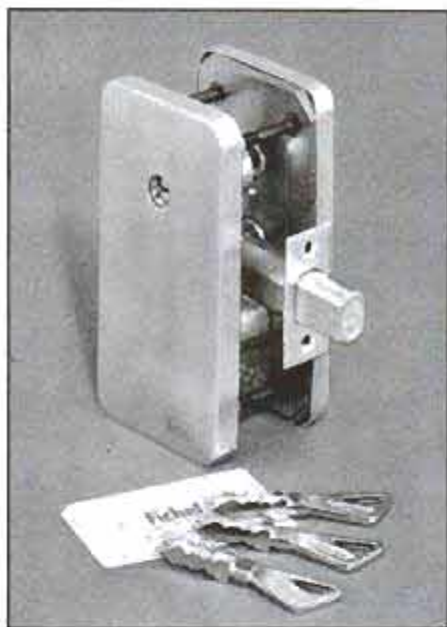
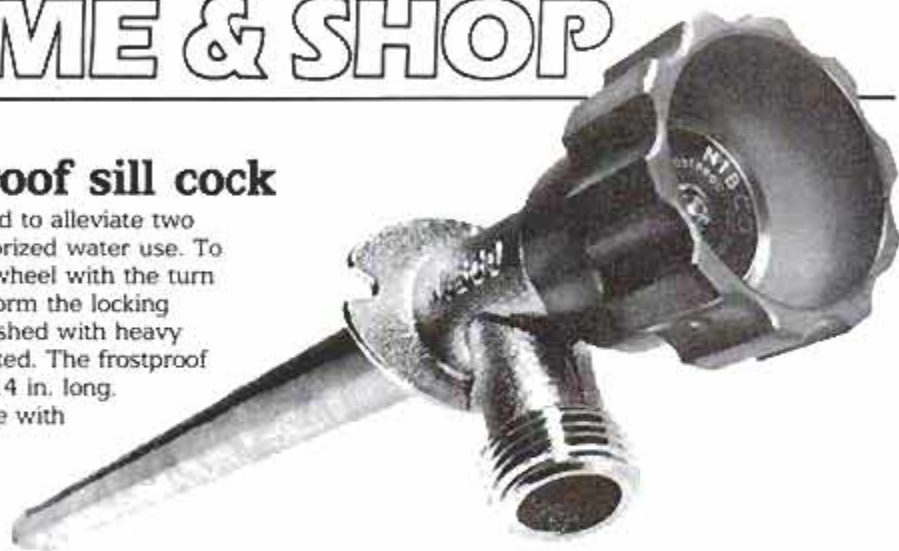
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NEW NOW FOR HOME & SHOP

Easy-locking frostproof sill cock

Nibco's new frostproof sill cock is designed to alleviate two big worries: winter freeze-up and unauthorized water use. To prevent vandalism, just remove the handwheel with the turn of a screw; the brass stem and body perform the locking function. The body is a reddish brass, finished with heavy nickel plating. Packing is Teflon-impregnated. The frostproof sill cocks are available in sizes from 4 to 14 in. long. Universal connections are available for use with 1/2-in. and 3/4-in.-diameter piping. Prices range from \$13 to \$15.50, depending on size. They're from Nibco Inc., Box 1167, Elkhart, Ind. 46515.



Bolt system boasts a pick-proof cylinder

The Secur-Bolt System from Fichet may succeed in providing needed security where most conventional tubular dead bolts fail. The new design protects the lock's cylinder with guard plates which are mounted on both sides of the door. This serves to prevent access to the lock through its collar. The bolt extends a full inch into the door jamb and is safeguarded against hacksaws with a case-hardened pin. The four-sided keys are individually computer-coded to prevent any unauthorized duplication.

Retailing for \$135 to \$150, the Secur-Bolt is available in polished or satin brass, bronze and satin chrome finishes. It can fit doors from 1 1/4 in. to 1 3/4 in. thick. It's from Fichet Inc., Box 92, Halesite, N.Y. 11743.



Meter measures well water

An electronic water level meter from Associated Specialties can help you monitor your supply of well water and maintain records of seasonal changes and recovery rates. The device uses a cable with water-sensing probes mounted vertically in the well. A second cable connects to a meter that gives readings of the number of feet of water in contact with the probes. The unit works on 110 v.a.c., and the standard instrument measures levels from 0 to 100 feet. Other ranges are available. It's \$250, from Associated Specialties, 1751 Main St., Orefield, Pa. 18069.

New incandescents save watts

General Electric has a new line of energy-efficient light bulbs that the maker claims will save 5 to 8 percent in operating costs. Dubbed Miser, the line features 95, 70, and 55-watt incandescent bulbs that offer the same light quality as 100, 75, and 60-watters, respectively. What makes the Miser incandescents more efficient than standard bulbs is a higher volume of purer argon gas at higher pressure, smoother filaments, and thinner filament-support wires. Three-way bulbs, 65- and 120-watt spots



and floods are also offered, as are Circlight fluorescents and fluorescent tubes. While there is no change in the design of the fluorescent lamps, G.E. is repackaging them with Miser labels, because fluorescents are more efficient than standard incandescents. Misers will be 15 to 20 percent more expensive than standard bulbs. They're from G.E., Nela Park, Cleveland, Ohio 44112.

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NEW NOW OUTDOORS

Camp stove system with everything

Campfires were fine when firewood was abundant and the scars of a camp would be trampled out by herds of buffalo. However, open fires really are inefficient and they're certainly hard to keep going in wind and rain.

Consequently, Pyromid Environmental Systems, Box 3138, Saratoga, Calif. 95070, is producing an all-purpose, fold-out model that's claimed to provide for a multitude of camping needs.

It is, the makers report, an all-weather campfire, stove, heater, rotary grill, broiler, barbecue, baking oven, smoker, dehydrator, steamer, hot-water wash basin and emergency reflector. In addition, the stove, side

serving tables, pots and pans drawer, grills, firebox enclosure and chimney all fold neatly into a compact carrying case.

A smaller unit called a Pyropacker stores in a 12x12x4-inch package and costs \$198. The larger Pyro-camper packs down to 18x18x4 inches, is 51 inches high when set up and holds four gallons of water below the fire for heating. This bigger unit, as set up at right, costs \$298. Both stoves are made of stainless-steel components.

Either model can be stowed in a car trunk, under the seat of a camper or aboard a boat, ready for camp-ground or beach cooking that won't bother the ecology.



Injection-molded wader

The traditional fishing and hunting waders that were famous for their bulky weight, clumsiness and, eventually, leaks, may be outmoded by



new models from Red Ball, Box 3200, Manchester, N.H. 03105. High-pressure molding of the Master Waders (about \$80 with insulation) are light, flexible and said to be virtually impervious to leaks except by puncture.

Knife innovations



Knifemakers keep improving on basic designs. Three recent examples from Gerber Legendary Blades, Box 23088, Portland, Ore. 97223, include the Presentation hunting knife, Cushiongrip model and Bolt Action folder shown above. The Presentation knife, \$53.70 with scabbard, is finished for display as well as use. The \$43.50 Cushiongrip (with scabbard) uses a softer, rubber-like material to add comfort and prevent any slipping of the hand. Gerber's variation on the lockback is a sliding lock. The Ebony Bolt action, with nylon scabbard, is \$17.70.

Resisting Recoil

Any high-powered gun is going to kick. PAST Recoil Shields, however, have reduced the impact up to 85 percent in measured tests. The pads, in magnum rifle or trap/skeet thicknesses, are made by PAST Corp., 210 Park Ave., Columbia, Mo. 65201. They are said to spread the impact rather than causing a sharp bounce. The shields are available for approximately \$30.

(Please turn to page 78)



Water's for floatin'. Dickel's for drinkin'.



Don't let water, ice, or anything come between you and your first taste of George Dickel. Because when you start out with a whisky that's been properly gentled in the first place, you don't have to half drown it or throw rocks at it to make it behave. Later on, if you feel compelled to

splash on a little water—or your favorite mixer—well, we try to be open-minded about such things.

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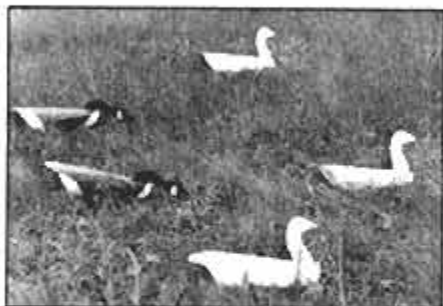
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APPROVED FOR VETERANS

Approved by the Commissioner of Education, State of New Jersey

NEW NOW OUTDOORS
(Continued from page 76)

Decoy geese with plastic
So light that a hunter can carry 75 decoys in a 30-pound backpack, these waterproof cones set up quickly to resemble snow and Canadian geese sentinels and feeders. Heads and



bodies of the Canadian and snow decoys are about \$40 a dozen from Farm Form, Box 748, Galveston, Tex. 77563.

New heights for hunting
Tree stands must be as old as blinds for hunters, but Crosman Airguns has made some improvements. Shooters, archers and photographers will find the Crosman TreeStand can be moved above protruding branches and does not injure the tree in any



way. Made of structural foam, it weighs only 7½ pounds and folds flat for easy packing into an area. A fold-up seat allows it to be used for sitting or standing, and the one-piece safety belt requires no adjustment. It's reported to be legal in every state.

Lead-free pellets
First there were no-lead shotgun shells and now there are no-lead hunting pellets for airguns. They're being imported from England by Barnett International, Box 226, Port Huron, Mich. 48060 in .177 and .22 cali-



bers. Plastic, self-lubricating skirts are said to help prevent barrel damage.

High-hunting harness
An independent support or a safety harness for hunters and photographers on a fixed platform, the \$42

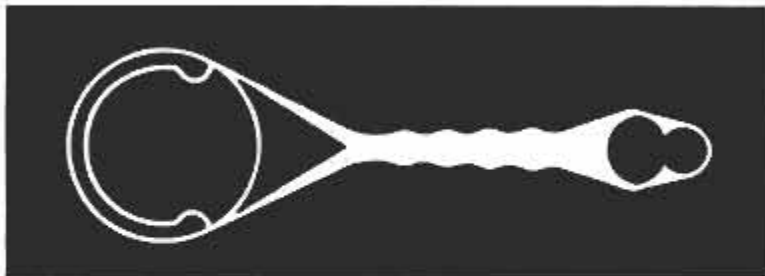


TreeSling from Anderson Designs, Box 287, Gladstone, N.J. 07934, can hold a heavy hunter without damaging the tree and even allow shots straight down. The device can also double as a game drag.



Simple but useful for users of two-cycle chain saws and outboard motors that require a mix of oil and gasoline, the Bob-Can container from the Fluid (Please turn to page 81)

PM BRIEFS



PM's Whatsit

The drawing is of an item made of flexible plastic. It is known as a "Hooper" and is of no practical use except when paired with the object it was designed to enhance. Turn the page to see it in action.

A throttle on the floor deserves a Bigelow on the door

We'll just stick to the facts in telling you that Mark Melanson is 37. He lives in Hollywood. It cost him \$300 to get the junked 1964 Valiant running. The acrylic shag black carpeting cost him \$400. It's California street-legal. You can rent it—for parades and things—at \$150 per day.



Pedal for profit



Student Lee Sokol with tourist fares in San Diego's Balboa Park.

We may remember 1982 as the summer of the pedicab. At least it seemed to be when this particular conveyance made a major jump from Hawaii, where it's been popular with tourists for years, across to several mainland cities. San Diego's Balboa Park has become a regular pedicab venue. So was downtown Knoxville, Tenn., as a number of World's Fairgoers will recall.

But not within the confines of the Fairgrounds, as one PM editor found out. Having hired a student-driven pedicab for a quick tour of the Fair, our reporter found out the exclusive, on-site pedestrian relief deal had been made with a fleet of battery-powered carts. He objected mildly, thus gaining the honor of being thrown out of the place where "Energy Turns the World" in the most energy-efficient of all conveyances.

PM BRIEFS



Whatsit revealed

Have you ever tried to pour from one of the popular two-liter-size soft drink bottles while holding it in one hand? The soft plastic collapses unless you cradle the bottle with two hands. But that was before Hooper. Merrick Industries, Box 2277, Sunnyvale, Calif. 94087 is marketing the invention as a premium or specialty item.

Three for the road

What is the compulsion with tricycle vehicles? None has ever set the automotive world on fire, yet they continually come and go, come and go. This one's out of England (Triking Cars, Marlingford, Norwich, Norfolk, NR9 5HU) and uses a twin-cylinder, 950-cc, air-cooled engine to hit 80 mph from a standing start in under 14 seconds. Claimed fuel economy's not bad either: 60 mpg at 75 mph. The car—er, trike's—stressed-skin side panels and FRP hood are set up on a steel frame. It is available in kit form.



How low can you get?



Down-to-earth C-5 (left) disgorges M-1 tank at ground level; 747 needs a lift platform.

In the annals of defense appropriations, it was a time of high drama. The Reagan administration and the Pentagon urged that a major budget item funding additional C-5 cargo planes (from Lockheed) not be axed by Congress. Boeing Co. thought it saw a chink in Lockheed's armor, and went over the Defense Department's head direct to Congress with a proposal that its 747 cargo planes be used instead of the C-5s, at a considerable saving. Despite the fact that the C-5 has something of a white elephant aura due to a costly re-engineering of wing spars (that tended to fail under stress), Boeing lost. One of the primary reasons is shown in the two photographs herewith, which were given wide circulation in advance of the Congressional deliberations ... by Lockheed.

NEW NOW OUTDOORS

(Continued from page 78)

Systems Div. of Flambeau, 801 Lynn Ave., Baraboo, Wis. 53913, carries both. The larger reservoir holds 1.75 gallons of gas and the smaller has .75 gallons of oil. The compact unit is made of rugged, high-density polyethylene.

Protective camouflage

For turkey hunters who need to cut down reflections from a polished gun stock, and any shooter who wants to fend off dents and rain, Kane Products, 5725 Canal Road, Cleveland, Ohio 44125, has developed stock and forearm Gun Chaps of fitted naugahyde. Produced with a camouflage



pattern, the fabric is said to protect the gun snugly with the use of Velcro tabs and all-weather zippers without interfering with gun operation. Designs are about \$25.

Walking-jogging distance

SporTach, a new belt-pedometer from Precise International, 3 Chestnut St., Suffern, N.Y. 10901, can be adjusted



for either hiking or running. Stride length from 1½ to 6 feet is preset on a dial, run or walk setting selected and mileage read on the top. It's available for \$20. **PM**



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So our chain saws are designed accordingly.

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

PM 'FLIES' THE SHUTTLE SIMULATOR

THE TRAINING OF AN ASTRONAUT

Centerpiece of America's tough Shuttle training program, this \$40 million machine is like the real thing!

BY DENNIS ESKOW SCIENCE EDITOR



PM photo: Peter Tenzer

PM science editor Dennis Eskow asks NASA's Don White for explanation of flight-instrument readings on video screens, as shown in inset.



I clutched the stick with both hands and worried mostly about falling out of my seat as Mission Control announced T-minus-two. "You can call it off if you'd like," I heard NASA's Don White say over the intercom. "The launch is the worst part. Everybody hates it."

Sitting in the commander's seat at a 90° attitude made me feel like a fly standing on a wall. And the flight deck's flashing lights and endless buzzers put an extra jolt of nervous energy in the air. Still, I wasn't about to miss the exhilaration of liftoff aboard NASA's \$40 million Shuttle Mission Simulator (SMS). The video display terminals blinked on and off as charts and animated instruments flashed numbers at me. "Gets a bit confusing, eh?" White said, flipping off the cabin oxygen supply momentarily in answer to buzzers going off around us.

My hand shook, but never let go of the stick as the Mission Control countdown continued



to ring from the headset inside my helmet. At T-minus-20 seconds, the flight deck began to shudder. I dug my feet into the Space Shuttle floor, anticipating the explosiveness of takeoff. My heart leaped as the engine roared and then increased in volume.

"... Four. Three. Two. One. Zero! We have liftoff." Looking out the cockpit window, I saw the launchpad fall away in a computer-animated blaze of glory.



Now I began to relax slightly, thinking that the takeoff wouldn't be so bad. Suddenly, the cabin swung away from Earth like a souped-up elevator rushing up a shaft to the top of a skyscraper. In a moment, the blue sky started to darken. Then a brilliant flash of golden light told us that the Shuttle boosters had separated automatically. We were on our own.

"You still with me, Den?" White asked in a way that mocked me only a little. I turned my head and saw him sitting in that same sharp attitude to the wall. I shot my thumb up in the affirmative. We were cruising in space now at an imperceptible speed—the instruments said 16,000 mph. I only had an hour to go in the SMS, and White gave me the choice of cruising

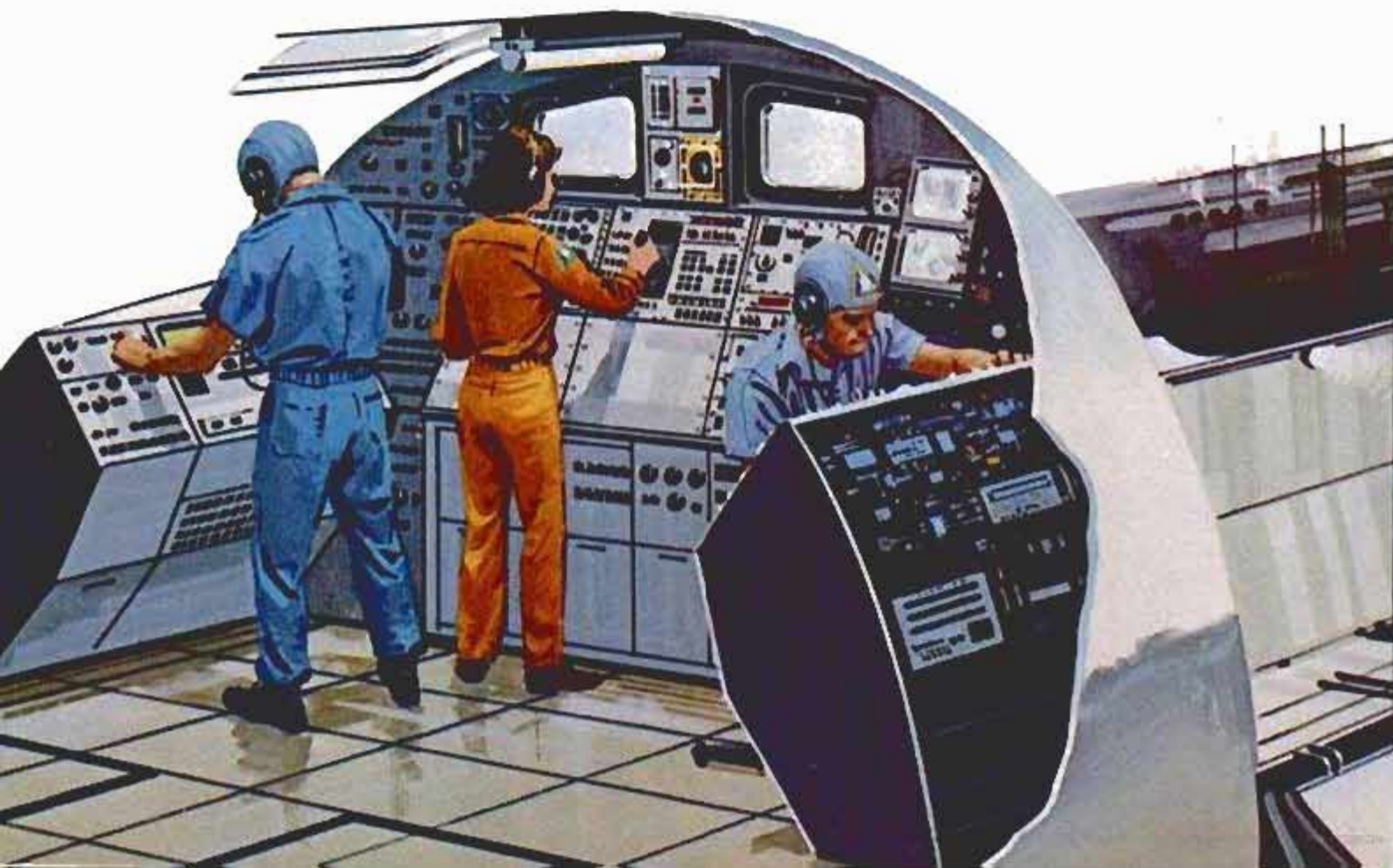


space for a while or trying several launches and landings. I went for the landings.

Night and day duty

"The SMS is so tied into the astronauts' training program that we operate it around the clock, seven days a week, most of the time," White explained as we waited for the computer programmers outside the cube-shaped simulator to reprogram the machine for landing practice.

The cockpit-sized metallic box sits about 15 feet off the ground on a moving platform whose six hydraulic piers keep it pitching and rolling in simulated flight. Designed by Singer's Link Div., the simulator's cockpit windows reveal a constant stream of true-to-life





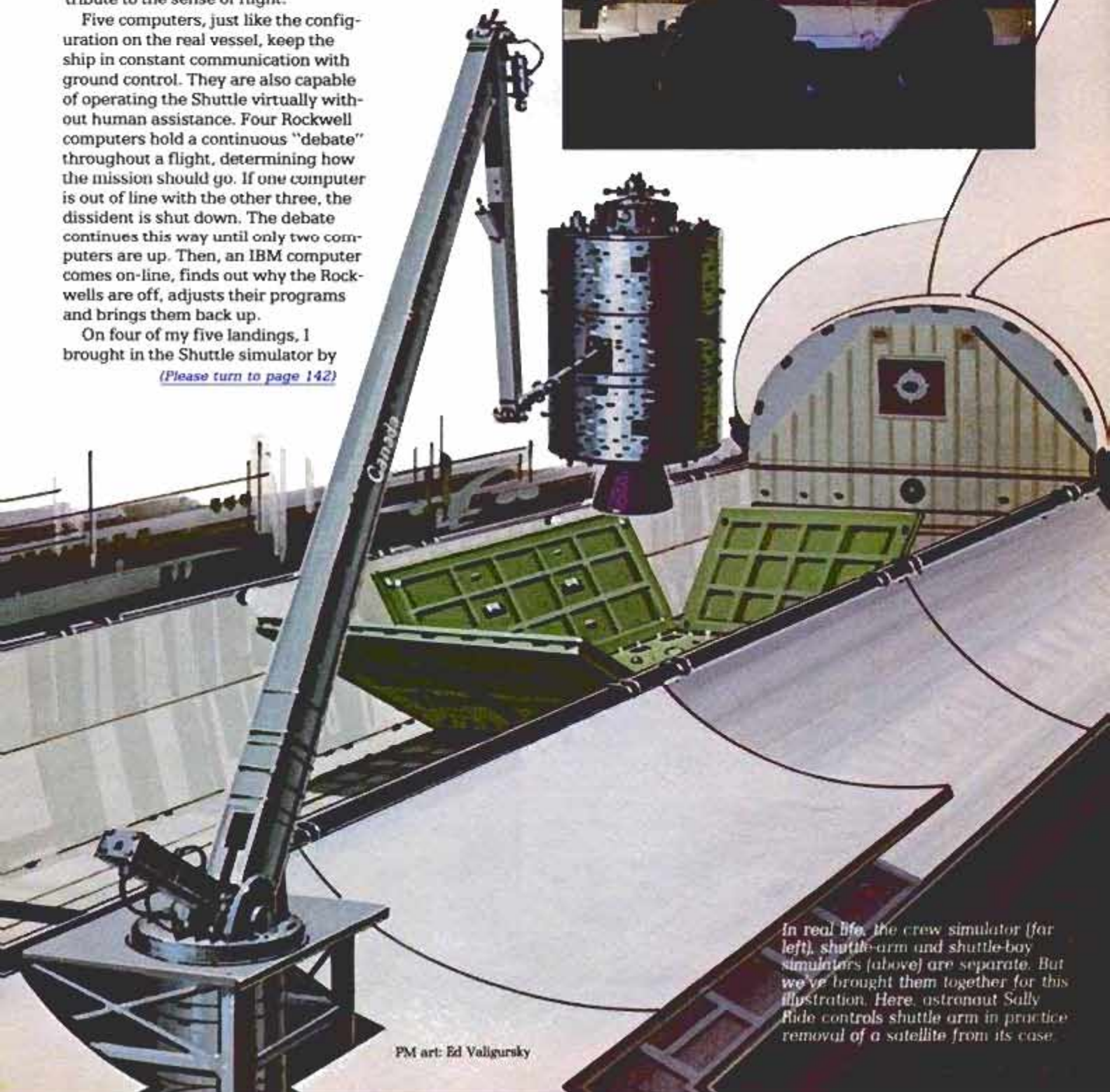
Astronaut training (from left to right) includes four-hour stints in the simulator, just 25 feet off the ground. Ann Fisher is one of the few who gets pilot training. All the trainees enter water tank, as Jack Lousma is doing here in buoyancy training session. And astronauts George Nelson, Richard Corey and Ellison Onizuka undergo weightlessness. Below, the Shuttle's programmers operate the simulator.



computer-generated images that contribute to the sense of flight.

Five computers, just like the configuration on the real vessel, keep the ship in constant communication with ground control. They are also capable of operating the Shuttle virtually without human assistance. Four Rockwell computers hold a continuous "debate" throughout a flight, determining how the mission should go. If one computer is out of line with the other three, the dissident is shut down. The debate continues this way until only two computers are up. Then, an IBM computer comes on-line, finds out why the Rockwells are off, adjusts their programs and brings them back up.

On four of my five landings, I brought in the Shuttle simulator by [\(Please turn to page 142\)](#)



In real life, the crew simulator (far left), shuttle-arm and shuttle-bay simulators (above) are separate. But we've brought them together for this illustration. Here, astronaut Sally Ride controls shuttle arm in practice removal of a satellite from its case.

Without These
Driving Skills, You
May As Well Be

**ASLEEP
AT THE
WHEEL!**

A taped-up windshield is part of the professional training to get you to keep your eyes up and looking down the road.

A lazy mental attitude and poor skills could make you more of a road hazard than you think. Here's how you can tighten up the nut behind the wheel.

BY TONY ASSENZA AUTO EDITOR

As regular as clockwork, a newspaper headline reports that a car "went out of control" at an intersection, jumped the curb and landed in somebody's living room. Or there's the other one, of a car going "out of control," jumping the median divider and colliding with oncoming traffic.

As smart as cars have become, with their computers and disembodied voices, they are still mindless assemblages of metal that respond only to a driver's inputs. And they respond in a surprisingly predictable and consistent manner. Jump on the brakes in the middle of a fast bend and you'll spin. Lock up the brakes on a patch of ice and you'll go straight off, no matter what you do with the steering wheel. Ultimately, in these "out of control" incidents, it's *the driver* that's out of control, not the vehicle.

The sad fact is that no institution exists which really teaches a prospective driver how to be in control of a vehicle. Driver education courses are essentially useless. Sure, they'll put you behind the wheel and give you enough instruction to pass a driving test. But the latest statistical results indicate that driver's ed is counterproductive. The accident involvement rate of driver ed graduates is actually higher than the

average accident rate for people of the same age group who have not taken a driver education course. The current theory for this phenomenon is that these people are younger, less experienced and overconfident. Whether that's true or not is debatable. But the facts are there.

Most driving schools are equally inadequate to teach real car control. They're in the business of making sure their customers can pass a test designed for the absolute lowest common denominator.

We all know, or we at least have seen, people who absolutely shouldn't have a license to drive. The problem is, driving has come to be perceived as an inalienable right, when, in fact, it's a privilege which should be earned. The price we pay for this indiscriminate dealing out of licenses is approximately 50,000 lives per year.

Graduate school

If it were within the power of this magazine to send every driver in the country to an advanced school of driving, we'd do it quicker than you could say trailing throttle oversteer. But since we can't, we'll do the next best thing and tell you what can be learned at an advanced school.

To find out how much I didn't know about driving, I packed up my helmet and sneakers and spent three days at the Bertil Roos Precision School of Advanced Highway Driving in Blakeslee, Pa. Roos, a race driver with a long string of victories to his credit, is currently campaigning a two-liter Can-Am car. He's also a little hyper and will call you a numbskull if you forget what he told you 10 minutes earlier.



Car control starts with correct wheel grip. Adjust seat so that your arm is stretched to reach top of wheel (left), then hold wheel at the 3:00 and 9:00 o'clock position.

First off, most people don't know how to sit up properly and grip the wheel.

The steering wheel shouldn't be in your chest or way out there where you can reach it only with your fingertips. By using a combination of seatback angle and fore/aft seat travel, you should arrange to have your arms almost fully extended when you reach for the top of the wheel. Once that's established, hold your hands at the 3:00 and 9:00 o'clock positions, elbows slightly bent, and leave them there.

Did you ever notice people driving with one arm out the window and the other hand on their lap, holding the steering wheel by one finger hooked around the bottom? That kind of relaxed attitude should be reserved for traveling at zero mph on your sofa.

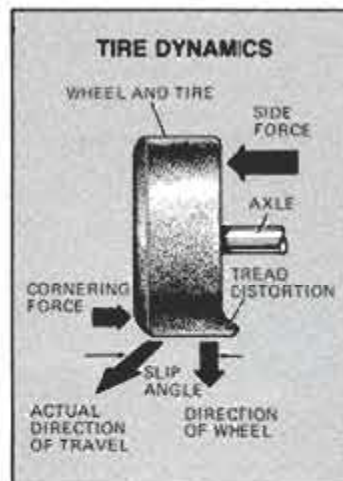
At 55 mph on the road, you're covering 80 feet per second. Let's say you have to crank the wheel sharply to avoid hitting something that jumped out from the side of the road. With the lazy man's driving mode, it will take at least a second to get the arm back in the car and both hands back on the wheel to execute the evasive maneuver. That second has eaten up 80 precious feet of braking space or reduced your escape route by 80 feet. That kind of distance could mean the difference between hitting something or being alive that night to tell your buddies about the cement mixer that ran the stop sign.

Two hands on wheel

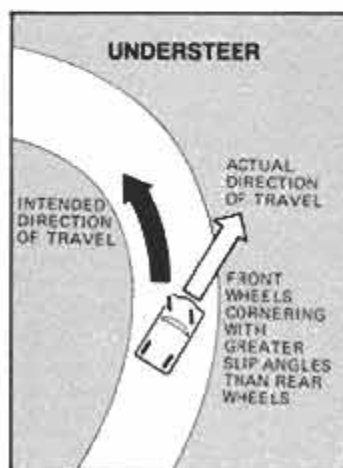
Therefore, both hands on the wheel at all times. If you have one of those skinny, plastic wheels with the spokes all in the wrong place for that 3:00 and 9:00 grip, throw it out and install a proper wheel.

Another very good reason to keep your hands at 3:00 and 9:00 is to establish a pattern. That position always indicates your straight-ahead attitude. Suppose your car starts to slide on ice and you find yourself all crossed up. If you're accustomed to feeding steering inputs by passing the wheel from one hand to the other, you'll never have the time to figure which way the front wheels are pointing. But if you've established the pattern that 3:00 and 9:00 on the steering wheel points the front wheels straight ahead, you'll be able to make the proper steering corrections to get the car pointed in the right direction.

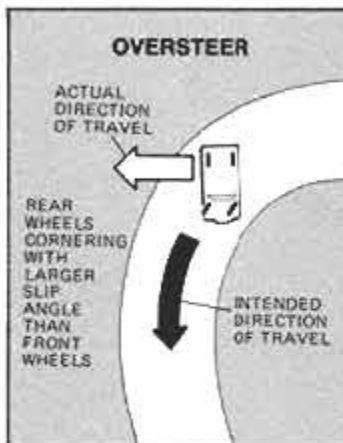
Driving with your hands glued to that position isn't the easiest thing to do in everyday driving due to the number of turns the wheel takes to get from lock to lock. Taking a 90° turn at an intersection, for example, will necessarily mean you'll end up with your arms crossed, barely holding onto the spokes with your thumbs. You'll look



Slip angle is the difference between the direction of the tire and wheel, and the actual direction of the car. Note the tread distortion of the right front tire of the race car. It's in a tight left-hander at Laguna Seca Raceway.



This production car is close to the point of terminal understeer. Note the weight transfer to the right front tire and the unloading of the left rear wheel.



The Slidecar is made to oversteer. The driver here has dialed in enough opposite lock to catch the drifting rear end and is actually in quite good control of car.

comical, and no one will want to drive with you. But it really is good practice. And, at less than 90° turns, you'll be quite surprised at how much more precise your steering maneuvers will become.

Using your eyes

Perhaps the most important driving technique of all is knowing how to use

your eyes. If you can see far enough ahead and recognize an impending emergency situation, you might never need to use accident avoidance driving techniques.

Part of Bertil Roos's method to highway driving involves keeping your head high and your eyes aimed high. To establish the habit, he tapes up the lower part of your windshield to just below

eye level. Doing this in your car on public roads is not recommended.

One other eye technique, which applies to both racing and highway driving, is to sight along the inside of the curve as you're turning into it, and shift your eye to the outside once you've completed the corner and are ready for the exit. The point at which you come closest to the inside of the corner is called the apex. By coming into a corner from the outside of the road, turning gently, hitting the apex and using all the road for the exit, race drivers can maintain high speeds through a corner with the least amount of drama while maintaining vehicle stability and maximum adhesion.

You can use the same technique on the road. Your aim, of course, isn't to go as fast as possible. Rather, it's to maintain a neutral balance, drive the car smoothly with as few changes in attitude as possible and be able to see into a corner as far as possible to spot any surprises that may await you.

The cornering diagram depicts a constant-radius corner. If you follow the centerline of the car, you'll see that the arc it follows is longer and flatter than the arc of the corner itself. This is the smoothest way around and the least upsetting to the car. If the car follows the inside line of the curve and maintains the same speed through the curve, centrifugal force unbalances the car. The driver must then make mid-course corrections. Correct cornering is especially useful when you're driving on wet or slippery roads.

Vehicle dynamics

The study of vehicle dynamics could, and does, fill acres of library shelf



Forward weight transfer under braking can provide help in an emergency by increasing the contact patch and consequently enhancing the steering response.

space. The most I could hope to do is provide a brief description of what happens in cornering situations and some techniques for recovering control if you lose it.

Fundamentally, all the action happens at the contact patch. That's the area of the tire in contact with the road surface. There's no point in discussing straight-line dynamics because not very much is going on. The wheels are turning, there are no side loads being imposed on the tires and you can accelerate or decelerate generally without much drama—on dry roads, at any rate.

When you begin to turn, however, many forces come into play. First of all, the car doesn't want to be turned. It wants to continue on a straight line. The tire and wheel turn, but the contact patch also wants to continue going in a straight line. But pneumatic tires have what is called a self-restoring charac-

teristic; this simply means that the sidewalls of the tire flex around the vertical axis of the tire and force the contact patch to turn. There's a considerable amount of tire deformation going on at this point.

This ultimately leads to what is called a slip angle. The slip angle is the difference between the angle of the tire and the actual direction of travel of the car. You've probably experienced this yourself. From behind the wheel, it feels like you're turning the steering wheel more and more, but the car doesn't respond and change direction in proportion to the amount you have turned the steering wheel.

Understeer

The nonlinear response to steering wheel input is called understeer. Simply put, it means that if you need to change the car's direction 20° from the straight-ahead position, you have to turn the front wheels 30° to achieve it. That 10° difference is the slip angle of the tire.

At the point of what is called terminal understeer, the wheels are cocked at full lock, but the car continues to go in a straight line. Essentially, the front wheels have all but stopped turning and the front tires are scraping sideways against the road surface.

Oversteer

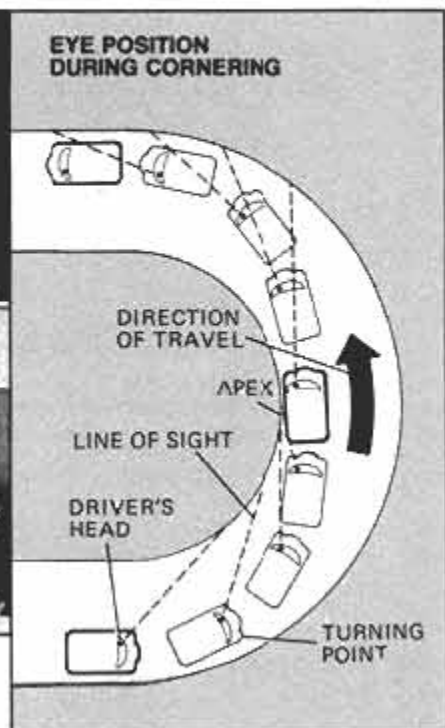
In an oversteering situation, the rear tires lose adhesion to the road and the back of the car swings around. This can happen for a number of reasons. Either the car is designed to oversteer (highly unlikely) or speed and road conditions, like ice, cause the rear tires to break loose. Most of the time, oversteer will cause an inattentive or incompetent driver to spin out.

When a car neither understeers nor oversteers, it achieves the ideal balance—neutral steering. Neutral steering occurs when all four tires are work-

(Please turn to page 156)



Bertil Roos shows proper eye technique during cornering. Come in wide, clip your apex and slowly unwind for the exit.





PM art: Robert Handville

The Best Old Guns Are New

Good replica guns and modern muzzleloaders are not cheap. But compared with collector originals, they are bargains indeed. What's more, replicas do a better job of demonstrating how the originals handled, and for that matter, how they shot, than the classics could do themselves today.

How can that be? Easy. Most of the original Revolutionary arms are in museums or private collections and are too valuable to risk firing. Those in good shape are too good to play with, and the bad ones are either nonworking, unsafe, or both. A good modern replica, however, feels like an original, fires like an original, and can give the real sensation of what old-time shooting was like.

An original Whitworth military target rifle, for example, of the type used by some Confederate snipers and English target shooters, might cost \$2,000

Fully operational replicas of antique firearms have become elegant collectables.

BY ANGUS LAIDLAW

to \$4,000 in good condition today. The Navy Arms replica of the Whitworth lists for \$575 and is gauged by the same gauges that were used to inspect the originals in the 1860s. The new barrels have the identical hexagonal rifling making one turn in 20 inches that enabled the original Whitworths to hit a 30-inch target at up to 1,000 yards. The replicas not only look the same, they shoot as well or better using modern cast lead bullets. Matches for these and other slug guns—so-called because they shoot a conical bullet or slug rather than than the round ball of

many other muzzleloading rifles—are featured in numerous black powder matches.

Since 1954, when the first mass-produced muzzleloading rifle and pistol replicas were introduced, more copies of some models like the Walker Colts, have been made than were ever turned out originally. Two developments during the last 25 years have given the black powder sports a major push. Military and civilian organizations and clubs have been formed to duplicate those of a century or so ago, right down to the same uniforms and equipment. And then there have been new laws that make primitive muzzleloader hunting seasons legal in most states.

Military units commemorating the Indian Wars, the Revolution and the Civil War have created a demand for exact replicas of original uniforms, equipment, personal arms and even



Dixie Gun Works modern muzzleloader (left) is Tennessee flintlock squirrel rifle. Customized Kentucky flint long rifle, by George Heinemann, replicates 1790 styling. Whitworth hexagonal-bore sniper rifle (center), from Navy Arms, has 1,000-yard range. Percussion Hawken II, by Navy Arms, is suitable field rifle for deer hunting. Navy Magnum 12-gauge shotgun (right) is a black powder choice for clay pigeons and waterfowl. Flintlock pistol copies specifications from Williamsburg for British Army 1761 Dragoon.

PM photos: George Ancona,
at Museum Village, Monroe, N.Y.



Cased dueling pistols would cost thousands for the 1870 originals. But shooters can now get Navy Arms copy set for \$700.

artillery. To meet the requirements of the Brigade of the American Revolution, for example, no nonperiod items are allowed. No digital watches, cigarette lighters, or zippers, and the barrel on your Brown Bess musket replica must be the correct 42 inches long, with all other features of the arm line-for-line correct when compared with an original. The result now is a quality assortment of authentic modern reproductions of historic muskets, rifles, fowling pieces and pistols. Inaccurate, poorly made copies have no market.

Hunters have also done much to foster the availability of good quality and

A 1750 Tinderlighter could strike light for attached candle. Navy Arms: \$69.95.

reasonably priced replicas. Ten years ago, few states had special seasons for muzzleloaders. Now, nearly all do. Many of the sportsmen attracted by these extra seasons were hunters first and black powder shooters a distant second. While they cared greatly about legal hunting, they gave less than a hoot about historic accuracy. What they wanted was a dependable modern muzzleloader.

From this demand came the Thompson Center Renegade, based on their earlier and more historically correct Hawken. The Renegade has a modern shotgun-style butt plate with no horns to poke you on recoil. It has adjustable sights so that a hunter can develop a load and then zero in his sights without files and a hammer. Introduced



Favorite old hideaways for pistols were imitation books. Navy Arms cases this 1862 New Police Colt with accessories.

just this year, the Renegade Cougar has stainless fittings and lock parts to make it more durable and to look more like modern stainless models. The wood is quality American walnut, and the result is a handsome piece that the old-time mountain men would have found a bit strange, but very desirable.

Besides being used for hunting and

(Please turn to page 144)



Double barrel percussion Ethan Allen pocket pistol from Hoppe's comes as parts kit or finished for under \$100.

Ethan Allen model (top left) is pepperbox. Mountain Pistol is by Connecticut Valley Arms. Ruger Old Army revolver is available in stainless steel. Lincoln derringer (bottom) is by Navy Arms. Most come factory-finished or as kits.



ONLY THE STRONG

It takes guts, stamina and desire to compete in a 24-hour race. The PM team had enough of all three to win!

BY GARY WITZENBURG
DETROIT AUTO EDITOR

It starts with two parade laps. Forty colorful cars guided by 40 nervous drivers snake two-by-two around the twisty, two-mile Nelson Ledges road course. The second time by, the tension thickens like summer heat as the drivers narrow their collective concentration toward the starter with his green flag.

The cars edge closer and closer to the starting line.

The pole-sitting Chevrolet Camaro and our second-qualifying Porsche 944 purposely hold down their speed during the pace lap to keep the turbocars behind us off their turbocharger boost, thereby limiting their power. But racers being racers, even in endurance

contests, everybody wants to be first into the first turn and lead the first lap.

Forty throttle feet hit the floorboards simultaneously as the green flag flies. Forty engines moan as they build power. Forty drivers grip the wheel tighter.

As expected, the Camaro wins the drag race to the first turn. But, oh no! Freddy in our Porsche is trying to pass him on the outside. Side by side down the short straight, toward the first turn, and side by side into it. Two expert drivers in two bright red cars, inches apart on a track still wet from an early rain, taking the measure of each other. And giving no quarter. One red car



SURVIVE!

No. 1 driver Fred Baker (above) zips along at speed behind the wheel of the Popular Mechanics-sponsored Porsche 944. Below: PM's race crew makes the final headlight adjustment the night before the big event.

comes out of the turn, accelerating toward the next. The other comes out backward, careening across the trackside grass. It is our Porsche.

"Nuts!" I say to no one in particular. "Freddy's spun!"

"One lap down, just 24 hours to go," proclaims the announcer cheerily as the leaders pass the start/finish line. I head for the pits.

It takes Fred Baker several minutes to muscle through the traffic back up to fourth and another hour and a half, thrashing the car as hard as it will go, to take over the lead. Then he has to pit for fuel. It's my turn to drive.

The crew dumps in 15 gallons of gas, checks the oil, the tires and all



PM photos: Dave Klein and Thom Carroll



Outstanding pit work by the Bedford Porsche + Audi crew kept PM's freight train on track and on schedule. The rearrangement of the bodywork was courtesy of an errant Pinto. Note cleverly applied wheel mark on the Porsche's door. The factory-backed Chevy Camaro (right) took pole, with Baker placing our Porsche in second.

the usual stuff. Freddy helps buckle me in, and in a bit over two minutes, I'm off.

Accelerating out of the pits, I know everyone expects me to drive as hard as Baker to hold onto the lead. Damn, I think, this is no way to run an endurance race.

I get up to speed and try to relax behind the wheel. I push as hard as I dare, threading through the many slower cars as quickly and carefully as possible. With 40 cars on a two-mile course, the traffic at times seems like rush hour. I keep reminding myself that there are 22 hours to go in this madness.

The Nelson Ledges/Quaker State Longest Day, as the madness is called (because it's run on the weekend closest to the summer solstice, the day with the most daylight of the year), has become the country's second most important 24-hour auto race. Actually, the only other one is the famous Dayto-



na 24-Hour in February. Longest Day was conceived three years ago by the people who run the Nelson Ledges track near Warren, Ohio, and by the Northeast Ohio Region of the Sports Car Club of America (SCCA) for SCCA Showroom Stock-class cars. Let's make it fun, and inexpensive, they reasoned, so almost anyone can come out and play.

The first Longest Day took place two summers ago. I was on a dealer-sponsored Porsche team co-driving a Show-

room Stock A-class 924. We qualified fastest and started from the pole, but failed to finish. A factory-backed, professionally run Saab Turbo won that event, and two of the co-drivers in it were *Road & Track* magazine editors. Second place went to a factory-assisted Mazda RX-7 that was prepared, entered and run by a team from *Car and Driver*. Thus began the factory vs. factory and magazine vs. magazine tooth-and-nail competition that has fast become a Longest Day tradition.



Expert strategist Joe Oldham (foot on fender) presides over crew and (left to right in front) drivers Gary Witzenburg, Tony Assenza, Bob Nikel and Fred Baker. Despite a few negative predictions from some, the 924's motor ran unfailingly strong.



Last year, I co-drove another Porsche 924 entered by Porsche-Audi Motor Cars of Bedford, Ohio. A new wrinkle was provided with the creation of a Prototype class for cars not yet eligible under the strict Showroom Stock (unmodified except for safety equipment) rules. Ford responded by entering an immaculately prepared Ford EXP for *Car and Driver* and a matching Mercury LN-7 for *Road & Track*. Also present were a pair of factory-assisted Datsun 280ZX Turbos, with drivers from *Autoweek*, the weekly car magazine. On *Track* magazine was also represented. Our Porsche 924 ended up the overall winner in '81.

With the 1982 event looking bigger and better yet, the opportunity seemed ripe for *Popular Mechanics* to get involved.

Fred Baker of Bedford Porsche-Audi and partner Bob Nikel were already planning to repeat their 1981 win this year with a brand-new Porsche 944. Several hundred phone calls between Baker and PM Executive Editor Joe Oldham and the deal was struck. It would be a team effort between *Popular Mechanics* and Bedford Porsche-Audi. The drivers would be Baker, Nikel, myself and PM Auto Editor Tony Assenza. Oldham would act as team manager. Additional support would come from CRC Chemical and Good-year.

I glance up in my mirror and one of the turbo Mustangs, the Car and Driver car, is coming up fast from behind. He has a bunch more horsepower and more acceleration out of the turns than I do, and it's obvious that I can't hold him off for long. A few laps later, he rockets past on the long back straight. I try to stay with him and do for a while, but before long, he disappears into the

distance. Again, I remind myself that there are many hours to go.

More time and a lot more laps go by. Suddenly, I find myself catching that same Car and Driver Mustang again. The driver is giving the car a breather, not going as quickly as before. But as soon as he sees me in his mirrors, he picks up the pace. And the chase begins again.

I attach the Porsche to his bumper like a trailer, drafting him as much as possible down the straights, crowding him into the corners, occasionally sticking a nose inside him looking for a chance to pass. But every time I move up alongside, he turns in and chops me off so close I have to nail the brakes and sometimes put a wheel off in the dirt to keep from T-boning his door.

We're three hours into a 24-hour enduro and this idiot's driving it like it's a 30-minute sprint. He flails at the wheel, ready and willing to wreck us both rather than let me by. I normally would be content to follow at a prudent distance. But he is going a second or two a lap slower than I, holding me up, costing us valuable time that might make a difference later on.

Apparently, the Mustang's brakes

are hot now from his earlier, faster pace. He brakes a lot sooner than I want to for the fast, right-hand turns one and two. He fends me off through the third-gear, left-hand turn four and the long, bumpy, decreasing-radius Carousel right, then pulls away on power down the back straight. I catch him again at the 110-mph, right-hand kink toward the end of the straight. As he brakes slightly for it, I sail through flat out at 6,000 rpm in fourth without lifting off the gas.

Then I try another pass, going into the next third-gear left turn a bit deeper under braking. The Porsche's plastic nose almost gets crunched for my trouble. I follow him through the tight right hairpin final turn, tuck in under his bumper, and try to stay with him accelerating down the front straight, past the start/finish and into turn one again.

This goes on, lap after lap, turn after turn. I push him, making him use up his brakes and tires and fuel. But his tactics are getting on my nerves. If blocking was racing, I think, this guy would be national champion. I keep hoping for a mistake on his part, a bobble, a miscue

(Please turn to page 134)



Car and Driver's SVO Mustang was dead and buried before nightfall, eventually winding up in a distant 33rd-place finish.

BIG LIFT: Salvaging A 437-Year-Old Shipwreck

In one of the trickiest recovery jobs ever attempted, the British will try this fall to raise a 16th-century wooden warship—very carefully.

BY F. WILSON McCOMB

About the time you read this—barring a last-minute technical glitch or maybe further trouble over the Falklands—the British will undertake one of the most ambitious marine salvage operations ever conceived. They will attempt to raise the *Mary Rose*, a 16th-century Tudor warship sunk in battle in 1545 near Portsmouth Harbor on the southern coast of England.

If the big lift succeeds, it will yield a spectacular archaeological treasure, for the *Mary Rose*, partially pre-

served in a kind of suspended animation, represents a 437-year-old time capsule, waiting to reveal the secrets of a bygone age.

But the job won't be easy. Though the wreck lies in less than 50 feet of water only a mile off shore, it's so weakened by rot that it will take a prodigious engineering feat to raise it in one piece. Built in 1509, the 130-foot-long, 700-ton sailing ship was constructed almost

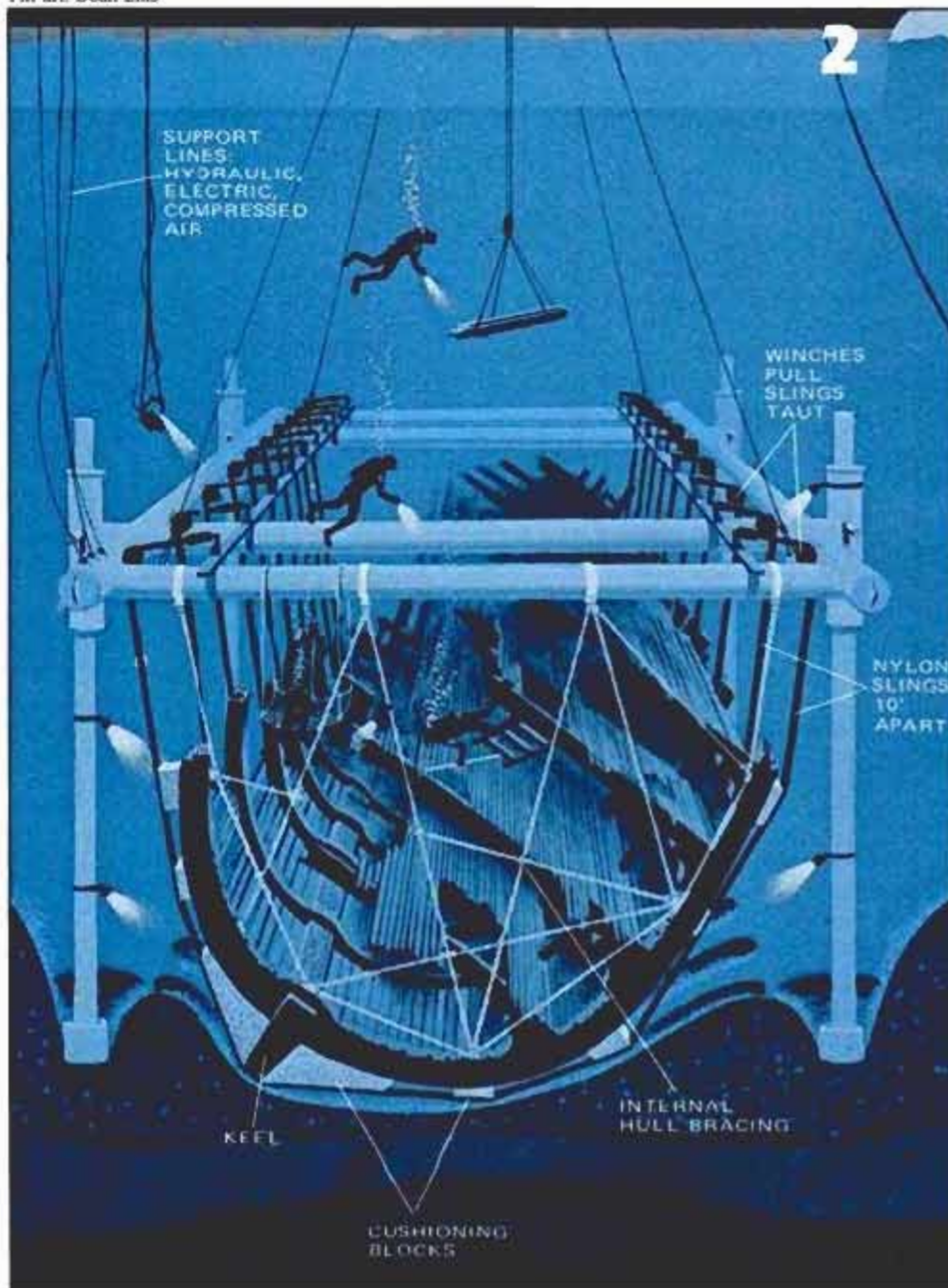
(Please turn to page 126)

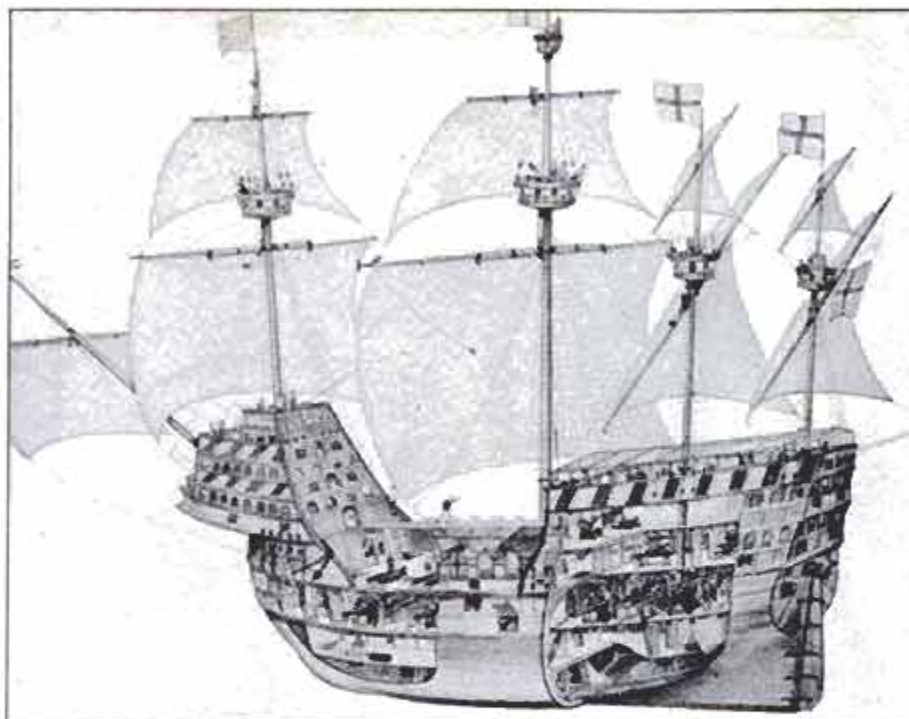
PM art: Dean Ellis



1 Starboard side of hull, almost completely embedded in bottom silt, is all that remains of the ill-fated 16th-century wooden warship *Mary Rose*. In the first step of the planned salvage operation (above), a huge 50 x 120-foot lift frame, made of 30-inch-diameter hollow tubes, is lowered over the wreck, estimated to weigh as much as 350 tons. Adjustable legs, fitted with removable stabilizing feet, are extended until they touch the bottom, then are locked by cross pins.

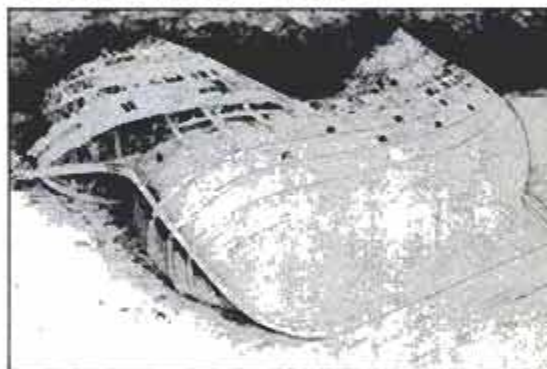
2 Divers, working on trapeze-like scaffolds slung from lift frame, install spider web of criss-crossed braces inside wreck to reinforce its fragile, rotted timbers (right). At same time, wide nylon lifting slings are snaked under the hull, anchored to frame and pulled taut by winches overhead.



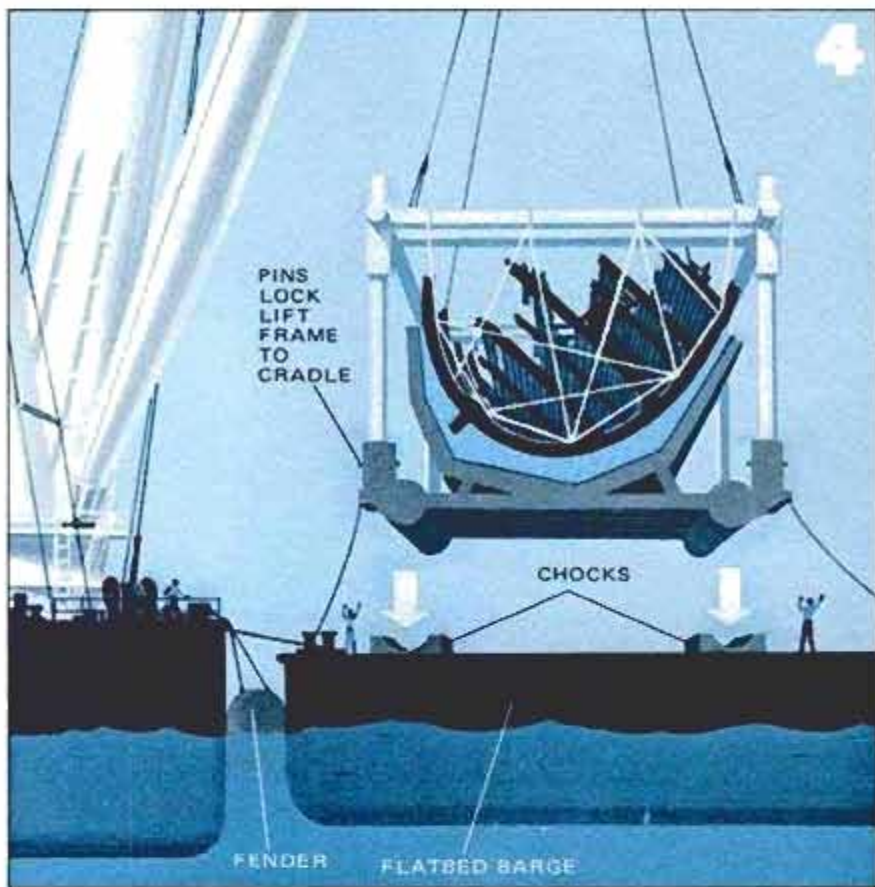


Cutaway drawing of Mary Rose (left) by famed British naval architect Colin Mudie shows the Tudor warship in her 16th-century elegance before sinking in 1545. Closeness of gun ports to waterline, allowing flooding, proved her undoing.

Early artist's impression of Mary Rose (below) lying on her starboard side after sinking more than four centuries ago. Bow and forecastle are at left, sterncastle at right. Actually, hull is now considerably more rotted away than shown.



© Colin Mudie 1979



3 Lift frame and wreck, now lashed together, are hoisted up and onto the underwater cradle precisely formed to fit hull's contours (left). Water ballast is blown out to give buoyancy and aid lift. Frame's feet are jettisoned and legs lock into similarly shaped sockets in the cradle, thereby forming a rigid unit.

4 In final step (above), cradle, hull and lift frame, now representing a combined weight of more than 500 tons, are raised to surface and placed on barge

for transport to museum site on shore. If all goes as planned, the frail, priceless treasure will be held so gently in its padded cocoon that no more than 1 pound per square inch of pressure will be exerted on it at any point. Same cradle used in lift will also serve as ship's display stand in museum exhibit to save moving delicate hull. (Drawings are based on sketches made for PM by Capt. Jon Brannam of the Royal Engineers Diving Establishment, who heads up the recovery project.)



The girl above would be hidden by windshield glare, if not for the polarizing filter. By rotating the filter, glare can be reduced or eliminated. The versatile filters also make colors deeper and add to sky effects. At right is another very colorful use for these filters: They can be used to show the areas of stress in a variety of plastic objects.

PM photos: Armand Ensanian



How To Use A Polarizing Filter

A polarizing filter should be in every gadget bag. Here's how they work and how to use them.

BY ARMAND ENSANIAN

Many of us had our first experience with polarized light back in the '60s at the local drug store. Amazing new sunglasses with polarizing lenses were taking over the display racks. Photographers, meanwhile, have had polarizing filters for years. Today, not only do they reduce unwanted reflections in photos taken through glass or water, but they also darken skies, reduce haze and add punch to color pictures.

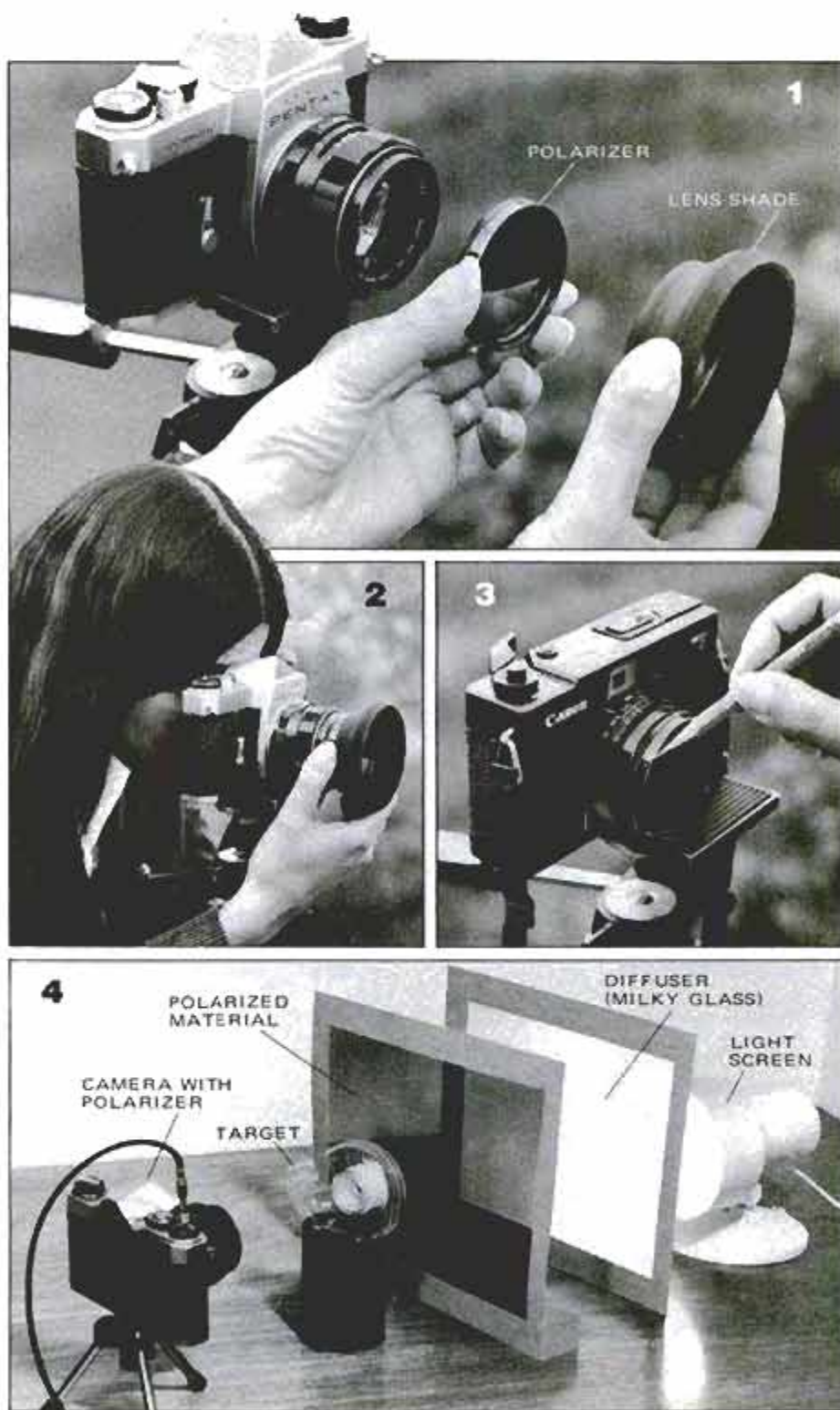
Unlike some other filters, a polarizer may be used with black and white or color film. It is also different in that, once screwed onto the lens, it may be further rotated by turning the front half of the housing. It is advisable, of course, to use a lens hood when photographing with any filter.

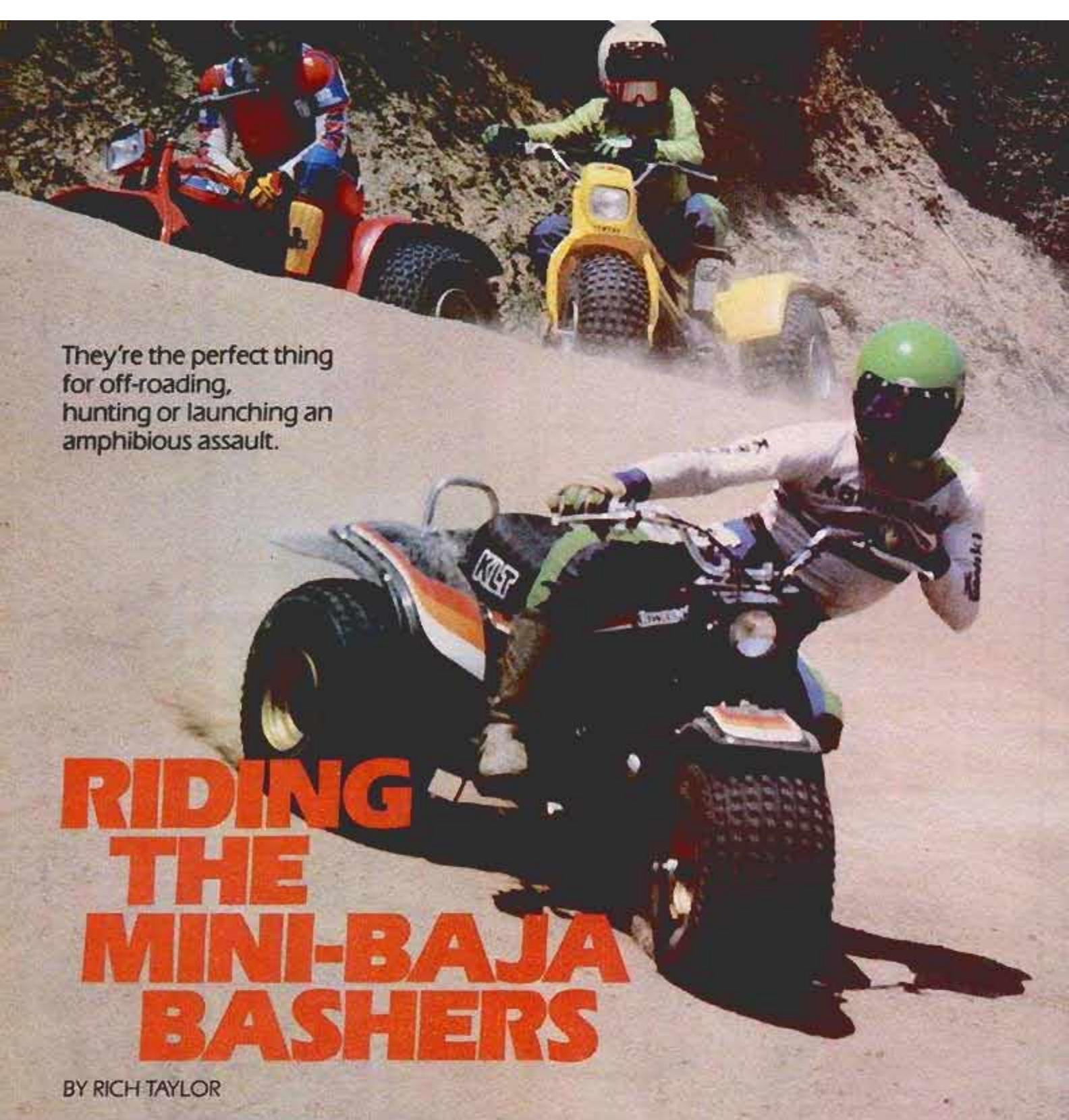
And these handy devices aren't expensive. Depending upon the size of your camera lens, a rotating polarizing filter will cost about \$5 to \$15.

Using a polarizing filter is quite simple, especially if mounted on a single lens reflex (SLR) camera. Look at the scene through the viewfinder and rotate the filter slowly until you get the desired effect. On sunny days, this should cause the skies to turn a darker blue, bringing out any clouds, especially when the camera is at a right angle to the sun. When photographing through a store window or picture frame, do the same until most reflections disappear. Try a different angle to the glass if not all of the glare is removed.

A polarizer has two minor drawbacks. (Please turn to page 128)

Polarizer threads onto front of lens (photo 1). Lens shade should be attached next. Using polarizer on an SLR (photo 2) is easy. Look through the viewfinder and rotate filter. A rangefinder camera (photo 3) calls for a look through the filter first, while still separate from camera. Then orient guide mark on the filter to same position once it's on the lens. Photo 4 illustrates a good method for shooting stress-marked plastics.





They're the perfect thing for off-roading, hunting or launching an amphibious assault.

RIDING THE MINI-BAJA BASHERS

BY RICH TAYLOR



On sand, gravel, forest trail, snow, ice and water, ATCs (all-terrain cycles) can boldly go where no motorized vehicle has gone before. From left to right: the Honda ATC 200, Yamaha Tri-Moto 125, Kawasaki KLT 200, Honda 200E, Kawasaki KLT 250 and Yamaha Tri-Moto 175.



Versatility? Is that what you want? How about a \$1,500, nearly unbreakable tricycle that can clamber anywhere a horse can go, be lifted by one man and outperform a snowmobile on snow and a dirt bike on sand? And it'll bring home a hunter, all his gear, plus an eight-point buck, run all day on a gallon of gas, replace a tractor for most farm work and top 50 mph if you dare to hang on?

It not only floats, but can paddle wheel upriver like a stern-wheeler. And it's so simple, a 9-year-old can ride it and repair it, too. When the work is done and it's time for fun, it can be jumped like a motocrosser, wheeled like a bicycle, flat-tracked like a go-kart and outfitted with everything from a racing suspension to gun mounts.

Sound good? Sound like we're exaggerating? See those guys doing wheelies in the picture? Not one of them will ever see the right side of 30 again. See them paddling across a river? As soon as the photographer's back was turned, they were T-boning their friends until one or another ended upside down, three wheels in the air, with the rider swimming away from the wreck and laughing hard enough to get stomach cramps.

An unsophisticated start 11 years ago

We've got Honda to blame for all this marvelous silliness. Some 11 years ago, Honda took the single-cylinder engine from their little 90-cc dirt bike and stuck it in the most rudimentary tricycle frame around. There was no suspension, just the natural springiness of fat, high-flotation tires designed originally for all-terrain vehicles. The bodywork was just molded plastic fenders to keep some of the mud off the rider, and the technical sophistication was on a par with a good claw hammer.

A decade later, Yamaha and Kawasaki have jumped into a blooming three-wheeler market that nobody thought existed. And there are rumors of new machines from industry leaders like Suzuki and Husqvarna, and off-brands like Italjet. There are now classes of competitive three-wheelers, ranging from 70-cc miniversions aimed at prepubescent moto-kinder to 350-cc high-performance race models vicious as a rattlesnake.

Super-promoter Mickey Thompson is staging three-wheeler races for cash prizes at the Los Angeles County Fairgrounds and Budweiser is sponsoring a series of Baja Cross events. But this sport is more than just factory race teams with professional riders: Dozens of the after-market companies are selling hop-up parts to thousands of weekend warriors hungry for the latest go-fast fad.

If you read the ATV magazines—oh yes, they even now have their own low-pressure press—you'd think that racing and high performance are the whole three-wheeler world. But according to the manufacturers, fully 80 percent of the 100,000 trikes they sell each year go to the Midwest. There, farmers are

(Please turn to page 138)



VIDEOTEX: Instant Info From Your TV

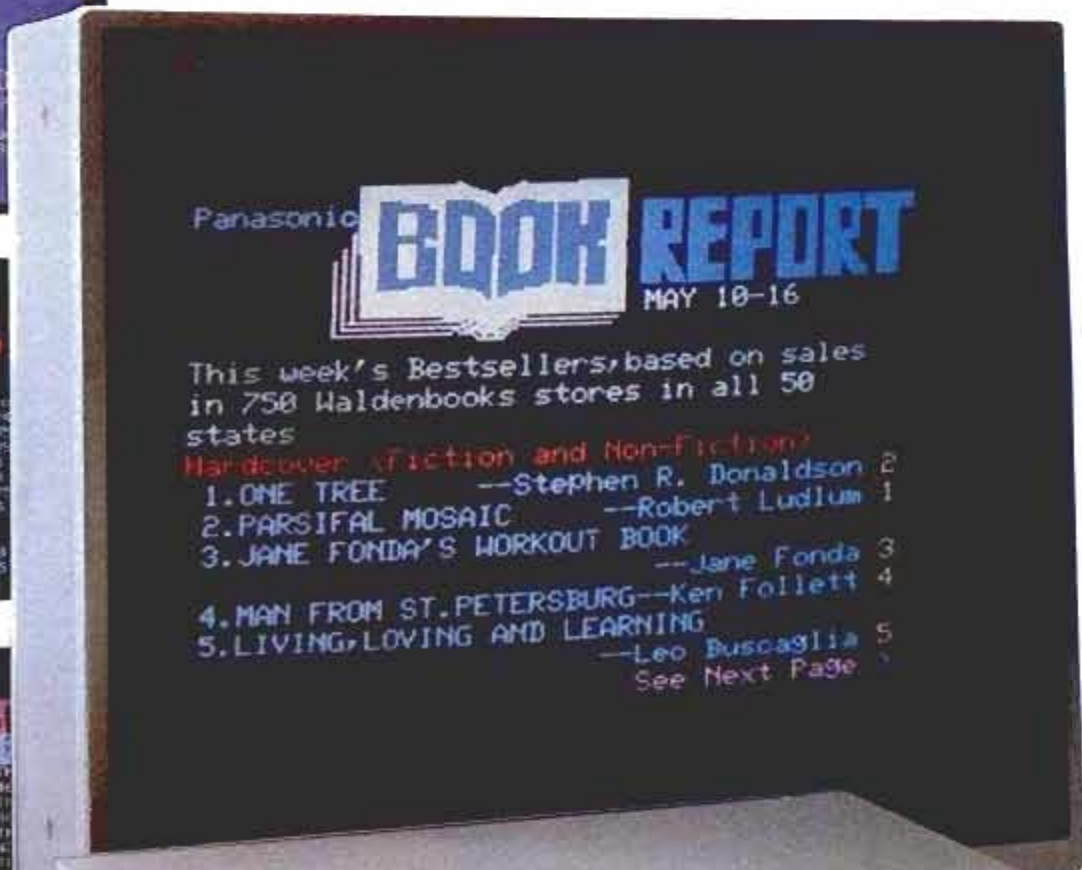
Hook your TV set or home computer to a huge database with a new videotex decoder and you'll have access to everything from stock market quotes to travel arrangements.

BY NEIL SHAPIRO ELECTRONICS EDITOR



CURRENCY REPORT	
EXCHANGE RATES, QUOTATIONS, ABOARD	
London	\$1.824
Frankfurt	2.285
Paris	1.9475
Rome	1.2705
Madrid	5.79
Amsterdam	47.77
Tokyo	234.15

Theater	
AMERICAN	212-244
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Norpak Mark IV and keypad (right) allow you to receive and manipulate screens of information. The screens are sent as encoded pulses over the telephone line, from huge computer databases. The keypad commands are then sent back on the same lines. The home color television set is used to display the screens of graphic and text information. Sample screens of Panasonic's proposed videotex service are shown above and at right.

With the addition of a new type of decoder box, your home TV can soon be bringing a whole world of knowledge, education and figures into your home. Videotex allows you to connect your TV, via the telephone line, with gigantic computer databases—without having a computer of your own.

While many U.S. experiments have been conducted, and Britain has used a service like this already, it is just now beginning to take off here. At last, it appears that the industry has settled—more or less—on how to get its act together.

Confusion resolved

There are two ways of hooking a TV to a computer database. One is called teletext, the other is videotex. Teletext is only one way: The information is sent out riding piggyback on a normal broadcast or cable TV signal. The teletext information is encoded in the signal's "vertical blanking," which is the black bar you see if you roll the picture down on your TV set. Videotex, on the other hand, is completely two way. It uses the telephone line to send digitally encoded information from the database to your home, and you can send commands back to the computer via a full keyboard or a small keypad.

Picking a standard

In England, the videotex system uses the Prestel standard. For a while it seemed that the United States, too, would go this route. But few companies wanted to gamble on one standard or another. If your database is speaking one "language" and the home TV another, the resulting scramble on the TV screen would make even the worst sitcom look visually inviting.

For years, corporate giant AT&T (Ma Bell) was not allowed legally to use the telephone lines to send data communications. In order not to be cited for monopolistic practices, AT&T agreed to divest itself of local phone companies in exchange for the right to become a computer database service.

Then, AT&T announced that it was going with videotex and using a standard called PLP, based on a previously existing Canadian standard, known as Telidon.

Suddenly, Telidon looks like the way America's TVs will become at-home data terminals. Panasonic, Sony and others recently exhibited various Telidon-standardized videotex decoders in New York at the Videotex '82 convention. Also on hand were companies like Canada's Norpak, which already has Telidon hardware in pro-

duction and is ready to supply U.S. markets.

What to expect

The type of information that these databases, both new ones and those new to the at-home user, will offer covers a broad spectrum of needs and wants—veritable on-screen almanacs.

You'll be able to read airline schedules or study the past few years' performance of any number of securities—right from your easy chair. Other databases will include such things as national newspapers, magazines, restaurant guides and all sorts of "information providers."

But because videotex lets you type in messages and commands, you can also have "interactive" services, where you and the database's computers work together. Such things as

banking at home, shopping and special-interest clubs become possible.

In fact, all of the above is already being done in the home-computer area. (See *And In The World Of Computers . . .*, below.) Such services as CompuServe and The Source offer many databases to their subscribers. CompuServe, for example, recently signed on its 27,000th subscriber.

What distinguishes new videotex services from the existing non-Telidon offerings is graphics—bright, colorful, eye-catching, even dazzling.

Walking through the Videotex '82 convention in New York was like being set down in the middle of a rainbow. Screen displays ranged from charts and bar graphs to multicolored, highly detailed pictures of everything from past presidents to cartoons. The

(Please turn to page 163)

AND IN THE WORLD OF COMPUTERS. . .



IXO's handheld terminal has its own single-line display or can be hooked up to a television set. It uses telephone lines to connect with a number of computer databases.

While videotex is just now showing up on your home TV screen, people with home computers and terminals have been enjoying such information utilities as CompuServe and The Source for a few years. Although they don't have many graphics (this may change as more Telidon equipment becomes available to consumers), they do offer a multitude of informational databases.

A home computer hooks up to a telephone line to communicate with a database computer through a device called a *modem*. Just about every computer, Apple II, TRS-80, Atari, PET and IBM, can use a modem. (See *Now Your Home Computer Can Call Other Computers On The Telephone*, page 130, Mar. '81).

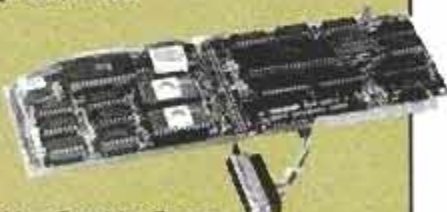
There is now also a melding of the two equipment philosophies, TV videotex and computer videotex, in the form of portable terminals. These portables use computerlike keyboards and modems, although they have no computing power of their own. And they use a TV for display, with perhaps a built-in, one-line display of their own for when no TV is handy.

The IXO terminal pictured above is hardly larger than a calculator. Yet it can access all of the text-oriented, computer databases from any telephone. The col-

ors of the keys, the scrolling display and its small size make it a very handsome unit. Units such as the IXO are the beginning of a trend.

And, with the advent of the new Telidon standards and the bright Telidon graphics, even some home computers are beginning to show Telidon capability. Norpak, for instance, has designed a Telidon plug-in accessory card for the Apple II computer. The card adds 16-color, high-resolution capability to the Apple, though the resolution is still below that of a Telidon-equipped TV.

Computers and terminals, which were the first to begin the information revolution, are now broadening its horizons. (For a first-person report on using both the IXO and the Norpak Apple II card, see this month's *PM Electronics Monitor*, page 10.)—N.S.



Telidon Graphics System plugs into the Apple II so that computer can use Telidon.

Build Our Master Craftsman's Woodworking Center

Two cabinets—a portable tool center and deluxe assembly bench—can turn your workshop into a dream shop.

BY HARRY WICKS
HOME AND SHOP EDITOR



Project design: Seth Steinn, Rhode Island School of Design; craftsmen: Roxana Caporaso, David Warren, Harry Wicks; PM (color photos: Mark Kuzlowski); Portable power tools, accessories: Sears; Roebuck and Co.; hand tools: Garrett Wade



Early in his woodworking pursuits, every woodworker realizes that he needs an assembly bench. Many craftsmen, myself included, turn to a sheet of plywood across a pair of low sawhorses to serve this function. But now, PM readers can move up in class. Our version—created by four experienced craftsmen—provides the

ultimate in furniture assembly and in storing and rolling portable power tools to the task at hand. This assembly bench is built lower to save your back when hefting projects about. Its grid top provides plenty of biting surface for clamps and, because it's on wheels, it can be rolled aside for storage. The portable tool center corrals many power tools and their accessories; like the assembly bench, it rolls on wheels.



PM's dream setup can become a reality in your own shop. Complete plans for the assembly bench and portable power tool center are on the following pages. The assembly bench has a grid top to make clamping easier than you've ever had it. For nonclamping tasks, the space is covered with a sheet of plywood (left).

A Craftsman's Assembly Bench

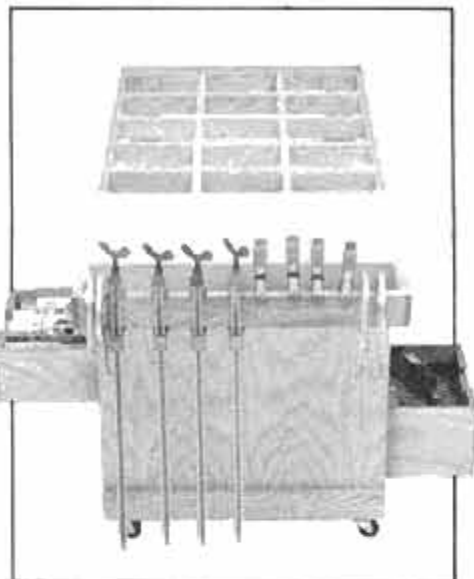
The assembly bench shown here features a removable top which exposes an open grid surface to permit easy vertical placement of clamps. The shelf below the grid can be covered with newspapers to catch glue drippings. The long shelf compartments below are great for storing clamps during assembly and they permit access from both sides.

The drawers are constructed so they can be opened from both sides, too. And the bench rides on rubber-wheeled swivel plate casters.

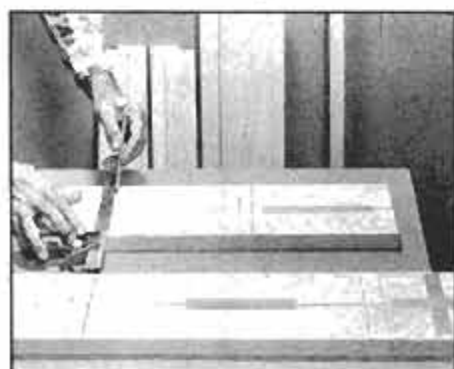
We used $\frac{3}{4}$ - and $\frac{1}{2}$ -in. white ash and

$\frac{3}{4}$ -in. plywood to build this bench and its companion piece, the portable tool center. Except for the drawers, all exposed plywood edges are banded (edged) with $\frac{1}{8}$ -in. solid stock (see drawing). Notice that the drawings indicate the overall sizes of the plywood parts. When you lay out the cutting lines, make sure you compensate for the banding by reducing the dimensions by $\frac{1}{8}$ in. or $\frac{1}{4}$ in. where applicable. For strength, edge the removable top with $\frac{3}{8}$ -in.-thick stock.

Begin with the bench top frame by cutting $\frac{3}{4}$ -in. stock to length and width.



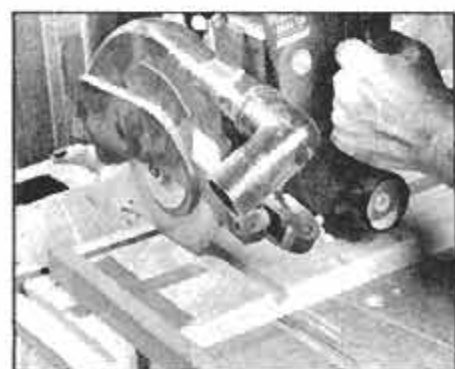
Completed bench, top removed, reveals grid which is a great aid for clamping. At near end are superhandy clamp racks.



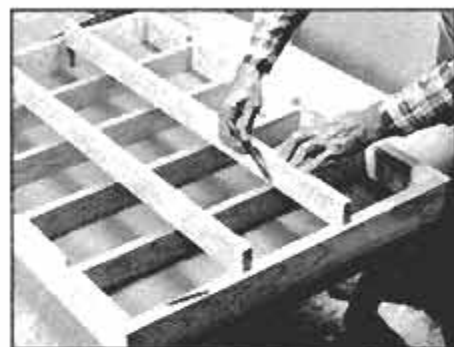
Tape paired members together to accurately mark and cut dados and rabbets.



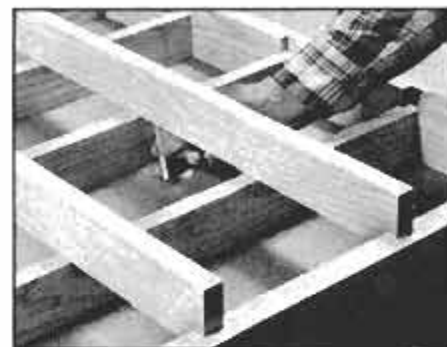
Cut a notch into a new fence to simplify alignment of cutting lines to blade path.



If work boards don't lie flat, notches will be too deep. Avoid this by clamping.



Mark the edge half-laps for grid with the parts in place. This will prevent errors.



A short pencil stub is the most accurate marking tool for reaching the undersides.



Overlapping kerf cuts form the notches. Tape permits working two pieces at once.



Use a sharp chisel to remove waste and to square the corner of the stopped rabbet.

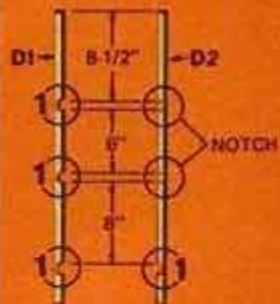


Clamp the assembled grid to bore the screw body holes into the cross members. For accuracy, you can use a square.

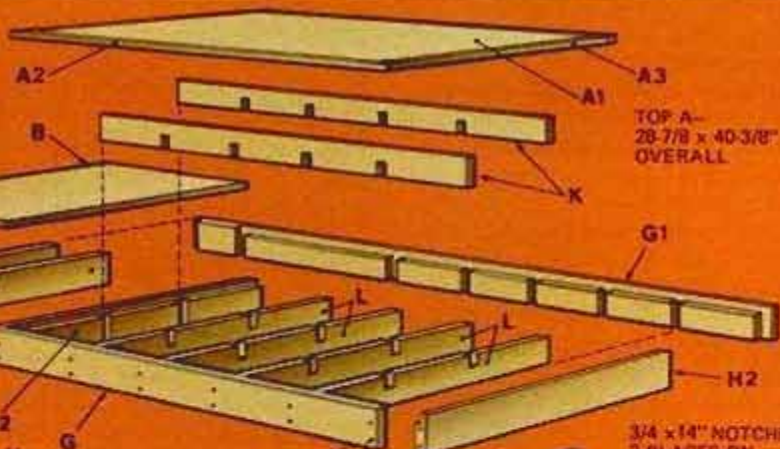


Cut your plugs of matching stock if you have a plug cutter, or use dowel slices.

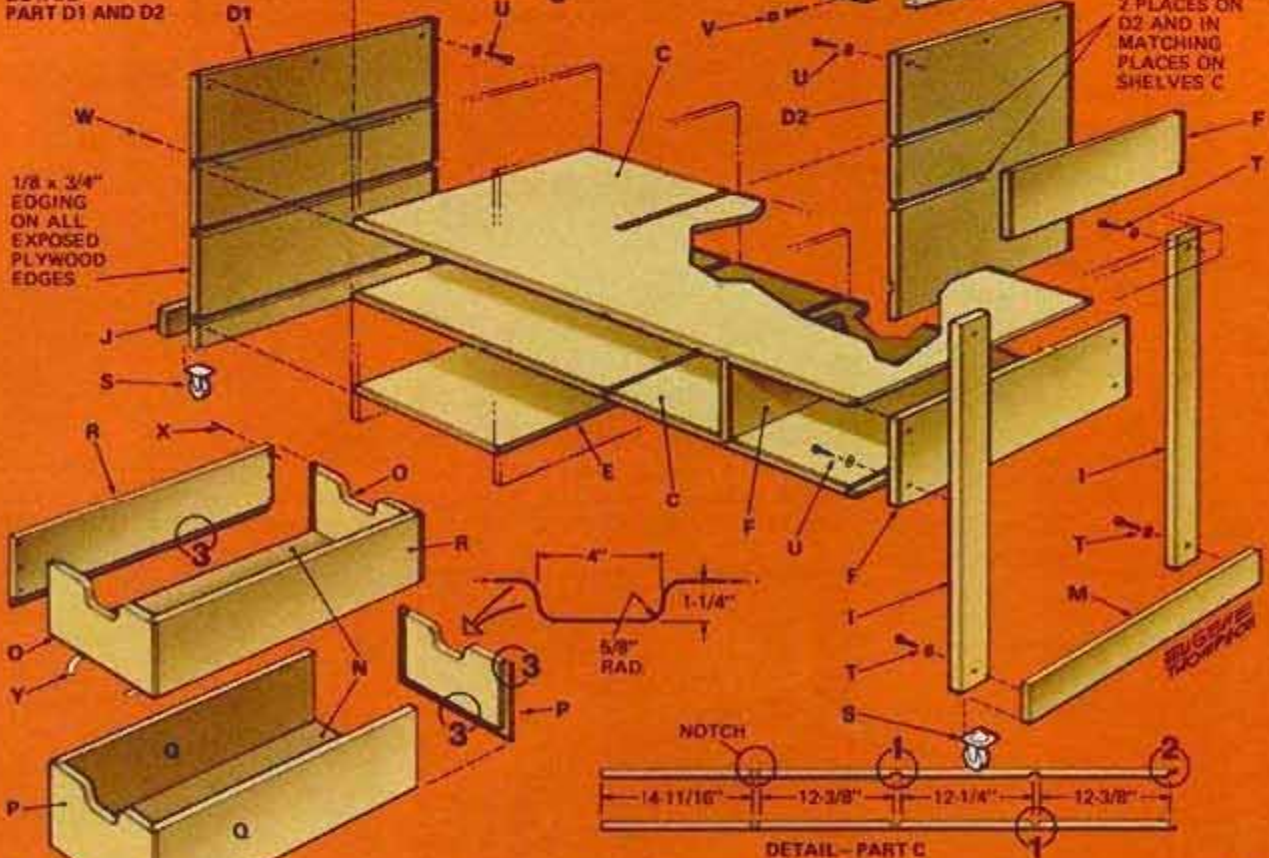
CRAFTSMAN'S ASSEMBLY BENCH



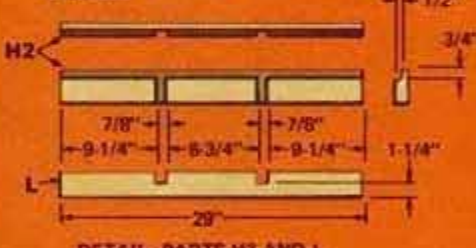
DETAIL—PART D1 AND D2



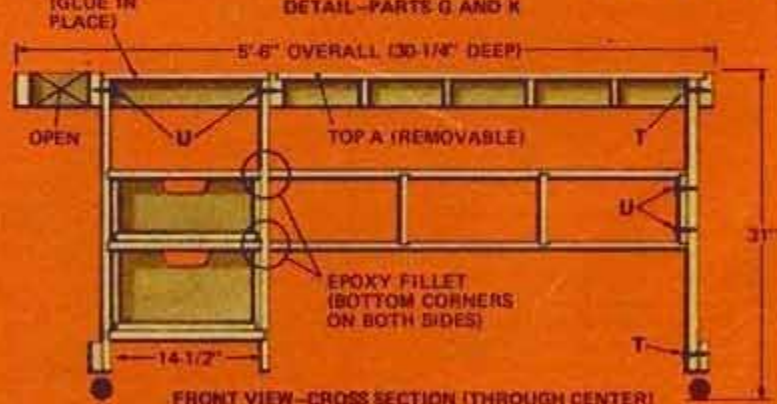
TOP A—28-7/8" x 40-3/8" OVERALL



H1 (WITHOUT DADO; 2 REED.)
H2 (CUT AS SHOWN; 2 REED.)



- NOTES:
- 1 DADO: 3/16" x 3/4"
 - 2 RABBET: 3/18" x 3/4"
 - 3 RABBET: 1/2" x 3/4"



This includes the two sides and the four cross members. Tape paired members together so they can be marked and cut at the same time (see photographs). Use a dado head on either a table or radial-arm saw to make the cuts. If you own both, the radial-arm saw's better.

Ash is a very hard wood, so set up the dado head at less than full-width capacity (about $\frac{3}{8}$ -in. maximum width) and make the cuts in several passes. If you move a clean section of fence into the cutting path on the radial-arm saw and make a cut into it, visual alignment for the cuts in the work will be quick, easy and accurate.

When the frame members have been notched, assemble them to mark the edge half-lap joints for the grid members. The grid is made of $\frac{1}{4}$ -in. stock. Lay the four short members into place and check for square with a framing square. Place the two long members on top and mark the top edges of the short cross members for the notch cuts. Then, using a short pencil stub, trace

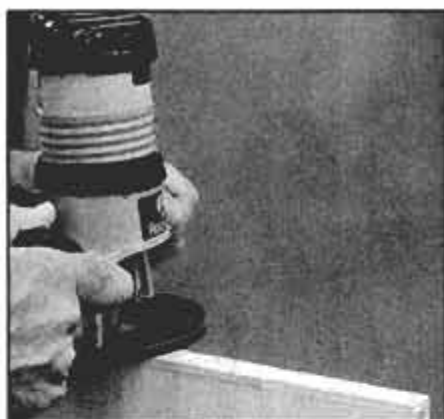
(Please turn to page 164)

MATERIALS LIST—ASSEMBLY BENCH

Key	No.	Size and description (use)
A1	1	$\frac{3}{4} \times 28\frac{1}{2} \times 39\frac{1}{2}$ " plywood (removable top)
A2	2	$\frac{3}{4} \times \frac{3}{4} \times 40\frac{1}{2}$ " solid stock (edging)
A3	2	$\frac{3}{4} \times \frac{3}{4} \times 28\frac{1}{2}$ " solid stock (edging)
B	1	$\frac{3}{4} \times 16 \times 29$ " plywood (stationary top)
C	2	$\frac{3}{4} \times 28 \times 54\frac{1}{2}$ " plywood* (shelf)
D1	1	$\frac{3}{4} \times 27\frac{3}{4} \times 28$ " plywood* (left side—drawer case)
D2	1	$\frac{3}{4} \times 27\frac{3}{4} \times 28$ " plywood* (right side—drawer case)
E	1	$\frac{3}{4} \times 14\frac{1}{2} \times 28$ " plywood* (bottom—drawer case)
F	3	$\frac{3}{4} \times 6\frac{3}{4} \times 28$ " plywood* (divider)
G1	1	$1\frac{1}{2} \times 3\frac{1}{4} \times 66$ " ash (long rail—right hand)
G2	1	$1\frac{1}{2} \times 3\frac{1}{4} \times 66$ " ash (long rail—left hand)
H1	2	$1\frac{1}{2} \times 3\frac{1}{4} \times 29$ " ash (short rail—square)
H2	2	$1\frac{1}{2} \times 3\frac{1}{4} \times 29$ " ash (short rail—rabbeted)
I	2	$1\frac{1}{2} \times 4 \times 27\frac{3}{4}$ " ash (leg)
J	1	$1\frac{1}{2} \times 3 \times 28$ " ash (side stretcher)
K	2	$\frac{3}{4} \times 2\frac{1}{2} \times 40\frac{1}{2}$ " ash (long grid stretcher)
L	4	$\frac{3}{4} \times 2\frac{1}{2} \times 29$ " ash (short grid stretcher)
M	1	$\frac{3}{4} \times 3 \times 28$ " ash (leg stretcher)
N	2	$\frac{3}{4} \times 13\frac{3}{4} \times 27\frac{1}{2}$ " plywood (drawer bottom)
O	2	$\frac{3}{4} \times 5\frac{3}{4} \times 14\frac{1}{4}$ " plywood (small drawer end)
P	2	$\frac{3}{4} \times 7\frac{3}{4} \times 14\frac{1}{4}$ " plywood (large drawer end)
Q	2	$\frac{3}{4} \times 7\frac{3}{4} \times 27\frac{1}{2}$ " plywood (large drawer side)
R	2	$\frac{3}{4} \times 5\frac{3}{4} \times 27\frac{1}{2}$ " plywood (small drawer side)
S	4	Heavy-duty 2" rubber wheel, swivel plate caster
T	4	$\frac{3}{16} \times 2$ " lagscrew, washer (for legs)
U	10	$\frac{3}{16} \times 1\frac{1}{2}$ " lagscrew (6 for sides D, 4 for end F)
V	32	$1\frac{1}{2}$ " No. 10 fh screw

Misc.: 4d and 6d finish nails, dowel plugs, sandpaper, Nyl-o-tape No. IP572 (self-adhering sliding tape), glue, wood filler.

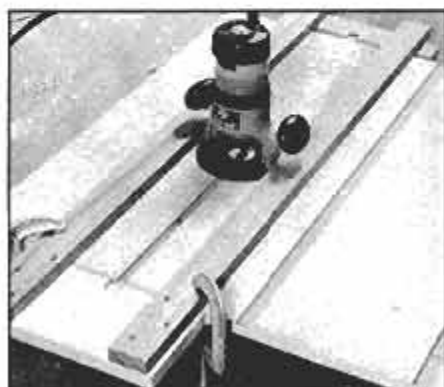
*Overall dimensions for part are given. Allow for $\frac{1}{8}$ "-thick edge-banding on exposed edges when cutting plywood to size. Note: White ash used throughout.



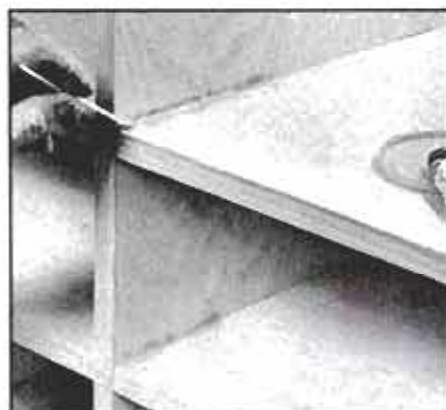
Flush trimming cutter in router trims the overhang flush with the plywood surface.



Parallel cuts halfway through panel form the deep edge half-lap notches. Use chisel or sabre saw to drop out waste.



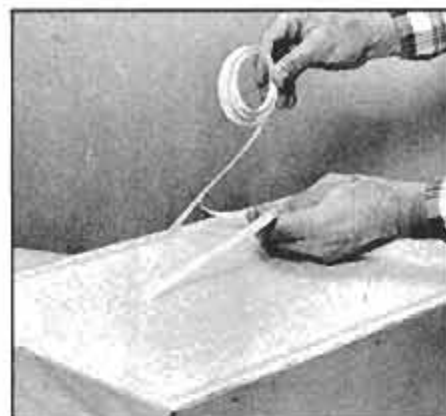
Router with simple guide makes dado cuts in the large panels. Partial cuts in cross pieces make alignment easy.



Quick-setting epoxy fillets are used to lock free ends of the panels in position.



View shows how a drill equipped with a right-angle drive is used to bore the lag-screw holes in this tight spot.



Special nylon tape is used to make drawers slide with ease. Tape is self-adhesive.



Deft's Danish Oil finish is very easy to apply; wood is simply saturated with it.



Close-up shows construction details: edge band around removable tabletop; screw-hole plugs; base-edge banding.



PM's mobile tool center is designed to corral portable tools and accessories, which are used on every shop project. Craftsman David J. Warren built it.

PM's Mobile Center For Portable Power Tools

In most home workshops, portable power tools are stashed away wherever there's room. This usually means many trips back and forth across the shop when building a project.

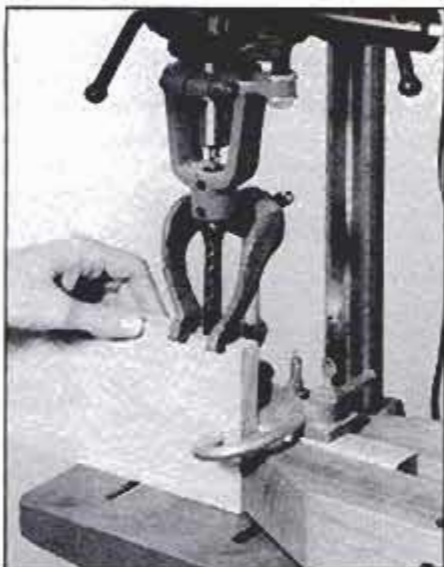
But with PM's portable tool center, you can store all your portable tools and many of their accessories in a handsome roll-about cabinet. The tools, including extension cords, are all close at hand when you're working.

Like its mate, the assembly bench, the tool center is built of two highly compatible types of ash: white ash,

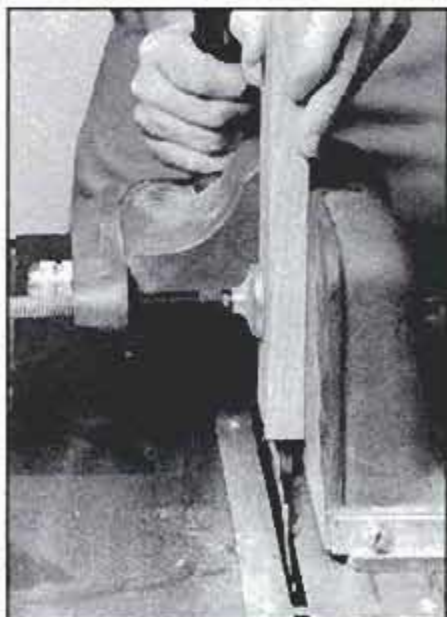
with a little brown streaking, and northern brown ash, with some white streaking. If desired, you can hold the cost down somewhat by using less expensive fir and pine.

The tool center has two parts, a base with roomy adjustable shelves and side storage panels, and a slightly smaller upper chest with six drawers. If you use ash, remember that it's a hard wood, requiring bored pilot holes for all nails used in construction.

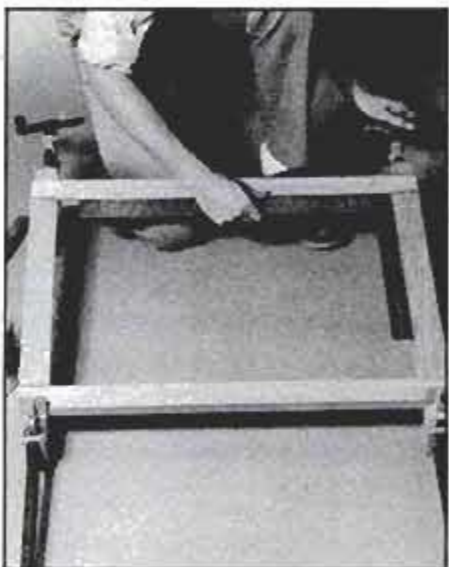
Start construction by gluing and clamping boards to make the base cab-



Mortise the facing stock with a mortising chisel; use a clamp as a stop to avoid measuring. Mortise left then right edges, and clean out center portion.



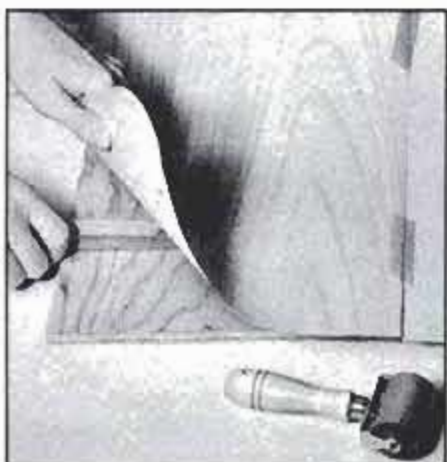
Using a tenoning jig on a table saw, tenons are quickly and safely cut square.



Glue and clamp facings, making sure they're square. Make final check for squareness by verifying that corner-to-corner diagonal distances are equal.



After facing has dried, bore 1/4-in.-dia. hole. Glue and pound in a 1/4 x 3/8-in. dowel. Sand dowel ends, stiles and rails.



Apply contact cement to the back of the veneer and to the plywood surface. Spacer sticks prevent the veneer from adhering until it's aligned with plywood.

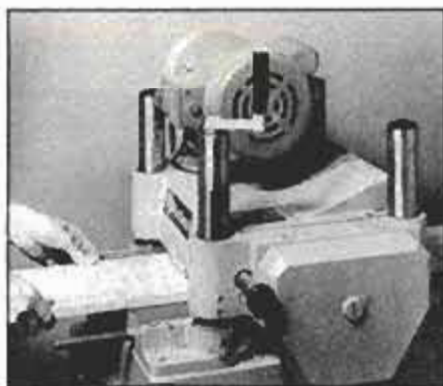


To attach facing, bore pilot holes to prevent splitting and to keep nails from bending due to the ash's hardness.

inet doors, partitions, bottom and top. Use 3/4-in. stock for the front doors, the center partition and the bottom, and 1 1/2-in. stock for the top. You can glue up long lengths, then cut two or more parts from each. To save time, you can have a millwork shop plane and sand your glued-up boards.

While your boards are clamped and drying, make the facing framework for the front and sides of the base cabinet. Cut the stock to length (see drawing on the facing page). Then, cut mortises in the ends of the horizontal stiles. Cut tenons in the vertical rails. The front center rails get a mortise to match a tenon cut at the center of the front top and bottom stiles. Glue and clamp the facing assemblies and place them on a flat surface overnight. Be sure that each unit is square. When dry, bore holes for 1/4 x 7/8-in. dowel pins, using a 1 1/4-in. drill bit to assure a tight fit.

We used 1/2-in. A/C plywood to fabricate the doors on each side of the cabinet, the side panels and the back. Cut



To create 1/8-in. lumber for sides, author used a planer. Or resaw on a band saw.



Cut sliding dovetails on drawer sides, using a tenoning jig, saw blade at 22°. Thicker stock is used as a spacer.



A practice dovetail joint was made as an exercise. The dovetails are cut first and used as a pattern for pins. Dots indicate the wood to be removed.

Clear out the dovetail socket in the drawer front with a 1/4-in. chisel. The groove located at the bottom of the drawer front accepts the drawer bottom.

MATERIALS LIST—TOOL CENTER

Key	No.	Size and description (use)
BASE CABINET		
A	1	1 1/2 x 26 x 56" ash, edge-joined (top)
B	2	3/4 x 20 x 26 3/4" ash, edge-joined (door)
C	2	3/4 x 4 x 29 3/4" ash (end stile)
D	2	3/4 x 2 x 41 1/2" ash (rail)
E	1	3/4 x 2 x 27 3/4" ash (center stile)
F	4	3/4 x 2 x 29 3/4" ash (side stiles)
G	4	3/4 x 2 x 22" ash (side rails)
H	4	3/4 x 1 1/2 x 28 3/4" ash (door side frame)
I	4	3/4 x 1 1/2 x 23" ash (door top/bottom frame)
J	1	3/4 x 22 3/4 x 47 1/2" ash, edge-joined (bottom)
K	1	1/2 x 28 1/2 x 47 1/2" A/C plywood with ash veneer (bottom)
L1	3	1/2 x 22 3/4 x 27 3/4" A/C plywood with ash veneer (partition)
L2	2	1/2 x 22 3/4 x 19" A/C plywood with ash veneer (shelf)
M	2	1/2 x 21 1/2 x 27 3/4" A/C plywood with ash veneer (side-door panels)
N	14	1/4"-dia. x 7/8" dowel pins
O1	2	1 1/2" (open) x 28 1/2" piano hinge
O2	2	1 1/2" (open) x 26 1/2" piano hinge
P1	2	3"-dia. swivel caster with brake
P2	2	3"-dia. rigid caster
Q	4	3" brass wire pull
Q2	4	roller catch
R	8	27 3/4"-long shelf support strip
CHEST		
S	2	3/4 x 24 x 52" ash, edge-joined (top/bottom)
T	2	3/4 x 15 x 24" ash, edge-joined (side)
U	1	3/4 x 13 3/4 x 23 1/2" ash, edge-joined (partition)
V	24	3/8 x 1 x 22 1/2" ash (drawer guide)
W	2	1/2 x 1 1/2 x 50 1/2" ash (drawer spacer)
X	1	1/2 x 14 1/4 x 51 1/4" A/C plywood with ash veneer (back)
Y	72	1" No. 10 fh screw (48 in chest, 24 in drawers)
Z	6	3/4 x 4 x 24 3/4" ash (drawer face)
AA	12	3/16 x 4 x 21 3/4" ash (drawer sides)
BB	6	3/16 x 3 1/2 x 22 1/4" ash (drawer back)
CC	6	1/4 x 21 1/2 x 22 3/4" A/C plywood with ash veneer (drawer bottoms)
DD	12	1/16 x 7/8 x 21 1/4" ash (slide)
EE	6	brass bail pull

Misc.: Carpenter's glue, 10d finish nails, 16 3/4" No. 12 rh screws (16, for casters), 16 1/2" No. 8 fh screws (16, for shelf support strip), filler, sandpaper, Deftco Danish Oil finish, walnut stain.

Note: Use white ash and northern brown ash.

the plywood to size, as per the drawing, then top it with ash veneer, applying contact cement to both surfaces. Place sticks or dowels between the plywood and the veneer to help position the veneer before the two cemented surfaces come in contact. When the veneer is in place, apply pressure and roll it smooth with a roller, or use a wooden block and hammer.

Next, cut 3/4 x 1 1/2-in. stock to lengths required for the side door frames and miter each end. Glue, nail and clamp to surround the side door panels, fitting the door flush with the exterior edge of the frame.

Your glued-up boards for front doors, bottom and the center partition, as well as the board for the top, should now be surfaced and ready for use. Cut out the components as shown in the drawing and start assembly, using 6d finishing nails and glue. Remember to bore pilot holes for the nails to avoid splitting your ash stock.

Nail the partition and the sides to the bottom, then attach the back panel to square the entire assembly. Finally, install the front facing frame, which you have previously glued and clamped square. For now, don't install the top—finishing will be easier with it off.

Like the assembly bench, the tool center was finished with Deftco Danish Oil. The tone on both was obtained by mixing 25 parts natural to one part medium walnut. To this you can add a few drops of McCloskey Mahogany Tung Oil stain for warmth.

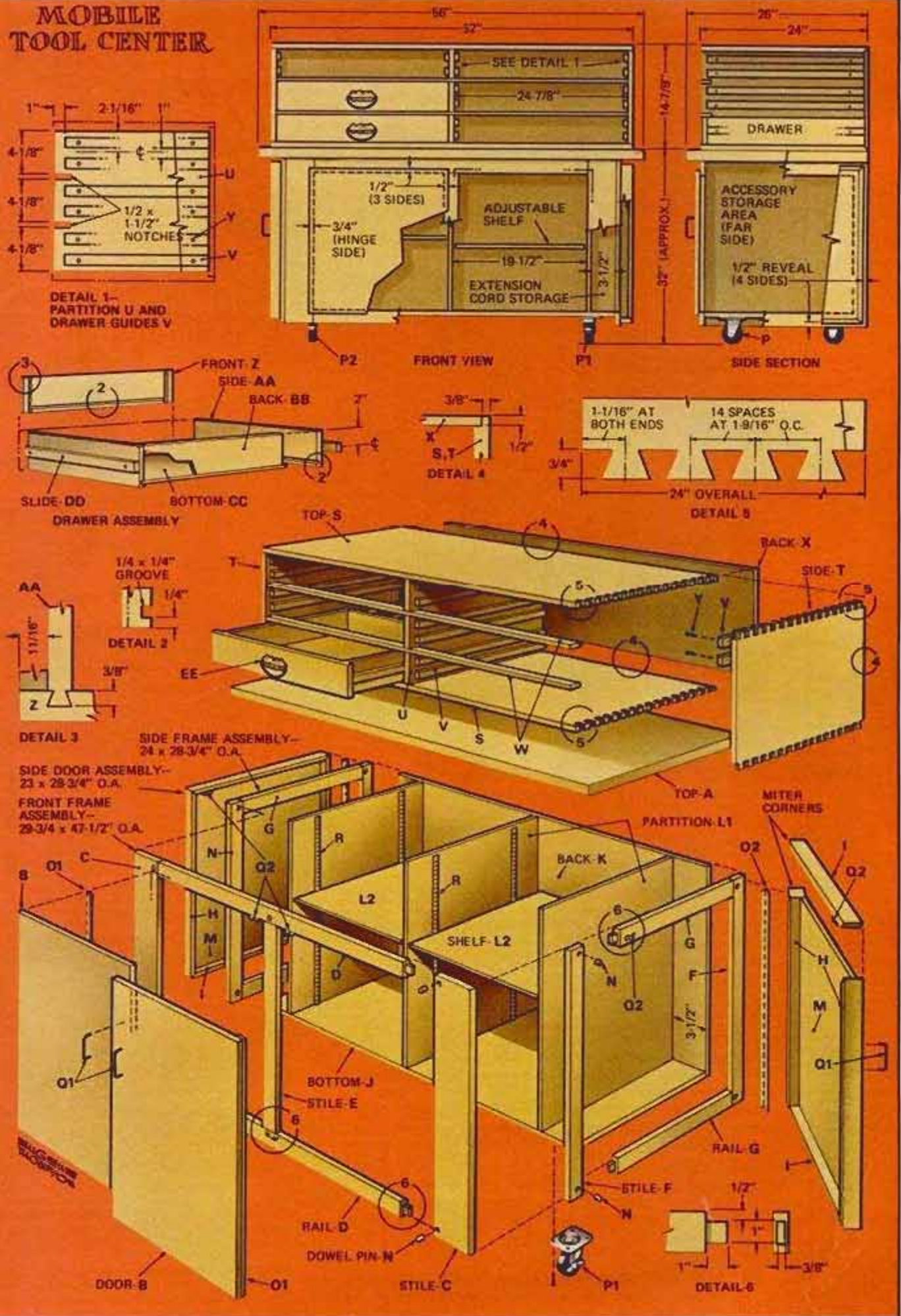
To complete the cabinet, install metal shelf support strips on the center partition and sides. Use a 4-in. block to position each strip. You might want to bore a series of holes for shelf clips instead of using metal strips. If so, make a template of your hole pattern and use it to mark the holes for boring.

Next, turn the cabinet upside down and apply heavy-duty industrial casters, preferably with wheel locks, to each corner. Use two fixed wheels at one end and two swivel casters at the other end. Then, place the cabinet upright, attach the doors with piano hinges and affix the door catches. Attach the top and use wax stick filler to fill all 10d nail holes.

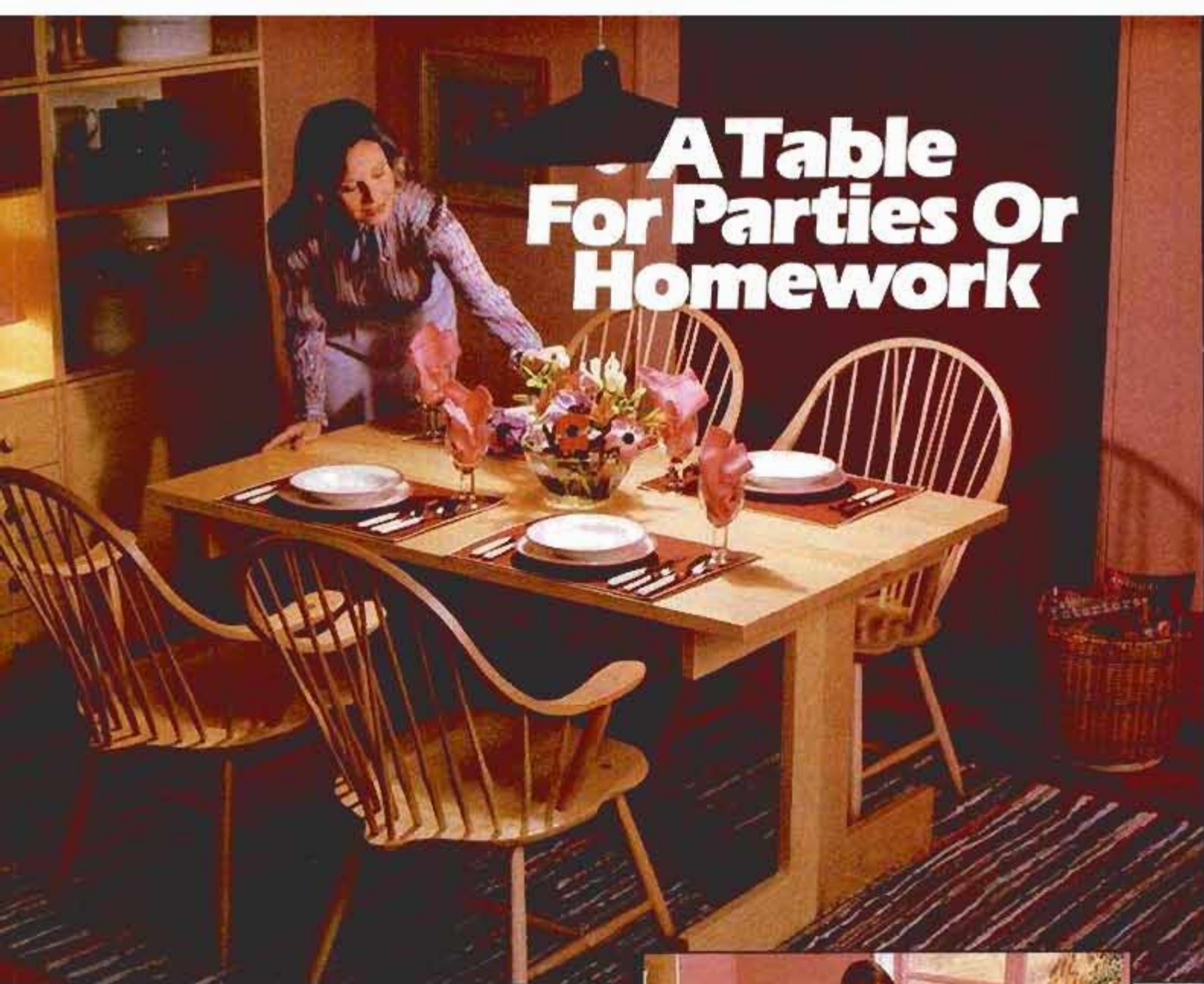
As a final touch, you can add a fused electrical outlet strip to the face of the cabinet. If you do, keep the cord short, so it doesn't drag on the floor and catch under the wheels.

Your base cabinet is complete and (Please turn to page 165)

MOBILE TOOL CENTER



A Table For Parties Or Homework



This handsome dining table seats four. Lower the drop leaf and you have a desk.

This elegant contemporary table does triple duty. Besides serving as a dining table, it converts for use as a desk or sideboard when the leaf is down. If you're diligent, you can probably build this project in a weekend.

The table is made of $\frac{3}{4}$ -in.-thick sugar pine. We used 15-in.-wide boards and added 3-in. strips, dowel reinforced, to make up the 18-in. slabs.

The legs are assembled with end half-lap joints. Arrange the leg members in proper order on a flat work surface and key all mating pieces. After the edges have been smoothed by jointing, trace against each butted piece directly to obtain the cutting lines.

Use a dado head to reduce the lap-joint areas to half thickness. When using a radial-arm saw, make a pass in a new section of the backup fence. Then align the joint line visually (on the

PM's adaptable dining table/desk is built of hefty 1½-in. sugar maple. Because this wood is so attractive, the table was completed using a clear finish to show it off. Plans for making it are on facing page.

workpiece) with the notch cut in the fence. Make one cut to establish the inside shoulder. Then make repeated cuts to remove the waste. If you use a table saw, cut a piece of scrap wood, then mark the cutting path on the table insert plate.

Note: Do not use a clamped limiting stop for making the cuts. A fixed stop won't compensate for variations in individual widths resulting from the sawing and jointing processes.



Partially drive a few thin nails when gluing the leg half laps to keep the parts from sliding during clamping. Allow room for clamp cushions. You

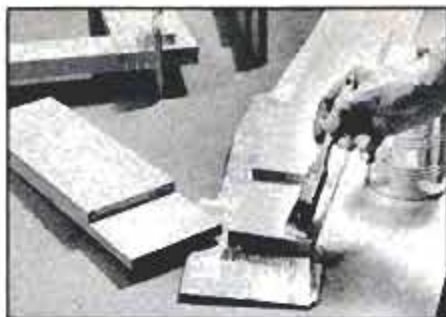
Construction, black and white photos: Rosario Capotosto; PM color photo: Harry Hartman Studios; Stylist: Gabe Herrick; PM technical art: Eugene Thompson

Wall unit, chairs, lamps, rug and accessories: Conran's, 145 Huguenot St., New Rochelle, N.Y. 10801; Window blinds: Kirsch Mini blinds, Kirsch Co., Sturgis, Mich. 49091

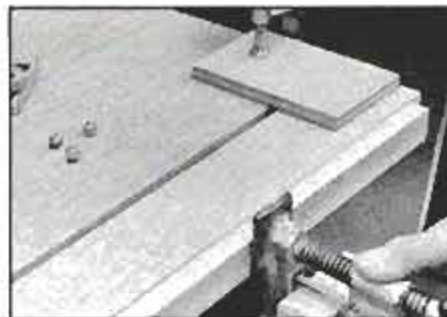
can remove the nails and fill the holes afterward.

Now, adjust the jointer for a shallow cut and make a pass or two to trim the hinge edges of the leg stiles (C). Cut a small chamfer on each back corner before jointing to prevent end grain splintering. Use a belt sander to smooth the faces of the legs. Sand with the grain only. To smooth any cross-grain scratches, use a finishing sander.

If you must edge-join boards to make the top and leaf, use dowel centers to mark the hole centers before using a
(Please turn to page 129)



Apply glue to mating leg surfaces. Use second coat on end grain (shoulders). Temporarily tack parts for clamping.

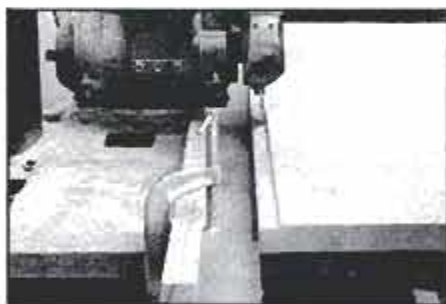


Clamping setup assures a true plane of boards when making dowel-hole center marks. Use a dowel center in each hole.

MATERIALS LIST—TABLE

Key	No.	Size and description (use)
A	2	1 1/2 x 18 x 56" sugar pine (tabletop and leaf) or assemble from: 2 pieces, 1 1/2 x 15 x 56" (A ₁); 2 pieces, 1 1/2 x 3 x 56" (A ₂); 10, 1/2"-dia. x 2" dowels (A ₃)
B	4	1 1/2 x 5 x 17 1/4" sugar pine (leg foot)
C	4	1 1/2 x 4 x 28" sugar pine (leg stile)
D	4	1 1/2 x 4 x 17 1/4" sugar pine (leg rail)
E	1	1 1/2" (open) x 55 1/4" hinge
F	2	1 1/2" (open) x 27 1/2" hinges
G	4	3" No. 12 fh wood screw
H	4	1/2"-dia. dowel plug
I	6	Nylon tack guide

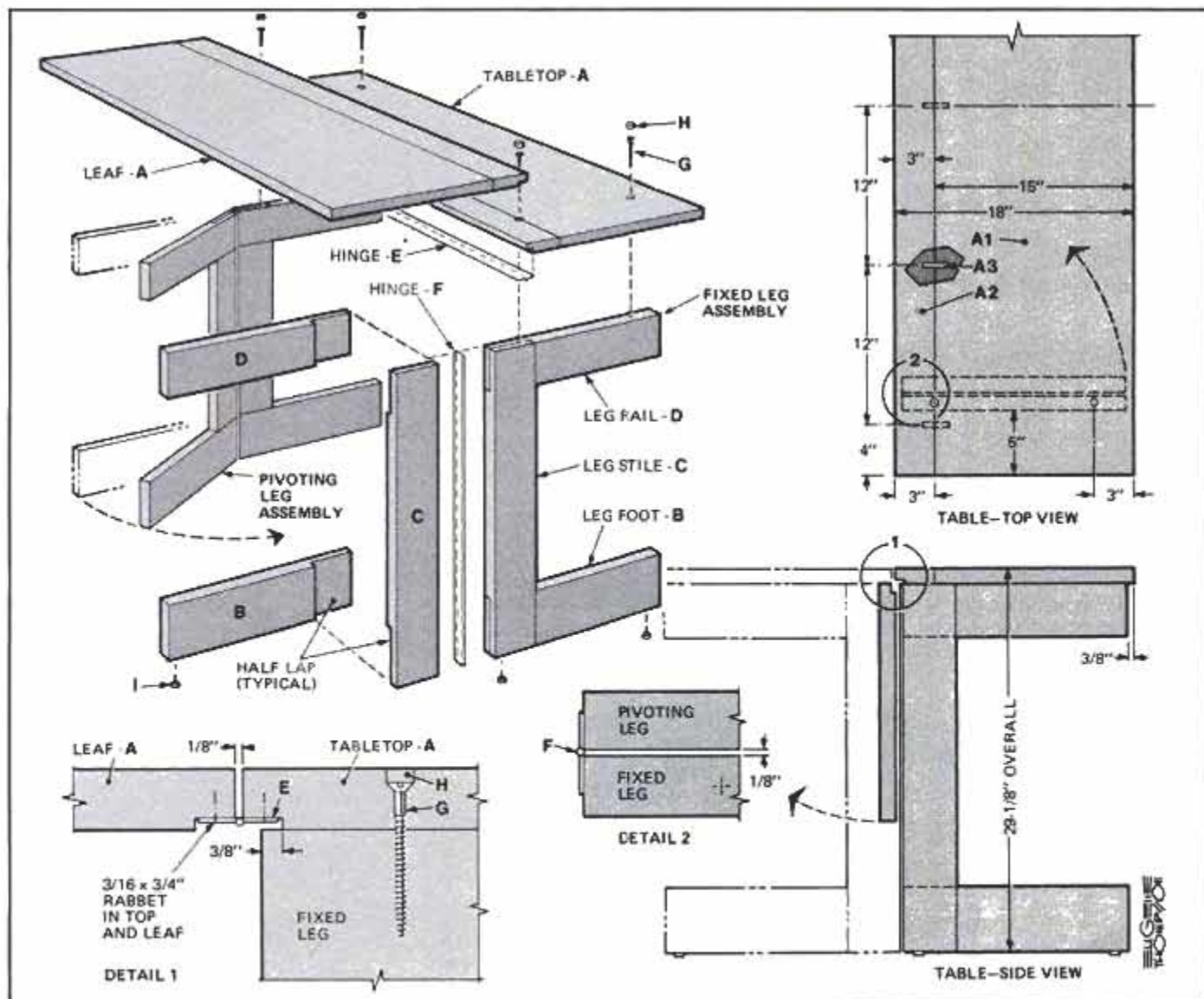
Misc: white glue; 120- and 180-grit sandpaper, finish (see text).



To edge, rabbet with the radial-arm saw. Use a spacing strip to position the work so that it's clear of the fence board.



After boring screw holes in tabletop, clamp legs to it. Continue boring from below into legs. Trim the leg later.



PM LOOKS AT...

Shaker Rocking Chair Kit

Being a person who builds between 20 and 25 large projects a year, it's a treat when I can simply put together a furniture kit. The rockers shown, which are sized for youngsters, sell for \$115.50, plus \$6.25 shipping from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013. (An adult-sized chair is available for \$139.00 plus \$6.25.) The kit chairs are precisely machined of solid Rock Maple and the back slats and legs are precurved.

Because of the precurving, it's necessary to shape the last 1/2 in. of each slat so it will enter its mortise fully. After assembling the front and back leg sections, bore through several of the holes to clear the dowel ends at 90° (photo, bottom left). The two kits I assembled went together without a hitch.

I finished one with a stain, then used the penetrating oil in the kit. The other one was painted and completed with a coat of semigloss varnish — *Harry Wicks, Home and Shop Editor*



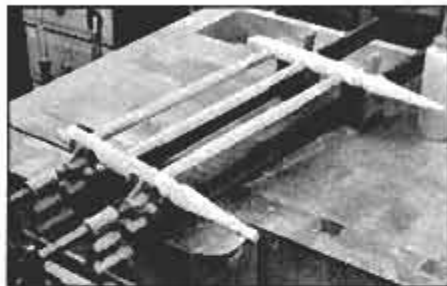
Pair of elegant Shaker rockers were assembled in two evenings. Weaving the seats took another hour or so. Chair at right is stained and varnished; the other has an antiqued, painted finish to simulate age. Paint, in turn, is protected with varnish.



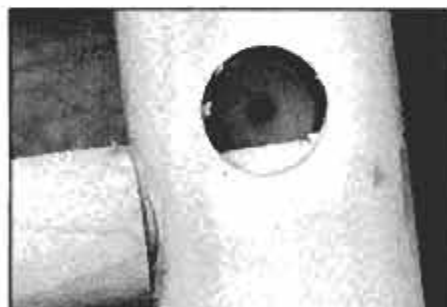
Back slat ends required a little reshaping (due to steam bending process). Surform Shaver does job quickly and accurately.



Last 1/2 in. or so at both ends of back slats were then sanded slightly before joining.



After a dry test fit, spindles and dowels are glue-joined. Clamps are used to pull the joints as tightly closed as possible.



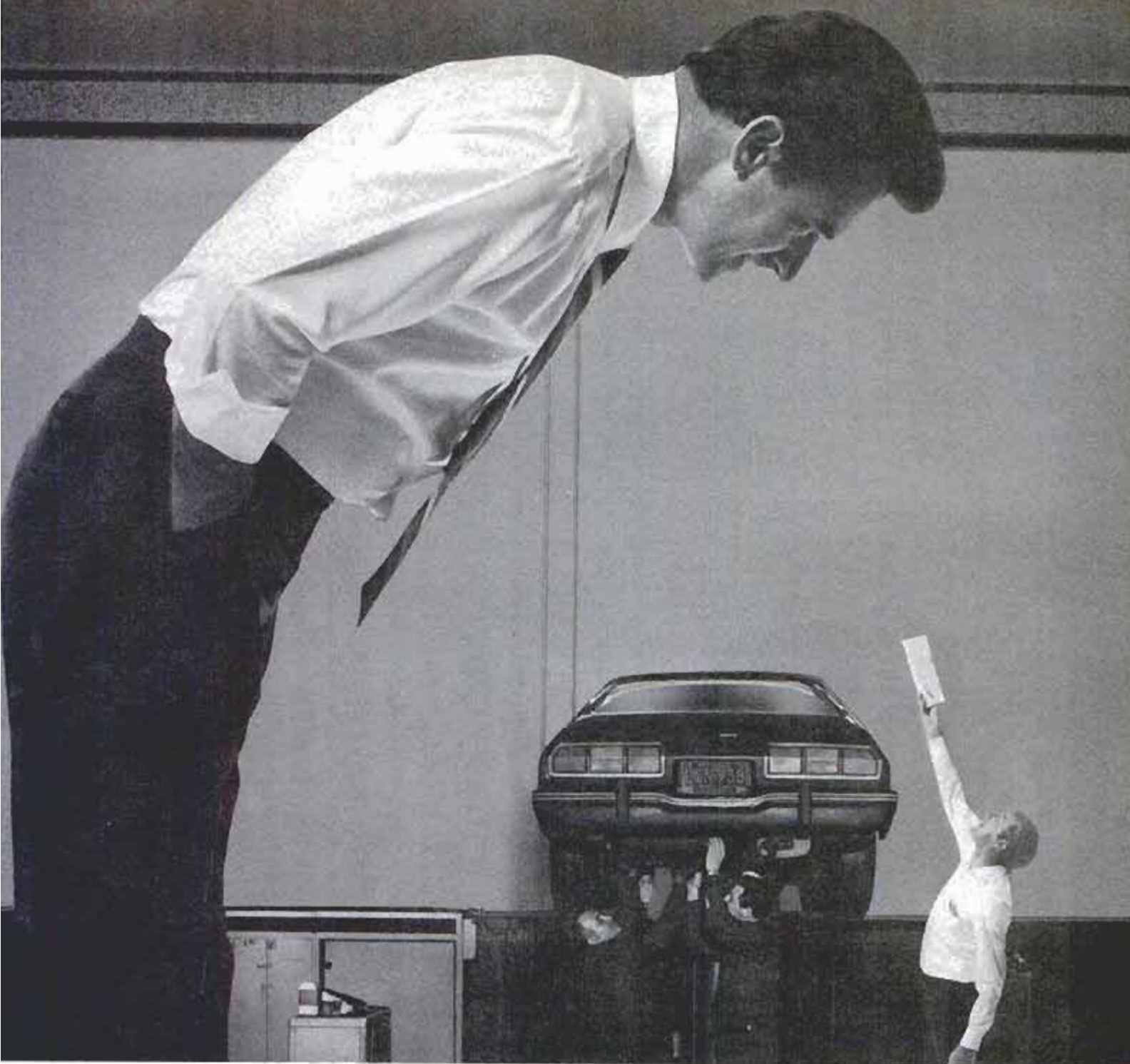
In some locations dowels will interfere with socket on adjustment face, as here.



Clear holes to bottom using a 1/2-in. bit.



Rockers are installed using (provided) screws only, no glue, just as Shakers did.



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The Right Way To Choose And Use Solvents



Random sampling of available solvents illustrates why picking one isn't always easy.

The correct solvent simplifies a job; the wrong one can ruin it or even lead to injury. Here's how to select.

BY BERNARD GLADSTONE

Chances are that hardly a day goes by at home or in your shop that you don't use a solvent of some kind, even if it's water—one of the oldest and most widely used solvents.

By definition, a solvent is a liquid that dissolves things to create a solution. For most of us, it's also a thinner (although there are technical differences).

The solvents that are sold in your local paint, hardware, auto accessory and marine supply stores are almost always organic compounds derived from petroleum or by-products of petroleum-based compounds. Many have long and strange-sounding names that would probably mean nothing to a store clerk if you asked for them by chemical name.

However, the most widely available and most useful of these solvents have

generic or "common" names that are familiar to most of us. The so-called common names are not always accurate, and don't always mean the same thing to everyone who buys, sells, and uses solvents. To avoid misunderstanding, it pays to be familiar with the most widely available and most useful solvents, and to know something about when, where and how to use each.

Most solvents can be used for more than one purpose. However, some are more useful for thinning paints, while others are more useful for either cleaning or removing finishes.

There are about a dozen generally available solvents that you will find useful. These are labeled with generic names that you can recognize (or that you can identify easily by reading the contents listed on the label).

Safety first

Since many of these substances are highly flammable and emit toxic fumes, observe strict safety habits when working with any solvents.

- Work in a well-ventilated room.

- Wear gloves and/or respiratory protection if required.

- Always read the manufacturer's instructions before you open the can.

Turpentine

One of the few common solvents not derived from petroleum (it's distilled from the sap of certain coniferous trees), turpentine is used principally for thinning oil- or alkyd-base paints. Contrary to popular opinion, turpentine (turps) is never actually used by manufacturers in formulating paint. One reason is that turpentine is more expensive than the other available solvents. However, there are also other technical reasons why manufacturers prefer one of the petroleum-based thinners, such as mineral spirits or VMP naphtha.

Another popular misconception is that turpentine is better than the less expensive, petroleum-based thinners for thinning paint. It is true that turpentine is a more powerful solvent; that is, it has more solvency than other paint thinners. But this can be a drawback. You have to be much more careful about the amount you use. If you add a little too much turpentine, paint can be overthinned, causing it to run and/or drip when it is applied.

Bernard Gladstone is Home Improvement Editor for *The New York Times*.



Although many makers of wood fillers recommend thinning the compound with their own brand of solvent, lacquer thinner can sometimes be used for this job.

This ability to thin or dissolve paint more effectively does have one advantage: Turpentine is more effective at cleaning brushes and rollers than most other types of paint thinner (although it is still not as good as a solvent that is made specifically for cleaning brushes). However, turpentine won't soften hardened paint; it only dissolves paint that is still soft and not fully cured.

Mineral spirits and varnolene

Also called "white spirits" or "subturps" in some areas, mineral spirits is the solvent used in most brands of paint thinner sold over the counter in local paint and hardware stores. Odorless paint thinner is much the same, except that it is treated to remove or mask the odor. These solvents have less of an odor than turpentine.

Mineral spirits and varnolene are refined petroleum distillates with a low aromatic hydrocarbon content and a higher flash point (less flammable) than naphtha and similar solvents that are sometimes used for thinning paint. It also is less volatile, so it doesn't evaporate as fast. This helps improve working qualities by making it easier to



You can use this odor-free, commercial paint thinner to thin oil or alkyd-base paints. Mineral spirits is the solvent in this product that thins the paint.

spread on the paint or varnish without leaving lap marks.

Like turpentine, mineral spirits can be used for cleaning brushes and rollers, but only if used immediately after you stop painting. Turpentine will soften a brush that is partially hardened if you soak it first, but mineral spirits generally won't; it only dissolves paint that is still liquid.

These petroleum distillate solvents can also be used as a cleaning and degreasing solvent to remove or dissolve grease and oil when cleaning metal, masonry and similar surfaces.

Naphtha

Very often, this is sold under the name of VMP naphtha (stands for "Varnish Makers' and Painters' " naphtha) or benzine. Naphtha can be used for thinning many oil-base paints, but its most popular use is to clean and degrease. As a general rule, it is better to use mineral spirits for thinning paint unless the label on the paint can specifically says that naphtha or VMP naphtha can be used.

Naphtha is more volatile than mineral spirits and turpentine, so it tends to



Use 1,1,1-trichloroethane to clean and degrease metal. For example, use it to clean typewriter type and machine parts. It also dissolves tar, oil and adhesive.

make paint dry faster. It also has a higher solvency rating, so it will thin paint more than the same amount of other thinners, though it's more flammable. Wear gloves and a respiratory mask when you work with naphtha.

Lacquer thinner

This substance is actually a blend of various solvents, such as acetone, toluene, ketone and others. There is no standardization of formulas, so not all brands are the same. However, as the name implies, the main use for lacquer thinner is to thin lacquer and lacquer-based synthetic finishes, as well as to clean brushes used in lacquer. It is also useful for thinning fast-drying wood plastic patching compounds.

Lacquer thinner is also a pretty good all-around brush cleaner. It will soften or break up most paints, as well as lacquer, even after they have hardened. In fact, if you spill or drop some lacquer thinner on a painted or varnished surface, it will blister and raise the finish almost immediately.

You can also use lacquer thinner to clean off excess adhesive when working with cements and adhesives that



A semipaste paint and varnish remover partly dissolves stain and varnish on this desk drawer for removal by scraping. Then surface is neutralized with water.



When you can't scrape paint off with a razor, it can be removed from glass and metal with acetone. It evaporates fast and is best for removing spatters.



This spot remover sprays on clear, then dries to a white powder to lift spots in clothing and upholstery. The cap is a brush used to remove the powder.

have a solvent base. As it will attack many plastics, be careful where and how you use it. It is much more flammable than regular paint thinners or turpentine, and evaporates much faster when left in an open container.

Alcohol

The type of alcohol we are talking about here is denatured alcohol (not medicinal or rubbing alcohol). It is used for thinning shellac and shellac-base sealers, and for cleaning brushes and tools that have been used in shellac.

Unlike some types of thinners, alcohol will soften dried shellac, no matter how old it is. It will soften a brush that has been used in shellac. It is also useful for removing light pencil marks from raw wood.

Other useful solvents

Acetone. One of the main ingredients in most lacquer thinners, and in many paintbrush cleaners, acetone is a very strong solvent and one of the most volatile. Although it can be used to thin lacquer and some synthetic finishes, it generally does not make a good thinner because it evaporates too fast. It is a major ingredient in many paint and varnish removers (and the principal ingredient in nail polish remover).

You can use acetone as a remover on small jobs. But it evaporates so fast that it is not effective except for removing spots.

Acetone, similar to lacquer thinner, is highly flammable. Its main use around the shop is when working with polyester resins and fiberglass. It is often recommended as a thinner for these products, and it is normally the best solvent for cleaning off tools and equipment when working with these



Solvents made for cleaning hands won't remove needed body oils as they clean. This waterless one foams on and wipes off to remove grime, grease and stains.

materials. It is also an effective solvent for removing excess plastic cement. It is almost the only solvent you can use to soften and remove one-drop or instant-type glues (the cyanoacrylates).

Acetone will dissolve many plastics and synthetic fabrics, so you have to use it carefully. It will soften and sometimes attack nylon. Therefore, you shouldn't use a nylon brush to apply any material that has acetone in it, or that uses acetone as a thinner. You can



Store solvents in a lockable metal cabinet out of a child's reach. Flammable solvents, especially, should be kept in a metal cabinet, preferably out of the house.

SOLVENTS—USES AND LIMITATIONS

Solvent	Flammable	Principal uses	Drawbacks
Turpentine	Yes	Thinning oil, alkyd paint and varnish; cleaning brushes and rollers	Strong odor; expensive
Mineral Spirits or Varnoline	Yes	Thinning oil, alkyd paint and varnish; cleaning brushes and rollers	Won't soften brushes that have started to harden
Naphtha (Benzine)	Very	Spot removal; degreasing; thinning paint	Highly volatile; very strong odor; wear gloves and face mask
Lacquer Thinner	Very	Thinning lacquer and some patching compounds; brush cleaning; grease removal	Evaporates very rapidly; attacks some plastics and many finishes
Denatured Alcohol	Very	Thinning shellac; cleaning shellac brushes	Softens shellac; affects some finishes
Acetone	Very	Thinning resins used with fiberglass; cleaning tools used with resins and some adhesive cements	Very volatile; attacks all finishes and most plastics; attacks nylon brushes; strong odor
Methylene Chloride	No	Removing paint and varnish	Tough on skin; attacks all finishes and plastics
Perchloroethylene	No	Cleaning; degreasing; spot removal	Fumes can be mildly toxic in confined quarters
1,1,1-Trichloroethane	No	Cleaning; degreasing; spot removal; dry cleaning	Fumes can be mildly toxic in confined quarters
Kerosene	Yes	Thinning asphalt paints for slower drying times	Strong odor; can irritate skin; leaves oily film

use it on natural bristle brushes, or those made of polyester filaments.

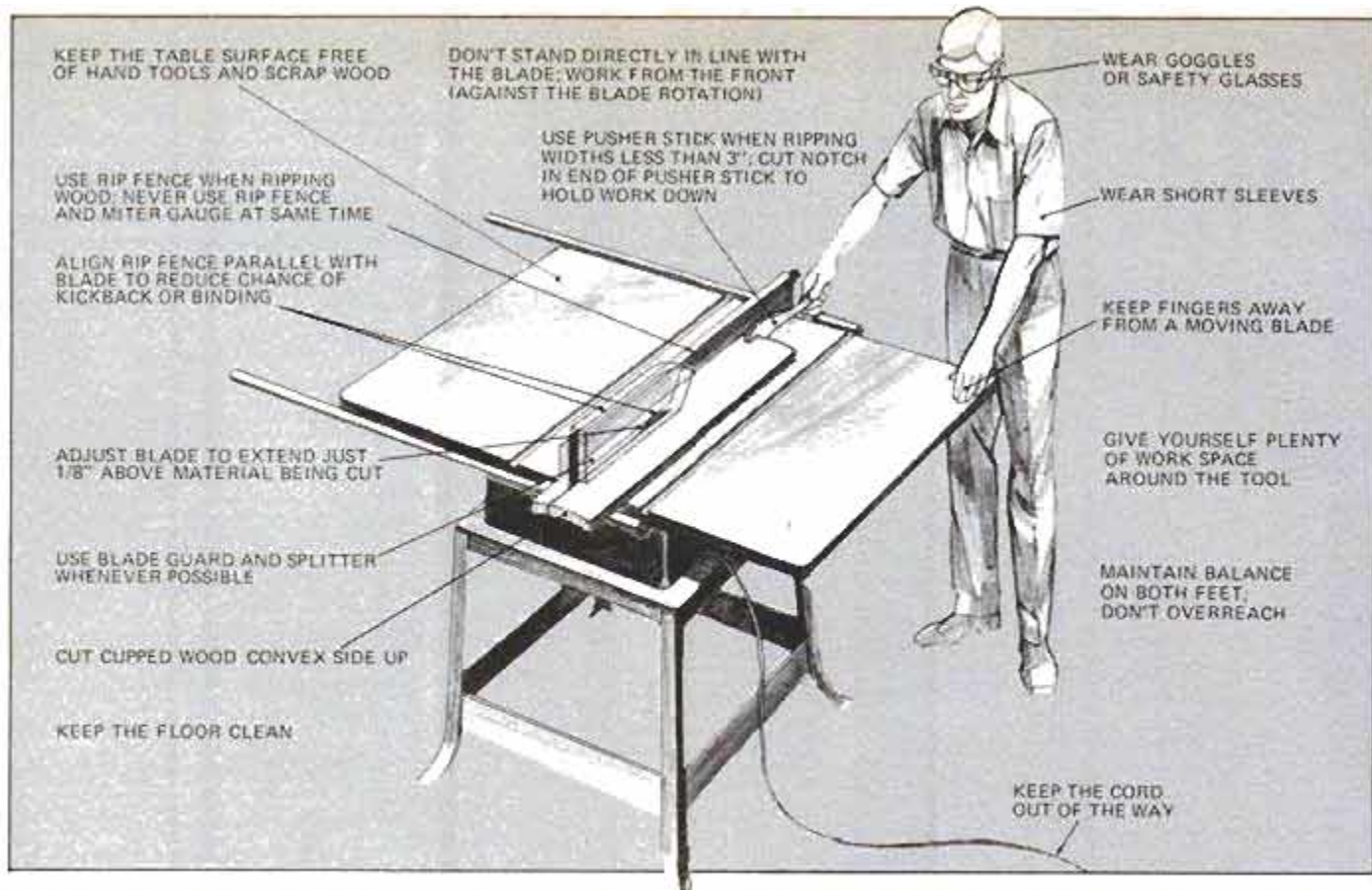
Methylene chloride. If you go into your local paint or hardware store and ask for this by name, you'll almost certainly get a blank stare. However, this is the principal ingredient in most modern paint and varnish removers.

It is a very powerful solvent that will soften most old paints and finishes. But it is almost always combined with other ingredients such as acetone, isopropyl alcohol, ethyl alcohol and one or two other solvents in order to improve working qualities, or to make it more effective on some hard-to-remove finishes such as epoxy.

Perchloroethylene. Here's another useful solvent that you really can't ask for by chemical name. However, you will find it listed as the principal ingredient on the label of many cleaning and degreasing solvents. Often labeled as a cleaning fluid for general use on fabrics and other materials around the home, it is the product that has taken over as a replacement for carbon tetrachloride since that dangerous solvent was removed from the market.

While still marginally toxic, the fumes given off by perchloroethylene are not nearly as dangerous or as toxic as carbon tet. It isn't flammable. It is an

(Please turn to page 130)



How To Avoid The Most Common Shop Accidents

PM looks at tool-related accident statistics and tells you how to avoid becoming one of them.

The old adage that a tool is only as good as the person using it has a corollary that applies to workshop safety: A tool is only as safe as the person using it.

According to the National Injury Information Clearing House (information service of Consumer Products Safety Commission), there were over 250,000 tool-related injuries in home shops in 1981. Based on this information, we have divided the most common shop tools into three categories and listed the tools in order of accident frequency—from the greatest to the least. For each tool, we detail safe methods and warn against unsafe practices that lead to accidents.

Injury statistics are a sobering consideration for everyone who enjoys shop work. Probably the two greatest causes of shop accidents are lack of concentration and lack of tool knowledge. You should become completely familiar with every tool that you own.

STATIONARY SHOP TOOLS

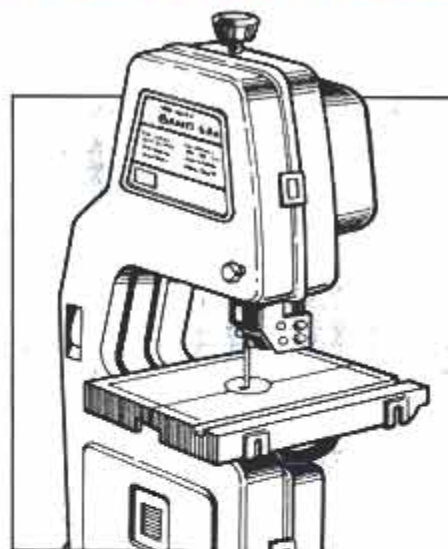
Table Saw

Follow the rules in the drawing above, and observe these, too:

- Hold the workpiece down as you push. When a push stick isn't needed, lock the last two fingers of the hand doing the pushing over fence; hold work down with other fingers, push with thumb against trailing edge.
- Never start the saw with its blade touching material.
- Be sure the edge riding against the rip fence is straight and smooth.
- Never hold the cut-off piece when crosscutting or ripping.
- Use only sharp blades.
- Disconnect cord to change blade.

Band Saw

- Use sharp blades only.
- Maintain correct blade tension.
- Use proper blade for material.
- Do not force work when cutting.
- Do not twist blades to cut curves.
- Adjust blade guide within 1/4 in. of top of stock to minimize blade exposure.
- Use miter gauge or fence to push



stock through when making straight cuts. Never push stock with fingers in line with the blade.

- Wear safety glasses.

Lathe

- Keep chisels sharp.
- Position the tool rest properly for each tool. Use turning tools at correct angles, and don't take oversized bites.
- Check for clearance by turning the workpiece by hand before turning on lathe.

(Please turn to page 124)

CAMEL

Where a man belongs.



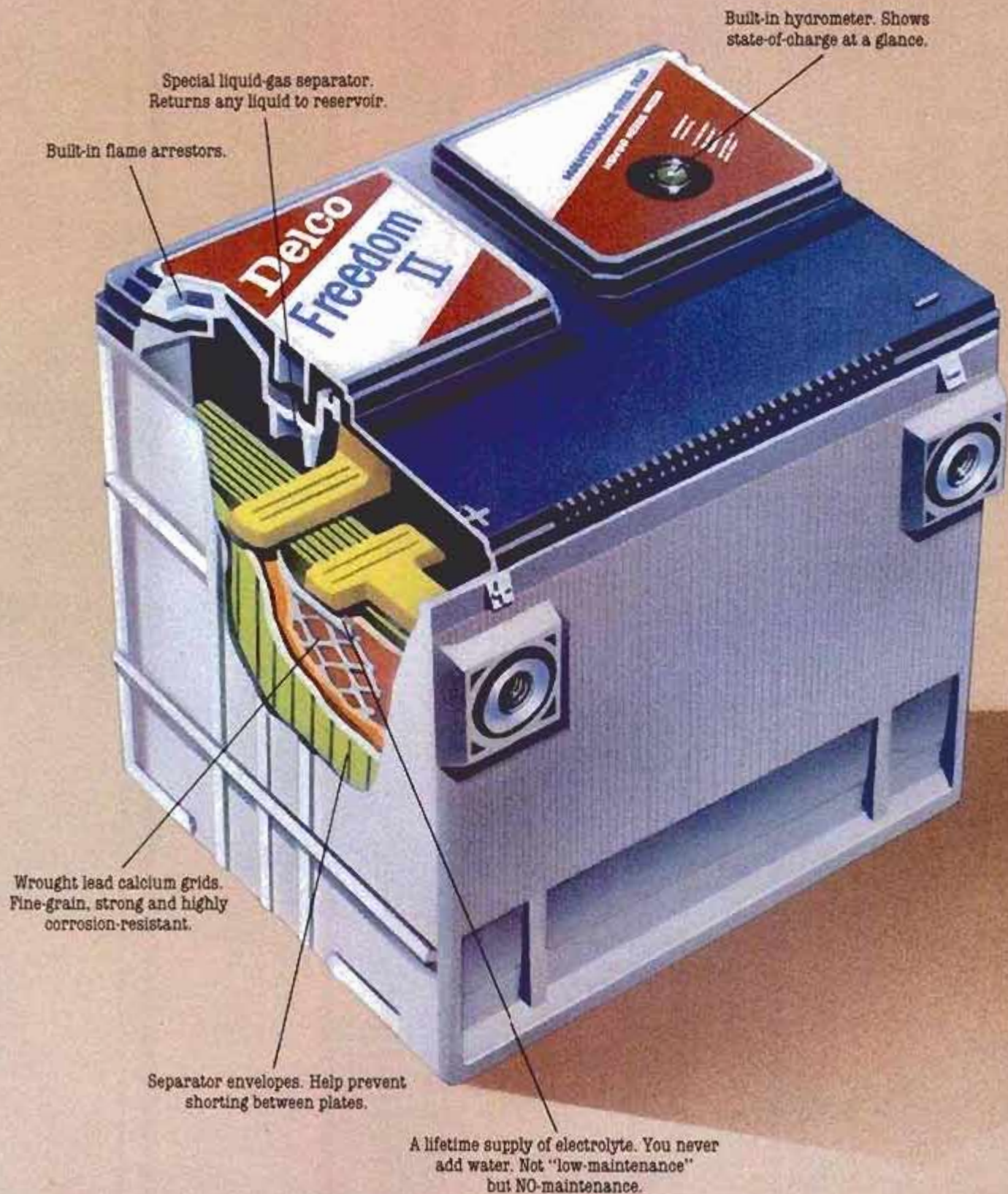
LIGHTS: 8 mg. "tar", 0.7 mg. nicotine av. per cigarette, FTC Report DEC. '81.
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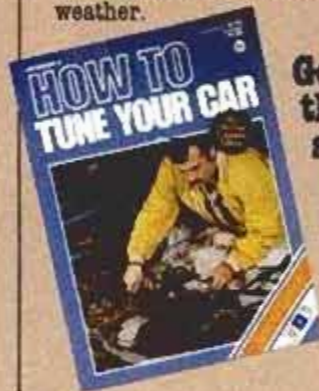
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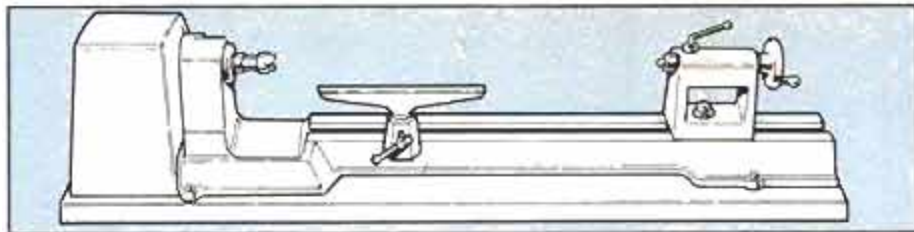
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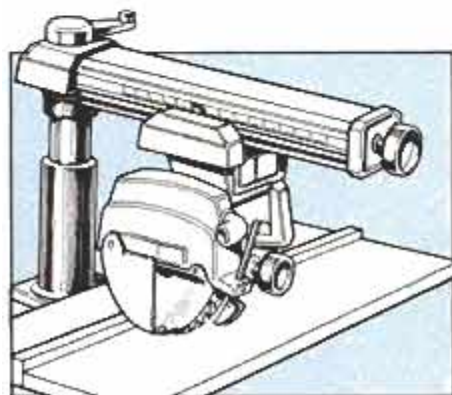
GENERAL MOTORS CORPORATION



- Use correct turning speed for work—refer to owner's manual.
- Remove the tool rest for sanding, staining and finishing.

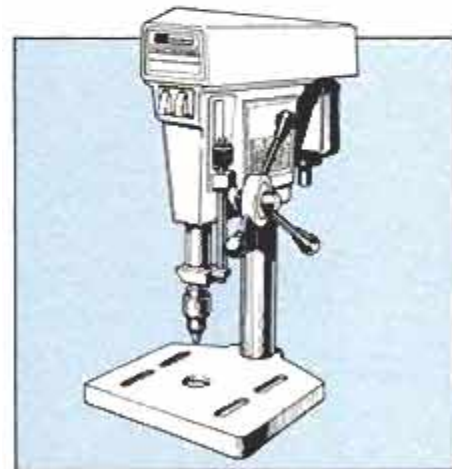
Radial-Arm Saw

- Use sharp blades. Keep the saw table level. Disconnect from power before changing blade.
- Allow the blade to reach full speed before pulling it into the stock.
- Hold work firmly when crosscutting. Push saw to back of table when cut is complete.



- Keep the saw table clear of tools and scraps. Always use the blade guard, except when routing. Clean it often.
- Do not stand directly behind a board when ripping. Adjust the back of the blade guard to suit stock thickness.
- Allow 1/4-in. clearance. Use antikick-back fingers.
- Use a pusher stick when you're ripping widths less than 3 in.
- Keep the saw adjusted.
- Wear safety glasses.

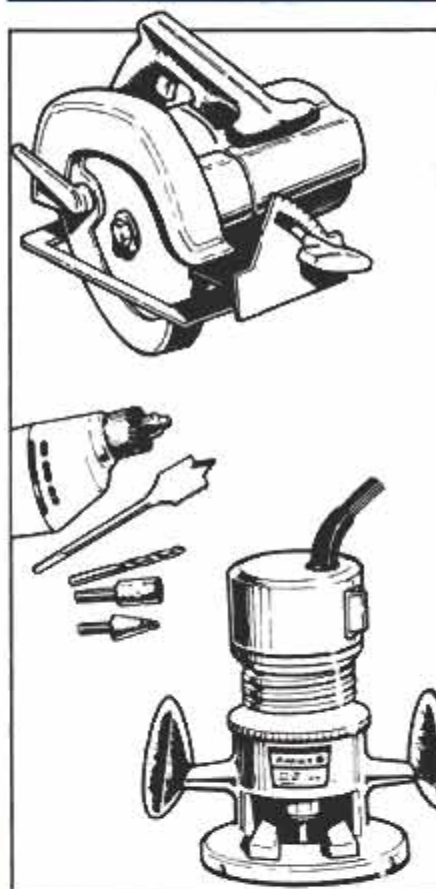
Drill Press



- Use faceplate chisels for faceplate turnings. Be sure the mounting screws won't contact cutting tools.
- Don't wear loose-fitting clothing.

- Hold work firmly on your drill press table; clamp hard-to-hold pieces.
- Clamp all pieces for high-speed drilling and all metal pieces.
- Keep fingers from turning bit.
- Do not work with overheated bits.
- Never leave key in the chuck.
- Don't use excessive pressure against drum sanding accessory.

PORTABLE POWER TOOLS



Circular Saw

- Use sharp blades only. Disconnect tool before changing blade.
- Never start a saw with the blade touching material. Allow blade to reach full speed before starting cut.
- Hold a saw by handles and knobs only, with two hands if possible.
- Work with the cut-off piece to your right and let it fall freely.
- Do not overreach with the saw.

- Set the blade depth 1/8 in. greater than the stock thickness.
- Start plunge cuts with the front of the baseplate resting on stock.
- On interior cuts, do not remove the saw from the kerf until the blade stops spinning.
- Wear goggles.

Portable Power Drill

- Use only sharp bits of the correct type for the job.
- Unplug drill before changing bits.
- Do not touch overheated bits.
- Hold the workpieces firmly; clamp if too small or difficult to hold.
- Make certain the bits are gripped correctly in the chuck, and tighten the chuck. Remove the chuck key before turning the drill on.
- Keep your hands away from turning bit and chuck.

Router

- Seat bit correctly and tighten the collet before operating.
- Do not turn on the power with a bit touching the workpiece.
- When possible, hold the tool with both hands.
- Unplug tool before changing bits.
- Make certain the bearing on the cutter with guide moves freely.
- Wear eye protection.

(Please turn to page 166)

Preventing Shop Fires

Here are 10 ways to eliminate fire hazards in your shop:

1. Keep your shop as dust-free as possible; fine particles ignite more readily than solid matter.
2. Keep shop solvents and other highly flammable materials away from heat. Store them in a metal cabinet in tightly sealed containers.
3. Store or discard oily rags in covered, metal containers, to reduce the chance of spontaneous combustion.
4. Ventilate the shop properly when using flammable materials. If the shop doesn't have windows, install an exhaust fan.
5. Don't heat the shop with an open flame source such as a fireplace or stove. Many solvent vapors are heavier than air and accumulate near the floor, where pilots are situated.
6. Make certain all power tools, receptacles and light switches are properly grounded. If possible, install ground fault circuit interrupters (GFCI).
7. Maintain all power equipment to reduce excessive arcing (sparking) in the motors.
8. Don't smoke in the shop.
9. Have properly rated and maintained fire extinguishers on hand.
10. Install a smoke detector.

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...

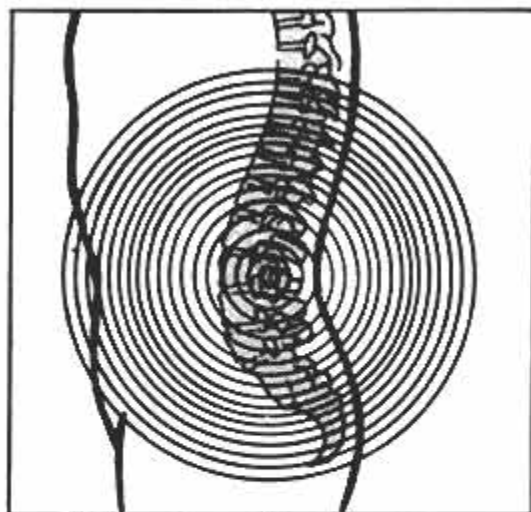
You Can Prove Its Effectiveness To Yourself Risk-Free For 30 Days!

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.



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

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

HERE'S WHAT USERS SAY:

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

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

(Continued from page 97)

entirely of wood, even to wooden fastening pegs called trenails. Now, exposed for more than four centuries to the ravages of salt water, erosion and marine borers, the hull has badly disintegrated, losing most of its structural integrity. Only the starboard portion, embedded in bottom silt, remains today, resembling half of a mammoth eggshell—and just about as fragile. Stretching more than 100 feet under the sea bed, it's estimated to weigh as much as 350 tons. So spongy are its timbers that they're supported largely by the surrounding silt and the buoyancy of the water itself.

You don't just tie a rope to such a frail structure and haul it up. Once out of water, the flimsy, sodden timbers would collapse of their own weight, crumbling to nothing like a sand castle swept by the sea.

Search for 'invisible' ship

Though the general location of the *Mary Rose* has been known since her sinking, no serious thoughts had been given to her recovery until World War II, when blitz-torn Portsmouth, home of the British fleet, was threatened by Nazi invasion. Alexander McKee, a young British soldier stationed near Portsmouth, became intrigued by an article in a local newspaper. It reminded Portsmouth residents that their ancestors had faced a similar invasion threat in the 16th century, when the French attacked the harbor and the *Mary Rose* was sunk mysteriously.

The story fired McKee's imagination. After the war, he worked as a military historian and, in his spare time, learned to dive. "Somewhere on my doorstep lay the most important known wreck in all Europe," he told PM. "I was determined to find it."

But McKee's initial dives revealed no traces of the wreck. It soon became apparent that he was searching for an invisible ship, her hull so submerged in silt that little showed above the sea floor.

Not until 1966 did help arrive in the form of sonar equipment, at that time still an experimental tool little used in underwater exploration. A scan of the suspected area showed a strange U-shaped anomaly. It proved to be the *Mary Rose*, lying on her starboard side almost completely enshrouded in muck. McKee's 25-year-old wartime dream was beginning to come true.

Since then, the recovery operation has been taken over by the British government and has become a \$10 million project. An ex-World War II salvage vessel, the *Sleipner*, serves as a diving support tender. The *Tog Mor*, a towering 5,500-ton floating derrick borrowed

from the North Sea oilfields, will be used to make the actual lift.

Over the past few years, British salvage teams have made an incredible 20,000 dives on the wreck, bringing up more than 10,000 precious artifacts. These range from bronze cannon and old coins to musical instruments and tiny sundials used as pocket watches.

Until the *Mary Rose* exploration, only one Tudor arrow and a few dried up examples of the deadly longbow existed in the world. Now divers have recovered hundreds of bows and arrows, many still in good condition. The finding of primitive protractors, dividers and other plotting instruments, suggesting the use of charts, has already shed new light on early navigational methods. One compass is 200 years older than any previously known English type. So many priceless relics have been brought up almost daily that one British archaeologist remarked: "Every day is Christmas here."

But the real prize will be the wreck itself. Using suction hoses that work like giant underwater vacuum cleaners, divers have carefully tunneled around and under the rotting hull, gently clearing away the silt in preparation for the delicate lift. One of the biggest problems they face is the inky blackness of the turbulent Solent waters near the harbor entrance, which reduces visibility at times to only a few inches. Often divers find themselves working almost by feel. Not without its dangers, the precarious venture has already cost one life, that of a young woman diver drowned in an accident.

Multistage lift

So tricky is the lift operation that it will have to be done in gradual stages, each designed to further protect and strengthen the hull as it's raised from the sea bed.

In the first step, a huge rectangular frame will be lowered over the wreck and suspended above it on telescoping legs. Made of 30-inch-diameter hollow tubing, the frame can be flooded initially to give it stability, then blown clear to provide buoyancy for the lift.

Working from trapeze-like scaffolds slung under the frame, divers will rig a spider web network of reinforcing braces inside the hull, as well as nylon slings around the outside, to hold every timber exactly in place. The wreck, now securely tethered to the lift frame, will then be hoisted up and into a pre-shaped cradle lowered to the sea floor—all still under water.

The legs of the lift frame are designed to lock into sockets in the cradle's carriage, completely encapsulating the wreck in a softly padded, precisely contoured cocoon. In theory, the hull will be supported so gently that no

more than 1 pound per square inch of pressure is exerted on its timbers at any point. The entire assembly—lift frame, cradle and hull, now weighing some 530 tons—will then be hoisted out of the water and placed on a waiting barge for transport to a museum site on shore.

Once in the recovery cradle, the *Mary Rose* will never again be moved. To save having to further disturb the delicate remains, the same cradle used in the lift will also serve as the display stand for public exhibition. In the museum, it will merely be rotated upward to bring the half-hull into an upright position. Visitors will then see a cross section of a 16th-century Tudor warship much as if it were a giant, open sided dollhouse.

Though no attempt will be made to restore missing portions of the ship, her recovered guns, stores and other artifacts will eventually be replaced inside the hull just as they originally were to complete the exhibit. But this may have to wait a while. First, the sodden timbers will have to be sprayed constantly with water in a slow, carefully controlled drying out process to prevent distortion and further disintegration—a procedure that may take as long as 30 years.

Mysterious sinking

No one knows to this day exactly why the *Mary Rose* went down. A magnificent warship, she carried 91 guns and was the pride of the English navy as well as the personal love of King Henry VIII, who named her after his sister, Mary Tudor. The *Mary Rose* was, according to some naval historians, the first true battleship. She had side firing cannon arranged in rows on her lower decks behind gun ports which could be opened. With such awesome firepower, she could stand off an enemy vessel and deliver devastating broadsides without having to maneuver in close.

On the morning of July 19, 1545, as the French attempted to enter the Solent channel on their way to invading England, the *Mary Rose* hoisted sail, opened her gun ports and readied herself for action. Suddenly, she swung around and heeled sharply to starboard, putting her lowermost gun ports below the waterline. The sea rushed in through the open ports, almost instantly flooding the vessel. Within minutes, the *Mary Rose* sank from sight, her crew trapped below decks or under antiboarding nets above.

Ironically, not a shot had yet been fired on either side, and the *Mary Rose* was untouched. Speculation is that she was grossly overloaded. Her normal crew complement was 415: 200 mariners, 185 soldiers and 30 gunners. But on that fateful summer morning, she

was carrying some 700, among them many high-ranking officers, all wanting to be on board for what promised to be a glorious, historic occasion.

Whatever happened, the end was swift. Divers exploring the wreck centuries later found the guns loaded and ready to fire, with the skeletons of crewmen still at their posts. There had been no time to abandon ship.

Still more ironically, the battle for which the men had been preparing never came. Unable to slip through the narrow channel, the French soon gave up the attempt and turned back home,

leaving the *Mary Rose* an enigma to be pondered by historians, scientists and shipbuilders for 437 years.

If the recovery is successful, it probably won't reveal the answer to the mystery, but it will give the world a stirring glimpse into a colorful past. In the words of Alexander McKee, "You can't get information like this from libraries. What we have in the *Mary Rose* is a four-centuries-old timber sailing ship, complete with everything it contained on one particular day in 1545. She represents a day in the life of Tudor England." **PM**



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HOW TO USE A POLARIZING FILTER *(Continued from page 99)*

backs. First, since the filter must be rotated, a polarizer slows you down somewhat. Second, it reduces light transmission by about 1½ stops. (This may be an advantage when shooting with fast film on a bright day.)

How it operates

A polarizer works because of the basic nature of light. Light waves vibrate in many planes, perpendicular to their line of travel. Polarizing materials permit only the oscillations

on one plane to pass through. The structure of the filter can be likened to Venetian blinds, molecular in size. When another filter is placed in the path of this less complicated light, with its axis or plane of transmission at a right angle to the first, most of the remaining light is absorbed and the transmission is blocked. The louvers are crossed.

When normal unpolarized light leaves its source and is reflected off a nonmetallic surface, it loses many of its

planes of vibration and becomes naturally polarized. Dust and water in the air cause such an effect on sunlight. By filtering out these distracting, glare-producing rays, we can use the mostly unpolarized light remaining for our pictures.

Magical pictures

In another application, polarized light passing through most hard plastics may be altered. Its plane of vibration can be changed by as much as 90°. This is enough to allow the light to pass through a second filter, its axis perpendicular to the first, held in front of the subject. The areas of greater brightness, as observed through such a setup, indicate the higher stress regions induced during molding and cooling. Scientists use this method to evaluate plastic models of real structures for stress distribution.

Stressed plastic also slows down some wavelengths of light. Only those colors (wavelengths) that make it through at the same time are visible.

We've illustrated a method of photographing such effects in common household objects ([see photo, page 99](#)). Hard clear plastic, such as that found in cosmetic cases, rulers and plastic forks, works best. The polarizing material in the background should be at least 8 inches square. Most photo stores sell plastic sheets for this purpose. It's less expensive if purchased without a frame and unmounted. Keep the transmission axis parallel to the ground (sheets are marked).

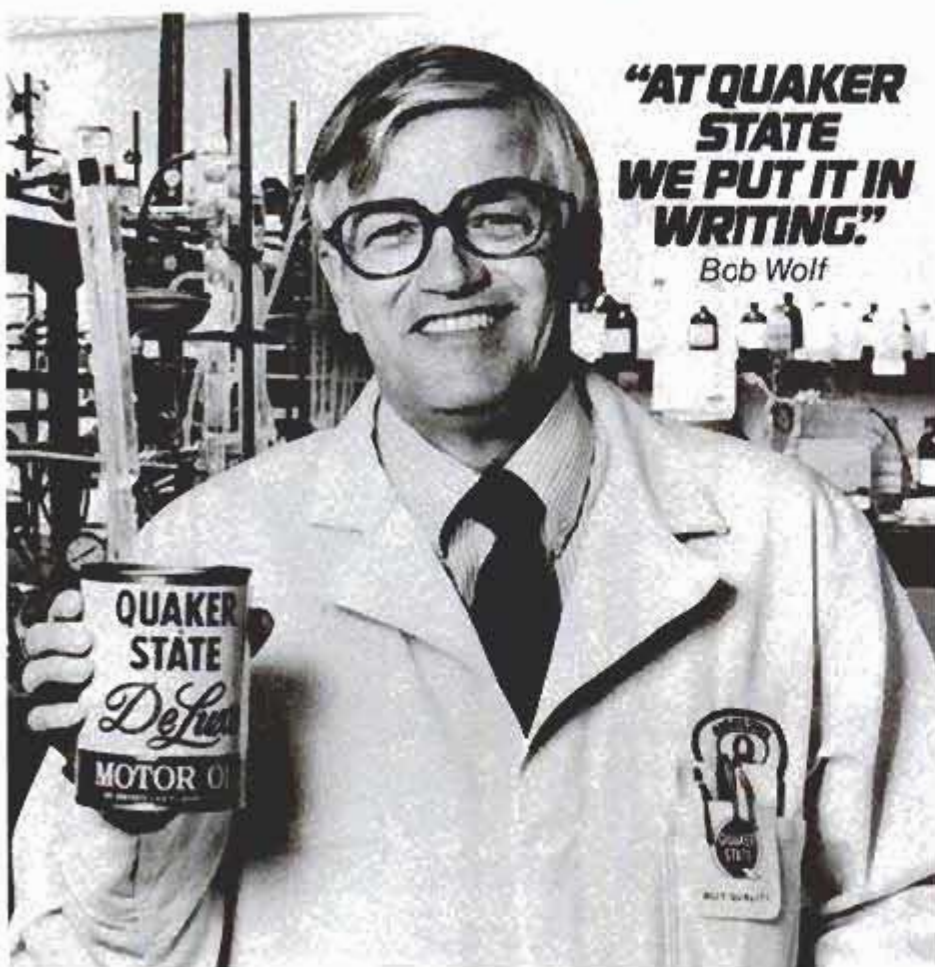
The second filter may be a smaller sheet held in front of the camera lens, or a more convenient lens-mounted polarizing filter. The light source behind the first filter should be uniform. A sheet of tracing paper, or opal glass, does a good job of diffusing the illumination.

You'll need a tripod or camera support, since most of the exposures will be beyond the hand-holding range. Closeup lenses or bellows extensions are also handy. They bring the camera in close enough to reveal more intricate patterns.

Place the object between the two filters and rotate the filter to obtain maximum background density.

Typical exposures range from ¼ to 2 seconds at f/11 with 200 ASA film and a 150-watt bulb as the light source. Use the camera's choice of exposure as a guide and then bracket by at least two stops to get the exposure for your setup. Change shutter speeds to maintain depth of field. Also remember that daylight films will show a color shift with tungsten light sources. This change produces more colorful pictures, making the otherwise clear stress areas appear yellow. **PM**

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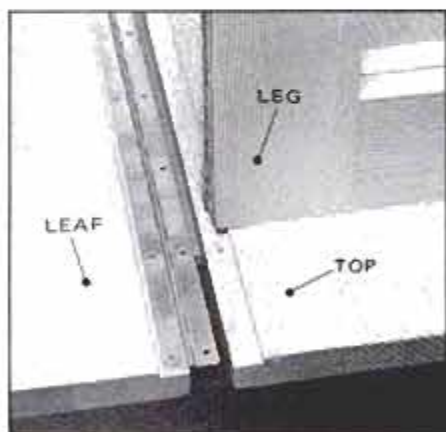
STAYIN' ON THE ROAD WITH QUAKER STATE

TABLE FOR PARTIES

(Continued from page 113)

drill press. Bore the holes in one member, then insert the dowel centers. To align, clamp two pieces of wood over the joint at both ends of wood, using moderate clamp pressure. Then use two bar clamps to bring the pieces together just enough to transfer the center mark impressions. Or you can skip this step, if you use a portable drill with a doweling jig.

Cut a wide rabbet along the bottom



In this view of the leaf and leg, the hinge screw holes are clear of the leg to permit removal of the pieces for finishing.

edge of the leaf and top for the continuous hinge, so the legs can swing past it. You can make this cut with a dado head on the radial-arm or table saw. Or, use a router. To make the rabbet on the radial-arm saw, set up for in-ripping and feed the work against the rotation of the blade. Test-fit the leaf to the top with a hinge secured by screws. Later, disassemble parts to finish them.

To secure the fixed legs to the top, outline the leg position on the underside of the top. Then use a drill guide to bore $\frac{1}{16}$ in.-dia. holes through the top for the screws. Clamp the legs in position with the table upside down on saw horses. Bore from below going through the original pilot holes into the legs. Remove the legs and enlarge the holes for the screws and plugs. Next, glue the legs in place. Join the pivoting and fixed legs with a hinge, leaving a $\frac{1}{8}$ -in. gap between the legs.

We finished the table with a thinned water-white shellac sealer coat (two parts 3-lb.-cut shellac, one part alcohol), followed by two coats of Constantine's Wood Glo satin finish. We sanded lightly between coats with 220-grit garnet paper.

Note: It's somewhat more convenient to pivot the outside legs. If you wish, you can adapt our version by relocating the screw holes on top to fasten the inside legs. However, in this adaptation, the barrel of the hinge would be visible.

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CHOOSE AND USE SOLVENTS

(Continued from page 118)

excellent "dry cleaning" and spot-removing fluid, which also works well as a degreaser for cleaning off metal parts or machinery. Although it is sometimes used alone, very often it is mixed with 1,1,1-trichloroethane and sold as a combination spot remover, cleaning agent and degreaser.

1,1,1-Trichloroethane. This solvent's name is seldom given as part of the brand name, but several products include the "1,1,1-" as part of their name. Like perchloroethylene, 1,1,1- is a nonflammable degreasing and cleaning solvent that is widely used in place of carbon tetrachloride these days.

Kerosene. Used primarily as a fuel, kerosene also removes grease and oil from machinery and metal parts, though it leaves an oily film. It has limited use for removing or softening tar and asphalt patching materials, but can be used to thin roof cement.

Chemically similar to mineral spirits, kerosene is much less volatile, doesn't evaporate as fast and is oilier.

Storing and using solvents

Although they vary in degree, almost all solvents are toxic if taken internally.

Most of them also give off fumes that are at least mildly toxic if inhaled to any degree. Therefore, it is wise to follow these safety procedures:

■ Store these products where children can't get at them.

■ Avoid using solvents in confined places that are not well ventilated. It helps to use an exhaust fan.

■ Not all solvents are flammable, but those that are should be stored in tightly closed containers *outside* the living quarters of the house, or at least kept in the garage in a metal cabinet.

■ Avoid keeping large containers of solvents if you don't often use them.

■ Periodically check containers for leakage.

■ Never store or use solvents near a furnace or other source of heat, such as a stove, outdoor barbecue or in front of a window that gets direct sunlight.

■ If you use solvents above eye level or in a situation where solvent may splash, wear safety goggles.

To clean paint, grease and other materials off your hands, use solvents made expressly for this purpose. The solvents mentioned above can penetrate the membranes of the skin or cuts, and create a toxic effect in your body. In addition, many solvents dry the skin and cause discomfort.

SOLVENTS—SUPPLIERS

Afa Chemical Corp., Box 44, Brentwood, N.Y. 11717: cleaning compounds.

Baldwin Oils & Commodities Inc., Box 5097, Greenville Station, Burma Rd. and Caven Point Rd., Jersey City, N.J. 07305: Full line of solvents.

W.M. Barr & Co., Box 1879, Memphis, Tenn. 38101: Klean-Strip paint removers and solvents.

Carbona Products Co., 330 Calyer, Brooklyn, N.Y. 11222: Cleaning fluid, rug and upholstery cleaner.

McCloskey Varnish Co., 7600 State Rd., Philadelphia, Pa. 19136: Bleaching oil, liquid surface preparation, paint and varnish removers.

M & M Chemical Sales Corp., and Tru Marine Div., 515 Providence Hwy., Dedham, Mass. 02026: Paint sundries, solvents and removers.

Master Products Inc., Box 274, Orange City, Iowa 51041: TM-4 paint remover.

Mohawk Finishing Products, Rte. 30 N., Amsterdam, N.Y. 12010: Paint and finish removers, upholstery and rug cleaner, silicone and wax wash, furniture cleaner.

Parks Corp., Box 5, Somerset, Mass. 02726: Full line of solvents.

Pyrock Chemical Corp., 5-40 45th Ave., Long Island City, N.Y. 11101: Rock Miracle paint and varnish remover and cleaners for aluminum and fiberglass.

Red Devil Paints and Chemicals, 30 North West St., Mount Vernon, N.Y., 10550: Paint and varnish removers.

Reliable Remover & Lacquer Corp., Long Island City, N.Y. 11101: Paint and finish removers.

Sparkle Plenty Inc., 233 East Erie, Chicago, Ill. 60611: Supra Soap hand wash solvent.

Star Bronze Co., Box 568, Alliance, Ohio 44601: Zip Strip paint and varnish removers.

Texize Div., MortonNorwich Prod. Inc., Greenville, S.C. 29602: K2r Spox lifter and household cleaners and detergents.

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by Philip E. Brancato Sr.

Yes, you can make \$1000 a month and more with just a hack saw in your spare time.

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All I ever wanted was something I could do in my spare time with my hands, make a little money and enjoy myself and not have to buy \$3000 worth of tools or merchandise to do it.

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Where can you buy the P.V.C. Pipe?

You can buy the P.V.C. pipe from any local hardware store to start. Plus I will supply you with the names and addresses of cushions and pipe manufacturers who will sell to you wholesale, plus I will supply you with my shop manual and six detailed shop drawings with pictures and measurements of six different designs.

Do you need my shop drawings?

No, you don't need my shop drawings unless you want to save hundreds of hours of trial and error work and thousands of dollars that I had to spend before I finally

found the right design and measurements and tricks to the manufacturing of P.V.C. pipe furniture. I only wish that when I started, I could have bought these shop drawings and I would have gladly paid \$100 for just one of them.

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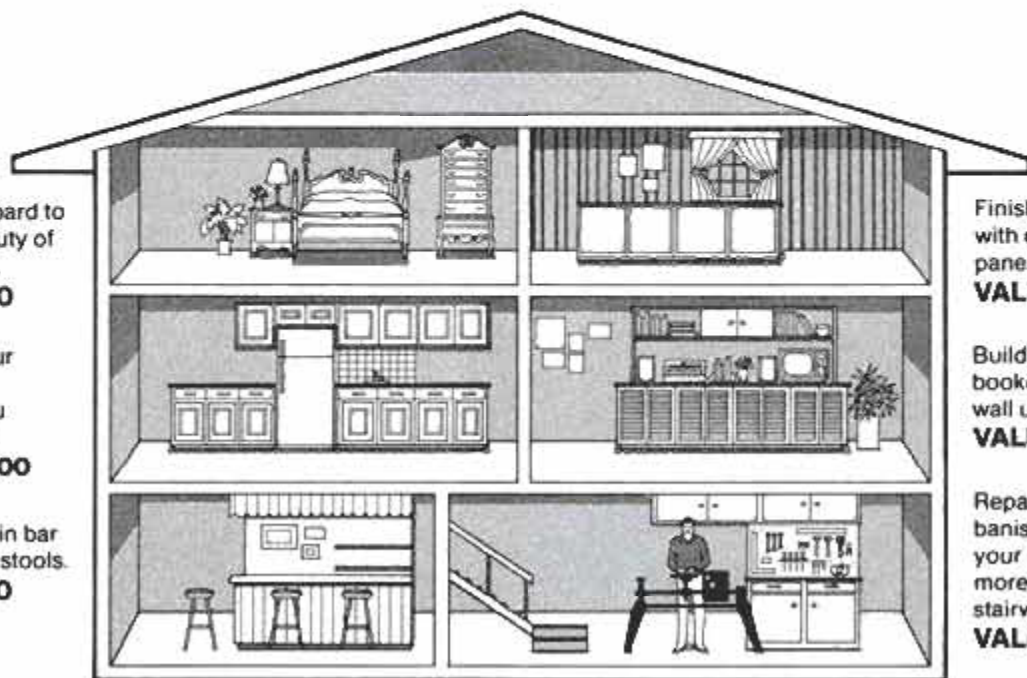
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ONLY THE STRONG SURVIVE

(Continued from page 95)

of some sort that will get him out of shape long enough to let me slip by.

But it is not he who makes the mistake. As I rush up on his tail for what seems like the umpteenth-hundredth time coming out of the kink, there is a much slower car in the middle of the track. The Mustang ducks left. I try the right, hoping the other car will squeeze him off to the inside of the coming left turn and leave me room around the outside. Instead, it dodges right. I manage

to miss it, but end up with all four wheels in the still-damp grass. One lazy half-spin and a short wait for traffic later, I am underway. The Mustang is long gone.

About an hour later, our third driver, Bob Nikel, gets himself hit by a slower car he is passing in the kink. He takes a wild, spinning ride through the pucker-brush. The car sucks up a lot of mud and grass, and bends a left front fender. But that would be our last mistake in what would turn out to be an ultrahigh-pressure 24-hour sprint to the finish.

With everyone congregating at the

track for Friday morning practice, our beautifully prepared, gleaming red Popular Mechanics Porsche 944 definitely looked like the car to beat. But the competition was super-strong. Ford's Special Vehicle Operations (SVO) group showed up with a brace of prototype turbocharged, fuel-injected, intercooled Mustangs for arch-rivals Car and Driver and Road & Track.

Stiff competition

Ford's support was so deep that they were able to pull the Car and Driver Mustang off the track at 3:30 the next morning after one of the drivers had blown the engine, put an entirely new engine in the car, and have it back on the track within four hours.

As it turned out, however, the Ford SVO threat never materialized and the overkill was for naught. They finished in 33rd and 34th places out of 40 cars.

There were also a couple of fast 5.0-liter, four-barrel, V8-powered Prototype Mustangs, one co-driven by three past national champions, two of whom were Ford engineers. Toyota and Mazda were represented by a pair each of Prototype Celica Supras and RX-7 GSLs. Chrysler had a matched set of Dodge Charger 2.2s in the Showroom Stock B class, one of them factory-entered. Peugeot also had a factory-entered car, a 505 turbodiesel.

The media represented by a variety of cars and/or drivers included Car and Driver, Road & Track, Autoweek, Motor Trend, On Track, Import Car, Gallery, The New York Times, and the TV show, Motorweek Illustrated. And of course, us.

But way down at the far end of the pits was the team that would give us the most fits: an immaculate, stock-looking but very trick Prototype Chevrolet Camaro Z28 entered by Dick Guldstrand Racing, but obviously financed and supported by Chevrolet.

Everything went well in practice that day and into the night, with Baker qualifying us second on the grid, about a second back of the Camaro and a tenth of a second up on the Car and Driver turbo Mustang. Our car was wonderful, its fully independent suspension, 50/50 weight distribution (front engine, rear transmission) and four-wheel vented disc brakes helping us make up in cornering and braking what we lost to the more powerful V8 and turbocharged cars on the straights. It was also very stable, forgiving and easy to drive fast through the turns, even on the bumpy Nelson Ledges surface. Its only vice was a tendency for the rear end to step out a bit under hard braking into a turn. Just as importantly, the flared, air-dammed, spoilered 944 looked like a race car.



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Shortly after turning the car over to *Nikel* some four hours into the race, the Car and Driver Mustang I'd been battling suffers a massive brake failure and checks into the pits. That puts us back in the lead. But the Camaro is just a lap behind. By the sixth hour, the very quick V8 Mustang catches and passes us, and we are less than a lap up on the Camaro. An hour later, we are still second with all three cars on the same lap. And so it goes through the night.

Then, about a minute before 1:00 a.m. comes the break we'd been hoping for. Coming out of the second turn, I see a set of headlights staring back at me from off the track on the right. It is the Camaro, backwards into the protective tirewall against the guardrail. The next time around, he is still there. And the next. Then he is gone. As I complete that lap and accelerate past the pits, he is just then limping in on a flat rear tire—apparently the cause of his spin. By the time his crew has replaced the tire and sent him back out, we have put almost five laps on him.

Recapture the lead

Within two hours, the Camaro had been off the track again, this time backward over the tirewall outside the first turn. More laps were lost while a wrecker struggled to get it free and back underway.

By 4:00 a.m., we were back in the lead. But the pressure was still on. That doggone Camaro, miraculously undamaged, had been flying through the night.

Despite its two off-course excursions, it was breathing down our necks just one lap back. And so was that very fast V8 Mustang. The race was turning into a 24-hour sprint. We were flogging our sturdy Porsche as hard as we could, but both of our tormenters could circulate faster by a second or more a lap when they chose to.

On the other hand, they were using up brakes, tires and fuel a bit faster than we were and had to pit more often. For our part, we were getting better than two hours on a 16-gallon tank of unleaded, six hours on our left-side Goodyear Eagle NCTs, much more on the right, since the course has only two left turns, and more than 12 hours—half the race—on a set of brake pads.

By mid-day Sunday we had squeezed out four laps on both of them. Baker was in the car and flying low. But it looked as if we'd have to pit for fuel twice more and change drivers at least once. Our left front wheel bearing was audibly protesting the nonstop pounding it was getting from Nelson Ledges's bumpy, high-G turns. The engine was running a little on the warm side, and Freddy had the heater on full blast to help keep it cool.


I was up next when he was to pit for fuel with 2½ hours to go. But at the last second, Joe Oldham asked him to stay in the car an extra shift. Baker's answer through the radio set was affirmative. Our excellent crew completed the stop, which included installing two new left-side Goodyears, in an amazing two minutes and one second. As the race leaders, all eyes were on us. When Baker took off out of the pits again, everyone broke into a hearty round of applause for the crew's performance.

I am disappointed that I will not get to finish the race. But it is such a tight

race and Baker is driving so beautifully. I understand Oldham's reasoning perfectly.

Then someone remembers that the rules, for safety reasons, prohibit anyone driving more than four hours consecutively. Baker can't finish the race. After some discussion, I am elected to do the final hour. I am elated, but the pressure is really on now. If we can keep up a fast pace, and have no mechanical problems, we will win. If the noisy wheel bearing gets worse and we have to change it, if I make a driving

(Please turn to page 136)



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ONLY THE STRONG SURVIVE

(Continued from page 135)

mistake and put our car off the road, if another car squeezes me off in a turn or spins in front of me and I can't avoid an accident . . . if anything at all goes wrong, we will lose. Like Peanuts' Charlie Brown, I will be a hero or a goat.

Baker comes in at 2:00 p.m. sharp, an hour before the 3:00 p.m. finish. With a few extra gallons of gas and a superquick check by our tired but still-enthusiastic crew, I am off. I get up to speed immediately, aware that the Camaro and the Mustang are still pushing as hard as they can. Aware that everyone—competitors, officials, spectators spread around the course, everyone—is watching. The slower traffic, still thick after 23 hours, is thankfully good to me, spreading like the Red Sea to let me through. After several laps, the Mustang comes up from behind and motors by on the back straight. But I get a message through the radio that he is now several laps down and not to worry. Then the Mustang slows to my pace and stays right in my sights, as if tempting me to risk a pass.

A Datsun 280ZX, still in a tight race in his class with a Triumph TR8, comes out of the pits and starts driving like a

madman just ahead of me. He is all over the track and seems half out of control. That's all I need, I think. I back off a bit and give him some room. If he is going to have an accident, I don't want to be part of it. At one point, he is cut off by a slower car in a gaggle of traffic, dodges left, then right, goes off the track and back on, almost collecting the Mustang in the process.

The pressure is off

Then the radio crackles in my ear. The Camaro has pitted for a tire and a splash of fuel. For the first time since the race began, the pressure is off! I can ease off a bit and take it slower to the finish. Or can I? I keep the hammer down just in case.

The heater is still on to help cool the engine and it is hot in the cockpit. But all I can think of is completing these last few laps safely, cleanly and quickly.

At last, the clock on my instrument panel shows 3:00 p.m. Coming out of the final hairpin, I see our red-shirted crew and most everyone else crowded along the pit straight guardrail, shouting and waving. But there is no sign of a checkered flag.

Just one more lap, I think to myself.

Sure enough, next time around there it is, the most beautiful sight in racing. I

throw both hands in the air in triumph.

My ear-to-ear grin must be visible even inside the full-face helmet as I cruise around on the cool-off lap, waving back at the applauding spectators and corner workers, honking the horn like a New York cabbie.

Events after that blend into a euphoric, delirious blur of thousands of congratulatory handshakes. Oldham being interviewed on TV, grinning and posing for a hundred photographers, cold beers that someone presses into our hands, more grinning and posing. Tony Assenza drove the victory lap with the rest of us piled into the back, smiling and grinning and laughing until our faces hurt, waving like crazy people with both hands and with the little souvenir checkered flag that they had given us.

We'd done it! We'd overcome everything the other competitors and the track could throw up against us. We'd beaten the other magazines. We'd mastered the machine, manhandled it at the limit of control for 24 hours of flat-out, high-pressure competition, made it our friend and ally and used it to accomplish our goal. And despite our unrelenting abuse, it had never let us down.

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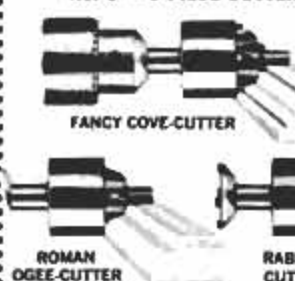


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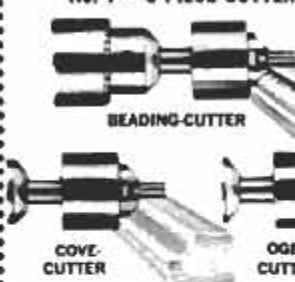
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MINI-BAJA BASHERS

(Continued from page 101)

apt to have three or four to use for chores that don't require a full-size pickup or tractor, but that can't be done on foot.

The manufacturers are catering to this utility market with a wide range of options. You can buy gang-mowers, trailers, cargo racks and gun scabbards. Honda has a rack designed to hold its EM 500 portable generator, and Kawasaki has a new trike painted in camouflage for hunters, fishermen and other outdoorsmen. Even the U.S. Army has some under test, on the assumption that an inexhaustible, all-season, all-terrain vehicle might be the ultimate personnel carrier.

To find out just what the state of the art is in this three-wheeled madness, we gathered six production three-wheelers, two each from Honda, Yamaha and Kawasaki. Then, we invited professional stuntman and three-wheeler racer PeeWee Gleason to conduct his first-ever riding school at Saddleback Park, in Orange County, Calif.

PeeWee's first order of business was to make sure that everyone was wearing a full suit of protective clothing—boots, padded motocross pants, gloves, goggles, helmets. His second task was to conduct his riding school, which consisted of one lesson. Popping a wheelie and carrying it 100 yards down the parking lot, PeeWee called back over his shoulder. "Close your eyes and gas it," he said.

FASHIONS FOR FALLING



Riding in the boonies requires a lot more than gas and guts. Before our testers ever swung a leg over an ATC, they donned a helmet, goggles, elbow and arm guards, long-sleeved riding shirt, shoulder pads, chest plate, leather gloves, motocross pants with hip, knee and shin guards and motocross boots with rubber shock absorbers over the shins, steel-tipped toes and a kidney belt. Don't go out without it.



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Honda

Honda owns the three-wheeler market; 90 percent of all the machines sold each year are Honda red. This is partly because Honda has been at it the longest, partly because it offers more models than anyone else.

The smallest Honda ATC is a 70-cc model for kids, which comes with a parentally adjustable throttle limiter. Next up is a teen-model 110 that's also too small for adults. The real Honda three-wheelers are all based on the same machine, with your choice of 185-cc or 200-cc engines and "sport" or "utility" bodywork. Finally, there's the ATC 250R, a three-wheeled motocrosser with full suspension—monoshock at the rear—and screaming two-stroke race motor.

We tested the most popular Hondas, the ATC 200 and ATC 200E, which Honda likes to call "Big Red." Big Red is by far the most useful three-wheeler on the market. Most important, it has electric starting, which is a virtual necessity for those awkward times when you stall going up a hill or crossing a stream. It also comes with a two-up saddle plus front and rear luggage racks so you can actually carry a load.

And finally, like all Honda trikes except the 250R, Big Red has an untemperamental, four-stroke single-cylinder bolted in just the right place for perfect balance.

According to the three-wheeler experts, Honda figured out the proper location for the engine in a three-wheeler, then patented that design. So Kawasaki has had to locate its engines higher and further forward, while Yamaha's are lower and further back—which makes them less balanced. The story is probably apocryphal, but the fact is the Hondas do handle better than their competition.

The original Honda trike had no suspension at all, and Big Red is still the only Honda—aside from the racer—that has a motorcycle-type front fork. Yamaha and Kawasaki have both zoomed past with more advanced suspensions. But realistically, the main suspension medium on any of these machines is the low-pressure tires.

Honda's Big Red is thoughtfully equipped for almost anything. The transmission is dual-range, a trailer hitch is standard and there's even an accessory terminal for electrical additions. If you're buying a three-wheeler for camping or farm work, there's really no other choice but Big Red.

Kawasaki

Kawasaki is going after Big Red's utility market with a pair of similar machines, the KLT 200A and KLT 250A. The 200-cc machine is considered

(Please turn to page 140)



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MINI-BAJA BASHERS

(Continued from page 139)

ably better equipped than Honda's competing ATC 185 and ATC 200. It has an electric starter, for example, auxiliary electrical terminal and trailer hitch.

All of these trikes are emphatically not street-legal, and the reason is simple. Except for the KLT 200, every one uses a solid rear axle with no differential. This means that to turn a corner, you either lift the inside rear wheel off the ground or slide the rear wheels like a sprint car on a dirt track.

Enter Kawasaki, with the first differential on a three-wheeler. The KLT 200's rear axle is even dual-mode, so you can drive it like a car, or slide it like a conventional trike. But, despite the differential, the suspensionless KLT 200 is not suitable for street riding.

The larger KLT 250 is essentially the same machine, but with a more powerful engine, heavier frame, larger tires and wheels, higher saddle and leading-link front suspension. It also has a handy, water-resistant "trunk" behind the seat.

Both Honda and Yamaha use an automatic centrifugal clutch on their trikes, so that you can not only start out in any gear, but shift up and down

through the five-speed gearboxes without having to worry about a clutch. Kawasaki, on the other hand, uses a motorcycle-type manual clutch on the left handlebar with its five-speed.

Kawasaki's newest machine is the Duckster. This is identical to our test KLT 200, but it is painted and upholstered in brown and tan camouflage. In addition, there are front and rear luggage racks, a rifle rack and brush guards.

It'd be pretty hard to sneak up on wily wild fowl to the bark of the KLT exhaust, camouflage or no camouflage, but a parked Duckster should be less conspicuous to over-flying game than a bright green KLT 200.

Yamaha

If Kawasaki has gone for the utility end of Honda's market, Yamaha has gone for the performance end. There are two Yamaha models, the teen-size YT125 and the full-size YT175. Both are very lightweight—the YT175, for example, weighs only 227 pounds, compared to 313 for the KLT 200 and 341 for Honda's Big Red.

Both Yamahas are high-revving two-strokes, with that distinctive two-stroke scream. Autolube oil injection pumps mean no premixing, but the oil tank must be topped up every other fuel

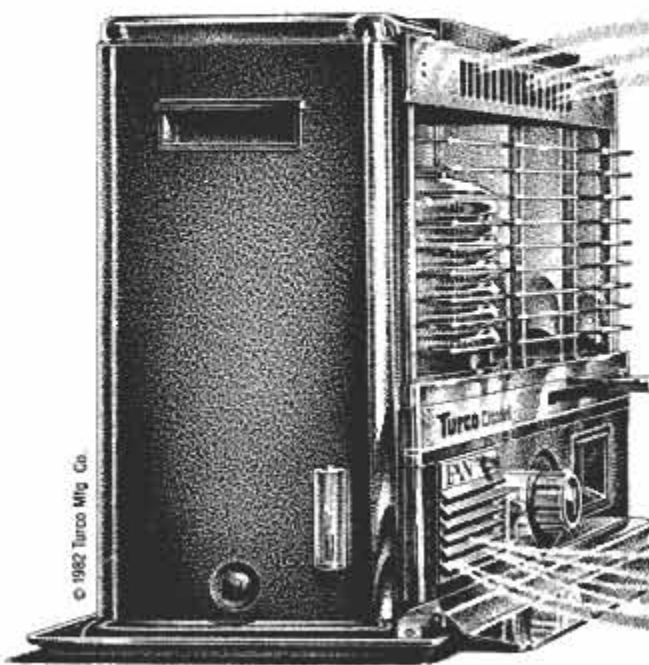
stop. Neither Yamaha is available with an electric starter, and both of our test models were difficult to start.

Because the engine is so far back in the frame, the Yamahas want to lift the front wheel even under the mildest acceleration. Cornering is difficult, too, because you have to lean forward to get enough weight over the front wheel for the tire to grip. The Yamahas are definitely harder for neophytes to ride.

On the other hand, the frisky YT175 is a rocket in the hands of an expert. With lots of torque, light weight, motorcycle-type front forks and a slick five-speed gearbox, it will zap around a motocross or flat oval faster than the heavier Hondas and Kawasakis. And that's really what either Yamaha is for—Saturday afternoon play racing at the track, not fence mending in the back pasture.

As you've no doubt guessed by now, we had a *blast* doing this test. We raced, laughed, crashed into each other and fell off a lot. And at the end, we simply washed the trikes off with a hose. Good as new. Not a one broke or gave us a moment's pause, and to a machine they were eager to go back again for a weekend of raucous craziness or a week of mule-tough work. Versatile? You can't beat 'em with a stick. **FM**

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SHUTTLE SIMULATOR

(Continued from page 85)

hand, controlling the pitch and yaw with a surprisingly responsive stick. But on one of the landings, I released the stick. The computers brought me into a simulated Kennedy Space Center without a hitch.

Of America's 79 astronauts, only 12 are qualified to fly the real Space Shuttle. Yet every astronaut must pull several four-hour tours in the simulator at Houston's Johnson Space Center before going up. The experience is so much like the real thing that even the veterans leave the cockpit sweating and fatigued.

Trouble in space

Just before I boarded the SMS, astronaut Paul Weitz, pilot of America's first manned Skylab mission in 1973, finished a simulated spacetour. Removing his headgear outside the cabin, Weitz looked genuinely troubled.

"They all look that way after training exercise," White smiled. "We really throw some curves at them." On one SMS landing, they threw a spitball at me. We were in the final minutes of descent, at the point where the 80,000-ton spaceship's engines cut off and it becomes the world's biggest glider. Watching the SMS video display terminals, I touched the vessel's stick gently, nosing it down gradually as a video graphic showed how much energy we had and how much we needed. To maintain the balance without an engine burning, you have to bring the Shuttle in just so.

Suddenly I felt the vessel's nose pull away. "What the heck's going on?" I demanded, as a couple of warning lights flashed on the console in front of me. One said CABIN PRESSURE DROPPING. Another said CHECK TELECOMMUNICATIONS. "Am I losing control of the ship?" I asked, half-believing I was and half-hoping I wasn't.

White's voice came over the intercom quickly. "We have a monster crosswind. You're fighting a crosswind, Den!" I brought the nose up a degree and pitched the vessel very gently, trying to find my way over the turbulence without losing the runway that was growing larger by the minute through the window. After about two minutes, the tension on the nose eased, and the Shuttle started to fall like a feather once again. Later, we learned that the programmers had thrown in a 150-mph crosswind to make things interesting.

Astronaut training is a 60-hour-per-week affair. All the trainees take half-hour sessions in a Shuttle mock-up submerged in a 25-ft. tank of water. And all go for at least one ride on a KC-135 (like a Boeing 707) transport jet, affec-

tionately dubbed the "vomit comet."

"The plane makes a parabolic flight," NASA spokesman Steve Nesbitt explained. "It goes straight up about 35,000 feet, then it plunges straight down for maybe 10,000 feet. That sends all the passengers flying around a padded chamber. It gives them the feeling of weightlessness." The parabolic flight, which lasts no more than 30 seconds, is also supposed to help NASA doctors decide what and how much medication to give each astronaut before rocketing into space.

"Unfortunately, it doesn't work too well," says Frank Hughes, NASA Director of Ascent and Reentry Training. "Sometimes a trainee who gets mildly sick on the parabolic flight gets deathly ill in space. And sometimes it goes the other way." Astronaut Jack Lousma, who became nauseated and incapacitated on a Shuttle flight earlier this year, had much milder symptoms in training.

"I don't think we're going to be able to figure out how to effectively diagnose and treat motion sickness until we put an M.D. into space for about a week," Hughes adds. The Space Shuttle program has 10 medical doctors, but none will go up until late next year.

Since the vast majority of Shuttle astronauts are classified not as pilots, but as mission specialists, another major device used in the program is the 1-G trainer, a huge, full-scale wooden model of the Shuttle. Contained in a half-mile-long hangar, the trainer is broken into three main sections: nose, fuselage and robot arm.

The nose section, complete with controls and supply lockers, lets the trainees work in space suits, while performing experiments in crawl spaces just slightly larger than a man.

The fuselage section is also used to practice space suit movement, and it serves as a measuring device, as well. Before going aloft, any piece of cargo that will sit in the Shuttle bay must be placed in the trainer first. If it's oversized, it goes back to the user or contractor for adjustment. Users pay at least \$1,200 per cubic foot of cargo bay to send satellites and experiments into space: NASA isn't about to let an inch go to waste.

"We've never found a drastic cargo problem, but some containers have had to get tightened up a bit after the measurement exercise," Nesbitt notes.

Sally can ride

The robot-arm trainer teaches astronauts how to control a delicate and key space instrument. The actual arm is entirely electric and very lightweight to accommodate its weightless environment. It will be used on a future Shuttle mission to lift a communications satel-

lite out of the cargo bay and insert it into orbit. A spinning device that rises out of the cargo bay will be used on this month's Shuttle mission to catapult a satellite into orbit.

On Earth, the practice Shuttle arm is much heavier than the real thing and it operates on hydraulics rather than electronics. But the principle is the same. When astronauts use the practice arm to move a 400-cu.-ft. helium sack, they face the same challenges of precision and timing they'd find in space.

"You can't underestimate the importance of all these simulated Shuttle experiments," Hughes says. "You know that experienced astronauts are watching each rookie's every move during training. After all, once you're out in space, you only get one chance to perform the operation correctly. It's life and death." Flight commanders are allowed to veto any prospective crew member. NASA insiders say that Sally K. Ride, who will become America's first spacewoman when she operates the robot arm in orbit during next year's second mission, won the respect of the veterans by the way she handled the practice arm.

In addition to the various simulators, astronauts often receive training in a jet fighter craft. It isn't mandatory, "but we find that most of the trainees become interested in flying, because of the program," Hughes says.

Who's astronaut material?

"As with medical school, no one flunks out of astronaut training—and for the same reasons," Hughes beams. "We manage to get the cream, despite the rigorous training, the professional problems that arise and low salary.

"When we last advertised for candidates, we received 8,500 applications for 30 positions. The crop was so good, we opened five other positions."

Most astronauts are professional scientists, including astronomers, geologists, biologists and physicists. Because of the rapidly changing nature of these fields, Hughes says, the astronauts usually fall behind in their own area while training for Shuttle flights. They simply can't get to the symposia or read the professional journals that keep pace with the latest developments.

But the salary is the biggest surprise. A new astronaut trainee with a Ph.D. degree is classified as GS-13, a salary level near \$20,000. The highest paid vet's salary is in the low forties.

"This is one of those fields you go into for reasons other than money," Hughes says. "I don't really understand the psychology, but it's clear from the dedication to training that the astronaut is a breed that loves to learn. And that's what all these mission simulation programs are about—learning." **FM**

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BEST OLD GUNS

(Continued from page 91)

reenacting battles from past wars, modern replica arms have rejuvenated a whole field of target and sport shooting. A few old-timers were still shooting originals in competition. But without the inexpensive replicas, there's no way the black powder sport could have achieved its present popularity.

Some stainless-steel muzzleloader



Thompson Center Cougar Hawken (top) and reissued Colt 1860 Army are in stainless steel. There are also blued versions.



Colt's reissued 1860 Army .44 (\$485) is of stainless steel. Connecticut Valley Arms' made-in-Italy replica is \$158.



Four percussion revolver replicas from CVA are (left to right) 1861 Colt Navy (in box), 1860 Colt Army, 1851 brass-frame Navy and 1858 Remington .44.

revolvers and rifles have been built to modern designs and are intended specifically for competition. Others may become instant collectables. The reissued Colt 1860 Army revolver in blued steel and more expensive stainless only will be in production for a short period. Those who shoot it and care for it well may expect considerable appreciation. And anyone who puts it away new for five years might double the \$484.50 cost. A quarter century from now, these

few stainless models could be worth more than their original predecessors which fought the Civil War on both sides and helped open the West.

Demands by the buckskinners and others for accurate replicas like the Tennessee Mountain Squirrel Rifle in .32 caliber (Dixie Gun Works) have caused many of these to be mass produced. Both flintlock and percussion cap versions of these are available with extra locks and fittings so that one rifle can be converted to either ignition system. The base price of \$295 for the percussion model is a bargain for an accu-



Ronald Plourde's Company of 4th Battalion Royal Artillery fire 3-pounder with South Bend tube, Ashe carriage.

rately styled, straight-shooting long rifle.

Both factory-made and handcrafted Kentucky long rifles are popular. The one shown here is a handmade example by New Jersey hobbyist George Heinemann. Accurately styled modern rifles like this one, made with highest quality locks (L&R), barrels (Bob Paris) and fancy maple stock blanks, can cost upward of \$5,000 when created by top-ranking modern muzzleloader gunsmiths like J.S. Brooks or William Buechelle. While this kind of expense can exceed the cost of an original, the buyer gets a safe rifle with a perfect bore capable of fine hunting or competition accuracy. He also gets a gun fitted to him so that it handles as no mass-produced arm ever will.

Besides historical and working replicas, less well-known but interesting arms of the 19th century are being replicated. Finely crafted dueling pistols in both flint and percussion (Navy Arms, Dixie Gun Works and others) can double as target shooters for handgun enthusiasts. Prices range from about \$250 per pistol to \$700 for the matched set of LePage duelers with French-style case, brass oiler, powder flask, nipple wrench, turnscrew (the formal term for a screwdriver as pretty as this one) and loading rod with rifling protector.

On a more affordable level, Penguin Industries, makers of Hoppe's No. 9 (Please turn to page 146)

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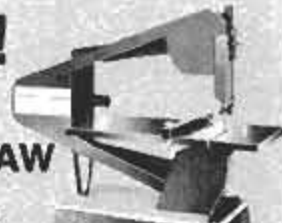


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BEST OLD GUNS

(Continued from page 145)

nitro powder and black powder solvents, have introduced three copies of the early Ethan Allen pistols produced in New England in the 1840s. The pepperbox, so-called because its six rotating barrels looked something like a pepper mill, was one of the early muzzleloading repeaters. It was cheaper than Colt's revolvers at the time, and may also have gotten its name from its tendency to fire all six barrels at once and pepper anything in its path. A simple side-by-side double pistol and a single-shot target model are also in the Ethan Allen line, selling for less than \$100 in home assembly kits or available prefinished.

Time was when a percussion double shotgun cost less than \$10 and you could find a good one in almost any antique shop. Those days are gone, but Italian-made replicas, like the 12 Gauge Magnum Percussion Shotgun (Navy Arms) now lists for about \$325. That's not expensive, however, when compared to the prices of many modern doubles. What's more, muzzleloader shotguns shoot just as hard as modern breechloaders, and the second barrel of a double can be fired almost as quickly.

Cannon replicas, too

Cannon shooters have also gone the replica route. But they can rarely afford to go it alone. This may be a good thing, since it takes teamwork and correct procedures to shoot these monsters safely. These reconstituted artillery organizations have special cannon shooting matches and engage in parades and battle re-enactments.

In the past few years, an International Muzzleloading Shooting Program has developed for firing everything from 16th-century Japanese matchlocks—a short length of clothesline ignites the charge—to modern replica percussion revolvers. Information about courses of fire and qualifying dates for future matches is available from Robert Reiber, USIMLC Tryout Chairman, 1505 Spruce Ridge Way, Stone Mountain, Ga. 30083.

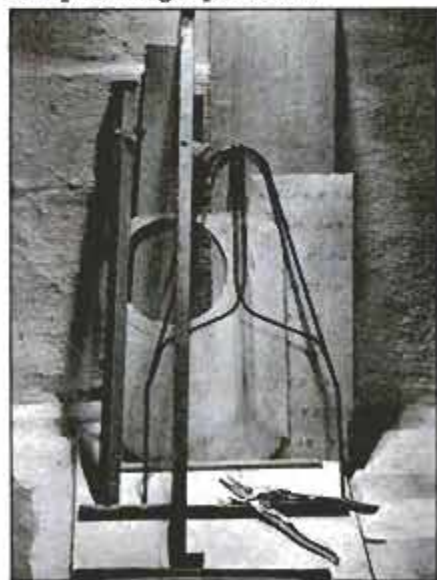
Those interested in modern black powder shooting can join the National Muzzleloading Rifle Assn., Box 67, Friendship, Ind. 47021. Dues are \$14 per year and include a subscription to *Muzzle Blasts*, their monthly magazine. In it are articles about the sport, lists of the many matches held around the country, and advertising for the originals, replicas and accessories that contribute to the appeal of the sport.

If the black powder sport is booming, and it is, it's because they don't build 'em like they used to. They build 'em better.

PMC

HINTS FROM READERS

Shop storage platform

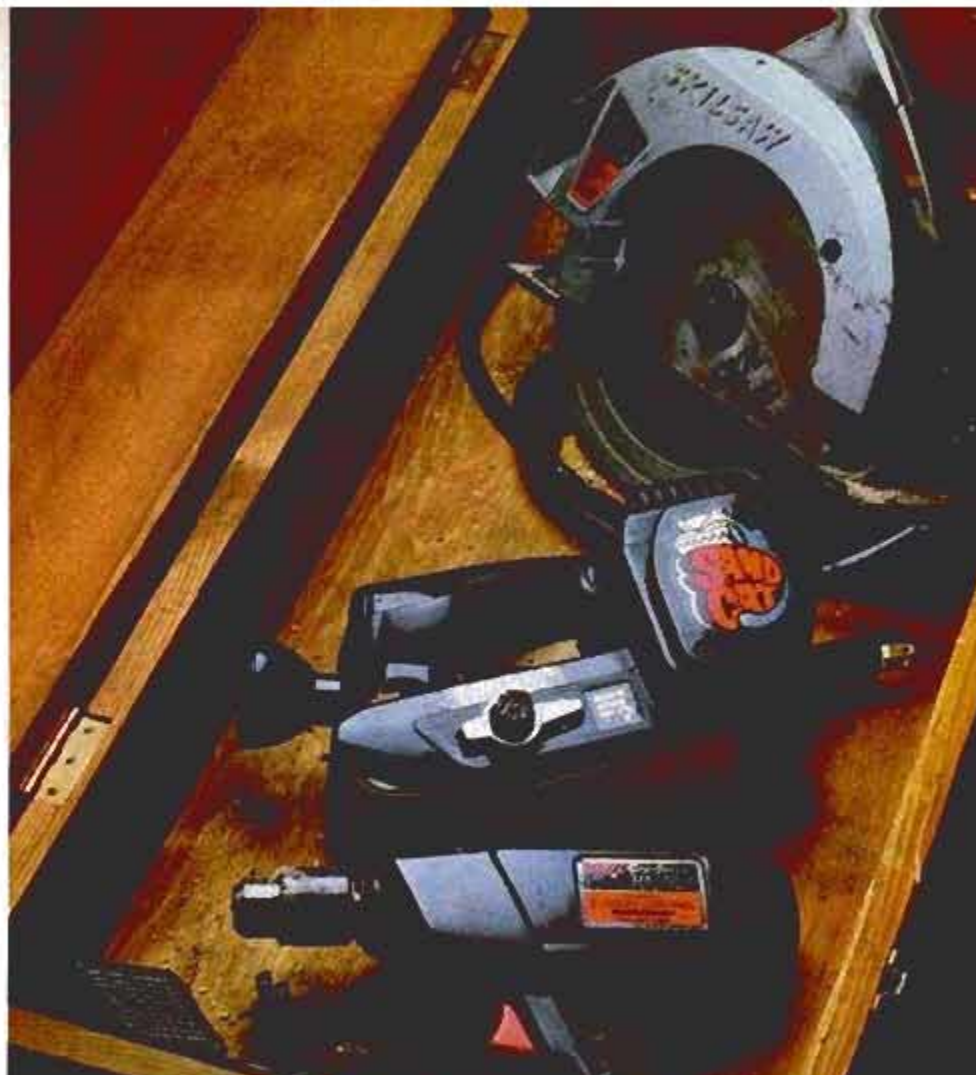


To store odd lengths of pipe, rod, sheet metal or similar objects, build this simple wooden storage platform. On a scrap piece of plywood (or side of a salvaged wooden crate), measuring 18 x 20 in., nail narrow strips of wood spaced at 6-in. intervals, beginning at the front edge. These strips divide the platform into segments which prevent stored articles from sliding forward. Place the platform on the floor, close to a wall and stand the articles between strips, leaning them against wall. This platform was painted white for maximum visibility.—*Walter E. Burton*

Removing damaged screws

When removing a wall cabinet in my motorhome, I ran into the problem of extracting Phillips-head screws which had stripped heads. I wanted to remove the screws without damaging the cabinet. I solved the problem by boring out the heads of the screws, then prying off the cabinet. With an electric drill bit the size of the screw, I bored through the head into the base, and the head came off, leaving the shank. Then I was able to remove the cabinet without damaging it. I removed the remaining screws with lock-type pliers. To remove slotted screws in the same manner, first centerpunch them to provide a starting place for the electric drill.

—*John Mednansky*



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HINTS FROM READERS

Scraping paint by spoonfuls



In combination with a flat scraper, a stainless-steel tablespoon is an ideal tool for scraping paint from ogee wood gutters. The spoon's bowl can be positioned to match the concave shape of the front. —*Kenneth Brooks*

Handy wrench strap



For turning milled or knurled thumb screws, rings and parts that won't yield to fingers, a "wrench strap" is helpful. This is a strip of flexible rubber belting or material such as leather. It must be wide enough to fit the job, and long enough to be grasped firmly between your thumb and fingers after it has been wrapped around the part to be turned. In stubborn cases, use pliers to grasp the wraparound "wrench" carefully. Here, a 3/4-in.-wide strip of rubber loosens a microscope lens. Tip: Belting layers can be parted to make thinner strips. **Warning:** Do not use pliers directly on milled or knurled thumbscrews. —*Walter E. Burton*

TECHNOLOGY UPDATE

Art frauds beware

Electronics

Real or fake? The cyclotron at the University of California's Davis campus can help find the answer quickly, safely and inexpensively. The cyclotron, situated at the University's Crocker Nuclear Laboratory, is delving into questions of origin, authenticity and originality of antiquities and works of art.

Dr. Thomas Cahill, director of the Crocker Laboratory and a professor of physics, and Bruce Kusko, an associate in physics, have developed the innovative use of the cyclotron as an adaptation of Cahill's ongoing air-pollution analysis project.

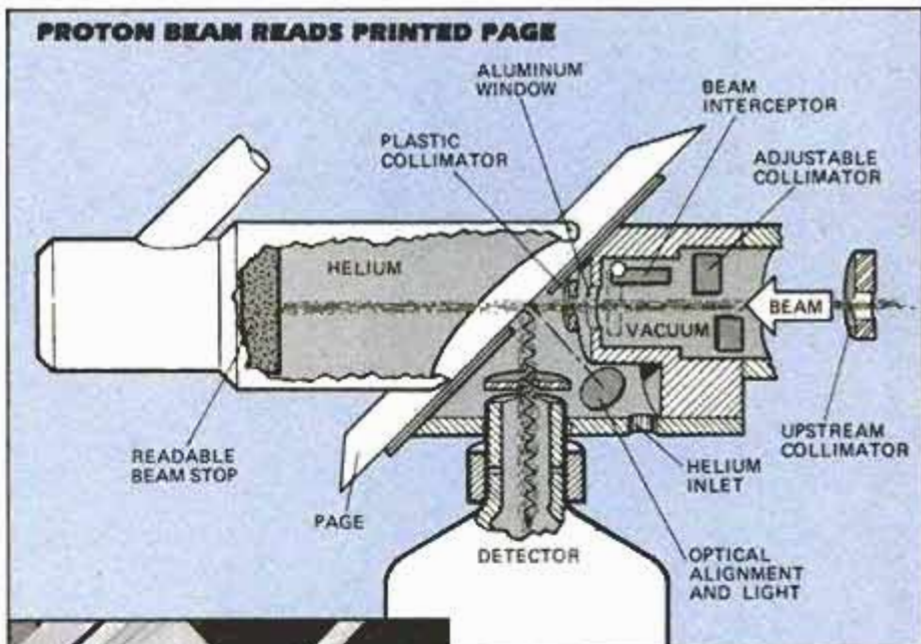
"If the cyclotron beam can identify chemical elements in polluted air," asked the physicists' colleagues in humanities, "could it be put to work identifying chemical elements in supposedly historically significant or valuable items?"

Why not? When the cyclotron now meets an art object behind the lab's thick concrete walls, accelerated protons (electronically charged particles from the nuclei of hydrogen atoms) are deflected into a vacuum tube, and narrowed into a precise stream of millimeter dimensions. The beam passes through the device (see diagram), out the vacuum tube and into an absorptive atmosphere of helium. The procedure is known as an external proton beam technique.

As the beam passes through the object being analyzed, protons in the beam collide with atoms of the various elements in the targeted object, generating characteristic X-rays from each element present.

The detector module processes the X-rays to determine energy and amounts and then transmits the information to a computer which prints out—in a matter of seconds—a detailed account of chemical elements that are present.

The pencil-like beam can analyze both large areas and portions small as an ink dot. It identifies a wider spectrum of elements, from both



Special lectern permits single pages of rare or antique books to be placed in cyclotron's beam for X-ray analysis.

ends of the chemical scale, than any other method. Even the most priceless and fragile antiquity is safe on the lectern in the cyclotron. Many nonvaluable items were tested before the physicists turned the beam on their first real antique—a page of Gutenberg's Bible, the world's first known work printed from movable type.

The cyclotron does not call out names, dates and an official pronouncement of authenticity or forgery. Instead, the quantifications are

Chemical elements in inks, pigments, ceramics and other materials emit characteristic X-rays under proton bombardment. Detector quantifies each element.

passed on to interested experts who compare the findings with what is already known about the technologies of any given time period.

An ancient Greek bible, many medieval parchment pages and 30 Gutenberg leaves have been analyzed. The reason why the Gutenberg ink has not faded: An extremely high lead and copper content.

A 16th-century Samurai sword, a large Renoir painting and even a meteorite have been scrutinized. But, according to the physicists, it's the bibliophiles who are the most excited with the cyclotron's nondestructive performance—mostly because of the extreme subtleties of which the proton beam is capable.

Thus far, the bulk of the cyclotron's work has been the building of a database by analyzing authentic works of art, as well as known forgeries, loaned by museums and collectors. But there have been some surprises. Some objects thought to be authentic have turned out to be frauds, and vice versa, to the dismay, or delight, of their respective owners.

Automotive

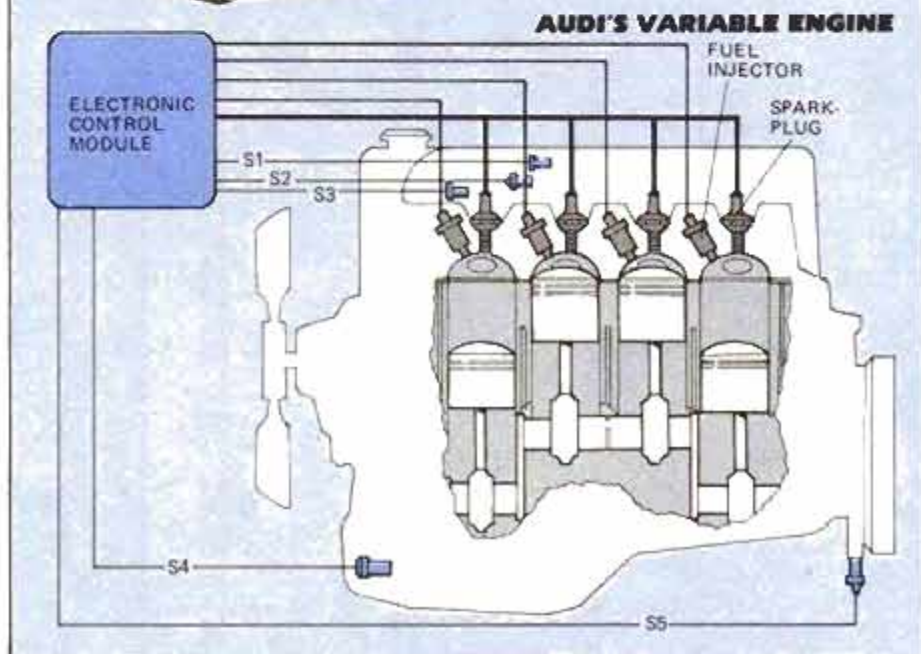
Running on two or four

Alfa-Romeo has recently completed a year-long test of a variable displacement, 2-liter engine on a fleet of 10 taxis. The engine, an electronically controlled four-banger, fires on only two cylinders during idle, part-throttle and coasting, but uses all four cylinders when you accelerate.

We tested this engine recently at Alfa's Balocco proving grounds and found the transition period between two- and four-cylinder operation barely noticeable.

The electronic brain is fed information from five sensors on the engine and automatically determines in which mode the engine should operate. The computer is also programmed to alternate which two pistons operate. This prevents the two inoperative pistons from cooling too much, thereby losing thermal efficiency. Every 2,000 revolutions the computer will shut off spark and fuel to the two outside cylinders or the two middle ones.

The fuel economy gains on the 10-car test fleet averaged 12.1 percent better than the full-time four-cylinder control group running simultaneously with the variable-engine group.



The five sensors located in the variable displacement engine that feed vital information to the central computer are: S1—throttle valve angle; S2—air temperature; S3—water temperature; S4—oil temperature; S5—engine speed.

Inventions

A true solar motor?

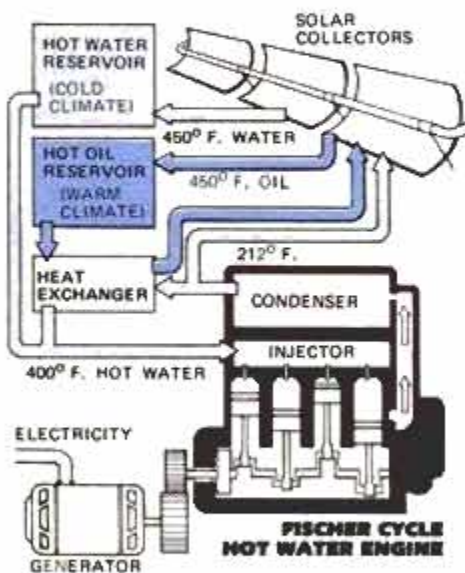
Australian inventor Victor Fischer refers to his patented new steam cycle machine as an "external combustion" engine. That's putting it modestly, since, if an American firm succeeds in mating the engine with solar-heated input, the combustion part will actually be taking place on the sun.

Fischer's engine is said to work very simply, with very little peripheral equipment needed. The engine is based on a well-known principle. Water heated to 400° F. is kept under pressure—maintaining the liquid state—until injected into the power section of either a reciprocating engine (as shown here) or a turbine engine. Injected into cylinders or a

turbine plenum, the water flashes immediately into steam, exerting pressure. The result, according to Fischer proponents and the Hong Kong-based holding company that owns world rights to the system, is an engine that would be more efficient at generating electrical power, for instance, than either diesel or steam units of conventional design.

According to Robert Starkovich, the president of the Phoenix-based Fischer Solar Engine America Inc., the 400° water requirement can be fulfilled by several solar collector designs now available. (For colder climates, a hot oil cycle with heat exchange, as shown at right, is interposed in the system.)

The primary aim of the Fischer engine developers is a stake in the electric power generating equipment market, with requirements that could top \$500 billion next decade.



Fischer engine modes for warm and colder climates (hot oil cycle added) are simple. Circulating pumps for pressurized water and condensate cut output.

Alternatives

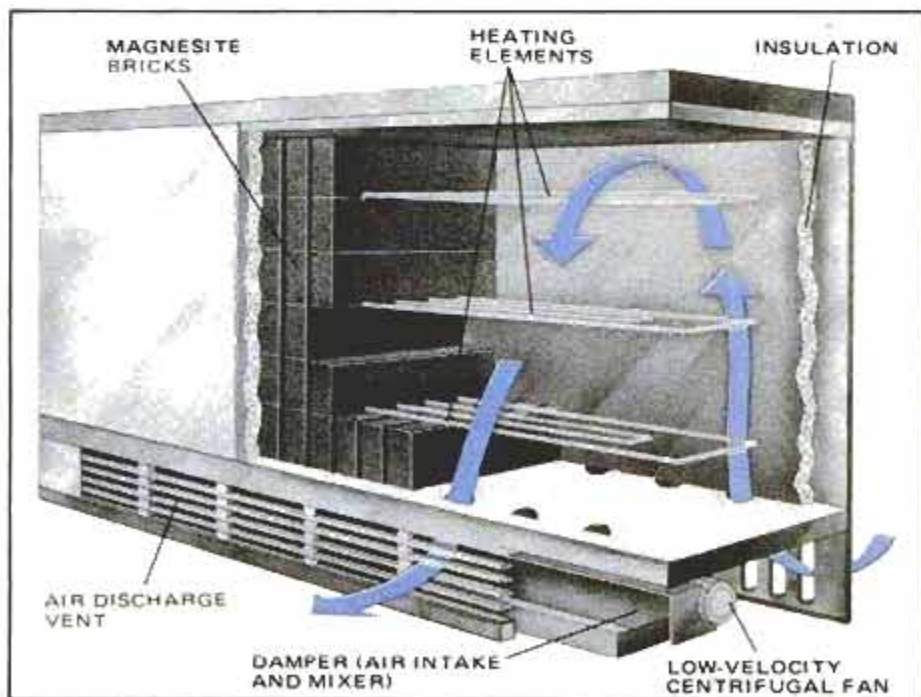
Working a night shift

Some experts say a specific type of electric heating could provide as much as 10 percent of the country's space heating requirements within the next 10 years. It's called electric thermal storage heat and it's much more widely used in Europe than in the United States at the moment. The unit we show is made in West Germany by Stiebel Eltron KG.

These storage heaters are designed to take advantage of lower "off-peak" rates offered by a growing



Stiebel Eltron storage heater installed in a home. Units are expensive, but savings from off-peak power rates add up.



Interior structure and air circulation patterns of electric thermal storage heater.

number of utility companies. Electric heating elements are situated between layers of magnesite (ceramic) brick, with the entire system heavily insulated.

A heating period of 8 to 10 hours (usually during the nighttime, when off-peak rates are in effect) is regulated by an outdoor temperature sensor to store only the amount of heat required for the ensuing 24-hour period. After the unit is "charged," heat

is produced on demand, via an in-room thermostat. The heat is dispersed by a small fan in the unit's base which circulates room air around the heated bricks.

Economic advantages vary, depending on the heating load and local utility rate structure. The average 3-kilowatt unit sells for about \$700. Stiebel Eltron's U.S. office is located at 84 State St., Boston, Mass. 02109.

All-solar development

Developers near Hemet, Calif., are working on what they call the first total solar manufactured housing community in the U.S. Called Bautista Solar Estates, the development

will consist of groups of individual homes receiving all space and hot water heating via centralized solar-assisted energy centers.

The energy centers will supply groups of 10 homes each via a paten-

ted recirculating hot-water system known as the Piper-Hydro hot water loop. In the event of a loop failure, adjoining loops can be automatically cut in. In addition, each center will house an auxiliary gas boiler that can supply the heating requirement independently in periods of low solar input. Southern California Solar, a San Diego-based firm, is installing the loop systems.

Homes in the tract will sell for \$70,000 to \$95,000 and are HUD-approved. The developer states that homeowners will be eligible for federal tax credits of as much as \$4,000. Owners will pay a monthly solar-energy center maintenance fee.



Model home in southern California tract gets heat, hot water from central solar plant.

Editor: Robin Nelson
Contributors: Tony Assenza, Yvonne Horn

Medicine

Patients and pressure

Treating hospital cases with hyperbaric (greater than normal atmospheric pressure) oxygen is more common in other countries than here. But that may not always be the case.

A recent article in the *New England Journal Of Medicine* addressed the subject of hyperbaric treatment of multiple sclerosis, suggesting for the first time that a cure may be possible. And a research group from the State University of New York is now engaged in similar research. This work is underway at the North American Hyperbaric Center on City Island, N.Y., a facility run by the Pro-



New York Professional Diving School's hyperbaric chamber will test M.S. treatment.

fessional Diving School of New York.

Proving itself as an effective treatment for M.S., always considered incurable, would be a huge boost for

hyperbaric medicine. The treatment is already acknowledged as beneficial in burn cases, carbon monoxide inhalation and gas gangrene.

Diagnosis by computer

Several hundred patients have been painlessly examined by a diagnostic computer installed at the Georgetown University Medical Center in Washington, D.C. Many neurological disorders have been identified by the machine, including multiple sclerosis and several forms of blindness.

The diagnosis is made by analysis of a patients' eye movements in response to such stimuli as flashes of

light and flashing checkerboard patterns. Data stored in the computer memory are compared and matched for a specific disorder. The patient, who has a number of electrodes fastened about the eyes and on the scalp, sits in a motorized chair in a cylindrical test chamber 6 feet in diameter and 6 feet high. The patient's responses to light changes and chair movements are electronically monitored and recorded.

The equipment, called CENOG

(Computerized Electro Neuro-Ophthalmograph) was developed by Dr. Robert S. Ledley, professor of physiology and biophysics at the University. He and Thomas Golab, chief engineer in the division Dr. Ledley heads, were recently granted Patent 4,320,768 for the CENOG. The computer has been in clinical use at Georgetown for more than two years. Test analysis is done by computer, within parameters set by an attending physician. The computer compiles an index for all the patients examined, and this information can be used by a reviewing physician.

A compilation of 59 different diagnoses coded by the computer includes multiple sclerosis, Parkinson's disease, blindness, various forms of palsy and many eye diseases. Dr. Ledley cited for PM an example, the diagnosis of myasthenia gravis (a neurological disease). A light spot is projected in front of the patient alternately from left and right, in intervals about a second apart. The patient moves his eyes to follow the spot, but is unable to do so accurately, and has to watch another sweep. He is then given a drug, called Tensilon, which changes eye muscle tone, and the patient can then track the moving spot. This syndrome identifies the disease.

Professor Ledley claims the instrument has demonstrated its value in diagnosing many neurologic and ophthalmic disorders.



Eye movements are key to computer diagnosis of neurological, ophthalmic illnesses.

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ing at, or practically at, the same slip angles.

Nearly all production cars in the world are designed to understeer mildly because it's safer for most drivers. Unless you're going extremely fast, understeering in a turn simply causes you to scrub off speed. And it requires the least driving skill and effort to keep the car in the general direction you want to go.

Oversteering cars are a real handful and will constantly try to swap ends. To keep that kind of car on the road at reasonable speeds requires a lot more concentration and skill than most people have. Race drivers, as a rule, prefer a certain amount of oversteer built into a car. But that's a whole other discussion.

Learning to use the car

Even though the above is a very brief discussion of vehicle dynamics, you can put it to some good use. Let's take an example of a car traveling in a straight line that suddenly encounters an obstacle. The driver has to do two things: slow the car to a stop or slow it sufficiently to drive around the obstacle.

The worst response is to lock up the wheels, freeze at the wheel and wait for the sound of the impact.

When you brake in a straight line, several positive things happen. First, there's a certain amount of weight transfer going on. This means that the weight of the car, rather than being equally distributed on four tires, is suddenly shifted and is resting on the two front tires. The front springs compress, the rear springs expand and the rear tires have far less traction than the fronts. But, most important, the contact patch of the front tires is increased. The amount of rubber in contact with the road is now greater, due to tire compression. Now you've got more traction there and more steering control. You can take advantage of the increased traction to turn the car away from the obstacle. In a sense, you've overcome the inherent understeer characteristic and found yourself a lot more steering response.

In the rain, this situation would require a different technique. Due to the reduced friction with the road surface, the front tires will generally lock up under moderate to heavy pedal pressure and you'll lose steering ability. A tire that stops rotating simply glides on the film of water and you essentially lose control of the steered wheels. You have to modulate pedal pressure to the point of impending lockup, keep the front wheels turning and steer away from the obstacle.

Let's take another example where

you need to slow down in the middle of a tight but fairly fast right-hand curve, like a two-lane country road. You're motoring along in the curve. The car is balanced with the weight evenly distributed on all four tires, but with most of the loading on the two outside (left) tires. Suddenly, you need to stop or avoid an obstacle.

Because you're in the midst of cornering, if you jump on the brakes hard, the car's weight will not transfer evenly to the two front tires. Instead, it will

transfer to the outside (left) front tire. The two inside (right) tires will become unloaded almost completely, and the left rear tire will become partially unloaded.

Your outside front tire will adhere quite well. But the two rear tires will lose adhesion. If you take no corrective measures and continue to brake hard, the rear end will come around and you'll end up in a spin. You can avoid a spin by cranking in some opposite steering lock, or, as they say in driver's



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ed, steer in the direction of the skid. Unfortunately, they never tell you how much to steer, how much opposite lock to apply or what to do afterward.

You want to crank in just enough opposite steering to catch the skid and get the front and rear wheels to travel in the same general direction. If you crank in too much, the car will start skidding in the opposite direction and you'll begin a series of pendulum motions which will send you totally out of control and off the road.

Don't panic and start sawing madly at the wheel. Easy, gentle motions will get the car balanced and gathered up enough for you to continue through the curve without drama. Provided you don't have traffic in the other lane, don't be afraid to use as much of the road as you need.

The same steering technique applies if you encounter ice on a curve and find yourself oversteering. Except here, of course, you're not braking to avoid something. You're just trying to correct

a possible spin. Dial in enough opposite steering to catch the skid, but keep a steady throttle. Lifting off on the throttle or jabbing the brakes hard will upset the car even more and reduce your chances of gathering it up.

Unfortunately, knowing how much opposite steering lock to apply is a learned response and you can only learn it by practice. The Roos School has developed a vehicle called Slidecar. The prototype was a modified Audi. The current Slidecar is a Saab. The rear wheels are allowed to toe out when a side force is applied, as in cornering. To the driver, it feels remarkably like driving on ice. After a few laps on Pocono Raceway's infield road course—the one used by Roos—finding how much opposite steering lock is needed becomes almost second nature.

Obviously, not everyone who wants to learn this or other emergency driving techniques, has access to a closed race course or a Slidecar. But you *can* practice and explore the limits of braking and adhesion in your own car. The best thing to do is find a paved open area, like a parking lot or perhaps an unused airfield. Set up some cones or markers to simulate various corners and obstacles. Then practice. Ideally, you should do it in the rain. A wet surface will simulate at very low speeds how it feels to slide and lose adhesion at high speeds under dry conditions.

If you feel like you need guidance, you might contact a local car club which organizes these types of events. The ultimate source of knowledge, however, is a professional organization like the Bertil Roos School (Box 221, Blakeslee, Pa. 18610).

Race face

Just before an auto race, drivers put on what they call their race face. It's as if they put on a new set of psychological clothes, screwing up their aggressiveness and getting their minds and senses up to speed. Mercenaries and soldiers call it a green, yellow or red light condition. It's nothing more complicated than getting your mind and body calibrated for the task at hand.

A green light mental attitude is reserved for putting your mind on hold and watching *Family Feud* on television. Red light is for a mission behind unfriendly lines, racing, or driving on public roads. That's not to say that you should be clutching the wheel in desperate anticipation. Stay loose and relaxed, but ever mindful that you might be called upon to make some fast decisions. And you'd better be awake enough to know what your options are. You just can't afford to be asleep at the wheel.

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Build This Heavy-Duty Garden Cart

Hitched to my garden tractor, this trailer cart satisfies my need for a large-payload, lightweight cart that's relatively rustproof and rot-resistant. The aluminum-edged, plywood cart holds an impressive 14 cu. ft. of material. Designed with floating-axle suspension to carry heavy loads evenly over rough terrain, it uses standard building materials and hardware—plus some valve springs from an old engine and two cast-off wheelbarrow wheels with axle housings. After you gather the necessary materials, you can duplicate it in a weekend or two.

First, on a 4×8 sheet of $\frac{5}{8}$ -in. CDX plywood lay out the bottom, sides and ends of the cart according to the materials list on page 160. After the parts have been cut, treat them with a wood preservative and then glue and tack them together, omitting the tailgate end.

This 14-cu.-ft. plywood trailer has floating-axle suspension to distribute the weight.

Next, cut the drawbar (D in materials list) and the T-stabilizer (E). Cross-lap join them as shown in the drawing. Fit the assembly flush to the sides and open rear of the cart's bottom; secure them in place with stovebolts (T) countersunk flush with the cart bed.

Now cut the spacer (G) for the under-carriage mounts. Cut a 1½-in.-deep × 2½-in.-wide dado in the spacer for the drawbar; the spacer should be flush with the bottom of the cart when installed.

Cut four hanger mounts (F), test-fit them with the spacer onto the cart bottom, and nail them to the spacer with

10d common nails. Then nail the assembly to the drawbar with 8d common nails. Secure the mounts to the cart with 2¼-in. wood screws (T2) from inside the cart.

Next, cut the sheet aluminum for the cart bed (C1). Using the pattern as a guide, notch the corners and fold as indicated by the dotted lines. Fit the covering into the bed and fasten it temporarily with tacks through the folded tabs.

To make the guide channels for the tailgate and the edging for the cart panels, you'll need about 76 in. of 2×2-in. aluminum angle and 29 ft. of $\frac{3}{4}$ × $\frac{3}{4}$ -in. aluminum angle. Hacksaw two 17½-in. lengths of the latter for the inner tailgate channel guides (W); cut two 18-in. lengths of 2×2-in. angle for the outer channel guides (X). Set the tailgate and the guides in place, clamp the guides to

(Please turn to page 160)

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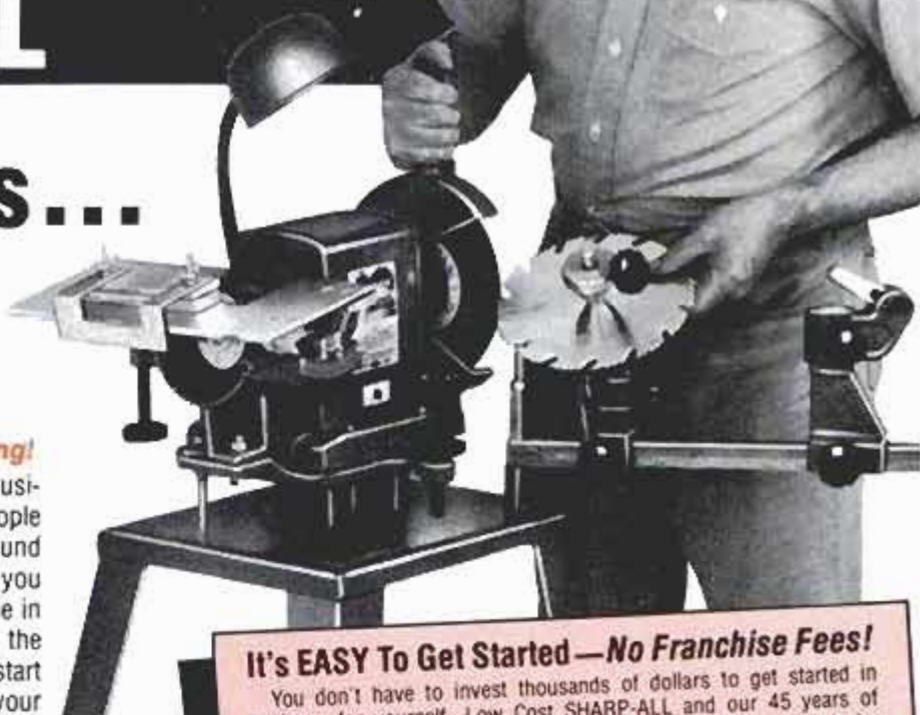
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GARDEN CART

(Continued from page 158)

the sides of the cart and remove the tailgate. Drill holes and bolt the channel guides together through the cart sides using 1-in. stovebolts, washers, lock washers and nuts (T3).

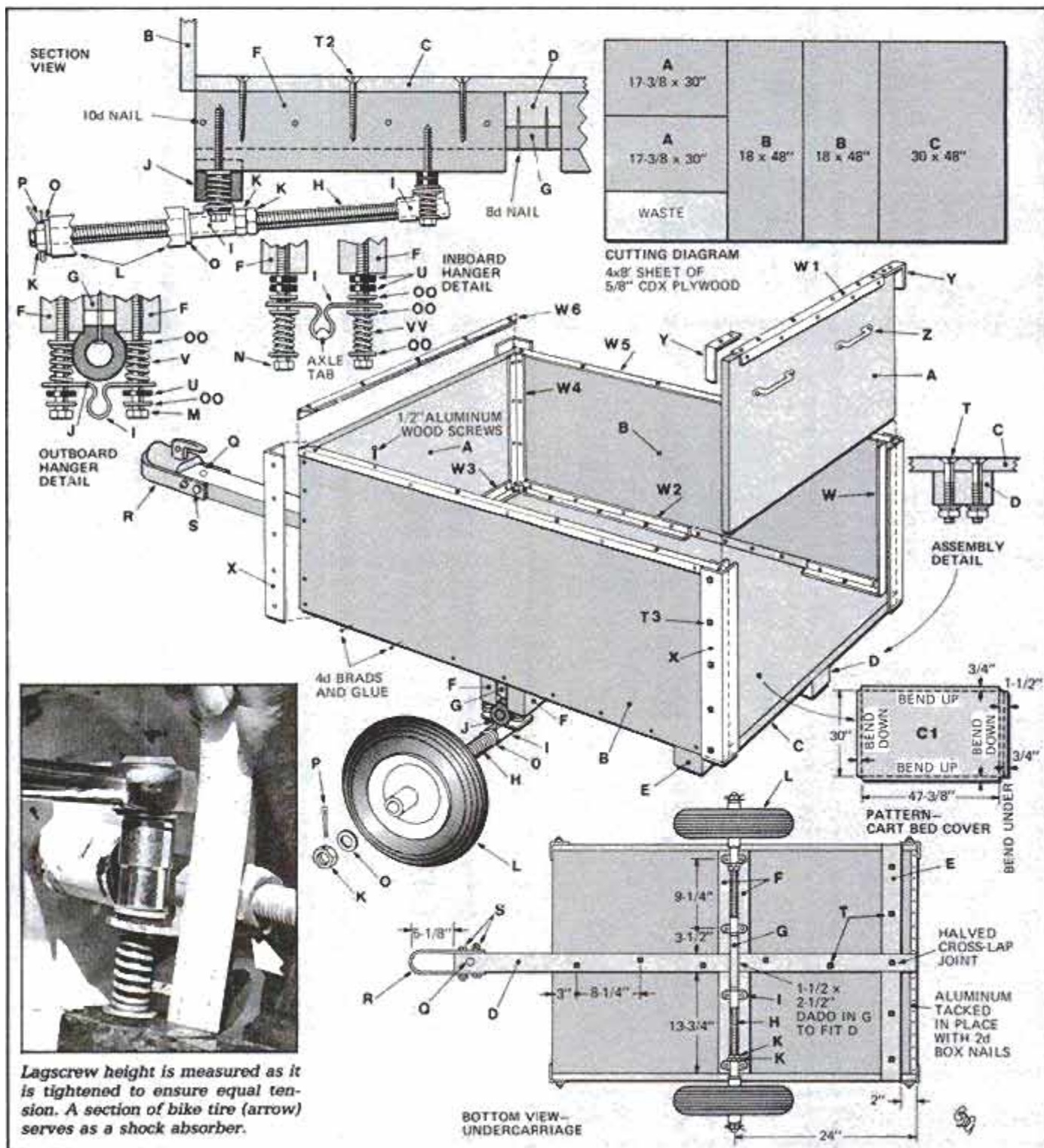
Finish edging the top of the tailgate with angle (W1), centered and secured with 1/2-in. aluminum wood screws countersunk flush to the outside.

Secure the locking hasps to the ends of the rail with wood screws. Then secure the two aluminum handles.

Miter cut the inside edging (W2 and

MATERIALS LIST—GARDEN CART

Key	No.	Size and description (use)	Key	No.	Size and description (use)
A	2	3/4" x 17 3/8" x 30" CDX plywood (front, back gate)	K	6	1/2"-i.d. nuts (axle assembly)
B	2	3/4" x 18" x 48" CDX plywood (sides)	L	2	4.00-8 (4" wide x 8"-dia. hub) tubeless wheelbarrow wheels
C	1	3/4" x 30" x 48" CDX plywood (bottom)	M	4	3/8" x 5" lagscrews (outboard hangers)
C1	1	0.25 x 31 1/2" x 49 3/8" sheet aluminum (liner)	N	4	3/8" x 4" lagscrews (inboard hangers)
D	1	1 1/2" x 2 1/2" x 61 1/2" fir (drawbar)	O	4	3/8"-i.d. washers (axle assembly)
E	1	1 1/2" x 2 1/2" x 31 1/4" fir (drawbar T-stabilizer)	OO	20	3/8"-i.d. washers (hangers)
F	4	1 1/2" x 3 1/2" x 13 3/4" fir (hanger mounts)	P	2	2" cotter pins (axle assembly)
G	1	3/4" x 2 1/2" x 30" fir (axle spacer)	Q	1	1/2"-dia. x 2" carriage bolt
H	2	3/4"-dia. x 18" threaded rods (axles)	R	1	Tractor hitch
I	4	Axle housings (from cast-off wheelbarrows)	S	2	1/4"-dia. x 3" capscrew, washer, lock washer, nut
J	2	2" bike-tire sections (shock cushions)	T	10	3/8" x 3" stovebolts, washers, lock washers, nuts
			T2	12	2 1/4" No. 14 flathead screws
			T3	as reqd.	1/2"-dia. x 1" rh stovebolts, washers, lock washers, nuts
			U	12	Rubber washers
			V	4	Stiff compression springs
			VV	4	Light-duty compression springs



- W 2 1/4 x 3/4 x 3/4 x 17 1/2" angle (inside gate guide)
- W1 1 1/4 x 3/4 x 3/4 x 27 1/2" aluminum angle (gate edging)
- W2 2 1/4 x 3/4 x 3/4 x 46" aluminum angle
- W3 1 1/4 x 3/4 x 3/4 x 30" aluminum angle
- W4 2 1/4 x 3/4 x 3/4 x 16 3/4" aluminum angle
- W5 2 1/4 x 3/4 x 3/4 x 47 3/4" aluminum angle
- W6 1 1/4 x 3/4 x 3/4 x 31 1/4" aluminum angle
- X 4 1/4 x 2 x 2 x 18" aluminum angle
- Y 2 1/4 x 3/4 x 2 x 2" aluminum angle
- Z 2 handles

Misc.: 1/2" aluminum wood screws, wood preservative, 1/4"-dia. x 1" rh machine screws and nuts, 4d brads, 8d and 10d common nails, waterproof glue, primer, heavy-duty exterior paint, lithium grease.



The tailgate slides smoothly up and down between channels. Angle hasps at the top of the gate securely lock it in place.



Axles float between two sets of springs. This tends to adjust the load and steady cart motion over rough terrain.

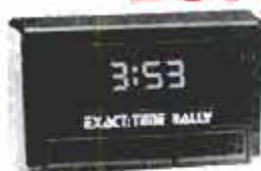
W3) and bolt it through the floor and sides with 1/4-in.-dia. x 1-in. roundhead machine screws and nuts. Miter cut and install top edging (W5 and W6) with 1/2-in. aluminum flathead screws.

Finish the edging by cutting the front vertical pieces (X and W4). Fit and bolt parts in place with 1/4-in.-dia. x 1-in. roundhead machine screws and nuts.

Flop the cart so you can work on its undercarriage. Begin work on the inboard hanger (see detail) by hack-sawing the axle tabs (stops) off two of the four axle housings.

Then, begin assembly by running
(Please turn to page 162)

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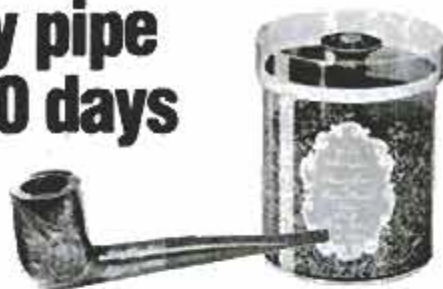


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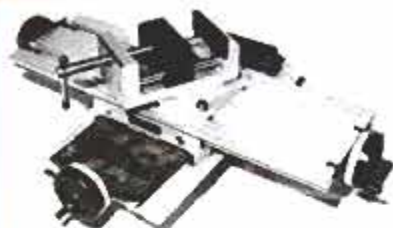
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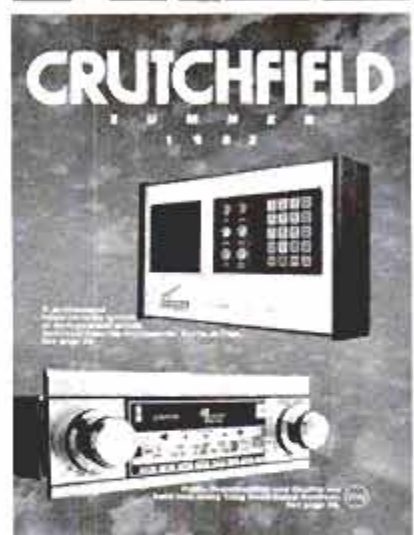
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GARDEN CART

(Continued from page 161)

two nuts near the center of one axle rod. Slide one of the open-ended axle housings down to the nuts. Add a flat metal washer, a wheel, another flat washer and another nut. Adjust this assembly by setting the nuts so 1/8 in. of the rod protrudes beyond the nut at the wheel end of the rod. Make sure that the wheel spins freely.

Begin assembling the inboard hanger onto the axle rod by slipping a close-ended axle housing onto the other end of the rod and running it up to the axle tab. Lay the completed assembly on the cart's axle mounts; then locate and mark positions of the four lagscrews that secure the assembly in place.

Repeat the steps with the other wheel assembly. Note that the two pairs of hole locations should be about 9/4 in. apart, with the inside of the tire 3/4 to 1 in. from the cart side (both sides). With a 3/32 bit, bore outboard holes in the mounts 3 in. deep, and the inboard holes 2 1/2 in. deep. Before hanging the wheel assembly, hacksaw two 2-in. sections from an old bike tire. Nail these into spacer at outside ends of wheel mounts as shock absorbers.

Outboard Hangers

You will need two pairs of heavy-duty springs (valve springs from an old engine are ideal) for the outboard hanger assemblies, and two pairs of lighter springs (available at hardware stores) for the inboard assemblies. Feed the necessary washers onto the lagscrew of the outboard hanger. Slip the screw through the axle-hanger lip; then add a heavy-duty spring. Add another washer and temporarily secure the assembly with a clamp. Repeat the procedure on the opposite lip of the hanger. Then run both screws into their holes, leaving 1 3/4 to 2 3/4 in. of shank showing.

Complete the inboard assembly with washers, lagscrews and light springs. Run screws into the mounting holes; leave 1 3/4 in. protruding.

Mount the opposite wheel assembly in the same manner. Then test to see that the axles float freely and evenly between the compressed springs when weight is applied. Adjust if needed.

Secure a hitch for the tractor onto the drawbar of the cart. Finish the cart by staining, varnishing or painting it according to your preference. We applied a coat of Fuller-O'Brien alkyd primer and painted the cart with an alkyd, semigloss, heavy-duty companion paint in a rich brown color.

Use lithium grease on the axles and secure the outer wheel nuts in place with cotter pins. Your cart should remain maintenance-free for a good many years to come.—Dick Roberts

VIDEOTEX

(Continued from page 103)

flash and panache of the displayed screens was startling to someone who was used to seeing just text on a computer screen.

But what is the real utility of these admittedly beautiful graphics that Telidon can send into your home?

Many companies, such as Time Inc. and Knight-Ridder, Times Mirror and others, have been running extensive "field tests" of both teletext and videotex information services. All depend heavily on graphics. But does it matter if the airline schedule you're reading is on a blue background with a 15-color picture of a 747 above the data? Isn't it really the information that you need, and not the picture?

Bill Dawes, spokesman for Norpak, feels that people are "turning more and more to graphics for interpretation of data." During an interview, he cited many uses, such as showing a thermometer instead of a number in a weather report. As he explained, "If you hear that the Dow Jones is at 830.2, it doesn't mean a damn thing, unless you can see the trends." So graphs and charts are handy.

But Compuserve, which runs the largest existing videotex service focused on home computers, seems lukewarm about converting immediately to a more graphics-oriented format.

Visual society

Compuserve's editorial director Rich Baker told us that Compuserve "intends to integrate graphics when there is truly some value to it. Graphics will be a vital part of videotex. We are a visual society and people are used to pictures."

Jeff Williams, who is Compuserve's database administrator, feels that "the use of Telidon to compete with newspapers and magazines in showing pictures is questionable."

He then pointed out that Compuserve does offer one Telidon area in its Microquote database. There, a user can call up charting capability for the latest stock figures. Charts are generated to fit each request, rather than being stored and called up. The charts are not only pretty pictures; they're a way of getting right to the heart of the information.

The near future

You may be seeing Telidon and other videotex services offered soon in your own locality. Many people are predicting phenomenal growth rates for this new industry. Some sources forecast that, by 1990, as many as 8 million homes will be connected to videotex just in this country alone. **PM**

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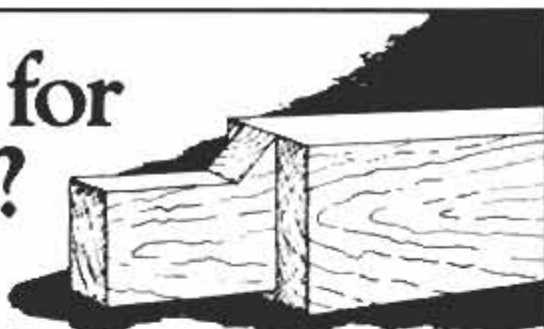
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MOBILE TOOL CENTER

(Continued from page 110)

now you're ready to make the chest.

Start by gluing up boards from which the 24-in.-wide top, bottom, sides and center partition will be cut. When these boards have been planed and sanded they should be $\frac{3}{4}$ in. thick.

When this work is done, cut each of the two sides and the top and bottom to the dimensions shown. Then, make the dovetail template in the drawing on page 111. Our template was made from sheet brass. But for one-time use, you can use heavy cardboard or $\frac{1}{8}$ -in. hardboard.

Use the template to draw the dovetails on the top and bottom edge of each side piece. When cut, use the sides to outline the pins to be cut on the ends of the top and bottom pieces. Be sure to mark mating edges so that they can be repositioned correctly when the pins have been cut. (See *How To Master Fine Wood Joinery*, page 98, Jan. '82, for instructions on cutting dovetails.)

When this step is completed, use a router with a rabbeting bit to cut a $\frac{3}{8} \times \frac{1}{2}$ -in. rabbet at the inside back edge of each side. Then, dry-assemble all components to check for fit. If dovetails and pins project slightly in the final assembly, sand them to make flush joints.

Next, cut and apply drawer guides to the side pieces and the partition as shown in the drawing. These are glued and the screws are countersunk. Use two 1-in. No. 10 wood screws on each. With a backsaw and chisel, cut the two $\frac{1}{2} \times 1\frac{1}{2}$ -in. slots in the center partition to accept drawer spacers. Then, cut the back panel to fit, making certain all corners are square and true. Clamp the entire assembly, nailing the back in place to square it up.

The drawers

Now you are ready for the drawers. Sides and backs are $\frac{5}{16}$ -in. stock, planed down from $\frac{3}{4}$ in. The fronts are $\frac{3}{4}$ -in. stock. Cut them to length.

Use a table saw to cut a $\frac{3}{8}$ -in. sliding dovetail the full height of the front end of each side piece. Then, use the saw to cut a $\frac{3}{8}$ -in. matching groove on the inside face of the drawer front. With a $\frac{1}{4}$ -in. chisel, cut away the waste the saw couldn't reach, so the groove will accept the dovetail.

Next, cut a $\frac{1}{4}$ -in. groove in each side, back, and front, $\frac{1}{4}$ in. from the lower edge, to accept a $\frac{1}{16}$ -in. plywood bottom. Finally, attach a $\frac{1}{16} \times \frac{1}{8}$ -in. guide strip to the outside of each side piece. Glue, nail and clamp the assembly and let it stand overnight. Test each drawer by sliding it into place in the chest assembly and sand as needed to assure easy sliding. When in place, the drawer front should recess about $\frac{1}{4}$ in. into the face of the chest.

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Finish all parts with the same finishing products used on the other members of the PM craftsman's center.

To locate the chest on the base, we provided small recesses in the top of the base cabinet. The wood plugs installed on the bottom of the chest fit into these. You can use nonslip pads if you prefer.—David A. Warren

ASSEMBLY BENCH

(Continued from page 108)

against the cross members to mark the bottom edges of the long members for the mating notch cuts.

Unless you have an oversize dado head, the motor housing on the radial-arm saw will interfere and prevent cutting the notches to the required 1 1/4-in. depth. Therefore, cut the notches by making repeated (overlapping) kerf cuts with a conventional saw blade. If you make a fresh cut in the fence, it will simplify visual alignment of the initial outside cuts for the notches.

You'll need a stopped rabbet on the top edges of the two side members. The rabbet can be cut with the dado head, but it's quicker to make two right-angle saw cuts into the edge and side. We used a chisel to sever the remaining waste and to square the inside corner.

Assemble the top with screws and glue. To bore the screw holes, drill 1/2-in.-dia. holes for the wood plugs 1/8 in. deep, using the drill press. Follow up by boring 5/32-in. through holes (body size for No. 10 screw). Assemble the grid and frame temporarily on a flat work surface and use bar clamps to hold it all together and square. Chuck the 5/32-in. bit in a portable drill and continue the screw body holes into the ends of the cross members. Disassemble the unit and bore 3/16-in.-dia. screw shank clearance holes in side parts.

All sanding must be done before assembly. To minimize sanding, use a cabinet scraper first. Now glue-assemble the top using two 1 1/2-in. No. 10 screws at each joint. Glue in wood plugs to conceal the screwheads.

The base

To cut the parts for the base section, you'll need three 4 x 8-ft. plywood panels. You'll wind up with three good-sized cutoffs for other projects.

Cut the plywood to size, then add the edge banding. Since a considerable amount of edging is involved, you may find it more convenient to use tape, rather than clamps when gluing the strips in place. Cut the banding from 4/4-in. stock, then partly drive two thin brads at opposite ends to prevent sliding after glue is applied. Allow the banding to overhang all around and use

strips of duct tape to force the wood into good contact. After the glue has set, remove the tape and alignment brads and use a router with a flush trimming cutter to trim the overhangs flush to the plywood surface.

The shelf and upright members are joined with a combination of dados and deep edge half-lap notches. Make two parallel kerf cuts halfway through the one upright and the two shelf members. Then clear out the waste with a chisel or sabre saw. The easiest way to cut the long dados is with a router chucked with a mortising cutter. This simple jig on page 108 will ensure accuracy and speedy setup. The two parallel strips are spaced so a pass against each side will leave a 3/4-in.-wide groove. If you have a 3/4-in.-dia. cutter, a single pass will do it. The spacing of the guide strips varies according to the diameter of your router base and the cutter used. For example, the spacing in the jig shown is 5 1/4 in.; the router base is 5-in. dia.; cutter is 1/2-in. dia.

Begin assembly of the base section by interlocking the edge half-laps. Instead of glue, apply a fillet of quick-setting epoxy to the corners of the undersides of these joints. (See photo, page 108.) Use glue and 2-in. finishing nails to assemble the dado joints. Set the nails and fill the holes.

The two legs are secured with 5/16-in. lagscrews inserted from inside the frame and the end shelf compartment. Because of space limitations, you can't bore the lagscrew holes from straight on. But you can use an accessory right-angle drive in a portable drill.

The drawers are assembled with simple rabbet joints, glue and finishing nails. The 3/4-in. plywood stock used for the sides and bottom results in a strong drawer. For friction-free sliding, apply two strips of Nyl-O-Tape. This is a self-adhesive, nylon band, available at hardware stores and home centers. While not listed in its catalog, A. Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461, has agreed to make it available to PM readers. Nyl-O-tape (item No. IP572) is \$7 postpaid per 6-ft. roll. You'll need two rolls.

Finish is optional, but a deep-penetrating, tung oil/urethane resin finish, such as Deftco Danish Oil Finish from Deft Inc. is ideal. Wipe on two liberal coats as directed on the label. For color accent, we mixed 25 parts Deftco with one part walnut stain.

—Rosario Capotosto

PLANS AVAILABLE

If you prefer to build the PM craftsman's work center from larger drawings, you can order plans with instructions printed on 14 x 22-in. sheets. Send \$5.95 to Popular Mechanics, Dept. CWC, Box 1014, Radio City Station, New York, N.Y. 10101.

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104-Page

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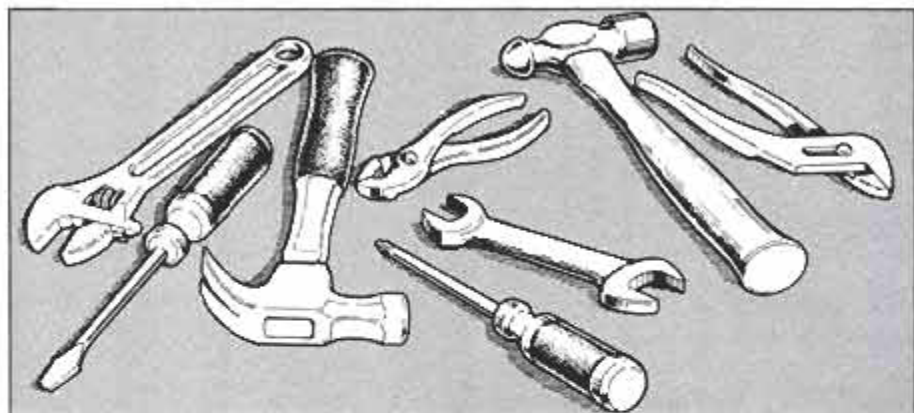
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HAND TOOLS

SHOP ACCIDENTS

(Continued from page 124)



Hammer

- Use the correct hammer size for the job: 13-oz. for light cabinet work; 16-oz. for all-purpose carpentry; 20-oz. for framing and demolition.
- Never use a hammer with a loose head or a split handle.
- Never strike one hammer with another.
- Do not use a hammer to pull large nails—the handle can slip or break. Use a pry bar instead.
- When starting a nail, hold it between your index and middle fingers, palm up. Hold your hand away after starting.
- Work on surfaces that are stable and well-supported.
- Use a ball-peen hammer for striking hardened steel.

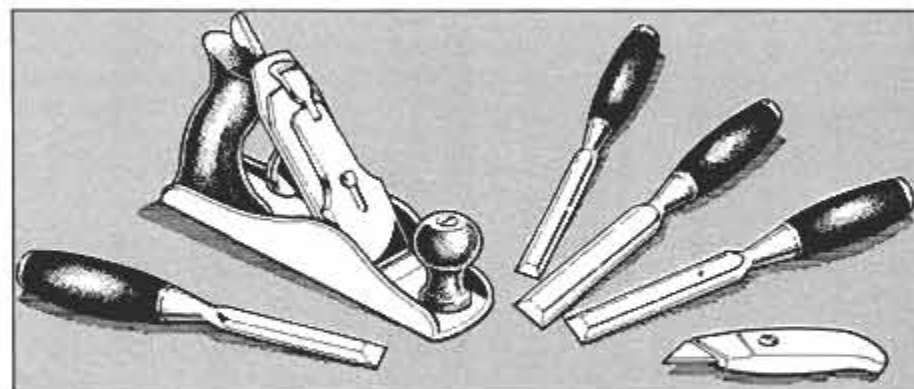
- Never strike a wrench with a hammer.
- Do not use pliers where wrenches should be used, as for pipes and bolts.
- Do use drop-forged tools, not brittle cast tools.
- When using an adjustable wrench, be certain that you exert turning force against the stationary part, not the movable jaw.

Screwdriver

- Use tip of the proper size and shape for the screw being driven.
- Never hold the workpiece in one hand while driving the screw with the other.
- Never use a screwdriver to do the work of a chisel.
- Never hammer on a screwdriver handle.
- Do not use screwdrivers with worn or chipped tips. They may slip and cause injury.

Wrenches And Pliers

- Never use an extender, that is, a length of pipe, to increase torque.



Utility Knife

- Always keep the blade retracted when knife is not in use.
- Use heavy-duty blades for general shop work.
- Let the blade do the cutting. Never force it through material with great pressure.

- Use great care when guiding a knife with a straightedge—the blade tends to ride up and slip off course. Make certain fingertips do not overlap the straightedge.
- Whittling strokes should be made away from your body or fingers.
- Store extra blades in the handle, not

in your pocket. Dispose of a blade as soon as it becomes dull.

Chisels

- Keep the cutting edges sharp.
- Hold the workpiece in a vise or clamp it to the workbench.
- Keep your other hand out of tool's cutting path.
- Use plastic covers for tips if chisels are stored in tool box or drawer.

Planes

- Keep plane irons well sharpened.
- When possible, hold the workpiece in a vise or clamp it to a bench or sawhorse.

- Keep your other hand out of the plane's path.
- Retract the plane iron when the tool is not in use.

Hand Saws

- Be certain to keep saws sharp and oiled.
- Use the correct saw—a crosscut saw for cutting across the grain and a rip saw for with the grain.
- Apply pressure only on the push

(cutting) stroke; the pull stroke cleans the kerf.

- Don't place your hand on the cutting line (below the saw's teeth). Grip workpiece alongside the handsaw.
- Clamp the workpiece to a bench while sawing small, hard-to-hold pieces.
- Set up the work so cut-off can fall freely to prevent binding.
- If you store a handsaw in your toolbox, protect its teeth, if possible.
- Start a cut slowly with three or four pull strokes. Use a cutting stroke after the kerf is started.

FM

General Safety Tips

- Keep your shop clean and well organized.
- Keep surfaces on large shop equipment free from hand tools, scrap wood, sawdust and oil.
- Keep all cutting tools sharp. When less effort is required, control is greater.
- Use only double-insulated or properly grounded power tools.
- Read all manufacturer's instructions before using a new tool. Keep machine guards in place at all times. If you have to work without the manufacturer's guard, make your own to suit specific needs.
- Use pusher blocks or sticks to feed stock through shop equipment, according to recognized safety practice. Keep fingers as far as possible from cutting edges.
- Wear goggles or safety glasses.
- Do not wear any jewelry.
- Do not wear loose-fitting clothes. Wear short sleeves, or roll up long sleeves. Wear rubber-soled work shoes or boots, preferably with toe protection.
- Do not work in your shop after drinking alcohol, or if you're on medication.
- Do not work in your shop, especially with power tools, when you are tired. Fatigue makes concentration difficult.
- Do wear a dust mask when doing a lot of cutting, sanding or grinding.
- Keep a well-stocked first-aid kit on hand.
- Try not to let distractions break your concentration when working with tools. Don't look up abruptly if someone calls to you or enters the work area.
- Keep dangerous tools and toxic substances out of children's reach.
- Always use switch safeties (on tools that have them) when you are out of shop.
- Keep unqualified users away from equipment.

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How To Increase Your Garage's Storage Space

If your garage is getting the cramps, we've got three fast-acting pain relievers.

BY TONY ASSENZA AUTO EDITOR

Next to money and cheap gasoline, the commodity most people never seem to have enough of is storage space. Even if you're not a pack rat and try to keep your inventory of accumulated material to a minimum, you almost always end up looking for more places to put things.

We've been discovering this fact of life as our Dream Garage (see *How To Design And Equip Your Own Dream Garage*, page 126, May '82) begins to

swell with the projects we've been running through it. It is only a 20 x 20 ft. area, so every inch of the place has to be used as efficiently as possible.

We've just about run out of wall space, so hanging anything else on the walls was out of the question. Luckily, our garage has a high ceiling; as a result, a loft appeared to be the ideal way to maximize the total volume of the garage.

You can build a loft out of just about



A storage loft is an ideal way to store items that you use only occasionally.

anything, but we decided to use slotted angle iron rather than wood for the main support beams. The virtue of using slotted angle iron is that you can assemble it with nuts and bolts and easily disassemble it if you need to

(Please turn to page 172)

CAP SCREWS, Hex Head
Grade 2 Steel, Zinc-Plated

U.S.S. WROUGHT WASHERS
Steel, Zinc-Plated

CAP NUTS
Steel

RING TERMINALS
Copper, Tin-Plated

CABLE CLAMPS
Nylon

BLIND RIVETS
All Steel

FINISHING NAILS
Steel

HOG RINGS
Copper Plated Wire

HANGER HOOKS
With Nails

CONCRETE HOOKS
High-Impact Plastic

EXTERNAL RETAINING RINGS
Spring Steel

MACHINE SCREWS,
Grade 2 Steel, Zinc-Plated

SELF-TAPPING SCREWS,
18-8 Stainless Steel

WING NUTS
Die Cast Zinc

SPADE TERMINALS
Copper, Tin-Plated

WIRE & CABLE HOLDERS
Nylon

BLIND RIVETS
Aluminum

STEM SNAPS
Black Nylon

WIRE HOSE CLAMPS
Spring Steel

WALL ANCHORS
Conical, Plastic

COTTER PINS
Steel, Zinc-Plated

E-CLIPS
Carbon Spring Steel

HEX NUTS
Grade 2 Steel, Zinc-Plated

MACHINE SCREWS,
18-8 Stainless Steel

MALE DISCONNECTS
Copper, Tin-Plated

SOCKET HEAD SET SCREWS
Alloy Steel, Phosphate Coated

BUTT CONNECTORS
Copper, Tin-Plated

CABLE TIES
Nylon

RIVET BACK-UP WASHERS
All Steel

TACKS
Tempered Steel

WORM SCREW HOSE CLAMPS
Stainless Steel

WALL ANCHORS
Steel

CLEVIS PINS
Steel, Zinc-Plated

COMPRESSION SPRINGS
Music Wire, Zinc-Plated

"S" HOOKS
Steel, Zinc-Plated

CAP SCREWS, Hex Head
18-8 Stainless Steel

SOCKET HEAD CAP SCREWS
Hardened Steel, Phosphate Coated

CLOSED END CONNECTORS
Copper, Tin-Plated

GROMMETS
Rubber

PLASTIC RIVETS
High-Impact Plastic

BUTTON SNAPS
Brass, Nickel-Plated

FRAME HANGER WIRE
Steel

SCREW HOOKS
Steel, Zinc-Plated

ROLL PINS
Steel, Zinc-Plated

EXTENSION SPRINGS
Music Wire, Zinc-Plated

SPLIT-LOCK WASHERS
Grade 2 Steel, Zinc-Plated

FINISHING WASHERS
18-8 Stainless Steel

CASTLE NUTS
Steel, Zinc-Plated

OPEN/CLOSED BUSHINGS
High-Impact Plastic

THREADED RIVETS
Aluminum

COMMON RIVETS
Steel, Nickel-Plated

FRAME HANGERS
Pronged

SCREW EYES
Steel, Zinc-Plated

PIN CLIPS
Steel, Zinc-Plated

SPACER BUSHINGS
Steel

SELF-TAPPING SCREWS,
Grade 2 Steel, Zinc-Plated

COTTER PINS
18-8 Stainless Steel

SNAP CAPS SCREW COVERS
High-Impact, Molded Plastic

FEMALE DISCONNECTS
Copper, Tin-Plated

SNAP BUSHINGS
High-Impact Plastic

DECORATIVE NAILS
Steel, Brass-Plated

COMMON RIVETS
Aluminum

FRAME HANGERS
Saw Tooth

SHOULDER HOOKS
Solid Brass

HITCH PIN CLIPS
Spring Steel, Zinc-Plated

O-RINGS
Neoprene Rubber

WOOD SCREWS, Flat Head
Grade 2 Steel

TINNERMAN NUTS
Multi-Thread Steel

THREADED INSERTS
Brass Alloy

ALLIGATOR CLIPS
Solventless

WIRE NAILS
Steel, Zinc-Plated

UNIVERSAL BUSHINGS
High-Impact Plastic

DECORATIVE NAILS
Steel, Chrome-Plated

GROMMETS
Brass

PLASTIC HOOKS
Adhesive Back

CUP HOOKS
Solid Brass

SQUARE KEYS
Steel, Unplated

CHRISTMAS TREE CLIPS
Nylon Copolymer

INTERNAL TOOTH LOCK WASHERS
Grade 2 Steel, Zinc Plated

TINNERMAN NUTS
Single Thread, Spring Steel

THREAD REPAIR INSERTS
Steel, Zinc-Plated

SNAP SPLICE CONNECTORS
Plastic

STRAIN RELIEF BUSHINGS
High-Impact Plastic

COMMON NAILS
Diamond Steel

COMMON SENSE FASTENERS
Steel, Chrome-Plated

CLOTH HOOKS
Adhesive Back

GATE HOOK & EYE
Steel, Zinc-Plated

HALF-MOON KEYS
Steel, Oil Coated

PUSH-PULL FASTENERS
Polycarbonate

CAP SCREWS, Hex Head
Grade 5 Steel, Zinc-Plated

NYLON INSERT LOCK NUTS
Zinc-Plated, Nylon Insert

WOOD BUNGS & BUTTONS
Hardwood Birch

ELECTRICAL WIRE
Copper, Thermoplastic Insulated

HOLE PLUGS
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LIFT-THE-DOT-FASTENERS
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INCREASE GARAGE STORAGE

(Continued from page 170)

modify the design or expand on it later. Wood just doesn't give you that ease of flexibility. Most of the iron in fact, came from the workbench pictured in the May issue on the Dream Garage. We took apart that workbench when we built the sturdy bench featured in last month's Car Care Guide (*Build PM's Garage Workbench*, page 128).

The first thing you have to decide is how high the loft should be. That may



The metal bracket for the storage bins can be installed with screws or lagbolts.



Once the bracket is installed, bins attach by press-fitting the lips into channels.

sound like an obvious bit of logic, but keep in mind that it not only has to be high enough to allow you to work underneath, but must also be high enough to clear your car's raised hood with the front end of the car jacked up. Overhead clearance is especially important if you own a pickup truck.

Once you've established the height, you can assemble the four uprights. We attached "feet" to the uprights and anchored the feet into the cement floor. Ideally, you should tuck the loft into a corner of the garage. That way, you will be able to anchor three of the uprights to the walls and ensure adequate vertical rigidity.

Since we planned to use sheets of 4x8 plywood for the platform, we placed the uprights 8 ft. apart. Once the

three uprights were anchored to the walls, the free-standing upright was anchored to the floor and the lateral platform pieces were bolted in.

After the perimeter of the platform was installed, we bolted in two stiffening ribs in the middle of the platform to support the plywood sheets.

In using angle iron, we've discovered that nuts tend to get loose and back off the bolts. We cured that problem by using Loctite on the bolts before screwing on the nuts and torquing them down. You can paint the underside of the loft white and install a light fixture. It gave us quite a large light-reflecting surface and kept the loft from looking like a cave.

One of the neatest ways we found of storing odd, but frequently needed, bits and pieces, was to use hanging storage bins. These heavy plastic bins can be stacked on top of each other if you want them to be mobile, or they can be hung



Steel chest of drawers will literally hold a ton of fasteners and other small parts.

on a wall with a metal bracket.

The bins attach to the bracket by press-fitting the lips at the back of the bins into the slots on the bracket. No other fasteners are used, which makes the whole setup very versatile if you need to use the bins elsewhere. When PM went racing last summer, we used a number of these at the track. The only source we know of for these bins is Akro-Mils, Box 989, Akron, Ohio 44309.

The last piece of storage equipment we've found invaluable for holding nuts, bolts, solderless connectors, wire, clamps, and the like is a steel chest of drawers. Although our philosophy is to build, rather than buy, we couldn't find an efficient, cost-effective alternative to this Equipto unit (225 South Highland St., Aurora, Ill. 60507). This piece will hold just about everything you'll probably ever need. If you outgrow it, you'll probably be ready to open your own hardware store.

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RALEIGH LIGHTS

PM DESIGNS TWO Utilitarian GTs

Lurking beneath the genteel manners of a Cavalier and the friendly tail-wagging of a P'up are two street-fighters waiting to be unleashed.

BY TONY ASSENZA
AUTO EDITOR



Until a few years ago, practicality and driving fun were nearly always mutually exclusive. If you wanted a "sensible" car you were stuck with awful seats, no instrumentation, poor sound insulation and barely adequate handling. While these vehicles have their own unique virtues, they ultimately become boring. And, anyway, who ever said that a family cargo hauler can't be fun to drive.

With that end in mind we selected

two classically practical vehicles, a station wagon and a pickup truck, as the base for some sporting improvements.

Cavalier treatment

For the wagon we picked the new breed of downsized haulers, the Chevy Cavalier version of GM's J-cars. No one could argue that the J-wagon, while economical and adequately capacious, is rather less than inspiring. The engine, a 1.8-liter pushrod Four,

is anemic and the base suspension, while competent, could stand improvement.

We knew we couldn't get the motor to generate much more excitement without major modification that would compromise its fuel economy, reliability and emissions levels. But, we could improve the handling to enable the Cavalier to carry as much speed as it could through any corner.

Magical transformation

With those parameters in mind we discussed the needed work with Quikcor Engineering (6710 Southwest 111th Ave., Beaverton, Ore. 97005). What we got back a few months later was a vehicle transformed.

Russ Harness and the crew at Quikcor began by removing the stock exhaust manifold and replacing it with a Cyclone tubular exhaust. This allowed them to retain all the stock pollution-control equipment yet gave us some freer breathing and more usable power in the top end. That modification is reflected in the improved quarter-mile times.

The car was then shuttled over to Recaro where the stock seats were removed and a pair of their middle-of-the-line seats were installed. The Recaros bolted right into the powered Chevy subframes without modifications. The rear seats were reuphol-

Behavior modification is apparent. Note difference in attitude between a stock Cavalier (far left) and our project wagon (left). The wagon is like a big go-kart.

PERFORMANCE COMPARISON CHART

	1/4-mile Acceleration (sec. @ mph)	Braking 60 to 0 mph (ft.)	Slalom* (sec. @ mph exit speed)	Skidpad† (cw/ccw sec.)
Stock Cavalier	19.80 @ 89.60	165	8.86 @ 53.89	.66/.66
Modified Cavalier	19.24 @ 70.98	159	7.95 @ 60.06	.72/.74
Stock P'up	20.28 @ 65.98	169	9.49 @ 50.31	.58/.53
Modified Puppy	19.84 @ 67.87	165	8.51 @ 56.10	.61/.61

*Slalom is speed in mph through seven cones spaced 100 ft. apart with an entry speed of 60 mph.
†Skidpad is measured in G force, with 200-ft.-dia. skidpad; cw, clockwise; ccw, counterclockwise.



stered to match the black bolster and gray inserts of the front seats.

The seats don't add anything in weight—the stock seats weigh nearly the same—but they're a lot more comfortable, especially on long trips.

The largest amount of work went into suspension modifications. Quicker lowered the car by replacing the

stock springs with their own units, which are shorter and have higher rates. The MacPherson struts were removed and the strut inserts were replaced with stiffer ones. Once that was done, a 28-mm antisway bar was installed in the front and a 19-mm bar installed in the rear. Finally, the

(Please turn to page 176)



Duesenberg wheel bolts into Cavalier column using hub adapter and nine bolts.



Flat-black Momo steering wheel replaced the thin, plastic bus wheel on the P'up.



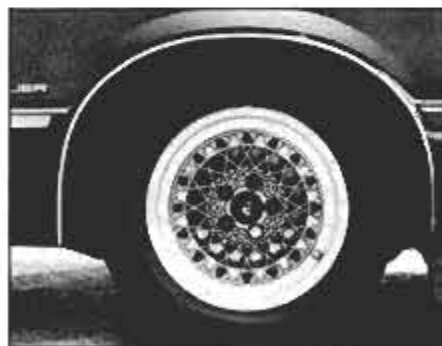
Ultra high-tech Recaro L-seats use the power brackets in the Cavalier frames.



Recaro LN seats were upholstered with cloth to match the truck's color scheme.



Headlight covers for Chevy (left) were handcut from clear plexiglass, painted with Cavalier logo. Aerodynamic spoiler for truck (above) has rubber extension.



The Epsilon modular wheels come with excellent Goodyear 195/60 x 14 NCTs.



Keystone wheels and 235/60 x 15 Goodrich Radial T/As improved handling.



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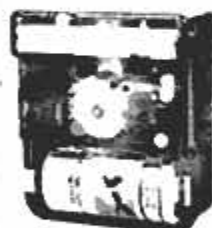
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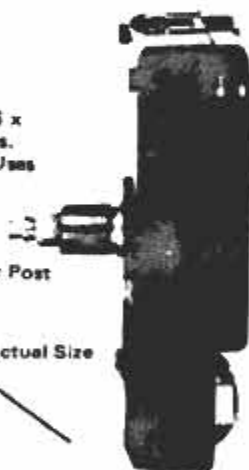


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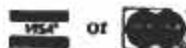


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UTILITARIAN GTs

(Continued from page 175)

stock wheels and tires were removed and replaced by Epsilon 14 x 6 in. modular alloy wheels and sticky Goodyear 195/60 x 14 NCT tires.

World's biggest go-kart

All those good things in the underpinnings turned the once uninspiring Cavalier into the world's biggest go-kart. There's virtually no body roll in cornering and it responds to steering inputs with laser-sharp reflexes. Nearly all traces of understeer are gone. Instead, the car is extremely neutral and when pushed hard will even oversteer. But with so much rubber in contact with the ground you have to push it extremely hard to get it badly out of shape. The transient handling response is the area where the biggest gains were made, as the comparative performance chart indicates. This makes the car a lot more manageable in an emergency situation.

The penalty you pay for all this handling, however, is ride quality. The car is very stiff, perhaps too stiff for some people. But after driving it on all sorts of road surfaces you become accustomed to it. Other cars begin to feel fat and positively wallow when compared to our Cavalier.

The finishing touches came in the form of a Duesenberg steering wheel (it's fatter and has better spoke configuration than the stock wheel), KC Hilites auxiliary lamps and a Sun Super II Tachometer.

For better aerodynamics and fuel economy we installed headlight covers and skirts made by Gila Products. These two items added close to 1 mpg to the Chevy's fuel economy.

The nice thing about this project is that you can do most of it with tools you probably already have in your toolbox. About the only thing you might need special tools for is the strut removal and installation.

PM project P'up

Nobody drives a stock pickup truck. It just isn't done. You have to think of your pickup as a blank canvas, just waiting for your painterly touch. We chose the new Isuzu P'up because it's the best looking pickup on the market, the most economical except for the smaller VW, easy to work on, has the biggest bed in this class and a load rating which will handle two motorcycles at the same time. We also enlisted the expertise of auto writer Rich Taylor to supervise the project.

The Isuzu's weaknesses didn't matter. The stock seats—which appear to be upholstered in an old Japanese

grandmother's bathrobe—were coming out. The cheap tires and radio were being replaced. And the first thing you do with any Japanese pickup truck is add a bedliner to protect the single-wall box.

We originally planned to build a liner of redwood, with built-in toolboxes, but then discovered a molded liner made by Brahma Thermoplastics in Grand Prairie, Tex. It comes in five pieces—one for each side and the bottom—so you don't have to replace the whole thing if you damage one. It's resistant to just about anything, including gasoline and caustic chemicals.

For maximum versatility, we or-



Keypad for Clifford alarm system was on driver's side armrest. System locks hood, kills ignition, blasts horns.

dered "summer" and "winter" bed covers.

In the summer, we use a tonneau cover made by Bestop and held down by continuous Velcro strips. In winter, we install a molded cap from Brahma, painted black to match the truck paint scheme. It has opening side windows with built-in screens, a pass-through window to the cab and locking tailgate. It adds 3 mpg to fuel economy, and 100 percent to the usefulness of the truck.

Minor chassis additions

We made only three additions to the chassis. Koni shock absorbers firmed up each corner beautifully. One of the small savings of pickups is that most of them still use conventional shocks, not MacPherson struts, which saves \$100 a wheel when it's time to change. The stock Isuzu wheels are 5 x 14s, fitted with 195-14 bias-ply tires. We fitted 7 x 15-inch Keystone alloy wheels, shod with 235/60-15 Goodrich Radial T/As. They look terrific and improve the P'up's ride and handling immensely. It's the best improvement on the truck.

We removed all the Isuzu emblems

on the body—they're all stuck on with glue these days, no holes—as well as the orange and red tape stripe which divided the black and red paint areas. I used black over silver Trimbrite tape stripes, to continue my black/red/silver color scheme. The headlights were replaced with Carello quartz-halogen, while the driving lights tucked under the bumper are Carello PF-190s.

All Isuzus come with big, "West Coast" rear-view mirrors, which eat up a good mile-per-gallon in gas. We made sure the dealer left these mirrors off, then installed small Vitolini mirrors intended for Italian sports cars. They look nice, don't cost much, and slip through the wind. Finally, we made our own fender flares to cover the wider tires, using black rubber Gila skirts intended to go along the rocker panels, and tried a Parts and Polish air dam beneath the bumper.

Interior changed most

The big changes are on the interior. We started with a pair of Recaro LN bucket seats in black, with an optional multicolor stripe. The stock carpets and door panels were red, which looked awful with the new seats, so we replaced the carpets with black ones from AutoMat and redid the door panels in fabric from Recaro to match. The stock red plastic steering wheel wasn't too hot, either, so we replaced that with a Momo Prototipo wheel that's covered in black leather. It's smaller in diameter, nicely padded and very durable.

Everyone who's ridden in the truck has commented on the excellent radio. It's a Sparkomatic system: a model SR-304 AM/FM/cassette, plus two SK-410 speakers and two SK-400 speakers. The secret of this system is the GE-50 equalizer/booster. This little amplifier is so small we mounted it in the ashtray—really!—yet it puts out 22.5 watts per channel. In a small truck cab, that's enough to blow your eardrums out. Tucked in the left corner of the dash is a Stewart-Warner electric tachometer; hanging under the equalizer is a Zemco trip computer.

Just to protect everything, we had the chassis Zieharted, sprayed the inside of the box with rubberized undercoating before installing the bedliner, sprayed the interior with Armorrall and covered the paint with a good silicon wax.

Obviously, this is a very personal truck . . . custom-built to our taste alone. To duplicate it at retail prices, you'd have to spend around \$13,000, though most of the items added are available at hefty discounts. Is it worth it? You bet!



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How To Pick A Log Splitter

PM gives 9 log splitters a workout and reports the findings.

BY WILLIAM BEYER



This 15-ton splitter is a Sears Craftsman. It's powered by an 8-hp gasoline engine.

For many cost-conscious homeowners, wood-burning stoves and energy-efficient fireplace inserts offer a cozy alternative to ever-rising fuel bills. With renewed interest in wood as an economy fuel, several manufacturers are now offering improved log-splitting equipment.

PM tested nine of the best-known splitters on the market ranging in power and sophistication from a hand-pumped model to a gas-powered behemoth delivering 15½ tons of ram pressure.

The operating principle

Each of the splitters we tested works on the same basic principle: Hydraulic or mechanical force presses a log against a wedge with tremendous power, splitting the log along the grain.

The nine splitters we tested offer different wedge and frame designs and varying degrees of power, sturdiness, portability and speed. We tested horizontal and vertical splitters with prices ranging from \$260 to more than \$1,600.

When selecting a splitter, consider the type of logs you'll be splitting and



With the Flowtron DS-26, you can get your woodpile coming and going. With wedges at both ends of the main beam and a double-action ram, this electric unit splits one log while next is set up.

the amount you'll need for the heating season. For example, if wood will be your primary energy source and you expect to split unseasoned hardwood logs, the more powerful, faster splitters will probably suit you best. The power of a hydraulic splitter is determined by the size of its cylinder and its speed by the engine horsepower. Also consider convenience and comfort of operation, safety features and storage options.



Ram pressure builds as the handle on the SolidAx is pumped by hand. With enough power to split seasoned logs easily, the SolidAx is lightweight and easy to store. It's also relatively inexpensive.

The SolidAx

The most economical and compact unit we looked at was the SolidAx from Cleanweld Turner. It's equipped with a hand-operated hydraulic pump that delivers eight tons of splitting force.

The complete assembly is 44 in. long and weighs just 80 pounds. Mounted on two small rubber wheels, it can be moved by hand easily. The pump and

(Please turn to page 180)

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LOG SPLITTER

(Continued from page 178)

ram are mounted on a heavy steel plate that slides along the main steel T-beam so the space between ram and wedge can be adjusted to each log's length.

The SolidAx operates horizontally. A log is placed on the beam with one end against the wedge. The ram is then butted against the opposite end of the log and the plate locked in position with a pin system. The ram is activated by pumping a long handle. As pressure builds, the log is forced against the wedge until the grain snaps. The ram remains extended after the split. To retract it, you must remove the handle from operating position and use its keyed end to turn a valve on the pump. As the pump pressure is released, two coil springs retract the ram.

The SolidAx is a lightweight but sturdy tool, highly portable, easy to store, and, with its broad wedge, very reliable for splitting seasoned logs. Because of its relatively low power, green logs may prove difficult.

The system for ram retraction makes the SolidAx relatively slow. It would be more efficient if the release valve were fitted with a handle of its own.

Flowtron DS-26

Among the motorized units we tested was an 11-amp. electric splitter from Flowtron with seven tons of force. The DS-26 is a horizontal, 150-pound



The Woodmate 1 shown at the left is a powerful and highly portable electric splitter designed for vertical splitting to ease backstrain. The All American, a gas-powered horizontal splitter with a 10-ton power rating, appears above.

There's an advantage to the low design of Didier's C26A—the user doesn't have to lift heavy logs very high to get them onto the main beam. The solid brass ram-guides are a feature that's not found on other splitters.



design mounted on two small rubber wheels for portability.

A good feature is its two-wedge design—one at either end of the tubular steel main beam. The double-action ram can exert force in either direction along its path. While splitting one log, you can set up another on the main beam. When the first log is split, the

ram direction can be reversed with the control lever to begin work on the second log. This speeds splitting greatly.

Wedges on the DS-26 are relatively narrow. This feature improves performance with green logs since thin wedges cut the tougher fibers in addition to exerting splitting action. The

(Please turn to page 182)

RELATIVE RATINGS OF SEASONED FIREWOOD

HARDWOOD	HEAT EFFICIENCY	SPLITTING EFFORT	SMOKINESS	SPARKING	OVERALL RATING
Apple, ash, beech, birch, dogwood, hard maple, hickory, locust, mesquite, oak, pecan, Pacific madrone	High	Moderate	Little	High when poked	Excellent
Alder, cherry, soft maple, walnut	Medium	Low	Little	Low	Good
Elm, gum, sycamore	Medium	High	Moderate	Low	Fair
Aspen, basswood, cottonwood, yellow poplar	Low	Low	Moderate	Low	Fair, good kindling
SOFTWOOD					
Douglas fir, southern yellow pine	Medium	Low	Heavy	Low	Good
Cypress, redwood	Low	Low	Moderate	Low	Fair
Eastern red cedar, western red cedar, white cedar	Low	Low	Moderate	High	Fair, excellent kindling
Eastern white pine, ponderosa pine, sugar pine, western white pine, true fir	Low	Low	Moderate	Low	Fair, good kindling
Larch, tamarack	Medium	Low	Heavy	High	Fair
Spruce	Low	Low	Moderate	High	Fair, good kindling when dry

Source: U.S. Forest Preserve

Here are factors to consider when you select firewood. Keep several types of wood on hand: Burn the more efficient hardwoods for heat; use softwoods for kindling. Pleasantly scented fruitwoods can add "atmosphere" to your fires.

For safety, avoid unseasoned wood and types that give off heavy smoke and sparks. Smoky fires cause a build-up of resins that can lead to chimney fires.

Plan ahead for your firewood needs: Split green logs take 8 to 10 months to dry.

If you don't own a wood lot, you may be able to get burnable logs nearby at no cost.

Most national forests permit clearing of dead wood. Call a ranger for local policy.

Check your local electric company: When clearing for power lines, it is often necessary to cut down or top off trees. Other possible sources include new construction sites and road-widening operations. Look for storm damage on private wood lots and orchards. Owners may be eager to have you clear broken limbs and damaged trees. Your local town dump may even prove a good occasional source for burnable wood. Important point: Always obtain owner's permission before removing any logs.

If you don't plan to prepare your own wood with chain saw and log splitter, check classified ads in your newspaper or look in the classified directory under "Firewood." Prices for cord wood vary according to species, moisture content and geographic area. Seasoned logs cost more than green wood.

Familiarity with a few terms is useful when ordering firewood. It is usually sold by the cord, which represents a stack of logs piled 4 x 4 x 8 ft. A face cord, sometimes called a tier or fireplace cord, is a stack of logs 16 to 24 in. long, 4 ft. high and 8 ft. deep.

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LOG SPLITTER

(Continued from page 180)

ram will travel to within 3 in. of either wedge. If a log fails to split and jams on a wedge, you can back off the ram, insert a log crosswise for a shim, and run the jammed log through.

While we found Flowtron's offering comparable to other splitters in its class, we also noticed some design problems. As with many horizontal splitters, the low main beam forces the operator to bend continually during operation. Also, there is a breaker switch mounted at the back of the motor housing that's likely to be tripped by an accidental bump. Incidentally, at first we mistook that breaker for the on/off switch.

Woodmate I

McCulloch's Woodmate I is a powerful, upright electric splitter. The vertical design eases back strain associated with horizontal splitters.

The Woodmate's ram and wedge are positioned between two, tubular-steel uprights. Its hydraulic pump and 9-amp. motor are mounted on a welded-steel base. A slightly curved bar is mounted on top of the ram to serve as a log rest. Its action is guided by the



The design of the High Profile model (above), is yet another approach to solving the back-strain problem—the main beam is positioned higher from the ground than those on most other horizontal log splitters. Here, the operator is able to work standing almost straight up.

The Model 1160 from Northern Hydraulics (below) can be set up to split logs vertically or horizontally. We preferred the vertical position because it requires less bending and less lifting.



PM'S SHOP EDITOR TRIES THE HEATH LOG SPLITTER

I have just spent a most pleasant afternoon splitting logs. Before you think I've lost all my marbles, I'll quickly add that the cutting was done with Heath's Model GU-1810 Hydraulic Splitter. The



tool comes in a kit—with very well-written instructions for putting it together. In order to give the kit a fair test (since I've got a lifetime of assembly experience), I asked my 21-year-old son, Jim, to do the assembling; I didn't even look over his shoulder. He did the job easily.

If you have ever assembled any Heath kit you know how complete the instructions are; that quality is maintained in the log-splitter instructions. The result is that putting the tool together "wasn't a job, it was fun," Jim reported. To this I'll add that using it is fun, too. Though the ram seems to travel slowly I was amazed at the quantity of logs that the two of us split in less than two hours. In fact, we couldn't keep up with the tool. With one man splitting and the other hauling logs to the splitter, we had to stop every 15 minutes or so to clear away the pile. The \$549.95 splitter is shipped Motor Freight Collect—Harry Wicks, Home and Shop Editor

Log splitter never hesitated during day of splitting 6- to 10-in.-dia. logs.

uprights. The broad wedge, shaped like a flattened cone, locks in place with a slipper-gripper mechanism. Released by a clutch, the wedge can be adjusted to the log length.

While holding a log in place on the bar, the operator activates the ram with a foot switch. A foot-operated lever retracts the ram.

We think the Woodmate I is a fine tool for the average homeowner. It is highly portable and comfortable to use. A fine built-in safety feature releases pump pressure should a log slip from point-to-point contact during use.

We were concerned, however, about the foot-switch position on Woodmate I. Since it's at the base of the machine, there's a good chance a piece of split log could fall on the operator's foot.

All American

Piqua Engineering invented the hydraulic splitter for industrial use in 1957. Now, it has developed the All American for homeowners. A horizon-

(Please turn to page 184)

SPECIFICATIONS OF LOG SPLITTERS TESTED

MODEL	MANUFACTURER ¹	OPERATING POSITION	POWER	DRIVE	MAX. LOG LENGTH	WEDGE (width × length × ht.)	SPLIT FORCE	CYCLE (Seconds)	MFR. PRICE ²
SolidAx	Cleanweld Turner	Horizontal	Manual	Hydraulic	24½"	5 × 5 × 6"	8 tons	NA ³	\$ 260
DS-26	Flowtron	Horizontal	11-amp. electric	Screw	26	½ × 9 × 9½"	7+ tons	40 ⁴	400
Woodmate I	McCulloch	Vertical	9-amp. elec. B&D ⁵	Hydraulic	28	7¼ × 6½ × 13½"	10 tons	18	450
All American	Piqua Engineering	Horizontal	5-hp B&S ⁶	Hydraulic	26	4½ × 9 × 9"	10 tons	15	995
Heath Model GU-1810	Heath Co.	Horizontal	5 hp	Hydraulic	21	¾ × 4 × 6"	10 tons	24	550
C26A	Didier	Horizontal	5-hp B&S ⁶	Hydraulic	26	1¼ × 6 × 7"	12½ tons	16	1,340
Sears Best Craftsman	Sears, Roebuck and Co.	Horizontal	8-hp B&S ⁶	Hydraulic	26	2½ × 6¼ × 8½"	15 tons	16	1,650
Model 1130	Northern Hydraulics	Horizontal	5-hp B&S ⁶	Hydraulic	25	1 × 6 × 8"	15½ tons	16	855
Model 1160	Northern Hydraulics	Either	5 hp	Hydraulic	25	4 × 6½ × 8¼"	15½ tons	16	1,190

¹For addresses see the manufacturers list on page 184; ² Many log splitters are unassembled—there may be charges for assembly, freight and handling.

³Not applicable; ⁴One way, splits in both directions; ⁵Black & Decker; ⁶Briggs & Stratton



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this ad in mind. You might need a new one sooner than you think. If not, this ad should be required reading.

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They'll give you from two to three *different warranties*, from *different companies*, at *different locations*. The seller doesn't stand solely behind his product...he just *assembled it*. Our One Year Limited Warranty is on a single sheet of paper, signed with only our own name. We proudly are *totally responsible* for it.

Assembling an ice auger from other people's products is an object lesson in compromise. These various disparate parts may work *acceptably*...but "*acceptably*" is *unacceptable* to us. We expect the best from ourselves, and we get it.

Consider. We designed and built a 1.6 hp engine for our auger, because that was *exactly* what was needed. We had in our inventory a 1.75 hp, a 2.5 hp, and a 3 hp engine. We *could* have used any one of them, and saved a bundle. Each of them was "*acceptable*"...but not

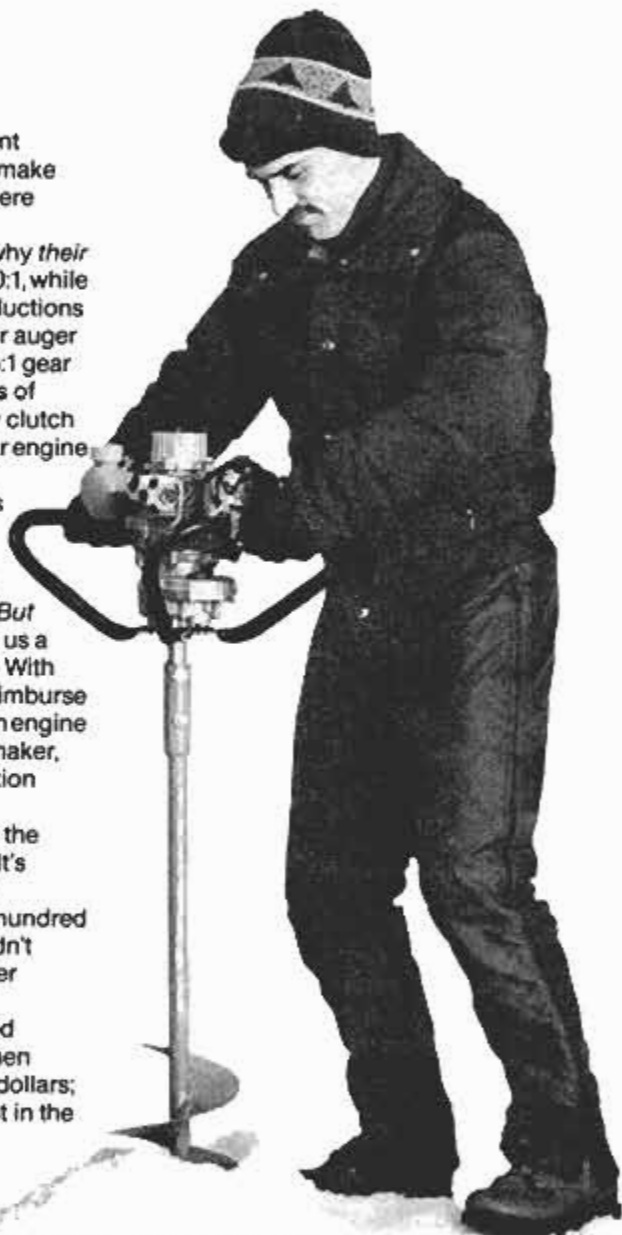
perfect. You'll see a lot of different engines out there. That doesn't make them right; it only means they were *available*.

Ask the right questions. Ask why *their* gear reductions are only about 10:1, while we use more expensive gear reductions of 35:1. Understand that a proper auger blade *must* turn slowly, and a 35:1 gear reduction is *essential*, regardless of cost. Understand that *our* safety clutch was designed *specifically* for our engine and blade, and didn't come off somebody's shelf because it was "*available*". Our clutch isn't "*acceptable*"...it's perfect.

You'd expect to pay *more* for our auger, because it's worth it. *But you pay less!* A lot less. You pay us a single, legitimate, modest profit. With the assemblers, you'll have to reimburse them for the profits they paid to an engine maker, a blade maker, a clutch maker, a gear maker, or some combination thereof.

Our retail price of only \$149 is the lowest retail price of any auger. It's probably lower than any of the assembler's *wholesale* prices. A hundred bucks more than our \$149 wouldn't get you a better auger. Or a better warranty.

This Introductory Offer is good through January 31, 1983, and then the price goes up by a hundred dollars; which is what it should have cost in the first place.



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SPECIFICATIONS

Engine...1.6 hp, 31 cc
Auger bit...48 inches long, 8 inch diameter
Replaceable Blades
Dead Man Throttle, Blade Guards
Gear Reduction...35:1
Total weight...22.5 pounds
RPM...7000
Multi-attitude Carburetor
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LOG SPLITTER

(Continued from page 182)

tal splitter with a gas engine and two-stage pump, the All American musters 10 tons of splitting force.

The wedge on the All American is the largest of any machine we tested and its ram cycle is the fastest. Controlled by a single lever, the ram is guided by Teflon shoes and a special wear plate. The main beam is heavy tubular steel and the entire assembly is mounted on large rubber tires. It can be towed by car or tractor with a suitable hitch and stored vertically when not in use.

The All American was by far the best looking splitter we tested, with a bright yellow frame and glossy red fenders. We found it split green and seasoned logs with equal ease.

Didier Model C26A

With its narrow wedge design and 12½-ton pressure rating, the Didier C26A is well suited for tough, unseasoned logs. A gas-powered, horizontal splitter, it has a two-stage hydraulic pump.

The C26A has three quality features not found on other machines we tested: replaceable solid brass ram guide bars, heavy steel tubing linking the cylinder to the hydraulic control valve, and a handsomely cast control lever. Most splitters have plastic or steel guides, ordinary pressure hoses and steel-rod control levers.

Other key features on the C26A include a heavy-duty axle and large

SAFETY STANDARDS

The National Hydraulic Woodsplitter Manufacturer's Assn. (NHWMA) has proposed standards for safe operating instructions and warning labels on log-splitting equipment. This voluntary, nonprofit industry group is working in cooperation with the Consumer Products Safety Commission, which reports there were 4,875 injuries related to log-splitting devices in 1981.

Among the points emphasized in the NHWMA guidelines are these:

- Read and understand the owner's manual fully before using a splitter.
- Never use a splitter for any purpose other than splitting wood.
- Never operate a splitter when under the influence of alcohol or while under medication.
- Never place hands or feet between log and wedge or log and ram.
- Don't straddle splitter or step over it when in use.
- Never allow more than one operator at a time. Keep bystanders clear.
- Wear tight-fitting clothing, goggles and safety shoes.

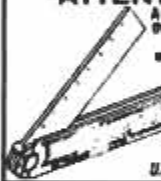
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Allow three to four weeks for delivery of your plans and instructions via third-class mail. For faster first-class mailing, include 75 cents extra.



pneumatic tires for over-the-road towing. An optional road-towing package includes safety chains and lights.

Sears' 'Best' Craftsman

Sears' top-of-the-line model is a gas-powered, horizontal splitter with a 15-ton rating. The main frame is a 4-in. steel I-beam mounted on large tires for road towing.

The Craftsman offers good features for safety and convenience. The control lever must be held forward for splitting. When released, it shifts automatically to neutral. Pushing back on the lever locks it into ram-return position until the ram is completely retracted.

Sears offers two splitter accessories we really liked: a folding hitch stand to keep the tool level during operation and a "log cradle" that's 14½ in. wide to eliminate the need to hand-balance logs on the main beam. Sears also supplies a breatherless cap that allows you to store the tool vertically without draining the hydraulic oil.

High Profile Model 1130

To answer the most common complaint about horizontal splitters—namely, that they require too much bending—the High Profile model is designed with its tubular steel main beam a comfortable 29 in. from the ground. With a mild-steel ram guide, underlaid with hard brass and a 15½-ton rating, the High Profile is among the most rugged tools we tested.

Standard equipment for the High Profile is a 5-hp Briggs and Stratton engine, but the maker offers an 8-hp Tecumseh motor which it claims cuts the ram cycle from 16 to 11.7 seconds. Another accessory is a quartering wedge that slips over the permanent wedge to divide a log into four parts.

Our test proved the higher design to be a mixed blessing. While there was less bending during operation, lifting heavy logs up to the beam required more effort. Using the quartering

wedge caused some flexing of the main beam and we also noticed some leakage of hydraulic oil and gas caused by engine vibration.

Model 1160

The maker of the High Profile unit offers another splitter—the Model 1160—one of our favorites. While identical to the High Profile in power and available options, the 1160 has some important design differences.

It can be operated either vertically or horizontally. Upright, it can be moved easily like a hand truck. Or, it can be towed by car or tractor. The Model 1160 is the only splitter we tested with the wedge mounted directly on the ram. A heavy steel plate backs up the log and serves as a base in vertical operating position.

The ease of operating the Model 1160 vertically was unmatched by any other tool. Heavy logs need not be lifted at all; they can be rolled up and tilted on end for splitting. We also liked the steel fingers or the frame which push off logs jammed on the wedge.

Splitting tips

Regardless of which tool you choose, these tips will ease splitting chores:

- Place the smaller end of log against the wedge.
- Split any large diameter logs into thirds.
- Don't set knots in front of wedge.
- Split crotch logs a leg at a time. **PM**

MANUFACTURERS LIST

- Cleanweld Turner, 821 Park Ave., Sycamore, Ill. 60178.
 Flowtron, 2 Main St., Melrose, Mass. 02170.
 McCulloch Corp., Box 92180, Los Angeles, Calif. 90009.
 Piqua Engineering, 234-52 First St., Piqua, Ohio 45356.
 Heath Company, Benton Harbor, Mich. 49022.
 Didier Manufacturing, 8630 Industrial Dr., Franksville, Wis. 53126.
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Now: Good Music From Tiny Cassettes

We listened to microcassette machines and found they're not just for dictation anymore.

BY ART ZUCKERMAN

If smaller is better, tape recorders are getting better all the time. And one thing is sure: The smallest are better than ever.

If you've seen, or heard, microcassettes before, you may be wondering what all the fuss is about. The tiny 2-inch-wide cassettes used to be suitable for dictation only. They just couldn't reproduce music in any way approaching true hi-fi.

But there are new (and more expensive) formulations of tape, and even newer machines that can take these souped-up microcassettes and record and play back high-fidelity music on them. These new microcassette decks look like the beginning of a trend because of the growing demand for good musical reproduction, conveniently packaged for people on the go: walkers, joggers, bicyclists and others.

Microcassettes with new, metal-tape formulations are anywhere from two to four times as expensive as the older ferrous-emulsion tapes. But, as the following specifications show, the new decks can extract a lot of enjoyment from the new breed of microcassettes. The decks themselves are more expensive than micro-cassette players used to be, which is to be expected. But, remember, if you want to listen to music and not conversation, only decks like these can give you high-fidelity sound in the confines of this small format.

First, the decks

Fisher was the first to take advantage of metal tape's capabilities when it introduced a microcassette deck for home use, the CR-M500. Looking like a downsized compact cassette deck—it

The microcassette (top of page) has opened the way for full-featured, tiny tape machines. Aiwa's plays both microcassettes and standard compact cassettes. Olympus is pocket portable. Fisher has a whole line, from at-home decks to portables that record with built-in AM/FM radios.



Aiwa CS-W7



Olympus SR11

Fisher CR-M500

Fisher PH-M20

Fisher PH-M88

Fisher PH-M25



Fisher's versatile PH-M77 dual-mouth deck is able to accept both regular-sized compact and microcassettes. Aiwa's CS-M1 portable unit features its own AM/FM radio.

weighs a hefty eight pounds—the CR-M500 has a claimed frequency response, with metal tape, of 40 to 12,000 Hz ± 3 dB. True high fidelity calls for reproduction up to at least 15,000 Hz, so the CR-M500's metal-tape frequency response is comparable to that of the early compact cassette decks.

The deck's Dolby noise-reduction system provides a claimed signal-to-noise ratio (the spread between inherent tape hiss and the quietest recorded sound) of -56 dB, using metal tape. This compares favorably with a good compact cassette deck with Dolby off. The M500 has no microphone inputs, but it does record from a stereo receiver, amplifier or other line source. An optional accessory lets you record directly from (or to) another tape deck without using an amplifier in between.

This microcassette deck operates exclusively at 2.4 centimeters per second (cm./sec.), and Fisher claims a fairly decent wow-and-flutter (speed irregularity) performance of no more than 0.07 percent. The CR-M500's suggested retail price is \$479.95.

Sony's top of the line

Heading the Sony line is its home microcassette stereo deck, the TC-MR2. Unlike the Fisher deck, the Sony has a diagonal front panel. In addition to a.c., it can be powered by external d.c. or two D-cell batteries in an inter-

nal compartment. The deck also has a stereo mike input, in addition to line inputs and outputs. With metal tape, the single-speed (2.4 cm./sec.) deck has a claimed frequency response of 30 to 12,000 Hz ± 3 dB. Wow and flutter are reportedly no more than a meager 0.08 percent.

The Sony deck has a claimed signal-to-noise ratio of only -47 dB with metal tape, but it has no Dolby or other noise-reduction system. That, together with the absence of computer-logic controls and the use of VU-type recording-level meters, rather than LEDs, probably accounts for the modest \$249.95 suggested retail price.

Both worlds

Aiwa, as well as Fisher, is offering a portable radio/tape combination with both microcassette and compact cassette transports. Both the Aiwa and Fisher units have built-in stereo amplifiers and speakers and offer two short-wave bands, as well as AM and FM reception. Each can dub tapes either way or record from radio or microphone. But the Aiwa can also start recording on a compact cassette and, when it runs out, continue recording on a microcassette.

Both units also have LED recording-level indicators, and they can use CrO₂ (chromium dioxide) compact cassette tape, as well as normal and metal tape.

The Fisher PH-M77 has a claimed

compact cassette (standard) frequency range of 70 to 14,000 Hz and a microcassette range of 80 to 8,000 Hz, both with metal tape. The unit is 20 inches wide and 7½ inches high, weighs 13 pounds and sports a \$449.95 suggested retail price tag.

The Aiwa CS-W7 has a compact cassette frequency range of 50 to 14,000 Hz with metal tape, 50 to 12,000 Hz with normal tape. Its claimed microcassette frequency range is 80 to 10,000 Hz with metal tape, 80 to 8,000 Hz with normal. It also has special features such as a bass-boost switch, program-search capability for the compact cassette deck and a sleep/timer mechanism. It's 20½ inches wide and 7¼ inches high, weighs 10.6 pounds and has a list price of \$430.

A portable world

The portable stereo microcassette recorder/radio combinations with built-in stereo amplifiers, speakers and AM/FM radios are gaining in popularity. But the stripped-down, pocket portables are moving along, too.

The kangaroo-pouch feature of Fisher's PH-M88 lift-out recorder puts this combination unit in a class by itself. The mother unit has a tone control and line inputs and outputs. The detachable recorder has headphones, two built-in microphones for stereo recording, two tape speeds, a cut-and-review feature and automatic stop. Fisher says its frequency range is 100 to 8,000 Hz. The entire package lists for \$309.95, including headphones and a.c. adapter.

Fisher's PH-M25 personal microcassette recorder weighs in at only 9 oz., but it doesn't have a radio or a built-in speaker. It does have lightweight headphones, two speeds, built-in stereo microphones, combination mic/line inputs, a pause switch and mixing circuitry that lets you hear the outside world through the headphones while listening to a tape. The PH-M25 has a frequency response of 80 to 8,000 Hz ± 5 dB. It lists for \$249.95.

Rounding out Fisher's personal portable line is the PH-M20 microcassette player. A two-speed unit, the PH-M20 is strictly a tape player, though it does have a built-in microphone which allows you to listen directly to the world at large through the headphones. Like the PH-M25, the M20 has a frequency response of 80 to 8,000 Hz ± 5 dB. Its suggested retail price is \$209.95.

Except for the lift-out feature, Panasonic's RN-600 portable microcassette AM/FM radio combination has features similar to Fisher's PH-88, including two-speed tape operation. But its built-in microphones are at opposite ends of the 10½-inch-wide chassis, and it has

(Please turn to page 188)

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(Continued from page 187)

recording-level, tone and balance controls, plus an LED recording-level indicator. An a.c. adapter is included for the suggested retail price of \$299.95.

One of the latest additions to Sony's famous line of Walkman personal tape players is the microcassette M-50. It comes with an FM tuner pack that fits into the microcassette well. It also features earphones that fit directly into the ears, without headband or retaining clips. It has a frequency range of 50 to 10,000 Hz and lists for \$199.95.

Somewhat larger, at 13 oz. with batteries, is Sony's M-80 Soundabout microcassette personal portable recorder. The M-80 offers two speeds and built-in AM radio, as well as FM stereo. It even includes a built-in speaker, which blends the two stereo channels, in addition to stereo headphones. At its higher speed, the recorder has an 80 to 8,000 Hz frequency range, using metal tape. It records from either the tuner or an optional, stereo microphone. Features of the microcassette Soundabout include a tape counter, pause control and automatic shutoff. Its suggested list price is \$199.95.

Olympus is very much represented in the new generation. With the SR11, it has upgraded its microportable by making it into a stereo unit and extending its frequency range considerably. The Olympus now covers 100 to 10,000 Hz, using metal tape. An FM stereo receiver is built into the tiny, 10.1-oz. (with batteries) recorder. It records from the tuner, external microphones or external line sources. Lightweight stereo headphones are provided, instead of a built-in speaker. The SR11 has a suggested price of \$199.95.

The Aiwa CS-M1 unit has only the standard microcassette speed of 2.4 cm./sec. It, too, has built-in stereo microphones, plus external mic inputs. There is tone control, an electronic pause control, digital tape counter, automatic stop and other features. Aiwa isn't reporting the machine's frequency range. The 1-pound, 15-oz. unit lists for \$250.

What lies ahead?

Before long, we should be seeing home decks with dual compact-cassette/microcassette transports to make dubs superior in quality to what the portable dual-transport machines can do. Prototypes of such decks have already been shown at trade shows.

Many experts feel the microcassette has a big future in small cars. For one thing, the electronics would take up little space in dashboards or consoles. And think of all the microcassettes you could store in a small glovebox! **PM**

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Shirley Kage, Oxford, Mi.

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J.D. Duch, Sr., Senecaville, Oh.

STRANGE SALE!

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leave it in the building or the sale couldn't be made. Strange? Not at all. The man just recognized a good thing when he saw it.

E.A. Knapp, Cedar Springs, Mi. SUITS HIM FINE

I was very skeptical when I read about your barrel heater stove 3 years ago in Popular Mechanics, but after paying \$1500 for oil in the winter of 79-80, I knew I had to do something. (I can't believe how fantastic the single drum works, in fact, I am so impressed I mailed a check for the top kit to put on this spring). Anyway, I installed it this last Sept., fired it up and it has been burning non-stop to date. Every morning before going to work (and getting home 10 hrs. later), I load the stove (with a 3-piece suit on) with the use of your Sotz Woodstove Tools, which are a definite must for maximum efficiency and safety...with your warming top and a circular pan filled with water the house has a deep warmth to it and no static from the rugs. Just want to express many thanks.

David Saylor, S. Lebanon, Pa.

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George L. Voss, Portland, Ore.

A HOT DESIGN

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Paul Fontaine, East Moline, Ill.

A WARM SALE

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Jan Knight, Aberdeen, Md.

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- No gimmicks. Just simple physics!

We at Sotz have been making the same quiet offer for years: Try a Monster Maul at our risk! Within one year, if you don't think it's the fastest, least tiring method of splitting firewood, let us know, and we will give you your money back, including shipping. Plus, it's guaranteed against failure for 10 years.

OUR 26TH YEAR

Sotz Corporation, 13643 Station Rd., Columbia Station, OH 44028



24" OAK

SMOOTH AS BUTTER

I've bought my last hickory handle for my splitting maul. My next door farm neighbor loaned me his "Monster" one day, that's all it took. I split all seasoned wood, Hickory, American Elm, White Oak and even red elm. Split um like a "hot knife" through butter.

Tom Rymer, Stover, Mo.

NO SHOCK WITH METAL HANDLE!

You can add me to the chorus of Monster Maul testimonials...it's so much better than any other maul I've ever used, it's amazing. My one concern was shock transmitted down the metal handle-no problem; It doesn't feel any different than a wood handle. Enclosed is an order for a 2 drum stove kit and a lift-n-saw. Have a happy New Year - I know I will.

Jeff Connaway, Council, Id.

I FEEL GREAT

I enjoy working each day and feeling good after accomplishing a worth while project, and let me tell you, after 3 to 4 hours of splitting wood with the "Monster Maul" I feel great. I've split lots of wood in the years past, and I haven't found anything that is even close to what the maul is like. This is the 2nd year we have used the Monster Maul and I see more results faster by using the maul. Before, it would take about twice to three times as much time and work to get the same kind of results as we do with the Maul. To me time is money and time is effort, by using the "Fantastic Monster Maul" I have more time and effort for other worth while

projects. Mark B. Bradford, Blanding, UT.

SPLITS 20" OAK! NEVER STUCK!

Last year was my first with a woodstove and the first that I cut my own firewood. I had been using a 8# splitting maul and a 6# sledge with wedges. For kindling I had a large supply of broken handles! As a joke somebody left an ad for the Monster Maul on my desk at work. It sounded great to me, so I ordered it. I couldn't believe your prompt response for I had the Monster in about a week. It was great! I couldn't believe how easy splitting even 20" oak was. To this part of the country a common hardwood is sweetgum which burns well but splits awful. Even the Monster can't always split gum in one shot, but it has never gotten stuck and it is the best way I know how to split this tough wood. (Many people who rent out log splitters will not allow them to be used on gum!) Two of my friends have been so impressed with the Monster that they've ordered their own . . .

Robert Prince, Virginia Beach, Va.

SURE PUTS OUT THE HEAT!

I purchased your single drum heater kit in 1977 and installed it in my house and now, 3 years later I am still using the same kit and the same barrel with no sign of any wear on either the barrel or the kit parts. With just a small amount of maintenance each spring I believe my stove will last for many years to come. I have looked at many other brands of stoves in other peoples' houses since installing my Sotz heater and I can't see

where any of them are more efficient than my Sotz, and many of them cost from \$300.00 to \$600.00. That barrel stove may not look as pretty as some of those "factory built" stoves but it sure puts out the heat!! Thanks again for making a fine product.

Paul Kuzman, Mars Hill, N.C.

BUYS 3 MAULS!

Please send me another Monster Maul. This is the third Maul I have bought. One for me. . . My son used mine and then I gave him one. Now a friend that sells wood for a living used mine and begged me to sell it to him on the spot and get me another one. So I did and here I am. Best wood splitter I have ever seen.

J.V. Kirkman, Kingsport, Tenn.

PRICELESS INVESTMENT

I was introduced to your Monster Maul... Not only did it save me a great deal of time, but it also saved me the expense of buying other mauls—as I would go thru 3 or 4 in the span of less than a year. In fact, the foreman of the City of Medford's Forestry Dept. referred to the Maul as "a priceless piece of equipment." The maul is one of my best investments...

R. DiGiacomo, Medford, Mass.

MONSTER FAILS!

In the last week I received your replacement maul for the one that had a defect. I wanted you to know I think your maul is great only surpassed by your fine service. I have a relative and a friend who will both be buying your fine product in the next few weeks. A pleasure doing business with your company.

William Goodrich, Ledyard, Ct.

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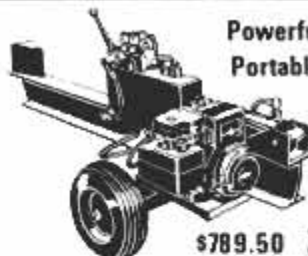
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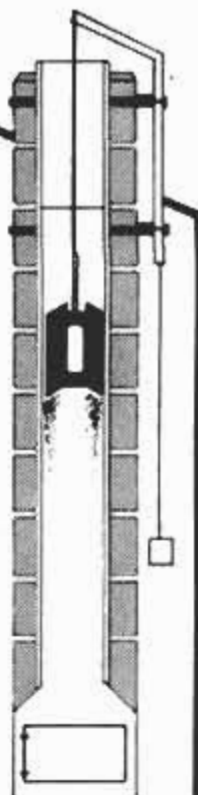
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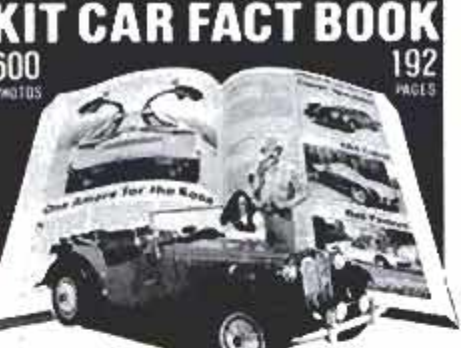
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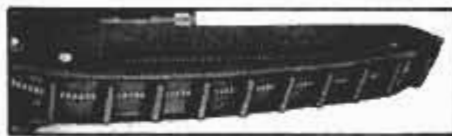
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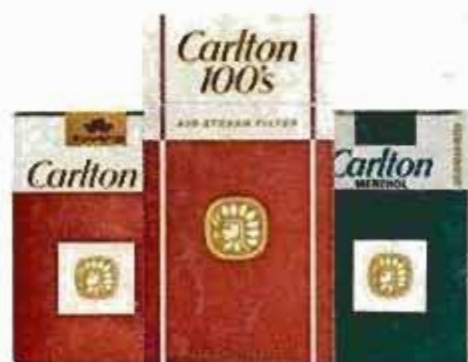
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