

Popular Mechanics

Most unusual workshop we've ever published Page 85

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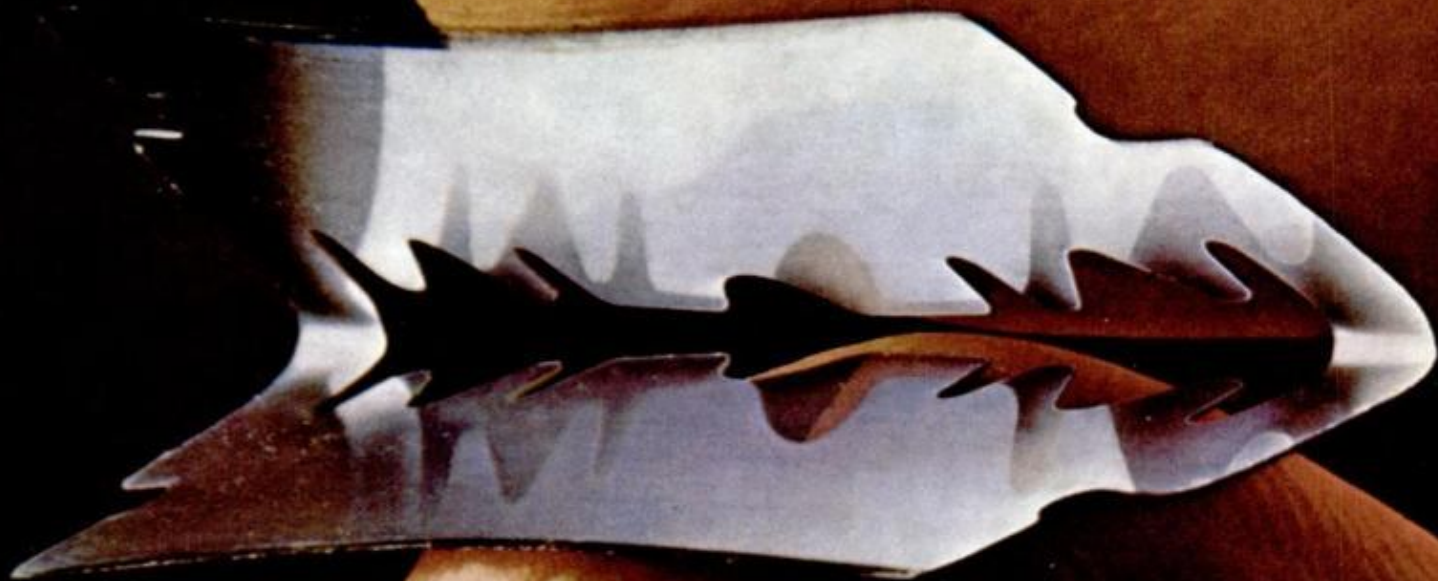
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Schick's done something for the double edge man.
Put both edges on your side.

You're a double edge man. And very loyal.
But what good are two edges if you can only use one of
them at a time?
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The new Schick Super II. It puts both edges on your side.

Schick Super II





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new Japanese machines.

"They're the best darn plug you can put in any engine or my name is Robert Tank, Omaha, Nebraska."



This One



TBDJ-7P0-5FH8

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Portland, Oregon 97204



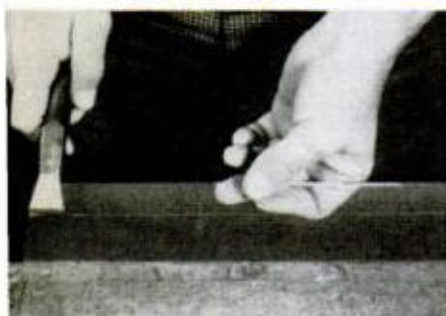
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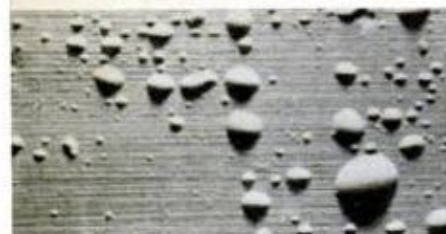
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AS A SERVICE TO READERS, Popular Mechanics publishes newsworthy products, techniques and scientific and technological developments. Because of possible variance in the quality and condition of materials and workmanship, Popular Mechanics cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects that result from plans published in this magazine.

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OCTOBER 1972

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LETTERS

TO THE EDITOR

Running out of ideas?

Your article on *Fancy fences* (page 72, Aug. PM) struck me funny. An article very similar to it appeared in your April 1961 issue. Have you run out of new hints?
 ORD, NEB. KEITH PAULSEN

No. It's just that sturdy wood fences are still built the same way as they were in 1961.

Just for men?

While going through some old magazines, I ran across the March '70 PM. Wondering what you men have been up to, I found in-



structions on how to build this "apartment workshop" (A lot of shop in 4 feet of space, page 150). I thought it would be great for getting my dad's tools in one place. So, with a hand-saw, hammer, electric drill,

some plywood and no knowledge of what I was doing, I started. I measured nearly everything wrong and had to put a drawer where the bottom of the shelf was to be. I found it easier to use a different type of socket and decided to cover the entire cabinet with contact paper. Many bruises, scratches, cuts, splinters and three weeks later, this is what I came up with.

Who said PM is a man's magazine? Got anything else I can try?
 LOS ANGELES KATHY HOCHDERFFER

How about a boat? (But you'd better not use that contact paper.)

Shermans performed well

In reply to comments by Roland Ramadan (*Letters*, page 6, Aug. PM), he is wrong in saying that the Sherman tank was outclassed by every country's tanks

(Please turn to page 8)

Have you seen this coupon before?

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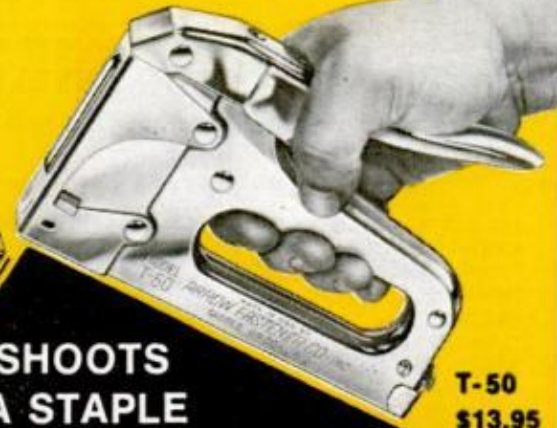
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LETTERS

(Continued from page 6)

in World War II. The Sherman had the most reliable roadability of all, as proved in the long dashes across France, the Bulge and North Africa. Its gun was not too good at first, but this was improved later with a 76-mm gun, equal to any German tank. Power traverse and gyro stabilizer gave the Sherman a great advantage.

Shermans used by the Israeli army in the Six Day War knocked out Russian T54s.

KINGSTON, N.Y.

CHARLES R. COLE

Chest is night-school project

Your *Spanish-Style Chest* (page 148, Sept. '71 PM) appealed to my wife and me. Being an apartment dweller and not having a shop, I built this chest while at-



tending a night course in cabinetmaking at McKee High School, Staten Island. The project provided many pleasant hours of work, plus a useful piece of furniture—and numerous compliments.

NEW YORK

RALPH JENSEN

Weatherproofing butcher-block table

I'm enthusiastic about constructing the butcher-block table (*High-style table from construction-grade lumber*, page 140, July PM). My only question is: Can the table and benches be made waterproof for outdoor use?

WESTBURY, N.Y.

RONALD M. LAZAR

Yes. Use galvanized screws, bolts and nails when you assemble the table. Then finish the furniture with a weatherproof sealer such as marine varnish. Moreover,

(Please turn to page 10)

You can earn \$5 to \$7 an hour starting soon!

New NRI AUTOMOTIVE MECHANICS HOME TRAINING acclaimed by experts

NRI commissioned one of America's best-qualified automotive writers* to prepare the home training programs, then asked its team of consultants to give it their critical review . . . Here's what they reported:



TOM McCAHILL

"I'm beginning to have some hope about finding good mechanics again."
"It's a great relief to see a highly qualified school like NRI come up with home training in the automotive mechanics field that should do much to improve the sad state of the car repair industry. The Master Automotive Technician course gives ambitious guys a great start on a top-dollar career. And that Tune-Up and Electrical Systems program can save do-it-yourselfers a bundle, or lead to some lucrative part-time bucks at a going rate of \$5 to \$7 an hour. I'm beginning to have some hope of finding top mechanics again—I'll just look for an NRI diploma on the repair shop wall."

Tom McCahill
America's foremost automotive editor/critic



RICHARD PETTY

"It's a lot of training for a very few bucks."

"I especially like the way NRI has programmed essential training equipment they give you into step-by-step instruction. There's nothing like learning with your hands, and having exactly what you need to do the job. The fact that the Master Automotive Technician course includes (among other things) an ignition-analyzer scope, dwell tachometer, timing light and exhaust analyzer is an indication that it's a lot of training for a very few bucks. Even the shorter Tune-Up course includes basic tools and equipment at no extra cost. I'm sure Petty Enterprises would give top consideration to a man with an NRI diploma."



America's winningest stock car racing driver



BILL FRANCE

"I've seen a lot of training programs and this one is up there with the best."
"I'm very pleased to find that NRI has developed home training programs in car repair that are right up there with the times. Both the Master Technician and the Tune-Up and Electrical Systems courses are amazingly complete and up-to-date. They employ an easy to learn method that has successfully trained thousands for technical jobs. Subjects are broken down into 'bite-sized' texts and programmed with essential equipment. You get the 'why' as well as the 'how-to' copy; from changing plugs to running your own garage. I've seen a lot of training programs, and this one is up there with the best."

William H. Crouse
President of NASCAR and International Speedway Corp.

*William H. Crouse, author of NRI mechanics training, is an internationally known automotive training expert. He knows what you need to know, whether you choose NRI's Master Automotive Technician training or the shorter Automotive Tune-Up and Electrical Systems course. Both courses include, at no extra cost, training and diagnostic equipment essential for both education and car care. Mail the coupon for full details. NRI AUTOMOTIVE TRAINING, Washington, D.C. 20016. No salesman will call.

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LETTERS

(Continued from page 8)

if you don't mind spending more money, you might consider building table and benches of redwood, which weathers well. Or you might compromise by building seats and tabletop of redwood and the pedestals of fir or spruce.

You're right: It won't start

I tried your idea, "Snuff out the ignition with your cigaret lighter" on page 119 of *17 Ways to thieproof your car* (page 112, July PM). Your instructions are incorrect—I know now. When I tried it, my points burned out. But you're right in one regard: The car refused to start.

I remain a faithful, but slightly discouraged, reader.
 SEATTLE DUANE L. VINCENT JR.

The switch should be connected between the coil and ground—not between the coil and a "hot" terminal as instructed. The only danger then is that your battery can drain if someone does jump your ignition.

Number trouble in New Products

Thanks for mentioning our Model 2855 EGS range/grill/oven combination in your August issue (*Exciting New Products*, page 151). Somehow, somewhere, the price figures got mixed up. List price is \$429.
 JENN-AIR CORP. DON WHITE
 INDIANAPOLIS, IND.

Sorry, we mixed up those figures. Correct price is \$429 (not \$249). And while we're on the subject of typographical errors, we'd better clear up another on that page. The Bar Keg by Sweeney Cooperage holds one quart, not one gallon. (A one-gallon model is available on special order for \$40.)

Source of locking casters

I am building the *Radial-saw accessory cabinet* (page 148, March PM). I have looked everywhere locally for the locking Shepherd casters. Where can I get them?
 SAN JOSE, CALIF. ED BANCROFT

If you can't buy them locally, write the maker: Shepherd Casters, Inc., St. Joseph, Mich. 49085. The model number is 40040SA-BX. ★★

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Sealed Gas Chamber: Super-X makes the most of progressive burning Olin Ball Powder by sealing all its hot expanding gasses *behind* the shot charge, preventing blown, patchy patterns. Super-X does it with an over powder wad we patented as the Sealed Gas Chamber. Upon firing, it seals tight against

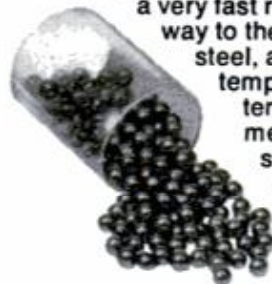


the shell casing and shotgun bore, to give you all the Super-X power you paid for . . . with full dense patterns to reach out and hit the fast flyers.

Non-corrosive primer: Most hunters buy an extra power load because they want extra energy and longer range. And they want sure, fast ignition instantly when they pull the trigger . . . in any weather. But they want all the power of their ammunition to fill up their game bag, not eat up the inside of their shotgun barrel. Non-corrosive priming is standard on Super-X and on every other brand of ammunition we make.



Mark 5 collar: You know that when your shotgun goes "bang" the shot charge gets a very fast ride up the barrel on its way to the muzzle. Lead against steel, at high speed and high temperature, equals flattened pellets. Flat pellets mean inaccurate stray shot instead of the dense, uniform pattern you want. The plastic Mark 5 collar we put around





the shot in Super-X prevents the pellets from touching the bore, keeping them rounder, truer, for up to 10% denser patterns . . . and more in the bag, whatever you hunt.

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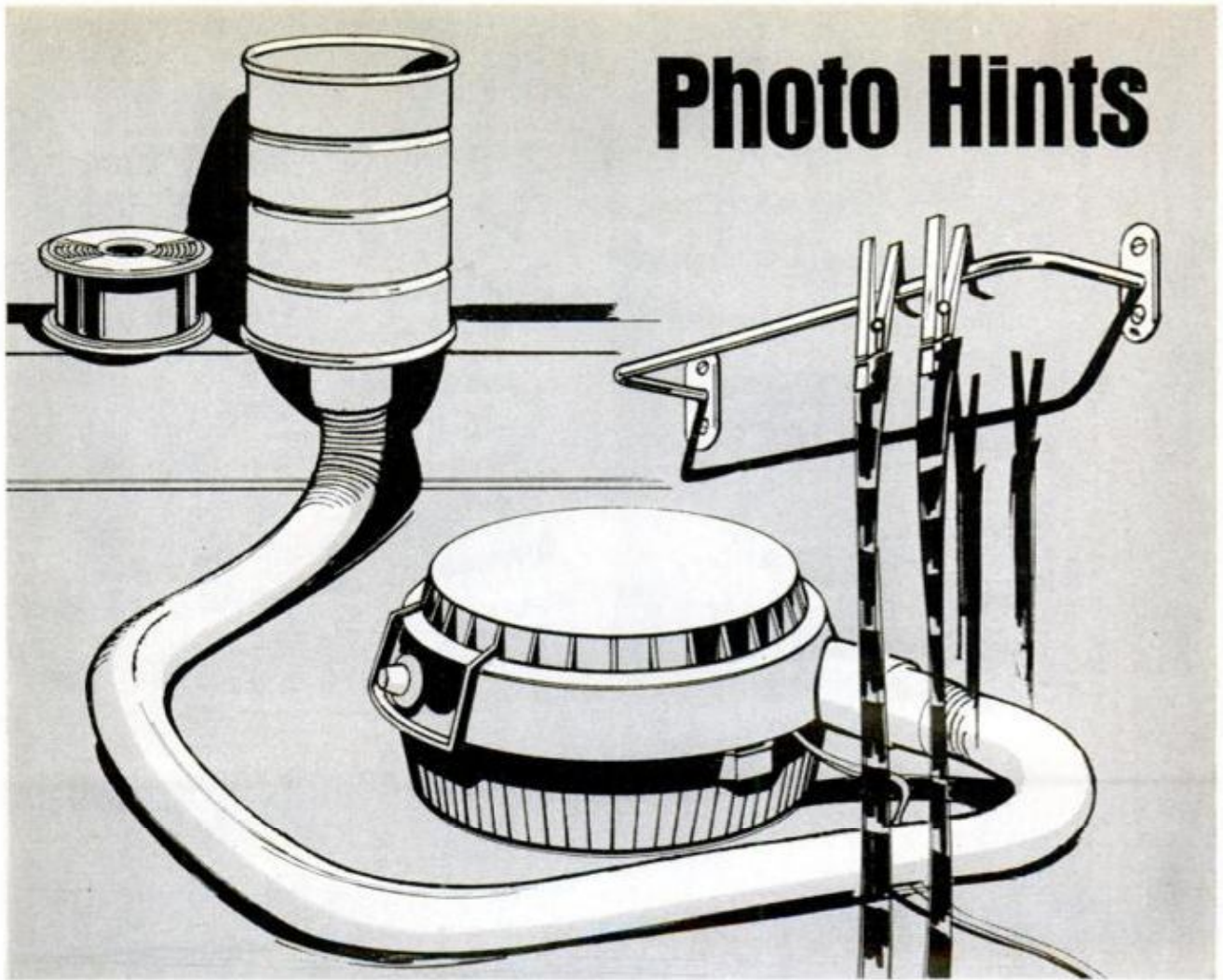
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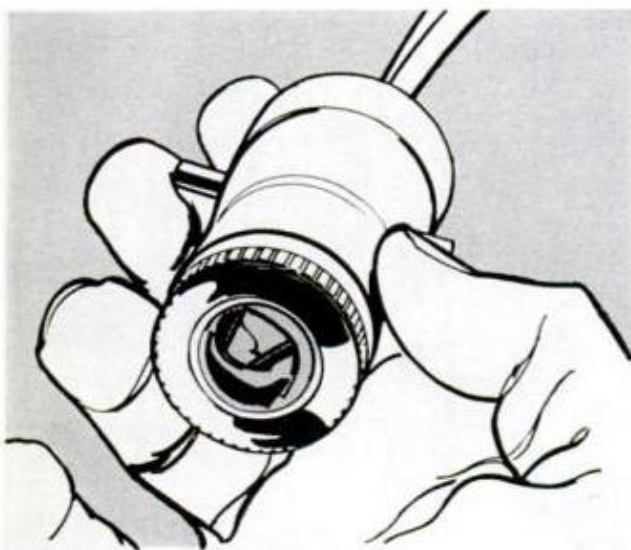
Photo Hints



Two solutions to the film-drying problem

Common household items can dry film. John Schad Jr., Carlinville, Ill., uses a coffee can with a cutout for a hose from a hair dryer. Run the blower a few min-

utes before loading film to prevent dust, and keep the temperature under 140° F. William Beuke, Chicago, uses a dime-store towel rack and clothespins (right).



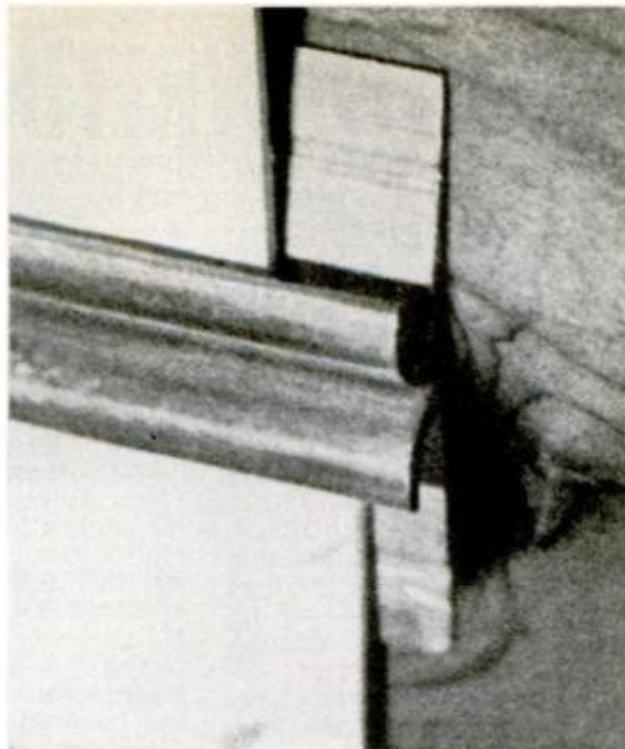
Simple pendant switch for floods

Screw a fuse into a switched light socket, and you have a cool and handy switch to turn off floods.—G. Stillwell, Manhattan Beach, Calif.



Easy lens-cap reminder

A double flap of tape extending from a lens cap across the focus scale reminds you to remove the cap before snapping the shutter.—J. Capotosto, Dix Hills, N.J.



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for 11x14 prints). Boards snap into aluminum-channel edge molding strips sold at hardware stores. Strips are nailed to the wall in pairs, back to back (close-up above).—Rod Moon, Saugus, Calif.

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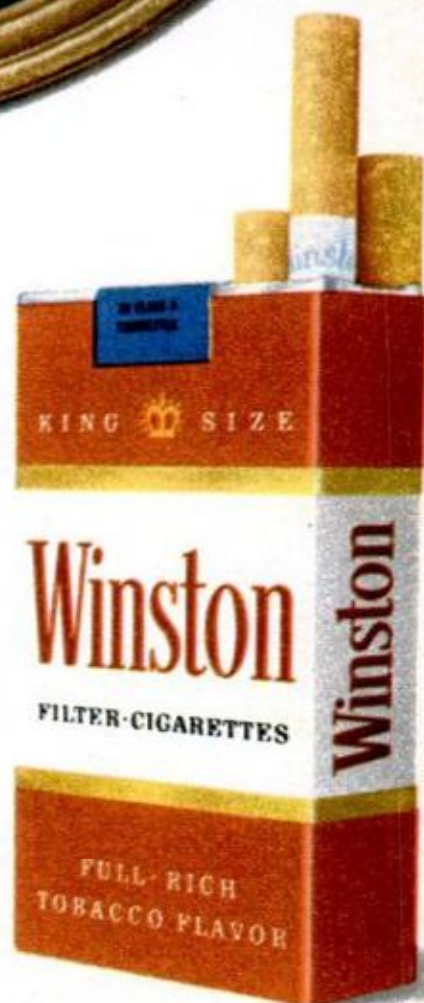
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AUTOMOBILE CLINIC

BY MORT SCHULTZ

Surging ahead

Although the Rochester carburetor of my 1963 Chevrolet with V8 engine has been completely cleaned and overhauled by a very reliable mechanic, the engine continues to surge. Why?—George Meyer, Costa Mesa, Calif.

Because a restriction in the carburetor is just one cause of surging. There are others: a weak fuel pump, restrictions in the fuel lines and a defective spark-advance unit.

Un-Sportsmanlike conduct

I drive a 1971 Dodge Royal Sportsman ¾-ton van with an automatic transmission that doesn't downshift as I slow down. It will downshift into second and only sometimes into first as the vehicle comes to an almost complete halt. A new valve body and governor have been installed. Now the dealer tells me this is normal. Am I getting the runaround?—John B. Alhern, Bay City, Mich.

This transmission is designed not to downshift as you slow down, but to automatically downshift directly to low gear only when you come to a complete stop.

There is no downshift from high to second because the 1-2 shift valve overrides the 2-3 shift valve to cause a direct downshift from third to first gear. According to service experts at Chrysler, only two malfunctions can cause the transmission not to downshift when the vehicle comes to a stop: A sticking 1-2 shift valve or a sticking governor valve.

Dim-bulb bumper

I have a 1970 Oldsmobile Delta 88. My backup lights are embedded in the bumper. Recently one went out, and when I went to get it replaced I was told that it would cost \$12 because the bumper had to be taken off to make the replacement. Don't you think the "brains" at Olds could have designed this better?—Will Montgomery, Fair Lawn, N.J.

Yes, as long as they can't guarantee that the bulbs will last forever. For example,

they could have used screw-on lenses so that all you would have to do to remove a bulb is to unscrew the lens. Oh, well.

Sticky stuff

How can I remove a bumper sticker?—Frank Gerrad, Scranton, Pa.

Soak it with gum label remover, available in stationery stores. Allow the solvent to penetrate and soften the glue. Then, very carefully so you don't scratch the bumper, work off the sticker with a single-edge razor blade. If you meet resistance, soak the area with more solvent.

Trailer-tire troubles

The last tires I had on my trailer rotted before the tread wore out. How come?—Charles Schneider, Cedar Rapids, Iowa.

Probably because the trailer was lying idle for long periods and the tires got "soft" (lost air pressure). Also, they may have been sitting in grease or oil, which eat away at rubber. To avoid the same thing with your new tires, keep them inflated to recommended pressure at all times and slip clean planks of wood beneath them if the trailer is to remain in one place for a period of time.

Balky bird

I have a 1960 Thunderbird with a 352-cu.-in. engine that is in excellent condition although it has 81,000 miles on it. The heads have never been off. My problem is with acceleration. When I give it full throttle quickly, it gags and sputters and will die out unless I pump the gas pedal hard. Once it catches, it literally takes off like a scared canary. I know it sounds like the accelerator pump, but the carburetor is only a year old and the pump appears to shoot more than an adequate supply of fuel into the venturi when I work it by hand. I've rechecked the timing, point settings and dwell. What have I missed?—Don W. Minium, APO, N.Y.

You missed a couple of things. For example, (Please turn to page 22)

AUTOMOBILE CLINIC

(Continued from page 21)

ample, fouled or improperly gapped sparkplugs that fail to ignite the fuel mixture can cause a stall on acceleration. So can a distributor vacuum advance unit that isn't working. Another thing to be suspicious of, although it doesn't happen too often, is a distributor primary that is grounding out. The insulation on the lead may have worn off after all these years, and the wire may be grounding itself against the distributor housing momentarily on acceleration. Finally, don't overlook the fact that your engine has seen plenty of miles. Low compression can be the cause of your trouble.

Tailgate troubles

I am having trouble with the electric tailgate window of my Chrysler station wagon. From time to time it won't go up or down. Service people at the agency tell me that is just the way they are. Can you help?—J.E. Mills, Mansfield, Ohio.

The tailgate window motor is a wound-field, series type which has two windings

—one for each direction. The fields are grounded to the body through the motor housing, with the switch completing the circuit. The trouble could be a bad ground—probably loose. It may also be a bad motor. Tell your dealer to conduct permanent-magnet and wound-field tests as outlined in the body service manual.

Manifold troubles?

I have a 1968 ¾-ton Chevrolet Camper Special with 327-cu.-in. engine. The No. 1 sparkplug fuses together after 1000 miles or less. This condition has existed since the car was new. The compression is okay. What do you think?—E. O. Holle, Inglewood, Calif.

It's conceivable that metal particles are coming off the piston or cylinder wall and causing a bridge across the electrodes, but by this time you would have started seeing other signs of trouble if this were happening, such as a loss of oil. My best guess is that there is a restriction in the intake manifold that is feeding this one cylinder, causing a reduction in the fuel mixture. This may be causing the plug to run

(Please turn to page 24)

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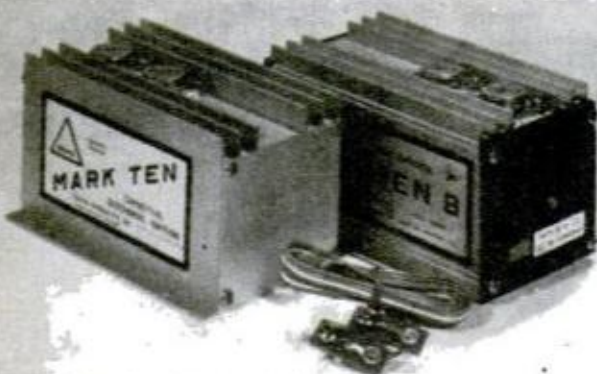
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AUTOMOBILE CLINIC

(Continued from page 22)

hot, which is leading to the fusion. Why not pull the manifold and see?

Jouncing along together

Can you tell me why I get a creaking kind of noise from the rear of my 1971 Mustang, especially when the car bounces?
—Norman Kessler, Fort Lauderdale, Fla.

It's possible that one of the rear-axle jounce rubbers is loose or lost. Raise the rear of the car and peer in through the wheel well. You should see a black rubber part inserted into a metal bracket. Determine if this bumper is loose. If it is, or if the part is missing and a new one has to be installed, be sure to file the inside surface of the bracket hole to remove burrs that may be preventing firm seating of the bumper.

Service tips

● **1972 Oldsmobile Toronado** brakes may squeak even when the brake pedal isn't applied. The disc brakes of this car have wear indicators that make noise when linings wear down to replacement level. A spring clip contacts the rotor and makes the noise as the car is being driven.

● **1971 or 1972 Plymouth Crickets** may be getting water on the front floor mats during a heavy rain or when the car is being washed. It's probably a water leak in the plenum chamber A-post area. It can be repaired by drilling an access hole and applying adhesive. Details are given in service bulletin 23-20-72C.

● **Volkswagen** reminds you to replace brake fluid every two years to avoid bad braking action. Fluid absorbs moisture that can cause brake lines to freeze in cold weather. The danger of corrosion to brake parts is also lessened by frequent fluid replacement.

● **Some 1972 Dodge Darts and Plymouth Valiants** with six-cylinder engines and manual transmissions have delayed clutch-pedal return action because the over-center spring is out of whack. The repair is to replace the present spring with one having part No. 2266784. ★ ★ ★

Got a problem with your car? Ask Mort about it. Send your question to Auto Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems of wide interest will be published in this column.

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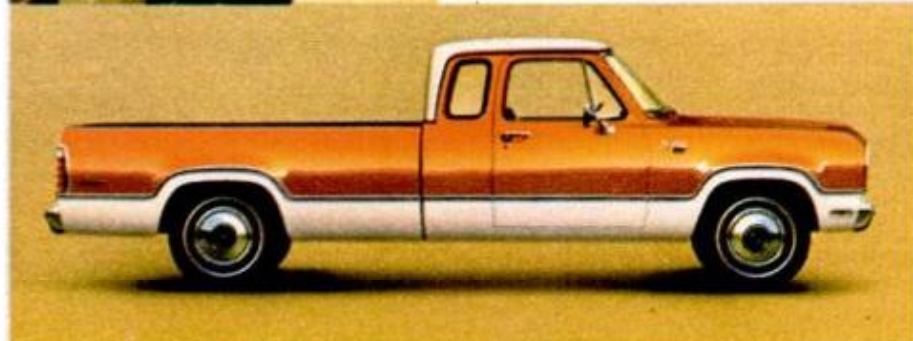
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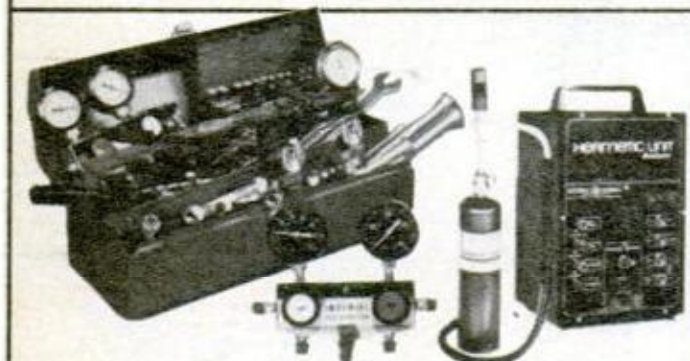
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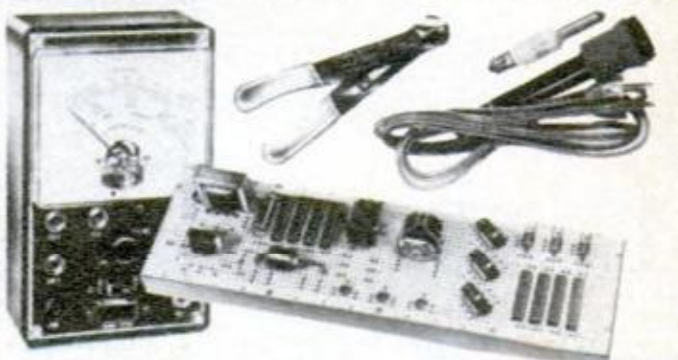
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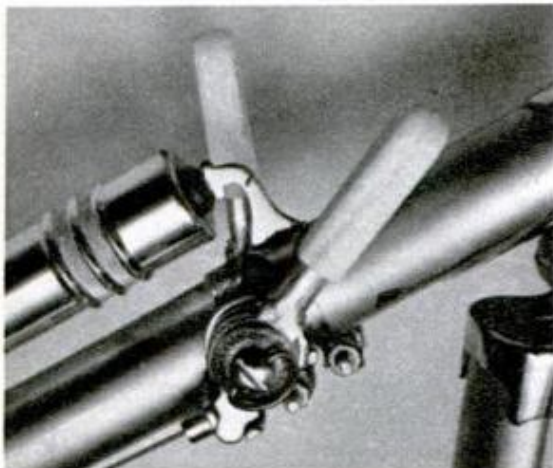
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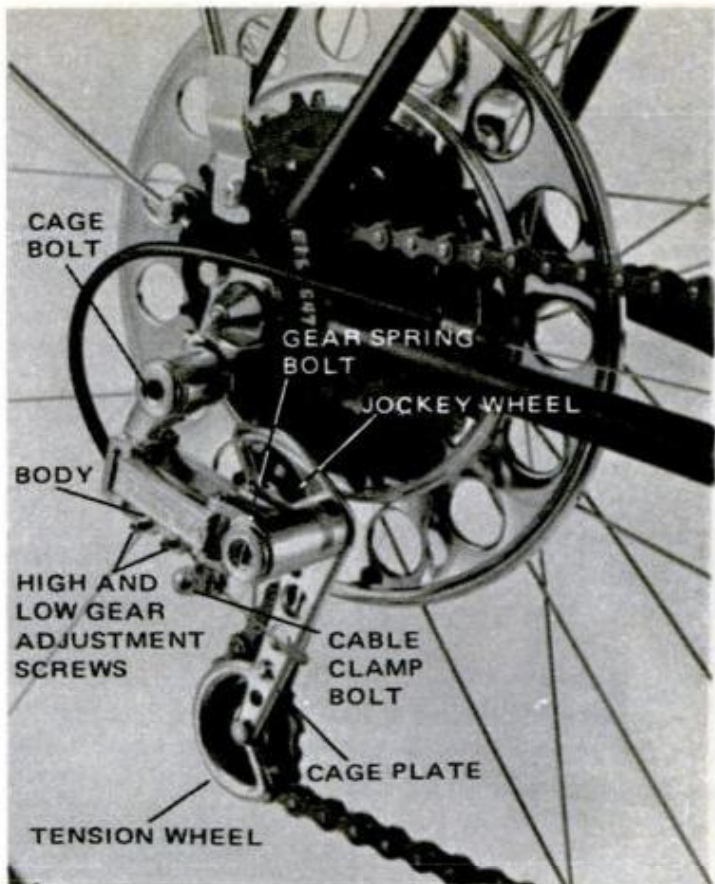


THE BICYCLE SHOP

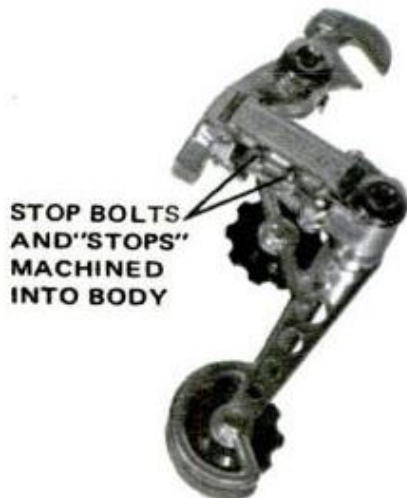
By EUGENE A. SLOANE



SHIFT LEVERS on down tube: Near lever is for rear derailleur, far one is for the front

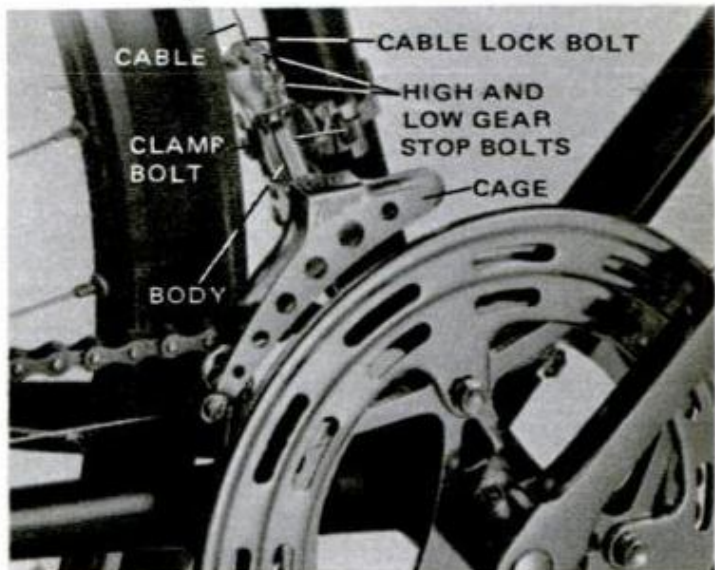


TYPICAL REAR UNIT, held on chainstay fitting by cage bolt



STOP BOLTS AND "STOPS" MACHINED INTO BODY

HIGH-GEAR STOP BOLT is generally closest to "stop" when chain shifts to highest gear; the other is the low-gear stop bolt. Stops and bolts limit cage travel so chain won't jump off



TYPICAL FRONT DERAILEUR, located over the chainwheel

How to adjust your front and rear derailleurs for best performance

FEW THINGS can be more frustrating to a cyclist than derailleur problems, yet most can be solved if you know how to adjust the derailleur. Gears that skip, slip or won't shift are common symptoms of a badly adjusted derailleur.

The word "derailleur," derived from French, means simply to "derail" or shift from one gear to another. It works on a parallelogram movement and is connected

by a stranded wire cable to a gearshift lever, usually located on the down tube. The levers can also be on the handlebar stem, but I regard this slight convenience more than offset by the hazard presented if the rider is thrown forward.

To identify parts of a derailleur, study the "Typical rear unit" photo. In particular, note that the rear derailleur has two

(Please turn to page 32)

THE BICYCLE SHOP

(Continued from page 31)

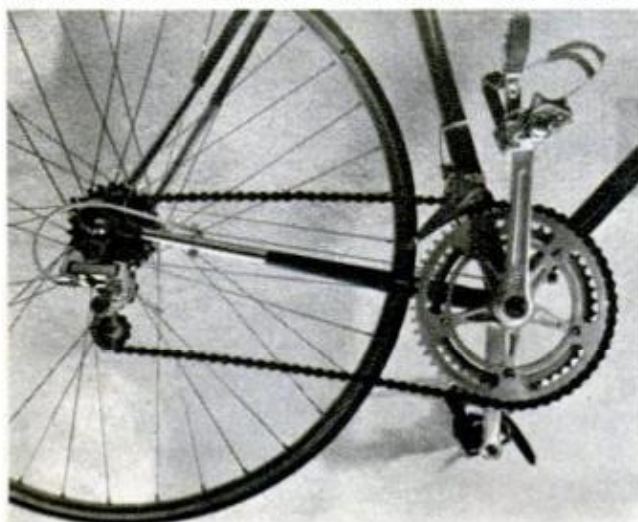
adjustment screws. It is not possible to tell you the location of these two adjusting screws for every make on the market: there are just too many. However, in general, all you need remember is that the two adjusting screws on the rear derailleur are to keep the derailleur from overshifting on the big gear too far, so that the chain gets caught between the gear and spokes, or jammed between the small gear and chain stay. Either type of jamming will likely lock the rear wheel and cause you to take a forward flyer.

If the chain keeps slipping off the big gear (nearest the wheel), shift the chain so it just moves onto that gear, then adjust the big gear stop on the derailleur.

Before trying to adjust the rear derailleur, make sure you know which adjustment screw is for the big gear and which is for the small gear. You can locate each screw by sighting behind the derailleur when the chain is on the big gear. Notice that cast or machined into the inside part of the derailleur cage are "ledges" or "stops" and that each screw lines up with a stop. The one nearest the stop when the chain is on the big gear is the big gear adjustment; the other is for the small gear.

Adjust these two derailleur stop screws by shifting the chain onto the big gear. If the chain won't shift up that far, back off the adjustment screw until the chain will shift to that gear and then tighten the screw *gently* up to the stop and no further. Check this adjustment by shifting the chain down a couple of gears and shifting firmly up to the big gear. The chain

BICYCLE TRANSMISSION includes rear derailleur, chain, front derailleur, chainwheel and cranks



should not "lift" or move over the big gear toward the spokes but should stay firmly on the big gear. A further check should be made by shifting while pedaling and then climbing a steep hill.

Now shift the chain to the small gear. It should shift all the way down, but not override so the chain is riding on the chain stay. Shift the chain just far enough to bring it onto the small gear, then turn the adjustment screw gently until it touches the stop. Check adjustment by shifting up a few gears, then shifting back down to the small gear. If the gearshift cable is too tight, you won't be able to shift down to the small gear at all. In this case, move the gearshift lever all the way back until it is as parallel as possible to the down tube. Then unscrew the derailleur cable locknut enough to let about a quarter-inch of cable slip through, or just enough so the cable has a bit of slack where it parallels the down tube. Retighten the derailleur cable locknut carefully so you don't strip it. Make one more check to be sure the chain can be shifted to the small gear, and readjust the small gear adjustment screw if necessary. Going back to the big gear adjustment, if the derailleur cable is too slack, you won't be able to shift up to the big gear. In this case, shift down to the small gear, loosen the cable locknut on the derailleur and pull just enough cable through (with long-nose pliers) to take almost but not all the slack out of the cable (gearshift lever should be flat, parallel with the down tube). Check the big gear adjustment again; make sure the chain shifts all the way up to, but not over, the big gear. Recheck adjustments by a road test.

Front derailleurs, also, are far too numerous to attempt to show location of stop bolts which limit derailleur travel and so prevent overshifting of the chain. A correctly adjusted front derailleur will shift the chain just far enough either way to place it firmly on the desired gear.

To adjust the derailleur, locate the small chainwheel stop bolt by shifting down to that gear and noting which stop bolt is closest to a "ledge" or "stop" machined into the derailleur body. With the chain on the small gear, adjust the stop bolt snug against the stop. Shift to high gear, and adjust the high-gear stop bolt the same way. Check adjustments by shifting rapidly from low to high gear. ★★★

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HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Slicker snowplow

I may be a little premature but winter's coming and I want to be ready for it. I have one of those hand-pushed snowplows but it has a rusted blade due to neglect. How can I "scour" it so snow won't stick?"—L. Hansen, St. Paul, Minn.

This will take some rub-a-dub with steel wool and perhaps a fine-grit abrasive paper to prepare the blade for application of a metal primer. Allow the primer to dry, then smooth it with 4-0 steel wool. Next, apply a coat of either appliance enamel or aluminum paint. If possible, apply either paint using the pressurized spray-can type.

Finally, to maintain a slippery blade you should apply either a paste wax or a silicone spray periodically.

'Popping' water heater is pooped

My water heater is about 10 years old and now, when hot water is drawn, there's a hissing, crackling noise for a couple of minutes. What could be wrong?—Tom Kusker, Racine, Wis.

Chances are that your 10-year-old water heater has had it, especially if you don't have a water softener. You would be wise to replace the old heater with a new one and to install a water softener at the same time.

If you don't replace a worn-out heater, you run the risk of flooding. There's no way of telling when the heater may let loose a torrent of water, resulting in damage that could cost you more than a new heater.

Removing candle wax from rug

I spilled melted wax (from a red candle) on my carpet. Though I have tried several methods of removal, I can't get it off completely. Can you name the solvent that will do it?—Mrs. Leonard Beam, Scottsdale, Ariz.

Since I do not know the type of rug, or its color, I can only suggest that you use dry ice. This will "freeze" the wax

so it can be crumbled and removed. But, this must be done with care so as not to damage the rug. The stiffened wax should yield to a gentle brushing with a stiff brass-bristle brush (like the kind used for cleaning suede shoes). *Caution:* Do not touch dry ice with bare fingers. Wear rubber gloves and handle the stuff with care.

'Antiquing' metal screws

I'm finishing an antique on which several exposed screws must be replaced. How can I make new screws look old?—Wayman Smythe, Nashville, Tenn.

You don't mention whether the antique will be painted or stained. But either way, your best bet is to "antique" the screws by aging. If the piece is painted, use a thinned paint of the desired color; for a natural piece, offhand, I would recommend that you use a black enamel. Apply the paint to the screwheads and wait until it is tacky; then rub it lightly until some of the metal shows through. For a longer lasting finish, you could cover the paint with a semi-gloss varnish. This method can be used on both steel and brass screws.

Restoring a copper wash boiler

I've seen old copper wash boilers prettied up to look like new. How do they do it? I have an old copper boiler, with what I think is a steel cover, that I want to look like those I've seen.—Larry Downum, Kansas City, Kans.

Restoration shops that specialize in this sort of thing use power scratch-brushing and polishing equipment. But if you are willing to supply the armpower, there are commercial polishes that will let you do almost as well by hand. Follow the directions on the can, then protect the cleaned copper by applying a coat or two of clear lacquer.

To refurbish the cover, rub off all rust and dirt using steel wool. Follow this cleaning with a spray coat of metal primer and finally, apply a spray-coat in a "brass" color. This should be acceptably close to the tub's color. ★★

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. While letters cannot be answered individually, problems of wide interest will be discussed in this column.

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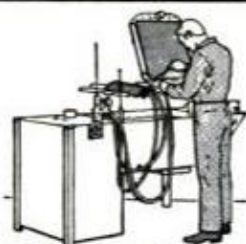
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One-of-a-kind car:

Volvo's Sportswagon

The new 1800ES is the only combination sports car/station wagon you can buy. Chances are nil that Detroit will ever do anything as nice with its ponycars



By **BILL HARTFORD**, Auto Editor / Photos by Elisabeth Ericsson

OUR ROMANCE with the automobile is over—so it's said. It's not only the terrible traffic, the service mess and the safety and emissions laws that are killing the fun of driving: There are very few cars that are fun to drive to begin with. Even rarer are cars that perform and handle with some spirit and still offer the room necessary for the needs of a small family, or even for a bachelor who wants to blast off with a trail bike or some scuba gear in tow.

Scratch the Corvette. Big car outside, but inside tight and trunkless. Firebird? Camaro? Nope: not even a hatchback to make the stuffing easy. Datsun 240Z? A little better. Volvo 1800E? Never. Small back seat, small trunk. Boss wagon versions of these cars exist on a lot of doodle pads, and a few have actually come out of custom body shops, but only one manufacturer has dared to go on the line with a wagon model. The Volvo 1800ES is the only sportswagon you can buy.

Before it was available here, I went to Sweden to drive it. I had only seen pic-

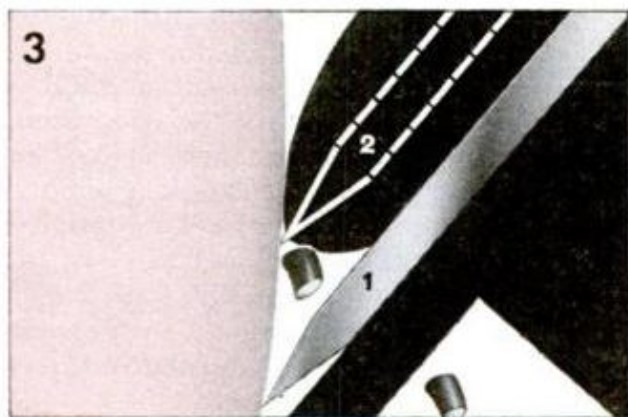
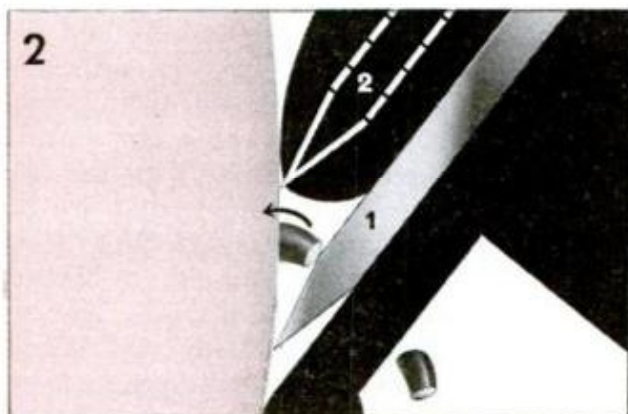
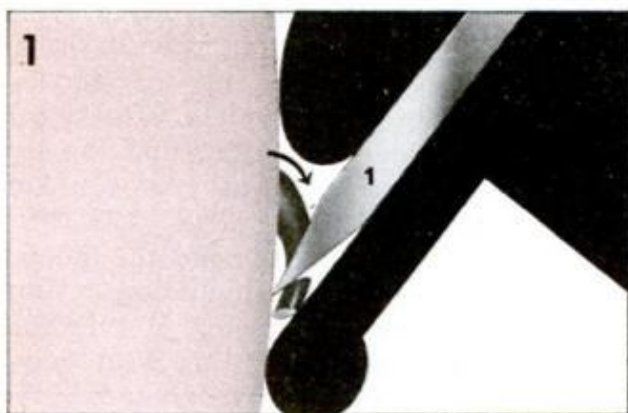
tures of it. My first reaction to the gold car parked in front of the new Volvo engineering building in Gothenburg was incredulity—that the machine, so pleasing to look at, was nothing more than a take-off on the old 1800, which after 10 years here, doesn't draw a second glance.

There was no snow on the ground in Gothenburg, but it was winter and, since only a fool would argue with a Swedish winter, I left on the four Michelin 165 F 15 studded, snow radials—which meant, of course, that I literally *hummed* along on dry pavement. It was a bit frustrating for hot-shoe driving, but I was soon to be in snow farther north—surefooted and secure as I've never been in a car before.

First leg of my two-week excursion, traveling with a Swedish friend, was Gothenburg to Stockholm. We loaded all our baggage, including my new arctic gear, toolbox, cameras and tripod, in the carpeted wagon without putting down the back seat. Heavy leather tie-down straps kept it all in place, and it didn't block vision out the all-glass tailgate. The glass is

POPULAR MECHANICS

Here's why your razor could use a second blade.

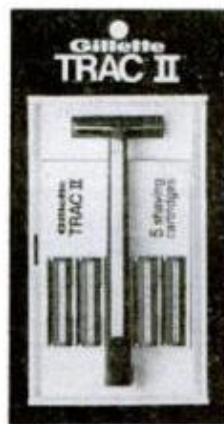


(1) When you shave with your one blade razor, the blade actually stretches the whisker out from the skin for a moment. (2) But after your razor shaves it, the whisker snaps right back. Now, if you had a second blade in your razor, right behind the 1st one... (3) you could shave that whisker again, before it had a chance to snap all the way back. This would mean you'd get a closer shave.

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GREATER RETOOLING INVESTMENT in redesigning the 1800 above the beltline could have been devoted to improving rake and area of narrow windshield



SEAT DOWN results in cargo area that's 60 in. long by 49 wide by 22.4 high. That's nearly 35 cu.ft.

electrically heated and we used this safety feature regularly.

Interior of the sportswagon is beautifully finished and fully instrumented—even if too much like the cockpit of an old dive-bomber—and extremely comfortable for driver and passenger. Period. Word of Volvo's skill with seats is getting around and needs no repeating. The back seat, however, is good only for kids and is, I was happy to see, complete with two lap belts. All seats are leather and the interior is fully carpeted—as you would expect with a \$5000, very "G", GT car.

A short time on the road up the west side of Lake Vänern (including a voluntary detour onto a stretch of incredible, unpaved "road," used in Scandinavian Midnight Sun rallies) was enough to confirm that "strong" is the word to describe the ES. However good-looking and comfortable, the car is first of all strong, structurally and in its power train.

The B 20 F is the same conventional, two-liter, overhead-valve, in-line Four used in other Volvo models that are fuel-injected. Horsepower is 112 SAE at 6000 rpm; torque, 115 foot-pounds at 3500 rpm in a car weighing 2600 pounds. The hefty four-speed is taken from the 164, has short, crisp throw using the baseball-sized gearshift knob. A steering-column-mounted stalk flips in a fifth, overdrive gear working only on fourth.

We were in overdrive, in fact, still busy getting acquainted with the car, when we noticed the fuel-gauge needle had "mysteriously" plummeted to near empty. It was midnight and not a gas station was open. But we didn't have to sleep in the wagon—we found a station with the "tank yourself" feature common in Sweden.

Fuel economy, as it turned out, is very



1800ES has wheelbase of 96.5 in., length 172.6 in., width 66.9 in., height 50.4 in., track f/r 51.6 in.

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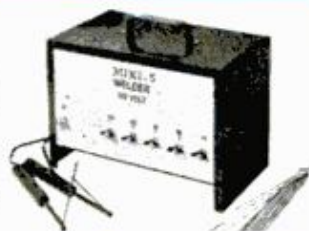
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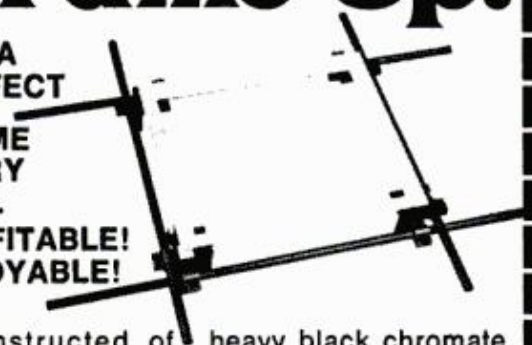
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good: What tripped us up was the fact that the 1800ES tank holds only 11.9 gallons—annoying when you want to gobble up road without worrying about planning stops closely, likely with one brand of gas in mind. Fuel consumption as we logged it was 10.12 kilometers per liter, winter driving, with the usual “fooling around” to feel out a new car. This figures out to 23.83 mpg over 2339 km, or 1453 miles.

We traveled that distance in the run to Stockholm, side trips north to Lake Siljan and the archipelagos and back to Gothenburg. We made the return trip along Lake Vättern. It was near Huskvarna (of motorcycle fame), at sundown, on a foggy Sunday, that we lost our headlights. It was the relay. Taping the contacts closed gave us lights again but high beam only. We left the circuit taped, adjusted the high beams down, and finished the last leg back to Gothenburg.

The glass tailgate requires a key whenever you want to open it—an inconvenience, as was the lock itself which needed adjustment. Otherwise, the sportswagon was perfect for touring. Cold-weather starting of the electronically fuel-injected engine is instantaneous and smooth. Handling on all road surfaces is good, with adequate suspension travel and just enough “softness” for easy riding all day. And, to twist the ultimate praise, there's no other car like it! ★★★



SMALL FUEL TANK, 11.9 gal., is annoying. One night we just made it to a self-service gas station. Machine digests 10-crown notes and turns on pump for the octane-number button you press. The 1800ES tailgate is practical, good looking and futuristic

STRONG AND ECONOMICAL we found B20F engine: 0 to 60 between 10 and 11 seconds, 23.83 mpg overall



How to get rich

How can you get rich some day? Make a hit record . . . a killing on the stock market . . . or invent a gadget like the hula hoop?

For most of us, these are just dreams. But have you ever stopped to think that there is a way to get rich—possibly only one sure way? Most fortunes, as you know, are made by people who own their own business.

Perhaps you've thought of starting a small business of your own . . . a franchised drive-in, or maybe a service business. Trouble is, you need \$10,000 to \$15,000 to get started and even then it's a gamble—with slim chances of ever making really big money.

But there is *one* business which could make you rich—almost overnight! And the beauty of it is, you can start on a shoestring during your spare time, even while holding your regular job.

Cash by Mail

The business is Mail Order—and it's fabulous! Come up with a 'hot' new item . . . and WHAM!

It strikes like a bolt of lightning!

Suddenly, you are deluged with cash orders from all over the country . . . MORE MONEY than you could ever make in a lifetime!

Like the Vermont dealer who ran one ad in Sports Afield Magazine. His ad pulled 22,000 orders—over A HALF MILLION DOLLARS IN CASH!

There is no other business where you can make a fortune so quickly!

● A beginner from Newark, N.J., ran his first small ad in House Beautiful—offering an auto clothes rack. Business Week reported that his ad brought in \$5,000 in orders. By the end of his first year in Mail Order, he had grossed over \$100,000!

● Another beginner—a lawyer from the midwest, sold an idea by mail to fishermen. Specialty Salesman Magazine reveals, "he made \$70,000 the first three months!"

Proof

It's a fascinating business! Running ads in newspapers and magazines . . . mailing gift catalogs . . . getting cash orders in your daily mail—steady as clockwork.

There is no other business where you can start on a shoestring and pyramid your profits—without investing in merchandise! One husband and wife mail order team took in \$40,000 selling one item. They obtained FREE ads in national magazines . . . didn't invest a cent in merchandise, and even got the supplier to ship all orders for them!

These exceptional cases are absolute proof that you can get rich in your own Mail Order business. Very rich. Even a U.S. Gov. Report stated: "A number of

one-man Mail Order enterprises make up to \$50,000!"

Pick up any magazine. Notice how the same mail order ads are repeated . . . month after month? That's concrete proof! You know those ads wouldn't be repeated over and over again—unless they were bringing in big cash profits to their owners.

The Secret

The secret of getting rich in Mail Order lies in *financial leverage*. It's a little-known, almost secret method—using other people's capital to make money for you!

You can get thousands of dollars worth of advertising in big national magazines—without investing your own money! And you don't have to write a single ad. Tested and proven ads are prepared for you by experts. Reinvest the profits from your first successful ad—to get more, larger ads, and the profits begin to snowball! It's like building a chain of stores . . . each new store puts more money in your pocket.

You mail out beautiful catalogs which offer hundreds of dollars worth of fine, quality gifts—yet you don't invest one



The thrill of receiving money in your mail is one you'll never tire of!

cent of your own money in merchandise! Your catalogs are printed with your name and address, so all orders come to you. Everything is "drop-shipped" for you, and there's up to 100% mark-up! You pocket the cash profits immediately—even before the orders are shipped to your customers!

Repeat orders alone, just from mailing catalogs, could bring you a steady income for the rest of your life!

Yes, Mail Order is the fastest-growing, most profitable business in America! And now, with more people moving to the suburbs . . . the population explosion . . . and the expanding teenage market . . . we are on the verge of the BIGGEST BOOM in Mail Order history!

Now, with the help and backing of Mail Order Associates, Inc., of Montvale, N.J., you can follow the same proven steps to Mail Order success—using the 'secret' of financial leverage!

Start Now

We supply you with beautiful gift catalogs throughout the year. All products are dropshipped for you, with up to 100% mark-up! You get free samples of top-selling mail order items, plus monthly trade reports on 'hot' new products . . . tested, successful ads are sent to you monthly. You get advertising directories, postal laws, complete courses, expert guidance—EVERYTHING you need to practically guarantee YOUR SUCCESS. Why? Because *our* business depends upon your success. It's mutually profitable!

A recent feature article in Income Opportunities Magazine stated, "Mail Order Associates Inc., offers the most comprehensive Mail Order program ever offered to beginners." They go on to say, "This could be the opportunity you've been looking for. A chance to get in on the ground floor in a little-known business which we believe is on the verge of a new boom."

Free

We are now accepting a limited number of charter members in our new Mail Order Program. No previous experience is required but you must be over 21.

If you are sincerely interested in starting a profitable business of your own . . . if you can see the tremendous advantages which Mail Order offers . . . then ACT NOW!

Mail the coupon today, or simply send your name and address on a postcard. No salesman will call. We will send you a free book—gift catalog, reprints of feature articles, plus complete facts about our program. Write to:

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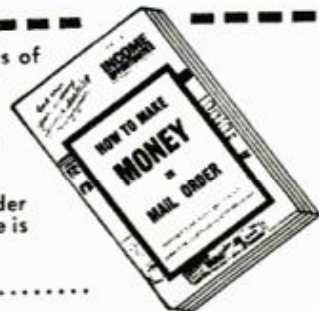
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Seats have deep foam padding. (Bucket seats are available.) There's a new padded instrument panel. And a new padded steering wheel. Plus color-keyed mats. And air conditioning, if you want. When you're out exploring for your own campsite, you need guts—and comfort. The Jeep Truck gives you both.

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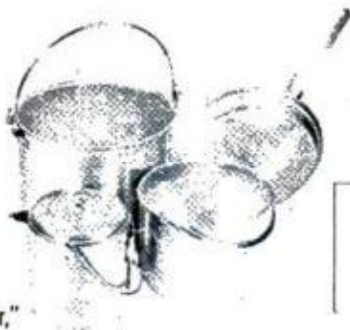
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POPULAR MECHANICS

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DETROIT

LISTENING POST

BY ROBERT LUND

FORD'S MINI-MUSTANG is wrapped up and ready to roll. The company's executive committee has approved a styling/engineering prototype and authorized production for next year. Pilot production will begin in July and the car will go on sale in September. The Mustang name will be retained—at least for the first year, but the new version won't show much of a resemblance to the current car. Built on the Pinto frame, the new job will be at least a foot shorter than its predecessor. It will have a token-size rear seat. Ford had been considering a one-seat, two-person design but scrapped the idea as too risky.

There'll be two models—a two-door and a three-door—sealed side windows in the back, disc brakes and a choice of two engines, a Six or an I-4. But low-rated engines don't mean the car will be low-priced. By the time you add a few extras, the price will easily edge \$3000.

How about a derivative car for Mercury? This is standard practice at Ford; bring out an original and then fancy it up for Mercury to market under another name. It's a good bet Mercurized sketches of the car exist, but there's no plan to build such a car before 1975. What you're likely to see hot on the heels of son-of-Mustang is a counterpunch car coming from American Motors—a junior Gremlin.

HOT ON THE HEELS of last month's cover story about electric cars came news of a survey done for the Electric Vehicle Council. The study shows that 42 percent of Americans in a national survey would be interested in purchasing a short-range, limited-speed electric auto if it were available for under \$2000. This percentage has been increasing steadily, up from 32 percent in 1967, and now represents 55 million people! The figure seems impressive enough to arouse even Detroit, where car production is in the hands of men playing the numbers game.—B.H.

MORE SAFETY FROM SAAB. The people who gave the United States its first five-mph bumpers which resulted in lower collision insurance rates has a new, free, seat-belt replacement program for its cars. Any belts in use at the time of an accident will be replaced free. J.J. Upham, presi-

dent of Saab-Scania of America, feels strongly about the use of belts: "Hopefully, our new program will call attention to the effectiveness of the seat belts and the need for their use at all times. Through this program we will also make sure that any belt that may have been subject to extra strain in restraining a driver or passenger at the time of an accident, is replaced with a 'fresh' and totally safe belt."—B.H.

GM'S SET A TOUGH GOAL for its safety engineers and suppliers who sell the company fabrics: beat the government standard on fireproofing car interiors. The government regulation allows a burn rate of four inches per minute. Not good enough, says GM. The goal is to come up with fabrics or a chemical treatment that will cause fires to self-extinguish.

WHAT'S OLD DEPT. If vent windows and hood antennas can come back, how about the two-piece windshield? Remember the years-ago windshield with the divider strip running down the center? There's talk of reviving two-piece glass as a safety feature. The ideal windshield would be one that cushions the impact in an accident, then pops out. Pop-out action is difficult to attain with a full-width window but might be possible with two-piece glass. Couple of cars have gone to the two-piece design for rear windows of '73 cars.

TRACKING THE WANKEL. Outsiders who report GM has solved all its problems with the Wankel are a lot more optimistic about the engine than GM insiders assigned to the project. Not that GM's pessimistic. "But the well-wishers want to anticipate solutions we haven't arrived at," says an engineer working on a key phase of the program. One of the hang-ups now is to match an automatic transmission to the engine while the engine itself is still under development. GM has paired dozens of automatics, foreign and domestic, with the Wankel and has yet to come up with a shifter that meets all the specifications GM has written for itself.

Why not go with something less than perfection to get the Wankel off the pad and improve on it later? This is accepted practice in automaking. Build it to the best of your knowledge now, build



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DETROIT LISTENING POST

it better as you gain experience or technology improves. But not with the Wankel. The engine is a personal project of GM's second highest in command, president Ed Cole, and his interest in it is widely known—by critical sharpshooters as well as friends. It's the last major engineering activity Cole will supervise before he retires. If the rotary piston sputters out, Cole gets the black eye. If it's a winner, he gets the credit. So there won't be any halfway or patch-it-later versions of the engine for as long as Cole is calling the shots.

TIPS ON TIRES. If you're buying a '73, don't assume there's a regulation-size spare tire in the trunk unless you've checked it out. There's a spare in all cars. But some makers have gone to an emergency tire, which you have to inflate yourself with an aerosol can mounted with the tire. The temporary spare will get you to a gas station or dealer, but it won't give you the mileage you get with a standard tire. Something around 2500 to 3000 miles is about maximum for a fold-up tire.

KEEPING MECHANICS HONEST. How do you know if the mechanic who works on your car knows what he's doing? The usual ways of finding out are to ask a friend to recommend a repairman or the take-a-chance method. It's easy to get gypped, easy to fall victim of bunglers. Prodded by Congress, which has been threatening to write legislation requiring mechanics to be licensed, the auto companies have come up with an idea distinguishing the duffers from the guys who really know.

Starting in November, mechanics can sign up for a series of four tests. There'll be a charge of \$10 per test. If a man passes all four tests—graded on a pass/fail basis—he'll receive a certificate attesting to his expertise. The tests are open to all comers: dealer mechanics, gas station attendants, back-alley tinkers, all ages, male, female, including the general public. An independent group has been set up to keep things on the level and guard against cheating.

This won't be a mail-order diploma mill. It's a straight operation. It will take a few years to get the program rolling and to convince both the trade and car owners that the certificate isn't another meaningless merchandising gimmick. But the day may not be too far away when you'll be able to check a mechanic's credentials just as you check the qualifications of other professionals.

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America from 1966 to 1972: Toronado, Mustang, Barracuda, Pinto, Vega, Chevy II, Pontiac, Thunderbird, Buick, Imperial, Cadillac, Continental, Dart, Ford, Mercury, Chevelle, Chevrolet, Chrysler, Plymouth, Rambler, Dodge, Oldsmobile, Buick Special, Comet, Corvair, American, Olds F-85, Falcon, Ford Fairlane, Nova, Tempest, Corvette, Front-Drive Cadillac, Lincoln, Mark III, AMX, Gremlin, Valiant, Cougar, Maverick, Montego, Javelin, Torino, Challenger, Hornet, etc. They're all included—plus Volkswagen. And you get tune-up and front-end alignment specifications for all cars built from 1946 through 1965.

And all this information is authoritative. It comes from the car manufacturers themselves. MOTOR's editors distill more than 300 official factory manuals and hundreds of service bulletins to make sure your auto repair questions are answered, your service problems are solved. That's why over 6 million copies have been sold—to auto buffs, beginner and professional mechanics, students—making MOTOR's AUTO REPAIR MANUAL the all-time best seller in the field.

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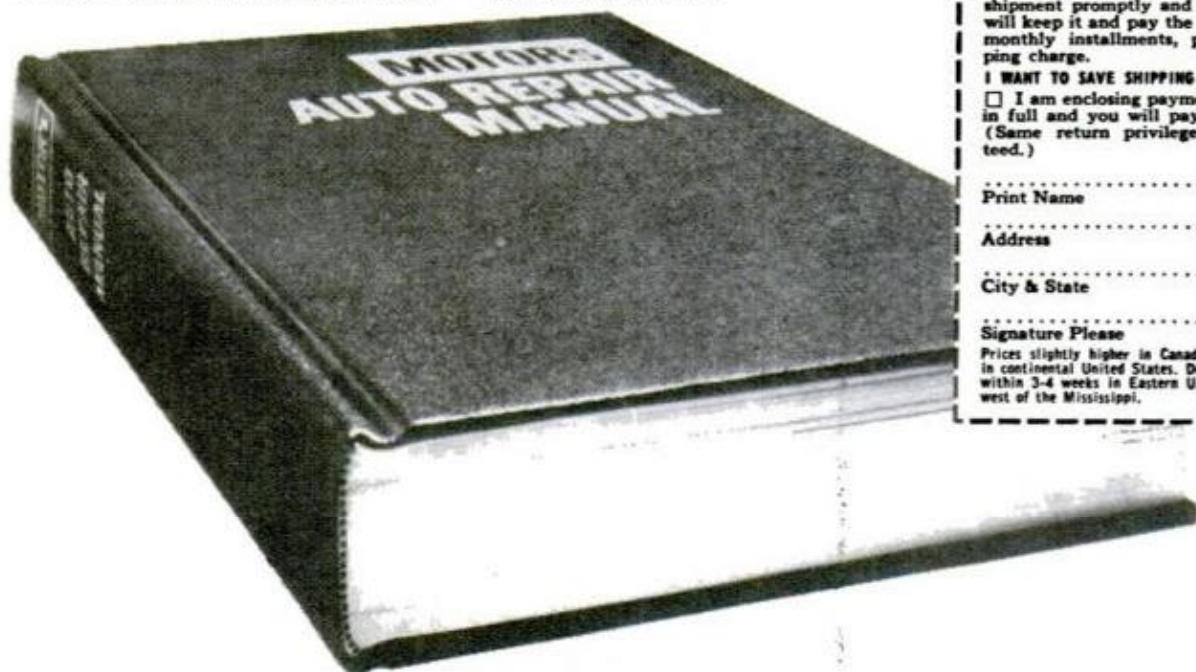
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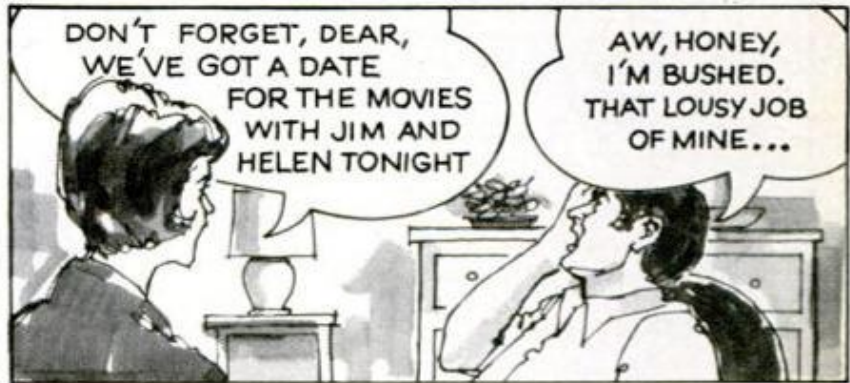


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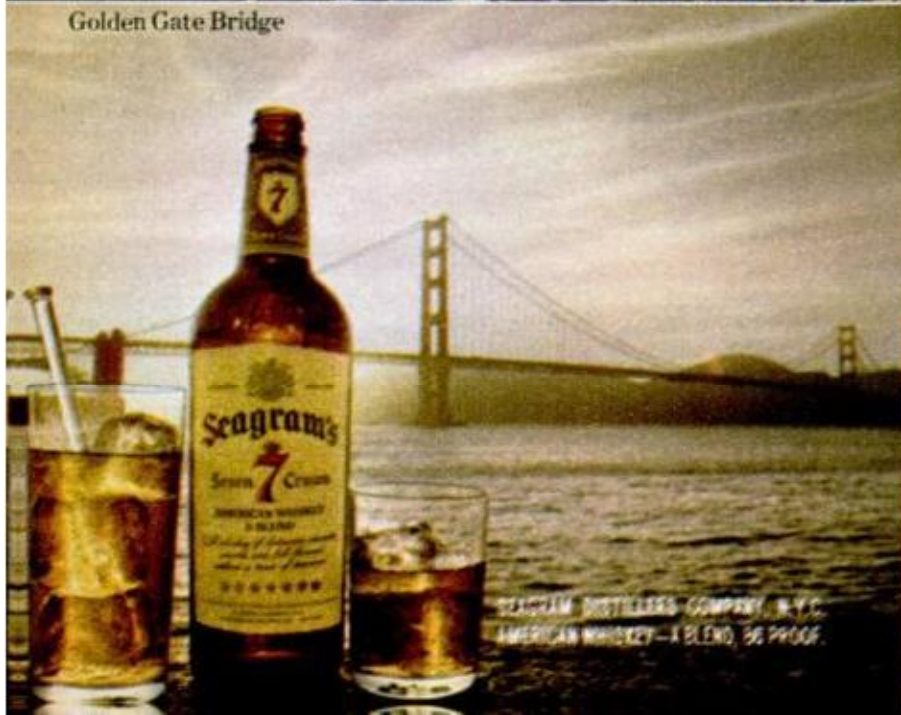
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Drivin' with Dan

What is rack-and-pinion steering? What does "GT" stand for and why do so many automakers use it? What is the size limit for an Indy-car engine? Dan Gurney answers these and other automotive questions

Q. What is rack-and-pinion steering and how does it work?—Peter Christensen, Eau Claire, Wis.

A. It is a little like a typewriter or a harmonica mechanism: The pinion moves the rack back and forth when it is turned by the steering wheel shaft. The rack is attached to the front-wheel arms. It is a simple and light method of steering. Most racing cars now use it, as do many sports cars and some passenger sedans.

Q. I read that they moved Jerry Grant back to 12th place from 2nd place at the Indy 500 because he used Bobby Unser's fuel. What difference does it make if he uses fuel from Bobby's fuel supply instead of his own?—Joe Rolf, LeRoy, Kans.

A. It is against the rules. The rules have now been changed so that everyone gets more fuel in the future. In Jerry's case, it didn't make any difference because he didn't need fuel but the USAC board upheld the penalty (\$72,000) in a show of solidarity (of the head!)

Q. What do the letters "GT" stand for? Why have

so many auto manufacturers used them on their cars?—Wayne Czerniak, Milwaukee.

A. Gran Turismo or Grand Touring. It's a "catchy" term. Manufacturers whose cars may not necessarily be grand touring cars in the real sense of the word hope that they'll get the image anyway!

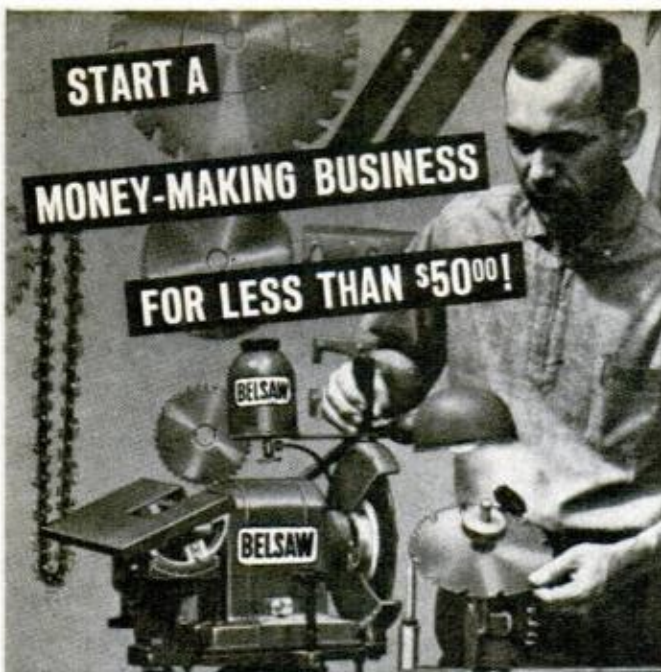
Q. What are the rules concerning placement of spoilers on USAC championship and Can-Am cars? What is the current philosophy regarding chassis design in championship and Formula 1 circuits?—Jim McLachlan, Livonia, Mich.

A. I suggest that you write for a copy of the 1972 USAC rule book to USAC, Speedway, Ind. Chassis design philosophy: Lower, lighter, simpler, stronger, safer, more agile, more forgiving, faster, more reliable, more durable, aerodynamic . . . all these things to be considered at once!

Q. My father says that the Indy cars have about a 289-cu.-in. engine. I think they have about a 429. I can't see how 800 hp can come out of a



A MIDWEST TRACTOR PULL—of sorts: It's Dan pulling his Eagle out of Gasoline Alley at Indianapolis Motor Speedway. In this car, Bobby Unser has taken the pole for all USAC races so far this year. As this is written (July) he has just set a new world closed-course qualifying record of 199.778 mph at Michigan International Speedway. Previous record of 199.658 mph was set by Bobby Isaac in NASCAR Grand National car at Talladega (Ala.) track in 1970



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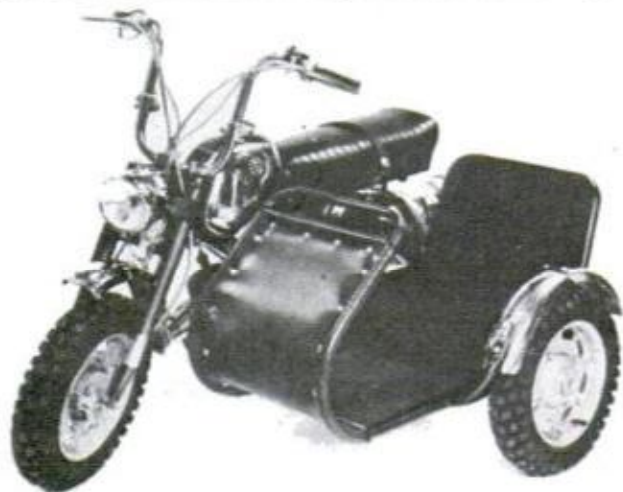
DRIVIN' WITH DAN

289-cu.-in. engine. Who is right or closer?—*Ricky Sharp, Deer Park, Tex.*

A. The limit for supercharged cars at Indy (every one of the qualifiers in 1972 was supercharged) is only 159 c.i.d.!

Q. I've been hearing the term "sidehack" recently. Is this the same as a motorcycle sidecar? And is it true you can get them for minibikes, of all things?—*William Winter, Syracuse, N.Y.*

A. The motorcycle sidecar, seldom seen these days, is (was?) a rather comfortable way for a passenger to go along for the ride with a motorcyclist. The sidehack, on the other hand, is not much more than a platform with an out-



rigger wheel that attaches to a bike. On the West Coast, sidehack racing is very popular. A rider hangs onto the sidehack and the two-man teams make for very exciting racing. There is a sidehack for Benelli's Dynamo series of bikes. For more information write to Cosmopolitan Motors, Hatboro, Pa. 19040.

Q. I would think every racing team in the country would be beating a path to your door to buy '72 Eagles for their drivers. Or wouldn't you sell to the competition?—*Martin Leonard, New York.*

A. The demand is great and All American Racers is building more of the cars—about a dozen more with orders standing for eight of them at this writing.

Q. I've seen Wendell Scott racing on the NASCAR circuit, but he's the only black I know of in auto racing. Are there any others?—*Shelley Davino, Flushing, N.Y.*

A. There are only a handful of black racing drivers in the sport. An all-black team, the Black American Racing Team (BART) was formed this past summer, however, with Bob

Introducing the Hornet Hatchback. A sports car with room to travel in.

Isn't that a nice idea? A car that does everything a sports car should do.

It moves like one. It handles like one. But it doesn't cost like one.

And the Hornet Hatchback gives you

lots of extra room when you need it.

Just fold down the back seats and load up through the hatch.

And only American Motors makes this promise: The Buyer Protection Plan backs every '73 car we build, and we'll see that our dealers back that promise.



Buckle up for safety.

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1. A simple, strong guarantee, just 101 words!

When you buy a new 1973 car from an American Motors dealer, American Motors Corporation guarantees to you that, except for tires, it will pay for the repair or replacement of any part it supplies that is defective in material or workmanship. This guarantee is good for 12 months from the date the car is first used or 12,000 miles, whichever comes first. All we require is that the car be properly maintained and cared for under normal use and service in the fifty United States or Canada, and that guaranteed repairs or replacement be made by an American Motors dealer.

2. A free loaner car from almost every one of our dealers if guaranteed repairs take overnight.

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4. And a toll free hot line to AMC Headquarters.

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We back them better because we build them better.

GUARANTEED!

Triple Your Money In 30 Days or Less

... Or Get Your Money Back!



WE MEAN IT! Now there's a guaranteed-safe way for you to actually TRIPLE your money inside of one short month... without risking one red cent! You can start as large or as small as you want... watch a \$50.00 investment grow to \$150.00, or watch \$500.00 grow to \$1,500.00—all within 30 days! Or, if you prefer, you can start with **no investment whatsoever**, and still rake in fantastic 200% profits that can make your spare time add up to a full-time income with an absolute minimum of effort! The secret? Merlite Rings—rings that look as if they must sell for hundreds or thousands of dollars each, but that retail for just \$6.00 to \$30.00! All you do is show them to your friends and watch them sell themselves—while YOU make up to \$20.00 and more on every sale! Plenty of extras, too—FREE gift boxes, FREE same-day delivery, FREE drop-ship service. PLUS an Unconditional Lifetime Guarantee on every ring purchased from you!

Everybody buys Merlite Rings—on sight! There's no selling required, no "sales pitch" or high-pressure tactics needed! Just SHOW these rings, and watch your profits pour in! Imagine a dazzling collection of over 100 exquisite, high-fashion styles for men and women... rings that LOOK as if they must cost hundreds, even THOUSANDS of dollars each, but that YOU can offer at the unheard of low price of only \$6.00 to \$30.00 each! Nobody can resist!

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AND REMEMBER—every one of these gorgeous rings pays YOU a whopping TWO HUNDRED PERCENT PROFIT! Sell a \$15.00 ring, and pocket \$10.00... sell a \$30.00 ring, and pocket \$20.00! Sell three, four, five rings an hour, and you've got a part-time business that pays you a FULL-TIME income!

NO INVESTMENT REQUIRED! Best of all, you can get started in this fantastically lucrative business for the cost of a postage stamp! Mail the coupon below, and we'll rush you EVERYTHING you need to start making money NOW: our lavish, full-color Customer Presentation Catalogue showing the complete Merlite Collection, a detailed Profit Manual, a handy pocket ring sizer, wholesale order forms... PLUS a Special Offer that lets you obtain our \$8.00 Professional Jeweler's Display Case... FREE! There's no charge, no obligation—so mail the coupon TODAY!

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I'm ready to start enjoying TRIPLE PROFITS with Merlite Rings! By return mail, rush me everything I need to get started! I understand that everything is FREE and without any obligation on my part!

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DRIVIN' WITH DAN

Dooley as the team driver and Leo Lillard, team manager. Dooley holds SCCA and FIA licenses and is driving in this season's Super Vee series. The team is also campaigning a car on the IMSA circuit. If you want more information, write to Steve McClellan, S&M Associates, 823 W. 21st St., Norfolk, Va. 23517.

Q. I've driven several sports cars with five-speed transmissions and found them a real pleasure—good pulling in the lower gears with fifth being an excellent "overdrive" gear for cruising. Why don't any of the more economical imports that I can afford have the fifth-gear feature?—*Dana Powell, Columbus, Ohio.*

A. It's a matter of economics: the fifth gear adding to the cost of the gearbox and bringing up the price of the car beyond where the manufacturer wants his car to fall in the competitive marketing categories. By now you're probably aware of the one and only economy sedan offering fifth as an option. The Toyota

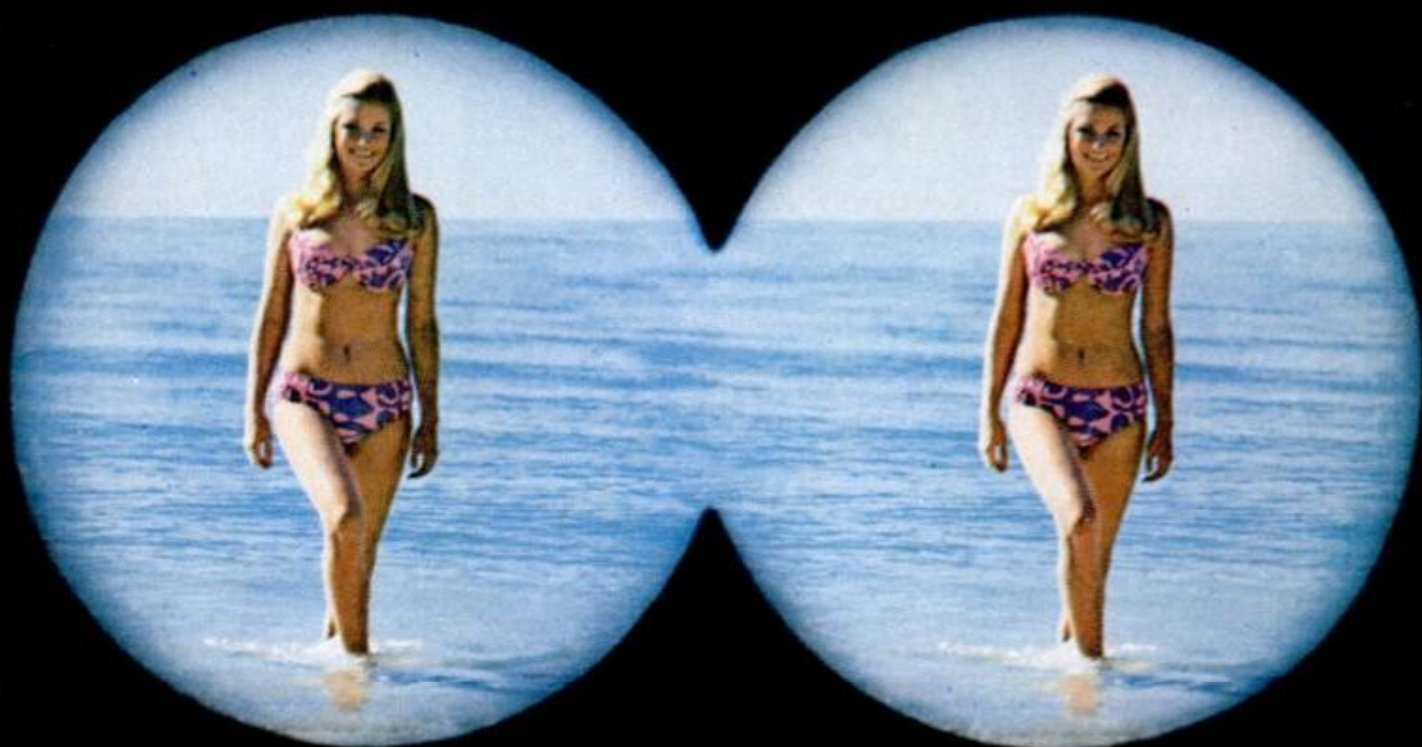


Corolla 1600 has a "package" of five-speed box, radial tires and console that adds about \$130 to the base price. It's an excellent option for the enthusiast. It boosts acceleration a bit, drops engine rpm and noise level at



speed and increases economy. The big "5" on the trunk lid marks models having five-speed transmission. ★ ★ ★

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 21).



Today, a man needs a good reason to walk a mile.

Start walking.



25 mg. "tar," 1.5 mg. nicotine av. per cigarette, FTC Report APR. '72.

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



I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

VICTOR B. MASON
1512 Jarvis Ave., Suite M-2-BL
CHICAGO, ILLINOIS 60626



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UPHOLSTERY DETERGER



WALL DETERGER

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Have your own money-making business and make the kind of income you probably thought impossible. You can when you clean carpeting or upholstery or walls with Von Schrader professional cleaning equipment. Every home, every building, are potential customers. And every customer represents repeat business.

Moreover, we help you every step of the way . . . just as we have helped thousands of other Von Schrader Associates build money-making businesses for almost 40 years.

There are three easy-to-operate Von Schrader Detergers. Each offers a proven way to a growing income. (1) *Von Schrader Carpet Deterger* gives deep-level cleaning to carpeting. (2) *Von Schrader Upholstery Deterger* cleans fabrics and synthetics beautifully (3) *Von Schrader Wall Deterger* cleans walls (and ceilings) five times faster than by hand.

You can start with just one Deterger. Then, as your business keeps growing, you may want to add the other two and thus offer a complete cleaning service.

There are no fees, royalties, or contracts. You own your equipment, the finest of its kind. And your investment is so small you may find it hard to believe. For complete information—without any obligation—send for the free booklet described below.

“Let me send you our free booklet that gives all the facts”

—Francis von Schrader, President

Read about the big demand for on-location cleaning, see why Von Schrader Detergers are the finest of their kind, how easy they are to operate. Learn how other men have become financially independent, how Von Schrader helps you every step of the way. Fill in the coupon and send for free booklet.

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ALL By BILL McKEOWN OUTDOORS

ELECTRONIC AIDS have come outdoors, and successful tests this year indicate they are here to stay. Yellowstone National Park, celebrating its 100th anniversary, has again been the pioneer and several other parks are trying out similar installations. As a driver approached one of Yellowstone's five entrances during the tests, he read a sign saying "Entrance Info./ Tune Radio to 650." There he heard a message about one minute long that gave the entrance fee, where to park for more information, and whether accommodations or campsites were available. Transmitters were also located at points of interest to give tips on what to see, where to walk and how to proceed safely. Surveys showed over half the visitors in the park were listening on car or portable radios to more than 30 transmitters that were broadcasting taped messages.

The pocket radio may join the pocketknife as an essential outdoor accessory.

EVERY STATE AND CANADIAN PROVINCE seems to have a different name for its tourist information bureau, and a number are now offering excellent maps and guides for outdoorsmen planning tours this lighter-traffic time of year. In Ohio the bureau is called Ohio Department of Development, at Box 1001, Columbus, and it offers a campground directory plus a guide to 80 points of interest and nine detailed auto tours.

Colorado's Travel Development Section, 602 State Capitol Annex, Denver, has free road maps, pamphlets on places of interest, and a schedule that gives dates this month for the deer and elk season, fall color festival in Estes Park, corn festival in Haxton, potato day in Carbon-dale, and even dog-sled races at Idaho Springs.

Manitoba's master angler booklet shows catches of a 46-pound lake trout last year in Clearwater Lake, a 7-pound brookie in Island Lake River and a 57-pound sturgeon in the Nelson River, among other notable catches—though all are well under the records for the province. Natural brook-trout waters in Manitoba reopen for a winter season of Oct. 1 to March 31, reports the sport-fishing guide. These and other pamphlets are available from the Dept. of Tourism, Recreation and Cultural Affairs, 401 York Ave., Winnipeg, Manitoba.

ADDITIONAL OFF-ROAD VEHICLE regulations appear to be in the works for public lands under the jurisdiction of the Public Land Management, Fish and Wildlife and Parks, and the Water and Power Resources divisions of the U.S. Department of the Interior. Federal agencies involved have been directed to issue, by February 1973, regulations prescribing operating conditions for off-road vehicle (ORV) use on the lands they manage. ORVs are already prohibited in official wilderness and primitive areas. Now they may be banned from some areas of national parks, national wildlife refuges, game ranges and other areas "possessing unique natural, wildlife, historic or recreational values" if it is determined ORVs would hurt "natural, aesthetic or scenic values." Presumably four-wheel-drive vehicles, dune buggies, trail bikes, ATVs and snowmobiles will be affected.

OUTDOORSMEN LUCKY ENOUGH to still be students—and that may include a majority of backpackers—have a good source of cut-cost travel information in the books and pamphlets of the Council on International Educational Exchange. Its offices at 777 United Nations Plaza, New York City, and at 607 South Park View, Los Angeles, provide free or inexpensive booklets on how to fly from Singapore to Amsterdam for one-third fare or find places to overnight in the States for a dollar. Older travelers without student identity cards



NEW 17-FOOT SIDEWINDER XL sports fast lines plus a cockpit up front in place of the foredeck. Sidewinder Marine, Anderson, Calif., makes the craft in trihull (shown) or deep-V models for out-board or I/O power, with water-jet drive as option



ALL-TERRAIN SPEEDSTER, this Attex with modified 460-cc, three-cylinder JLO engine is said to top 60 mph as one of fastest ATVs. It's raced here by Deke Scott, last year's factory racing champion

can still belong to American Youth Hostels, 20 West 17th St., New York City 10011, and take part in their bike, camping and hiking tours, can fly at bargain rates on Icelandic Airlines, or can shave expenses by traveling with a sportsman's club or other group.

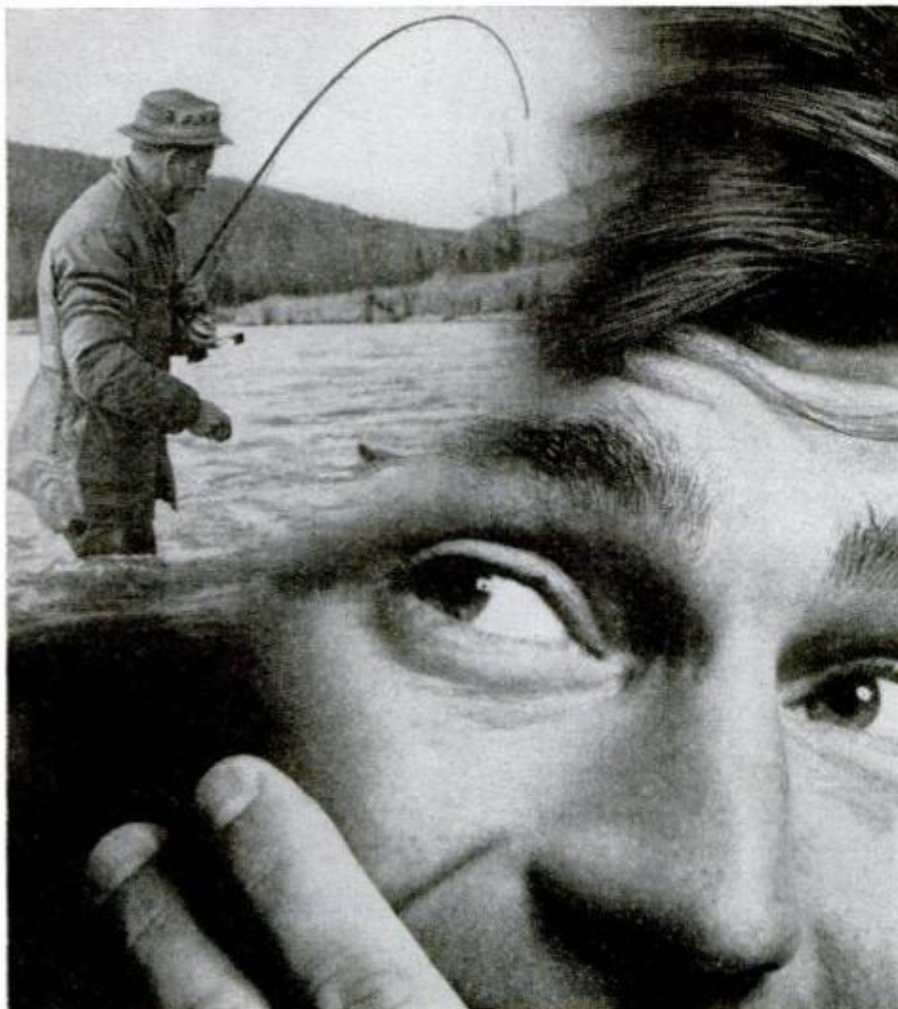
WITH COOLER WEATHER on the way, a camper may want to find gear that is not too hot for hiking during warm spells of a hunting season yet can keep out the chill of a snow dusting



CHOPPED VANS designed for pulling new fifth-wheel trailers are being produced by Tri-Van Co., Anaheim, Calif. Chopped Chevrolet Beauville and Dodge Royal vans are five-passenger, airconditioned vehicles with power brakes and 4.10-1 rear-axle ratio

overnight. One sleeping-bag answer is the multi-layer type that can be used as a light cover—you sleep under the top layer much of the year—then unzip to slide under more covers as the temperature drops. The Stag Four Seasons, sold by suppliers stocking Hirsch-Weis gear, is one of these bags. Under it, of course should be some form of insulating pad. Vibram, of 2 East Main St., East Brookfield, Mass., famous for lug soles for hiking and climbing shoes, now sells an as-

(Please turn to page 62)



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If you love the feeling you get when you're out there . . . the clean air, the fresh smell, the exhilaration . . . and you would like to have that feeling every day, reach for Timberline after shave or cologne. Timberline's rugged, refreshing scent will make you feel like you're in the great outdoors . . . indoors. Timberline after shave, cologne, soap, deodorants and gift sets from \$2.50. Also in plastic for travel.



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NAME _____

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ALL OUTDOORS

(Continued from page 61)

sortment of camping gear by mail order, and is one of a number of sources for foam pads to keep out ground cold.

And for heat from the outside, Igloo in Houston, Tex., now markets stoves, lanterns and catalytic heaters. So does Trailblazer by Winchester, along with a complete line of camping gear. Primus-Sievert, 354 Sackett Point Rd., North Haven, Conn., has introduced, along with a Campecue "charcoal" LP grill that doesn't even need real charcoal, a miniheater, lantern and stove that use the small LP cans and will fit in a backpack. Primus dealers should have them in stock by now. For defrosting the inner man in a daybreak duck blind or an afternoon stadium, Thermos has a padded insulated shoulder-strap sportsman's bag with stainless vacuum Thermos bottle that won't break and a plastic box for sandwiches. No need to freeze this fall. ★ ★ ★



EVEN ON A CALM DAY, 15-foot racing cat, Dingo, moves briskly with its co-designer, Richard L. Gibbs, in control. Gibbs' firm, Gibbs Boat Co., LaSalle, Mich., a leading producer of racing catamarans and sails, was recently acquired by MFG Boat Co., Union City, Pa.; the new division is called Sail MFG, and Gibbs is general manager. Other boats brought into the MFG line by the acquisition—and all designed by Gibbs and J.R. Macalpine-Downie of London—are 18-foot Phoenix and 20-foot Shark catamarans and the 22-foot, four-berth Cobra, a fin-keeled cabin cruiser and racer

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The principle is the same. The potential is different.



Start with an inquiring mind. Add a passion for making things work. Then combine these qualities with a love of machines and a craftsman's hands, and you've got a natural born mechanic.

When the Air Force gets hold of a guy like that, they'll spend thousands of dollars to train him to be a master at his skill. And from automotive repair to computer maintenance, the skills the Air Force teaches can be as valuable out of the service as in it.

What are you interested in? Whether you know for sure or not, you've got to be interested in what an Air Force job can mean to your future. And right now, as a special incentive, your local Air Force recruiter has a selection of jobs that he can guarantee you *before* you enlist. You just make your choice, and the skill of your life is locked in our future.

One more good reason to go Air Force is the recent pay raise that almost doubles your starting salary as an airman.

For more information, mail in the coupon. Or, call

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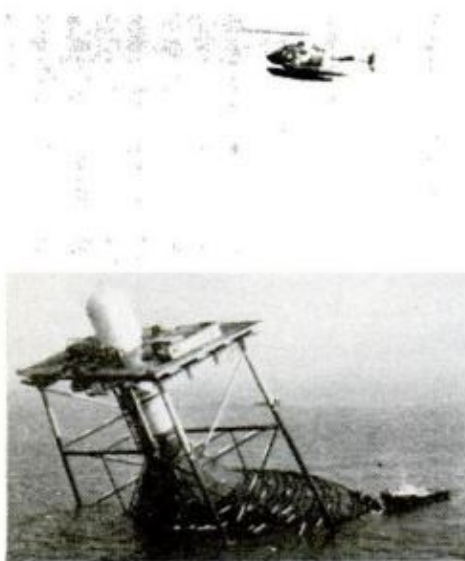
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City _____ State _____ Zip _____

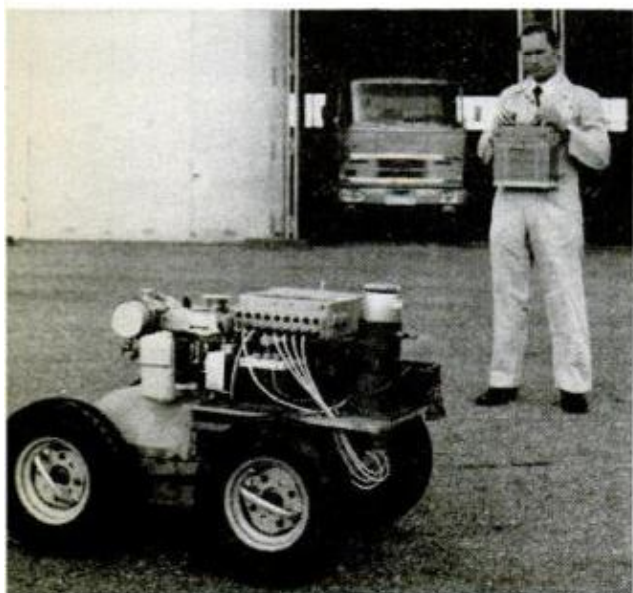
Phone _____ Date of Birth _____

I understand there is no obligation.

Find yourself in the Air Force.



Tank settles to bottom of Gulf



Cart seeks out the hot spots



Mini-loaves: good enough to eat

LOOKING MUCH LIKE A HUGE INVERTED FUNNEL, an underwater oil-storage tank recently was towed 58 miles into the Persian Gulf and sunk. Made of steel and concrete, the tank is 20 stories high and has a capacity of 500,000 barrels. Crude oil is pumped into it from nearby underwater wells. As the oil flows in at the top, water is forced out at the bottom. Ultimately, the oil is transferred to tankers, which take it to refineries. The system eliminates the need for costly port facilities and miles of underwater pipeline. Operator of the facility is Dubai Petroleum, a subsidiary of the Continental Oil Co.

THE DENTAL DRILL MAY TAKE A BACK SEAT if a chemical called GK-101 proves out in a series of clinical tests. Developed by researchers at Tufts University dental school, Boston, the chemical reportedly dissolves tooth decay without causing pain or damaging healthy enamel. In tests, GK-101 removed large areas of decay in under seven minutes. The researchers describe GK-101 as a "colorless, practically odorless, practically tasteless" liquid, and theorize that it works by attacking dead protein molecules. They warn that even if the experimental treatment proves 100 percent effective, some drilling will still be required—to gain access to some areas of decay and to prepare a cavity for filling.

A 70-MAN NUCLEAR EMERGENCY BRIGADE—equipped with advanced monitoring gear and remote-controlled manipulators, drills, saws and welding apparatus—has been organized in West Germany. The mobile force is on 24-hour call in the event of an atomic accident inside or outside the Federal Republic. A key piece of equipment is a gasoline-powered, radio-controlled cart that can reconnoiter an area, take Geiger-counter readings and transmit them to the operator. In addition, the cart automatically tags a radioactive spot by dropping a small marker.

A "CAST IRON" DIGESTIVE SYSTEM would seem to be a requirement if you have ambitions of becoming an air traffic controller. Nearly one-third of the present group of controllers suffer from stress-related peptic ulcers, according to a recent survey. No other occupation scores as high on the ulcer scale.

LILLIPUTIAN LOAVES OF BREAD regularly come out of the ovens at a Kansas State University lab in Manhattan, Kans. Each loaf, measuring about two inches long and one inch high, has a special mix of ingredients. The loaves are made small to conserve the lab's

(Please turn to page 66)

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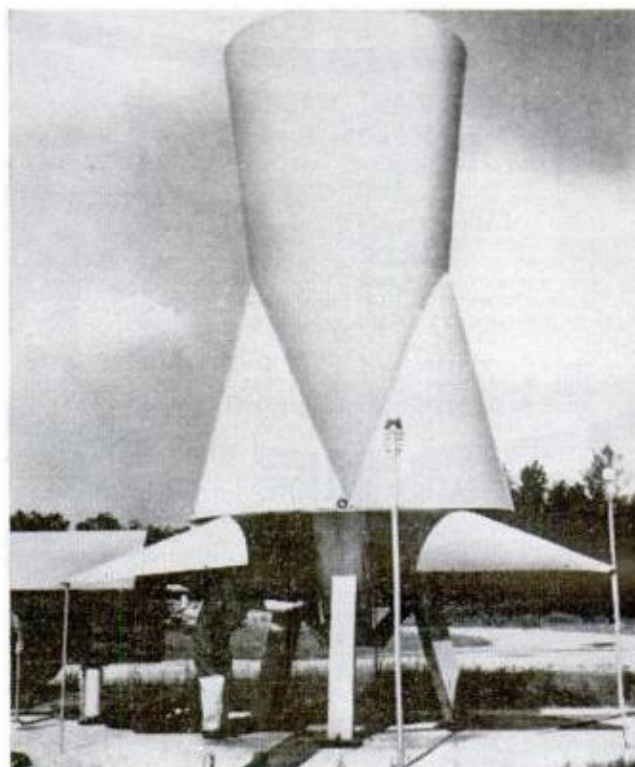
SCIENCE WORLDWIDE

(Continued from page 64)

supply of proteins used in the test program. The object: to upgrade the quality of commercial flour and, ultimately, the quality of wheat grown by farmers.

The environment

AN ADVANCED DISPOSAL SYSTEM for liquid industrial wastes is helping to keep Waukesha, Wis., clean. Key unit in system is a retort (resembling a truncated rocket) that can be fired to temperatures of 3000° F. Wastes are pumped from a holding tank, atomized by a stream of air and injected into the base of the retort. Ignition takes

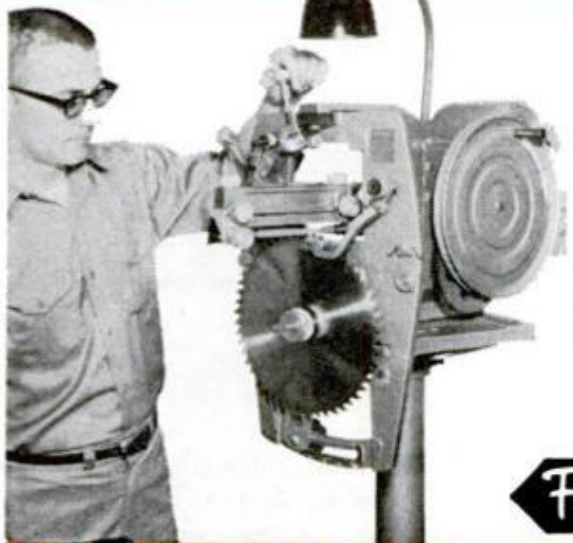


place almost immediately because of the high temperatures. Pressurized air is introduced through a system of ducts to insure efficient decomposition. Operating 24 hours a day, the system can cleanly consume oils, coolants, plating wastes, paints and other liquid wastes. A scrubbing unit isolates solid particles.

HOW TO IMPROVE THE ENVIRONMENT with plants is the subject of the 1972 Yearbook of Agriculture, *Landscape for Living*. The 416-page volume is a combination biology text and do-it-yourself manual for home gardeners. Copies are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price: \$3.50. ★ ★ ★

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APPLIANCE CLINIC

By PAUL MANN

Grounding a washer

We purchased a Maytag washing machine from a neighbor who moved. It has a three-prong plug, but our house has two-prong receptacles. I bought an adapter at a hardware store to use the plug in a two-prong receptacle. Is this okay to do?—Arthur Harkness, Kingston, N.Y.

Yes, but you must ground the washer in some way to eliminate the danger of severe shock. Didn't your neighbor provide you with a clamp and ground wire? They usually come with the machines when purchased and are for use whenever the three-prong ground connection can't be made.

Buy a ground wire and small grounding clamp at a hardware store. Attach the clamp to a cold-water pipe at a point from which the pipe runs directly to the outside, not through a water meter or another appliance. Connect one end of the wire to the clamp and the other end to the metal frame or housing of the appliance. Usually, you'll find a sheet-metal screw on the rear or bottom of the machine that will serve to make this connection. If not, drill a hole in an inconspicuous part of the frame and turn a sheet-metal screw into it for the hookup.

Litany on lint

Much to my delight I found out why the cylinder of my gas clothes dryer hardly turned, although the appliance operated. I've just extracted enough lint from around the cylinder to make a molehill, if not a mountain. If every machine is like mine—it's a Hamilton—there is a small trap door in the cylinder that can be removed to get at lint. I used a wire clothes hanger bent into various shapes to pull the lint to the trap. Do you think this is important enough to pass on to your readers?—Ken Meyner, Denver.

I sure do. I also think it is important to know that lint builds up in the vent pipe. If the pipe becomes sufficiently clogged, the machine may run too hot. Unfortu-

nately, many owners of dryers believe that frequent cleaning of the lint trap, which is important, is sufficient to keep the machine in good operating condition. However, the other two areas also should be cleaned periodically.

Call for Robert

Would you please tell me where to obtain repair instructions for a Robertshaw oven control and the parts?—M.J. Pennington, Morrison, Tenn.

Try Robertshaw. The address is the Robertshaw Controls Co., New Stanton Div., Youngwood, Pa. 15687; the telephone number, (412) 925-7211.

Where did the wire go?

For years, asbestos insulated wire for steam irons was sold all over the place, including such stores as Sears, Roebuck and Wards. Now I need some and no one seems to sell it. How come? Has it been replaced by something new?—William Harrison, Littleton, Vt.

Stores in my area, including hardware stores, still sell this type of wire. Perhaps the stores in your area don't because they found little call for it. However, I think that if you tried a small appliances service center or an electrical supply outlet you will be able to get what you need. If the store doesn't carry the wire, the dealer should be able to order some for you.

Cleaning out water heaters

I recently discussed why gas-fired water heaters rumble when a faucet in the home is turned on, pinning the cause on sediment which has settled at the bottom of the tank. Afterward I contacted M. G. Balogh, service manager of Mor-Flo Industries in Cleveland which is a leading manufacturer of water heaters.

The rumble, although usually harmless, can be annoying, and I wanted to know if there was a way to get rid of it. Balogh told me that it isn't easy to clean sludge from a tank, but it can be done by employing this procedure:

1. Shut off the water and drain tank.
2. Remove the drain cock.
3. Attach a piece of 1/4-inch copper tubing to a hose and insert the tubing into the tank through the drain cock opening. The tubing should be bent so it can be moved in all directions around the bottom

(Please turn to page 70)



Can a hunter learn anything from a skeet shooter?

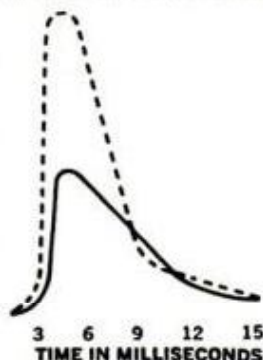
Yes", say Remington experts . . . including why our Model 1100 Automatic Shotgun—the top gun in skeet—is tops in the field!

It's said some hunters don't shoot skeet because they can't eat clay pigeons. But, if you don't count taste and plumage, there is virtually no difference between a clay bird and a game bird. As far as a wing shooter is concerned, both are moving targets with the same problems of pointing, swing and lead.

If you go hunting with a skeet shooter, don't bet against him. Because skeet actually came from the field. It was developed about 50 years ago by the late Charles E. Davies, at Andover, Mass. He was an avid upland game hunter and wanted to practice shots he had missed while hunting. And don't forget that a dedicated skeet shooter may shoot at *thousands* of clay birds a year, each one simulating a game bird in flight. So it would take a really ticky bird to fool him. Naturally, like the hunter, the skeet shooter wants a shotgun that points naturally, patterns consistently and is reliable. That's why you'll find so many Model 1100's in the hands of so many skeet shooters, especially at championship events.

When you hold an 1100, you can tell it's different. The 1100 is designed with "muzzle preponderance" . . . balanced so there's weight at the muzzle. We believe this helps you hold an 1100 steadier than a shotgun without it. And we think it helps you point easier and faster and swing more smoothly, too.

Remington designers have given the 1100 a rate of fire they feel is optimum. Pull the trigger, and the 1100 ejects the empty hull and chambers a fresh shell automatically. You can fire again as soon as this cycle is complete. But, if the cycle takes too long, you may lose the chance for a quick second shot. And if the cycle is too fast, you're apt to shoot too soon . . . and miss. Remington's designers believe that the 1100's rate of fire is an ideal compromise between those two extremes.



The dotted line shows the recoil force from a typical fixed breech shotgun action (Shotgun weight: 7 lbs. 2 oz.). The solid line shows the recoil force delivered by a Model 1100 (Weight: 7 lbs. 12 oz.). Checked and proved by computer, the Model 1100 delivered 55% less force than the fixed breech gun. Each gun tested with a 12 ga. magnum load.

The 1100 really reduces recoil sensation. Remington has found a way to "soften" recoil sensation by distribut-

ing it. The chart shows how the Remington Recoil Reduction System works by plotting shoulder force against time. The dotted line shows what happens when a 12 gauge magnum load is fired in a fixed breech shotgun of approximately the same weight as the model 1100. The recoil quickly rises to a high peak. The solid line shows the recoil when the same load is fired in an 1100. The line starts to rise but the system traps some of the recoil force, releasing it later. Thus you feel a "push" instead of the usual jolt you can get from a competitive gun.

If you like good-looking shotguns, you'll like the looks of an 1100. Those looks are functional, too. Our RK-W wood finish does more than dress up the stock. It's tough and scratch-resistant. Our "vibra-honing" metal finish not only permits a deeper, richer bluing . . . but it also makes the working parts smoother so there's more glide and less friction.

The Model 1100 comes in 12, 16, 20, 28 and 410 gauges. And there are optional interchangeable barrels within each gauge. In addition to the standard models, there are three-inch magnum 12 gauge, two lightweight 20 gauge models (one a magnum), deer models with rifle sights, and trap and skeet versions. Prices start at \$184.95*.

Use the shells we test the 1100 with. The champions do. Here's something else you can learn from skeet shooters: use Remington-Peters shells. Consistently, winners at the world skeet championships have depended on the top performance built into every Remington-Peters shotgun shell. Skeet shooters know their ammo as well as their shotguns.



The Model 1100 is available in these 5 gauges.

Remington Reports are based on information direct from the men who design and engineer our products. If you'd like a free 1972 color catalog, send a postcard to: Remington Arms Company, Inc., Dept. 637, Bridgeport, Conn. 06602.

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Vent. Rib

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Remington **DUPONT**

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APPLIANCE CLINIC

(Continued from page 68)

of the tank. Place pails so that water which will flow from the hose won't flood you out.

4. Turn on the water to flush out the bottom of the tank. Move the copper tube around the bottom of the tank to get out as much sediment as possible.

5. Turn off the water, remove the copper tubing and insert a narrow piece of flat steel. This, too, should be bent so you can move it all around the bottom of the tank. This device is used to scrape the bottom, which will loosen up stubborn stuff.

6. Repeat the flushing operation.

7. Replace the drain cock. Turn on the water, but leave the drain cock open, allowing water to run out until it's clear.

Ridiculous refrigerator

A small refrigerator we keep in our downstairs family room runs too cold, causing food and drink to freeze. We have tried every temperature control setting. What can we do now?—Eric Freedheim, Cleveland.

This is a problem we've discussed before, but it keeps cropping up so let's look at it again. This control is operated by a temperature-sensitive substance in the bellows, tube and bulb. As the temperature changes on the surface of the evaporator, to which the bulb is clamped, the bellows expands or contracts. This activates the switch. You can alter the temperature by moving the control knob, which lessens or increases the spring tension on the bellows.

Let's assume that the temperature control is in good shape. If it isn't, you have to replace the whole thing. A major cause for this kind of trouble is a bulb that is loosely fastened to the evaporator or is detached from it altogether. This would mean that the temperature control would be responding to the temperature of the air in the box rather than to the surface temperature of the evaporator, which are vastly different. The bulb must be clamped firmly to the evaporator. ★★

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

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The trail bike that thinks it's a half-track



EQUALLY AGILE streaking through brush (above) or taking off on a jump (left), this track-powered bike is a rugged, versatile performer. Note luggage rack at rear—handy for toting camp gear on woodland trips

By **SHELDON M. GALLAGER**

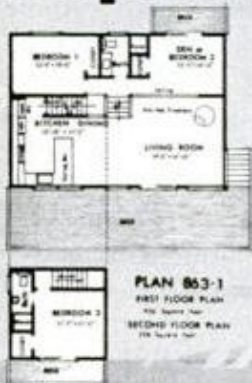
Photos by Robert D. Borst

PEOPLE COME UP TO YOU, rub their eyes, shake their heads and wonder if what they're seeing is actually for real. It's real, all right—one of the most exciting and unusual trail bikes we've had the pleasure to try. What makes it strange is that it has no rear wheel. In its place is a track—an honest-to-goodness crawler tread, complete with sprockets and bogey wheels, that gives the machine the look of a miniature military half-track.

The Trakcycle, as it's called, represents just about the ultimate in all-season, go-anywhere ruggedness and versatility. Its rubber-ribbed, cord-reinforced track belt is nearly

From the design staff that created the Vacation Homes appearing in the May issue of Popular Mechanics

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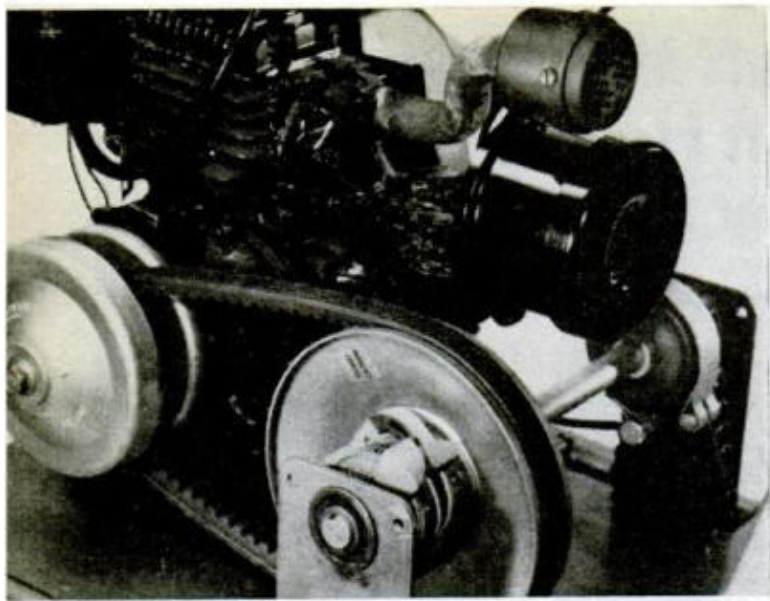
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VARIABLE-RATIO DRIVE consists of belt from centrifugal clutch on engine to split-sheave pulley on jackshaft in foreground. At far right is friction-type brake drum on other end of the jackshaft

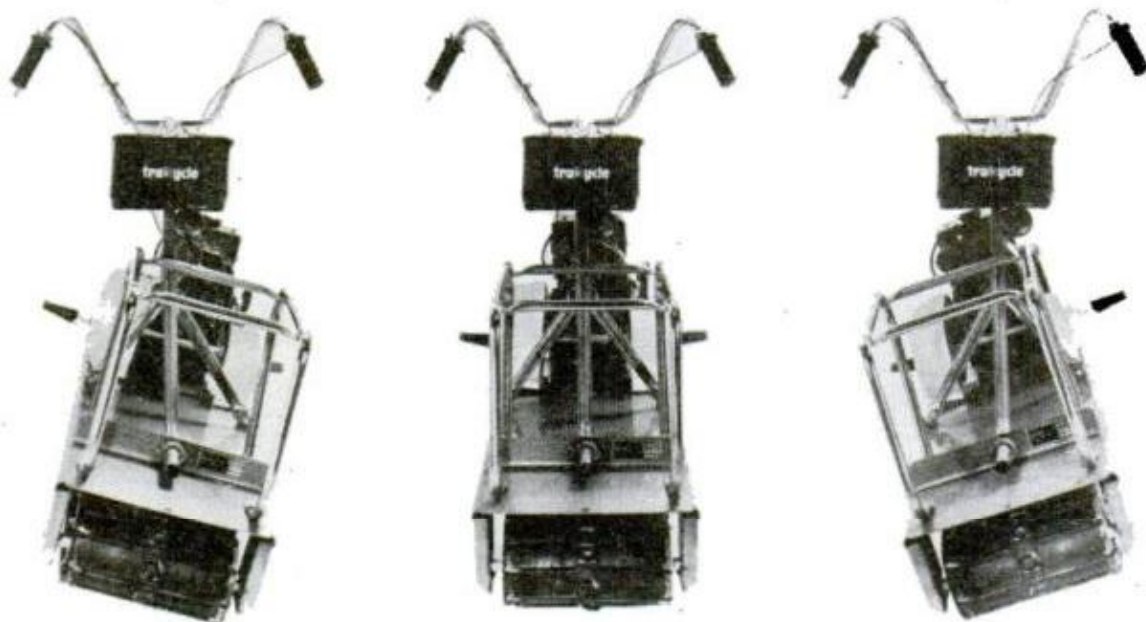
a foot wide and heavily treaded, giving the bike tremendous traction. It will scamper up grades that would leave a conventional two-wheeler huffing and puffing at the bottom. It will slog through mud and sand, roll nimbly over rocks, potholes and tree branches and generally take any kind of rough terrain in its stride. Fitted with a ski on the front wheel, it will roar through snow, kicking up a white rooster tail plume in its wake. In fact, the bike is probably at its best in snow—at least for fun and thrills. On dry land, the track gives the machine a surefooted stability that makes it virtually impossible to skid.

Braking is superb, again because of the track's ground-hugging ability to grab and dig in.

But safe handling isn't the Trakcycle's only virtue. If you like your trail riding wild and racy, the machine will rear up on its hind end and hurdle jumps with surprising gusto, something I at first didn't think possible. I bet it wouldn't get off the ground and it did—somewhat farther than I had anticipated. One added advantage of the heavier rear end is that there's less tendency to nose over in a jump—a comforting feature as you watch the ground drop away below you.

How do you maneuver a tracked vehicle? Your quick impression is that the design simply won't work. How do you steer if you can't lean into a turn? How do you ride along the side of a slope without tipping over? The answer lies in a slick bit of engineering geometry. The entire track, engine and drive assembly is pivoted independently of the seat and front-wheel fork. Thus the track remains flat, but you can lean your body as you bank into a turn. On grades, the track tilts to follow the angle of the slope, but you stay upright. This is what makes it possible for the track to remain in firm contact with the ground at all times for maximum traction regardless of the terrain. Spring-loaded stabilizer struts prevent excessive or accidental tipping for safety.

Your first ride on the Trakcycle is an eerie, uncanny experience, but you get used to it quickly and learn to like it—



SWIVEL-HIPPED ACTION of pivoted track is shown in three views above. While seat and handlebars re-

main upright, the track tilts to follow grade angle, is always in contact with ground for good traction

Inside 35.

Four reasons why the Nikkormat is one of the most respected names in 35mm photography.

What goes into a camera has a lot to do with the quality of what comes out. Case in point: the Nikkormat FTN 35mm single lens reflex. Here are four interior design features that you might never know about unless you cut the camera in half with a laser beam (which is just what we did, above). They're four of the very best reasons why Nikkormat can consistently turn out more great photographs in more situations.

The focal plane shutter

A focal plane shutter utilizes a slit of varying size in a curtain, which moves across the film plane to effect the exposure. Curtains are usually cloth or foil or both. But not in a Nikkormat. It's metal, and it moves up and down. The advantage of metal is obvious: durability. Now think a little about the up and down part. Distance up and down is *shorter* than side to side: 24mm vs. 36mm. So less time is required for shutter to complete its trip. Which is crucial to accuracy and especially electronic flash synchronization. Most focal plane shutters can't synch above 1/60th. The Nikkormat goes to 1/125th.

All meters are not created equal

Just about every built-in exposure meter on the market reads through the lens. But just about everyone does it differently. "Averaging" meters read the whole scene (fine, but easily fooled by contrasty scenes, back-lighting), "Spot" meters read a little piece of it (reverse situation; difficult to use with normal scenes). And some cameras even have both (known as working at making life hard!). Nikon engi-

neers discovered that if you read the whole scene but concentrate the meter's sensitivity in the center (60% of the sensitivity in 12½% of the area), you get correct readings in just about any situation. Sounds too simple to be true, but it is.


Flatter film means sharper photographs

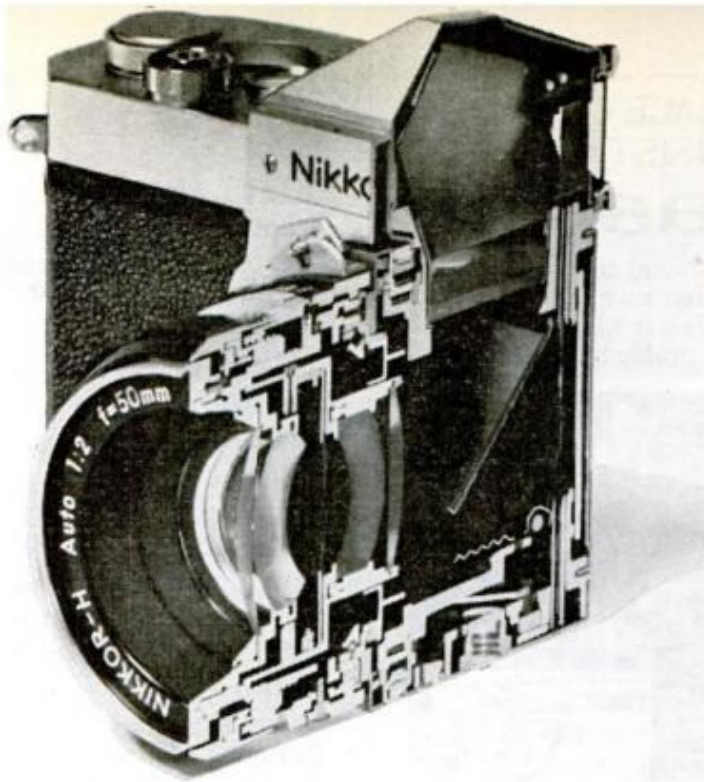
The first time you load film into a Nikkormat you may be a little surprised by the way the film winds. It's a reverse wind. If you're used to an ordinary 35mm camera, it'll seem backwards. But film naturally curls in on the emulsion side. It's a persistent enough curl that a pressure plate just isn't enough to keep it flat. In a Nikkormat, the film is pulled around a sprocketed roller, under tension, (getting more teeth in the sprocket holes in the process) effecting the finishing, flattening touch that can make the difference between almost-sharp and razor-sharp.

The lens mount can make or break the lens

The finest lens can operate in second-rate fashion if its lens mount doesn't hold it firmly and precisely in the plane in which it belongs. The time-honored way to do it is with an ordinary screw-mount. The problem is that interchanging lenses can take an eternity when you're in a hurry. Then there is the breech-lock system,

with the locking ring. It's faster... but turn the wrong ring...and suddenly you're lensless. The Nikkormat uses a bayonet lens mount that lets you change lenses with a 1/6 turn twist of the wrist. And when it's locked, *it's locked*. And very precisely too. Fact is, Nikkormat is one of the very few cameras that can accept a wide aperture f/1.2 lens which requires extremely precise mounting to assure accurate focus.

Not surprisingly, all this sophisticated engineering adds up to a camera which is amazingly simple to use. Most people merely center the needle in the viewfinder of the Nikkormat to take consistently outstanding photographs. See it at your dealer, or write: Dept. PM, Nikon Inc., Garden City, N.Y. 11530. Subsidiary of Ehrenreich Photo-Optical Industries, Inc.  (In Canada: Anglo-photo Ltd., P.Q.)



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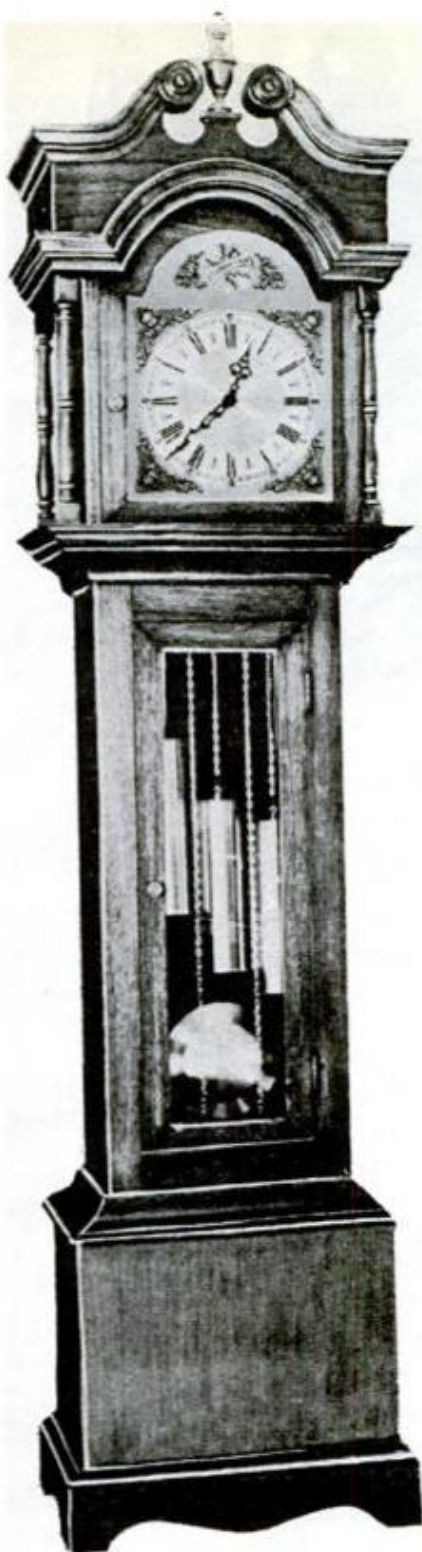
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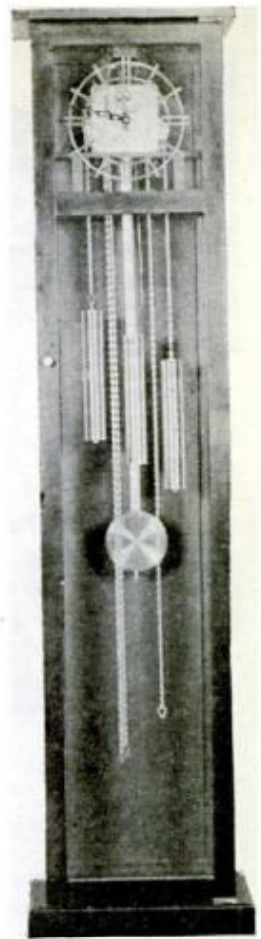
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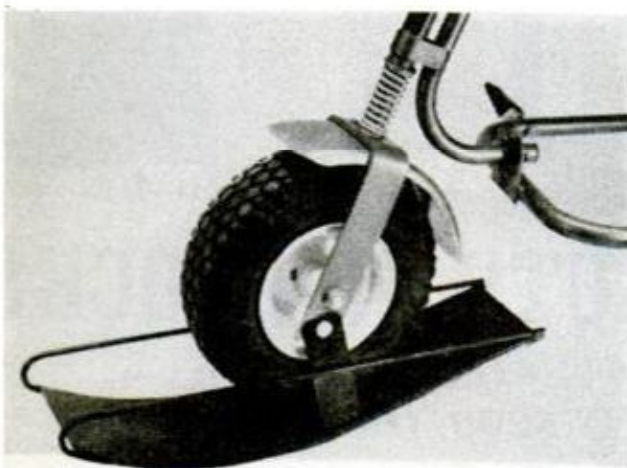
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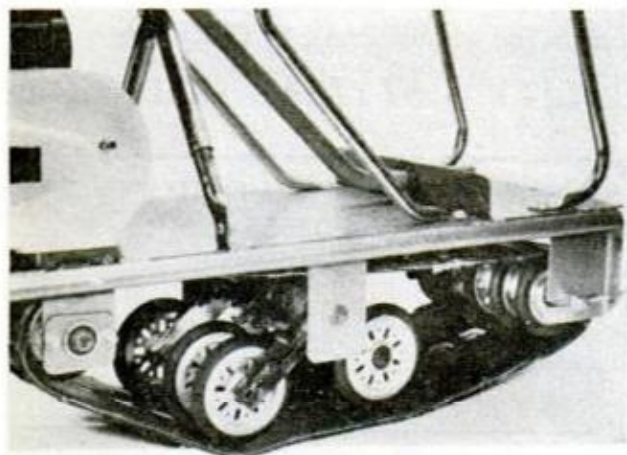
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ACCESSORY SNOW SKI snaps over studs on front-wheel fork, can be slipped on or off in seconds. Bike's performance in snow is excellent because the wide rear track digs in for power, provides fast, safe, nonskid braking. Pivot bearing on which the wheel fork tilts can be seen just behind the fender

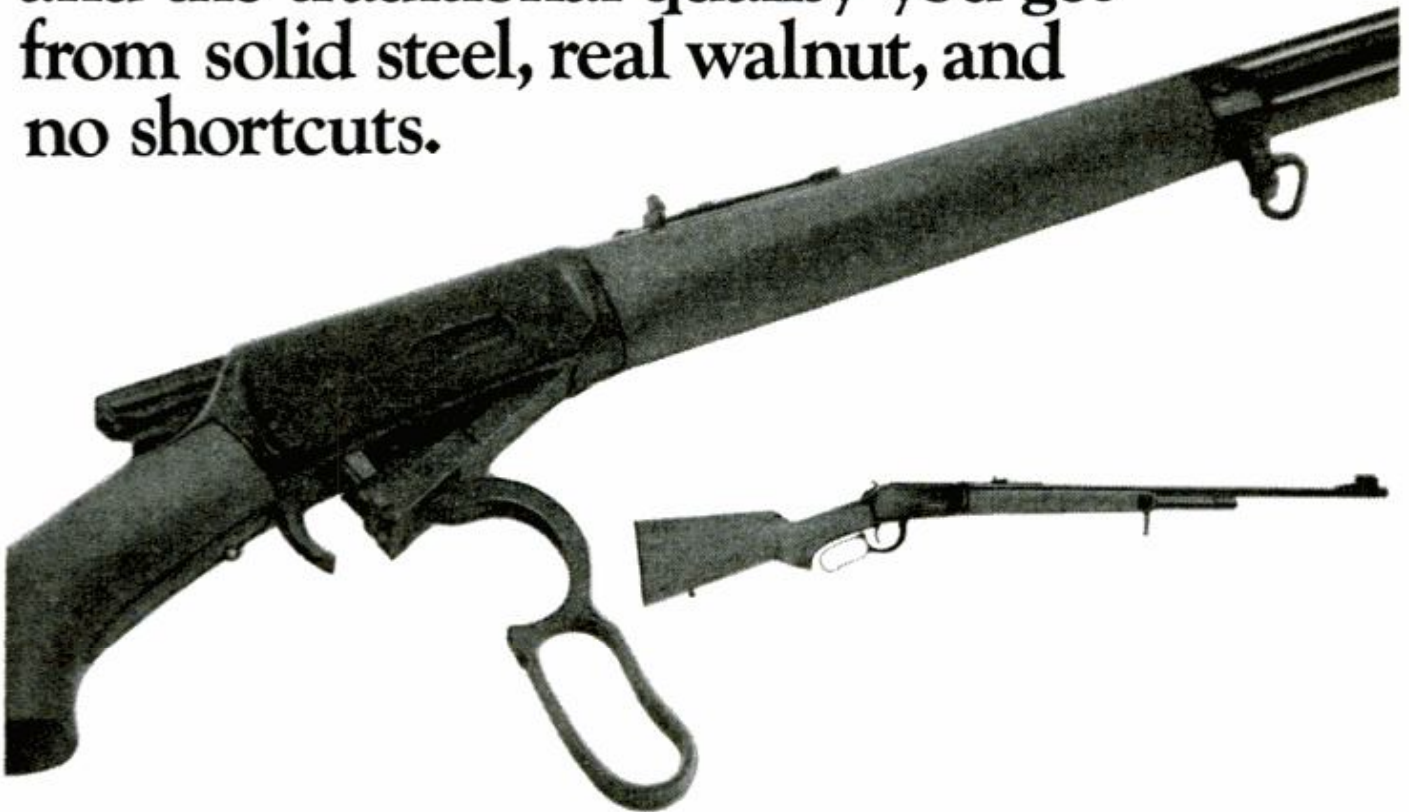


SPRING-LOADED BOGEY WHEELS support center of track, bobbing up and down to give smooth ride, even on bumpy ground. Bike weighs 145 pounds, has overall length of 67 inches, track width of 10½ inches

you can do things that would be suicidal on a conventional two-wheeler and the machine is marvelously forgiving. It's tough, sturdy, takes abuse well and handles with ease. Except for the track, its construction pretty much follows standard trail-bike design. The front-wheel fork is sprung to absorb shocks, and the handlebars sport a motorcycle-type twist-grip throttle on one end and a hand-brake lever on the other. An engine kill switch is also on the handlebars. Retractable foot-rests fold out of the way when not in use.

Power is from a four-hp, four-cycle Tecumseh engine with a centrifugal clutch and variable-ratio V-belt drive to a jackshaft. From the jackshaft, a chain turns a toothed roller on which the track belt rides. The engine has a three-amp. alternator, which also powers a headlight for night use. The variable-ratio drive is self-adjusting—as speed decreases on steep hill climbs, it automatically “downshifts” to increase torque. As a one-of-a-kind design, the Trakcycle is definitely a specialized vehicle and does have some limitations. It's strictly for off-the-road use. Its track offers no particular advantages on smooth, level ground, and its top speed of 25 mph, while plenty fast on woodland trails, may be considered a trifle tame by sport-bike standards. But if you're looking for a rough, tough trail rider, especially for use in snow, the Trakcycle has a lot going for it. Priced at \$374.50, it's made by B. G. W. Industries, Inc., Box 1683, Mansfield, Ohio 44907. ★ ★ ★

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24" Proof Steel barrel holds five 30-30's.

Pistol grip stock: Made from solid American walnut, the dark tones of the satin finished stock are a pleasure every Winchester buff will want to see. The stock features a contoured pistol grip and a fluted comb. The butt plate is marked "Winchester Repeating Arms", because the Model 64A is part of a long tradition that men who know guns will understand.



Detachable swivels: If you're the kind of deer hunter who likes to use a carrying strap or rifle sling we make steel sling swivels standard equipment. We also made the swivels to detach in a hurry. It's a small extra, but it's the kind of professional finishing touch you expect from Winchester.



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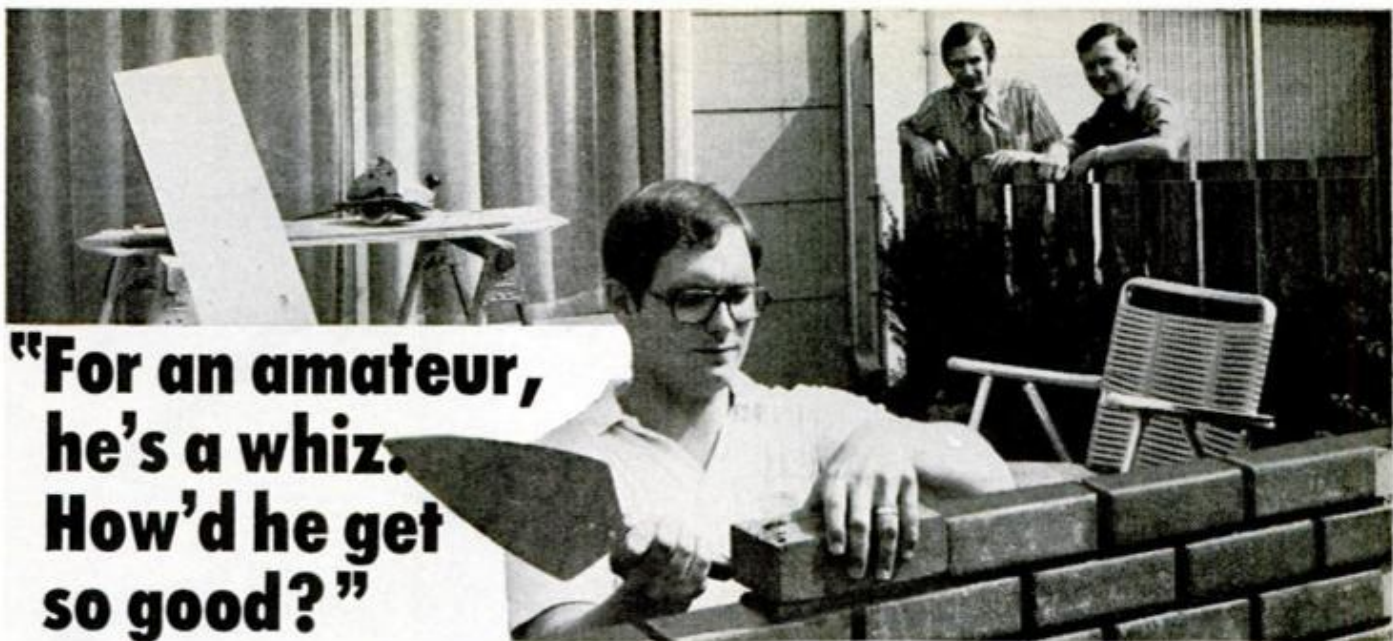
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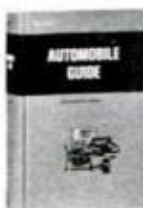
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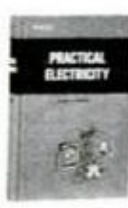
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Riding the 80-foot snorkel (top photo) of a Newcastle and Gateshead, England, fire truck, a closed-circuit television camera (center photo) enables the fire chief to monitor the blaze (bottom photo) and thus direct firefighting operations more effectively. The camera is mounted on its own hydraulic extension and can be swiveled and raised by ground-station controls. The unit also makes videotapes for later viewing.

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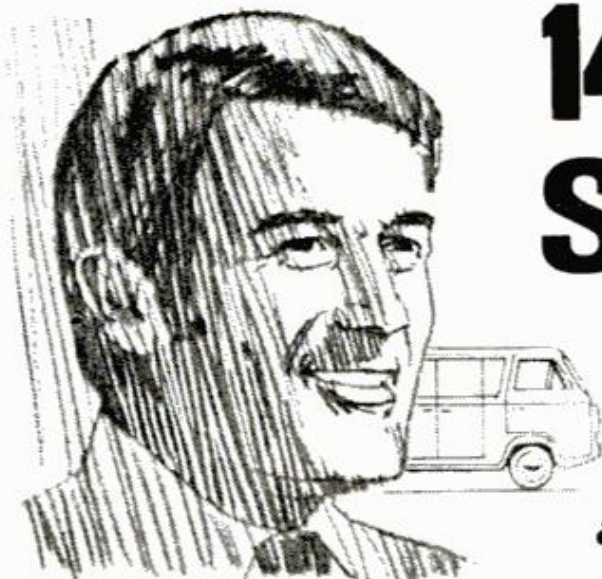
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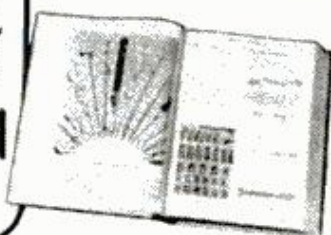
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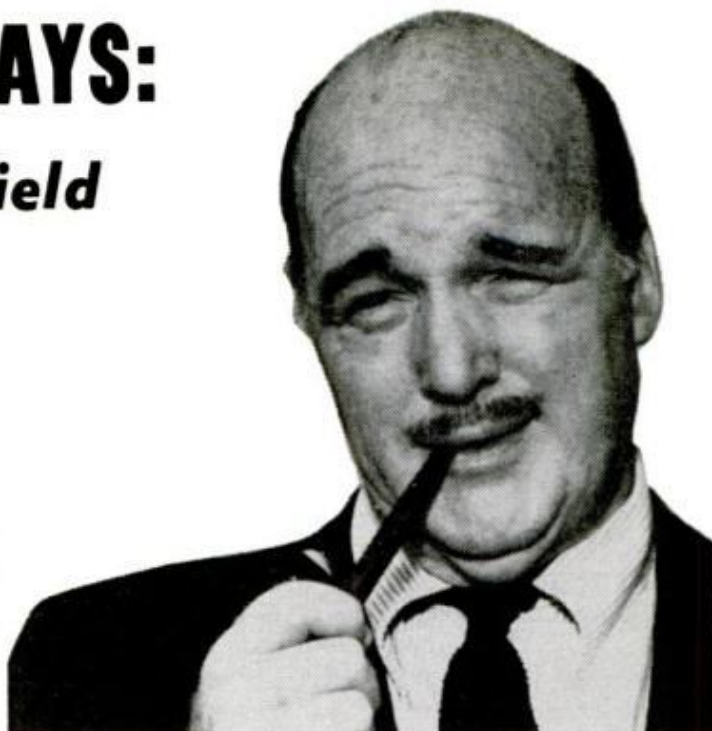
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Someone once said that if you build a better mousetrap, the world will beat a path to your door. In the home appliance business, a lot of enterprising companies have gotten rich peddling a list of handy electrical gadgets for the home longer than Wilt Chamberlain's arm. The trouble is, the dozen or more appliances in the average American home can go on the fritz, and men with the proper training to do repairs are as scarce as knee-length skirts on teen-agers.

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Tom McCahill

TOM McCAHILL

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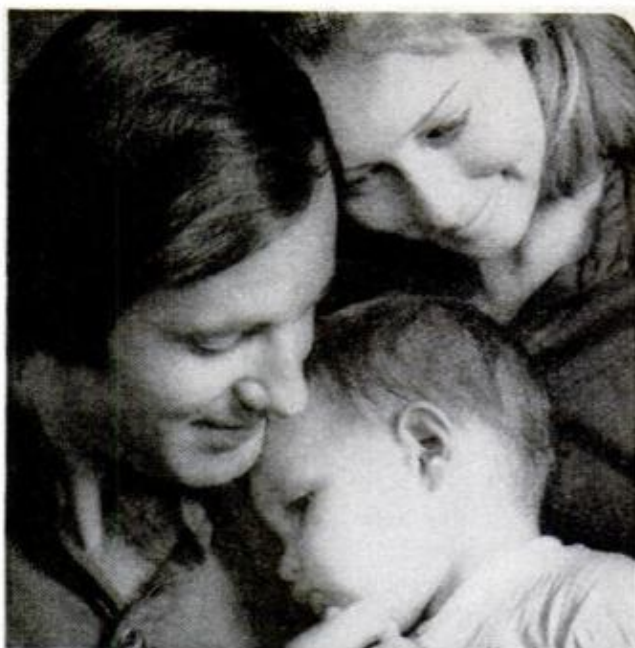
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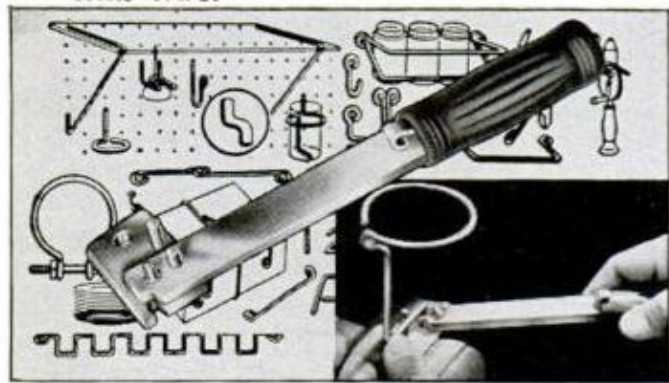
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lawn building offers plenty of storage space and has loads of eye appeal. Basically, it's a two-story structure measuring 8 ft. wide by 12 ft. 4 in. long. In addition, there's a covered walkway that runs the length of the structure, widening the second floor by 2 ft. 4 in. The first floor is designed as a storage area for everything that ordinarily accumulates in a garage. However PM's complete plans show you how to equip it as a workshop or as an office where a man can escape. We also show how to equip the second floor as a back-yard bunkhouse that sleeps two youngsters. If you have a swimming pool, you can use the space beneath the stairs as dressing rooms. And there's even space set aside for a kennel for your dog. The plans show you the exact location of every framing member. You may need an extra set of plans for your local building department. A single set of plans (B1277) is \$3.95; two sets of plans (1277A) are \$5.49 from Popular Mechanics, Dept. CH, Box 1014, Radio City, N.Y. 10019.

REVISED EDITION of the *Popular Mechanics Catalog of Plans, Publications, Projects* is a 32-page booklet crammed full of fascinating and useful projects you can build yourself. Send 25 cents in coin to Popular Mechanics, Dept. CAT, Box 1014, Radio City, N.Y. 10019.

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You know how tangy cheddar made Wisconsin famous. But maybe you didn't know how Old Crow made Bourbon famous.

The first Bourbons were virtually homemade. There were no standards of quality. Early Bourbon-makers never knew if one day's batch would taste as good as the next.

In 1835, Dr. James Crow became the first distiller to use scientific principles to make good Bourbon. His process, once and for all, took the guesswork out of distilling good Bourbon.

Soon, other distillers tried to make their Bourbons the way Dr. James Crow made his. But there was, and still is, only one Old Crow.

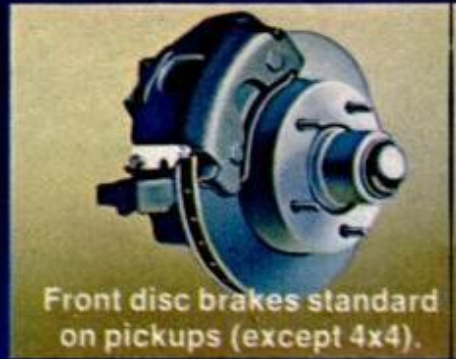
KENTUCKY STRAIGHT BOURBON WHISKEY, 86 PROOF, DISTILLED AND BOTTLED AT THE FAMOUS OLD CROW DISTILLERY CO., FRANKFORT, KY.



Full-foam seat 5 in. deep is standard in every cab.



Famous Twin-I-Beam front suspension; smooth, strong.



Front disc brakes standard on pickups (except 4x4).



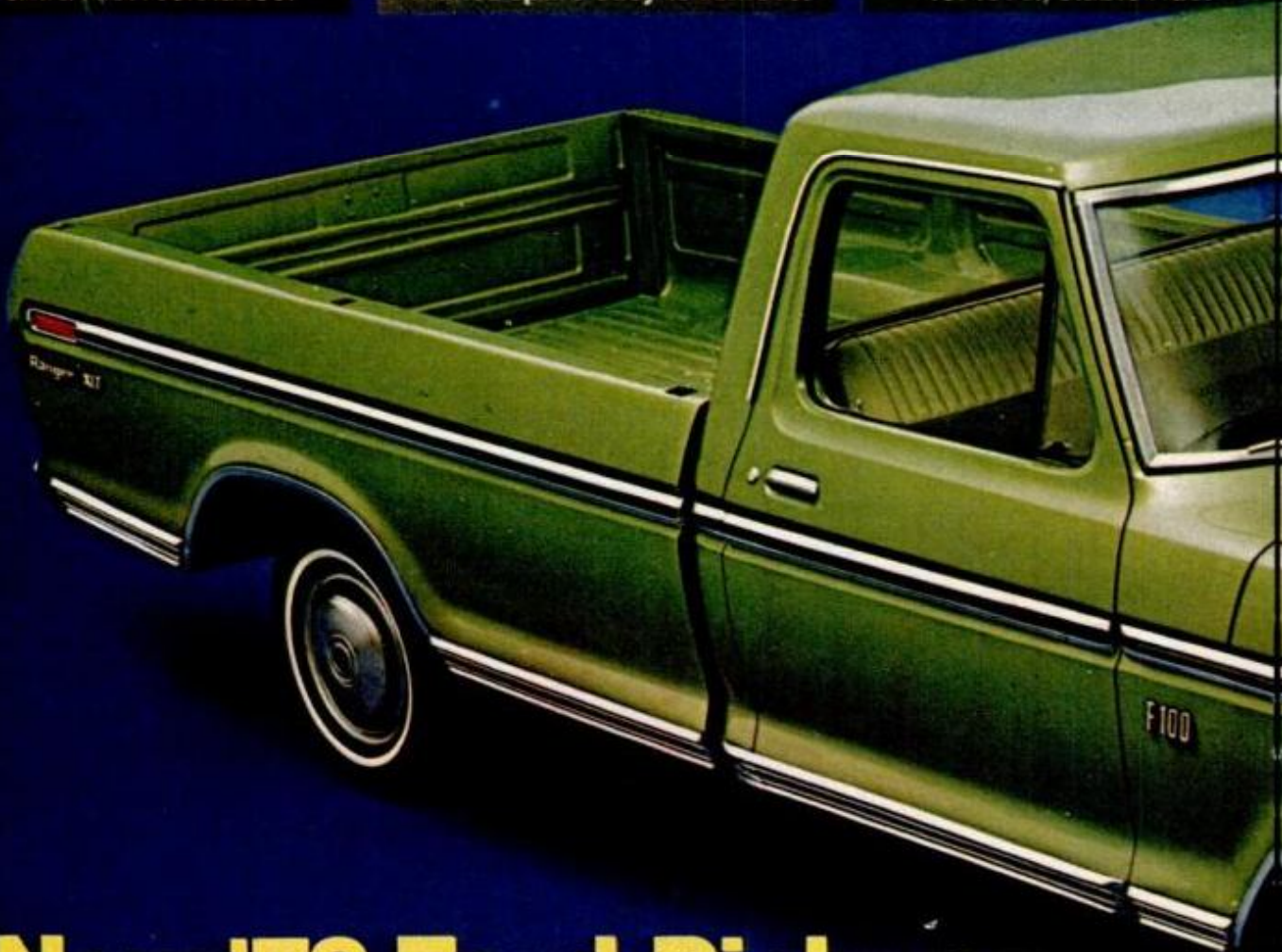
Over 100 sq. ft. galvanized for extra rust resistance.



Optional slide-out carrier makes spare easy to remove.



133 in.
Long wheelbase, wide tread for level, stable ride.



New '73 Ford Pickups

Ford leads again with a whole new generation of better ideas



Ford box cover looks and fits right, protects cargo.



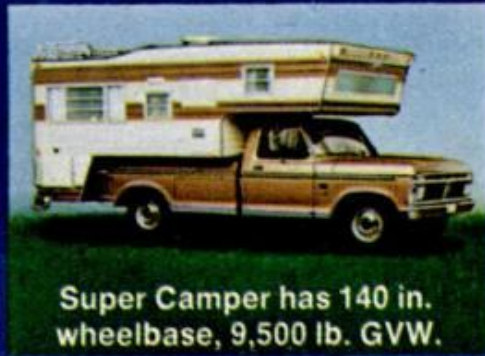
Behind seat is storage, not gas tank on most models.



Box sides are double-wall full depth with no seams.



Roomiest Ford pickup ever —unusual quiet, comfort.



Super Camper has 140 in. wheelbase, 9,500 lb. GVW.



Heater is blend-air type; optional "air" is built in.



*Works like a truck,
rides like a car!*

And the better ideas keep coming (please turn page) ▶

Here are 26 more ideas pickup owners asked for.

New Wide-Track Stability results from tread over 64 inches wide front and rear.

Ford 4-Wheel-Drive Pickups now offer optional power steering and Cruise-O-Matic for driving ease.

One-Piece Sides of the doublewall box have no joints to rust.

New Gas Tank on most '73 models is protected between the frame rails.



Avocado and Ginger are among six eye-pleasing colors for Ford cab interiors.

New Larger Payload Ratings give you as much as 4,700 lbs. load capacity.

New Front Fender Aprons are galvanized to fight rust, as are other key areas.

New Glove Box is over 50% roomier than last year's.

Power Brakes are standard on conventional models rated over 5,000 lbs. GVW.

Spare Tire Mounting in Super Camper Specials is behind side panel in the pickup box.

New Full-Foam Seat adjusts 5 inches fore and aft.



Computer Selection of front springs automatically provides right capacity.

New Recessed Handles on doors are luxury-car type.

New Low Brake Pedal (F-100) lets you pivot foot from accelerator to brake pedal.

New 39% Bigger Rear Window lets you back up with greater ease.

Sliding Rear Window

(optional) offers 29% larger opening than previous model.



New Wheelhousings are integral with body walls to eliminate rusting joints.

New Anti-Sway Bars are available front and rear (standard on all '73 Ford Camper Special models).

New "Green Glow" Lighting fully illuminates gauges and hand controls.

New Coved Corners make box easy to sweep clean.

You can tow up to 10,000 lbs. with new '73 Trailering Special options.

New Seat-Back Latch allows you to tilt the seat-back from either side for access to the storage space.

Wide 51-inch Space

between wheel-housings helps you load plywood without damage.



New Rear Leaf Springs are 56 inches long for smooth action, 2½ inches wide for added stability.

New Tailgate Latch opens with a single pull.

Over 92 out of 100 Ford trucks built in the last 12 years are still on the job... according to latest official industry registration figures compiled by R. L. Polk & Co.



Ford Ranger XLT interior

Now you've been introduced to some of Ford's better ideas for 1973. They all team up to bring you an extra measure of riding comfort...of driving ease...of utility and durability. The very things you want in your next pickup!

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Availability may be subject to Environmental Protection Agency certification.

FORD PICKUPS

FORD DIVISION



A busy shop with a living-room look

This homeowner's shop is neat enough to double as a study—and it does

By **HARRY WICKS, Workshop Editor** Photos by *Fred Ward, Black Star*

WHEN Fred Hale of Winchester, Va., walks into his workshop and flicks the switch on one of his power tools, he does it in a room situated in a wing of his home. Crisp breezes that flutter through his shop rustle handsome drapes on the windows instead of scattering sawdust all about. If he needs a particular carving tool or gouge, Hale walks over to a highly polished walnut cabinet next to his bench saw and selects it from one of 20 drawers.

Elegant? Yes. In this shop the walls are paneled with cedar planks, the unwaxed maple floor is kept scrupulously clean, and the owner works in comfort. But don't think the elegance and orderliness are signs that the shop



HANDSOME AND STURDY describe Hale's workbench. Plan details for duplicating it are on page 89

isn't used. Rather, they reflect a craftsman's attitude about everything he is associated with.

An active woodworker, Hale's great interest is the accurate reproduction of fine old furniture. From the Hepplewhite desk in his shop to the beautiful George Washington desk displayed in the living room, his attention to detail places all of his work in the professional cabinetmaker class.

He likes special challenges, too. When fluting and reeding techniques fascinated him, he searched out projects with such features that he could build. When he undertakes a new technique, he practices it by building shop cabinets incorporating these features. The shaper accessory cabinet below came into existence when he was in his "tambour door period."

"I was fascinated with this type of door," he said "and, as a result, I literally hunted for things to make where I could build and install them."

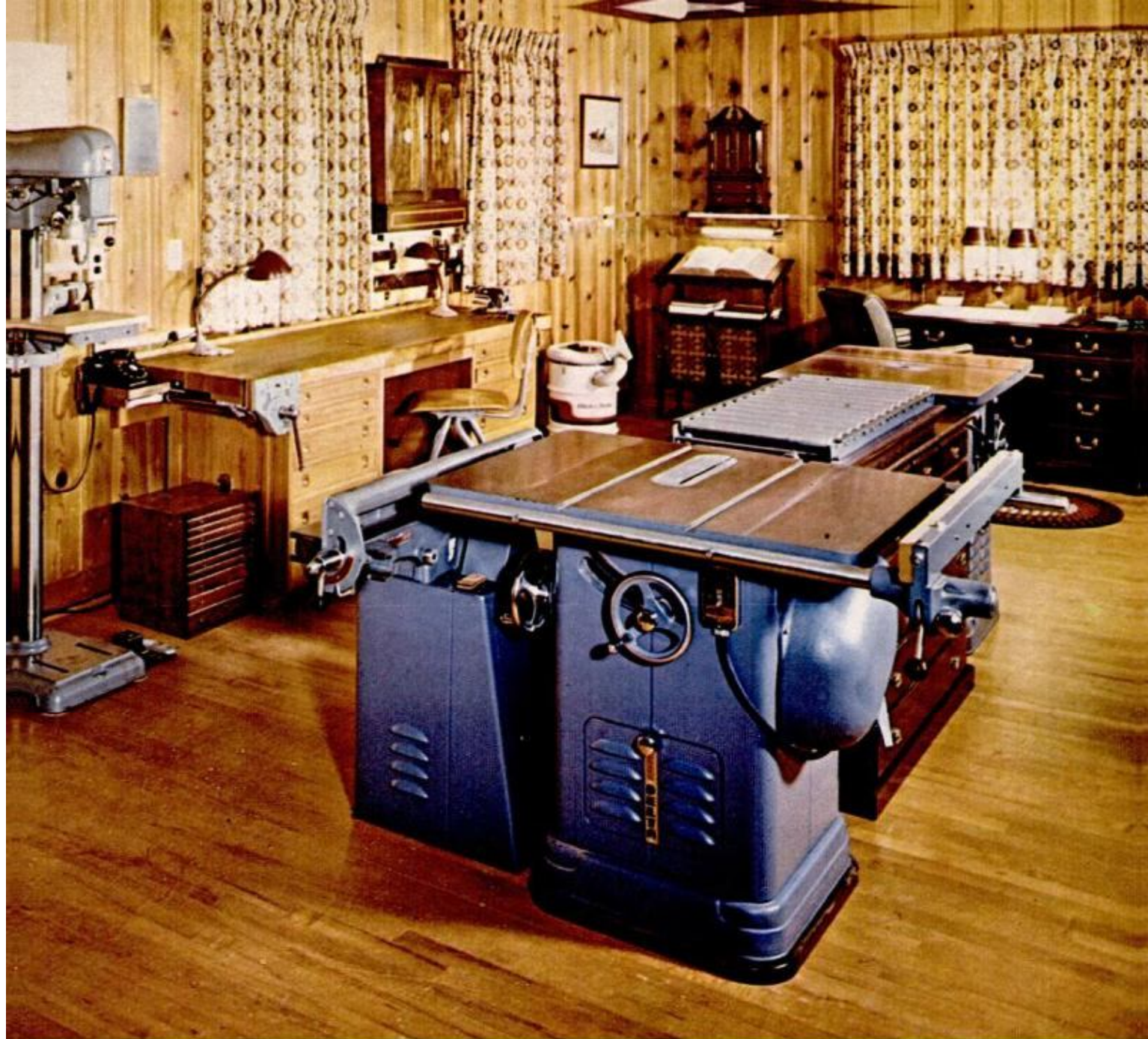
The net result of all this enthusiasm and energy is a shop—and home—full of extraordinary furniture, as can be seen in the photos.

Hale's last step on each project is to burn in his name, usually in a drawer, with a custom-made branding iron.

For project inspiration, he turns to a number of sources: *Popular Mechanics*, fine furniture books and museums. A vacation wouldn't be vacation for Hale if he couldn't spend at least a couple of days of it browsing through a museum or restored village such as Williamsburg (Va.) or Sturbridge Village

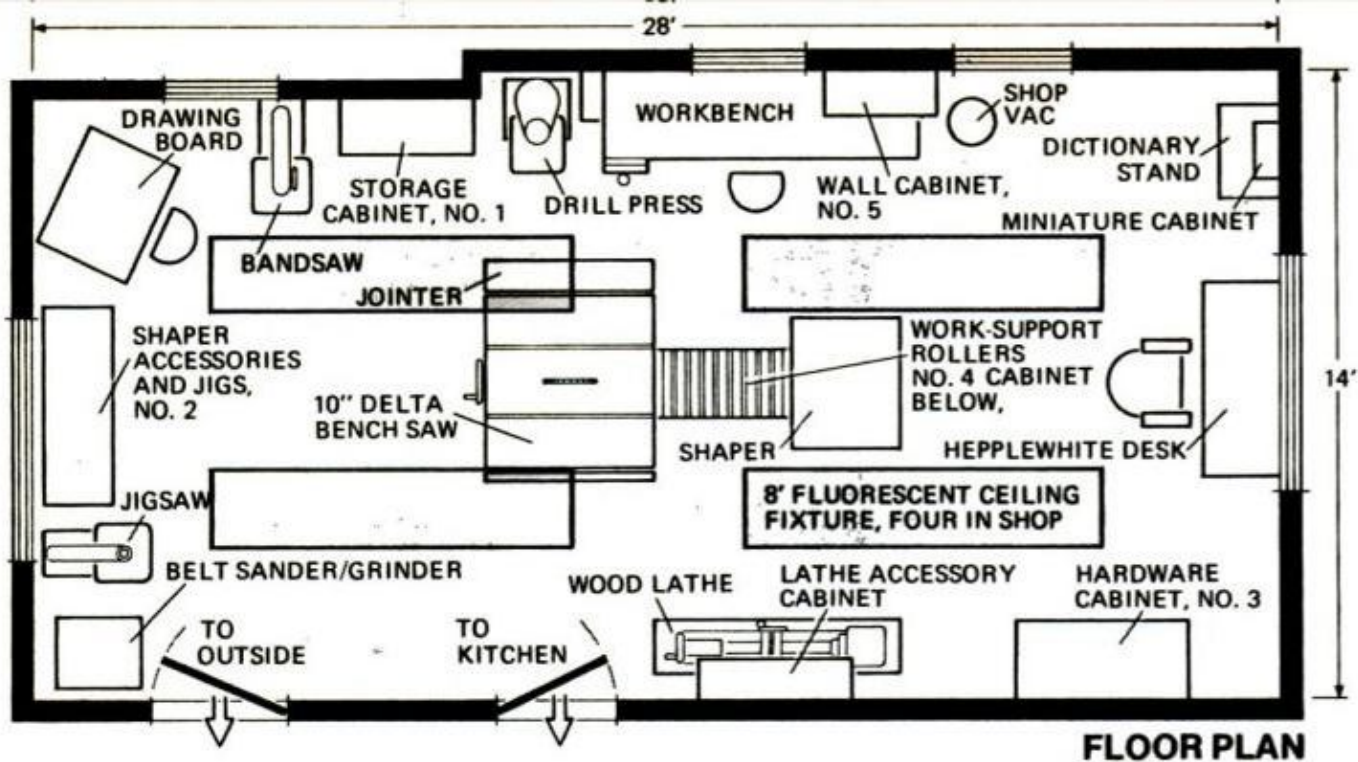


EASY-TO-CLEAN SHOP, designed and furnished as a shop/study, is filled with expertly crafted furniture, including the reproduction of a Hepplewhite desk in the background. The shop cabinet at left (No. 2 on the floor plan, page 88) displays the typical attention to detail and the degree of craftsmanship that Hale puts into all his projects. This one was built when he was in his "tambour door period." Inlaid cabinet has false drawer fronts; doors are hand-made of solid walnut



PIECES SHOWN BELOW were selected from houseful of furniture that Hale has created. He prefers to duplicate museum pieces after getting permission to measure them so he can draw his own plans





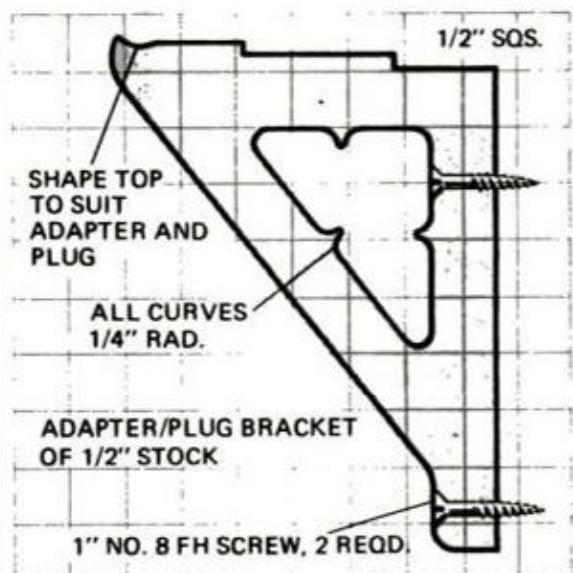
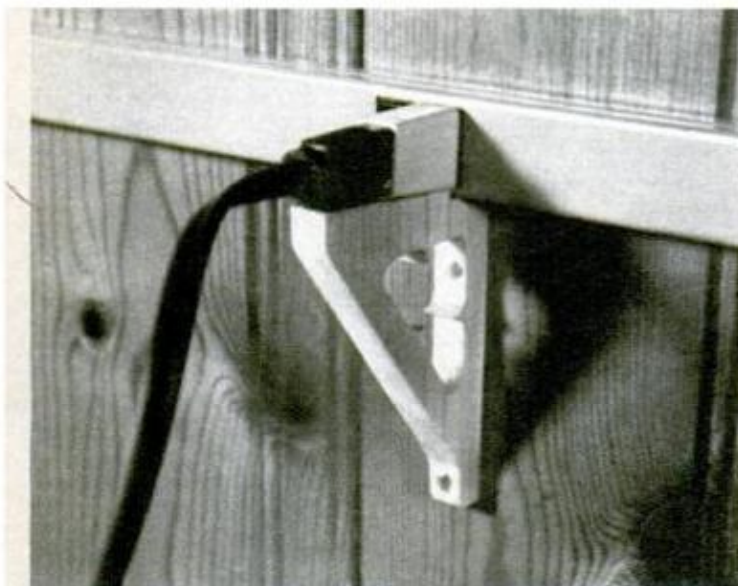
(Mass.) When he spots a piece that he particularly admires, he asks for, and usually gets, permission to take measurements. When he returns to his shop, he works at his drawing board and executes professional-quality drawings that he can build from. (Note: In a future issue of *PM*, we will present his drawings of the revolving drink caddy shown on page 87.)

For shop expertise and tool know-how, Hale also has several sources; he usually turns to *PM* and/or a couple of professional cabinetmakers. He admits he is just about a fixture at two nearby fine-furniture shops. He has cultivated friendships with Ed Copenhagen of Copenhagen Furniture and John Wiltshire at Virginia Gal-

leries. He is quick to credit both with providing the solid basics of his woodworking knowledge. "I don't believe that I have ever visited either of these places without learning something new," he said. Then, shaking his head, he adds, "In woodworking, it is the darndest thing how the correct, and usually easiest, technique can completely escape you."

To illustrate his point, he wondered aloud just how many pieces of furniture he had built before he learned that pros use stock no wider than 3½ to 4 in. to make up a tabletop. "The minute these fellows told me that, I knew from then on my finished projects would be warp-free." Since that time, every wide piece on Hale's

SIMPLE SUPPORT-REST for adapter and plug eliminates the usual sagging and inevitable loss of power. Obvious concern about appearance of items as small as this is typical example of why this shop is a standout



CLASSIC WORKBENCH

TOP MADE UP OF 13 PCS. 1-3/4 X 2-3/8 X 84" STOCK, PLUS 1 PC. 3/4 X 2-3/8 X 84"

REAR APRON, 3/4 X 10 X 84"

LEFT END OVERHANGS PEDESTAL 9-3/4"

PLYWOOD BACK, 4 X 18-3/4 X 21-3/4"

7/8 X 1-5/16 X 19-3/4" GLIDE (2 REQD.)

7/8 X 1-5/8 X 19-3/4"

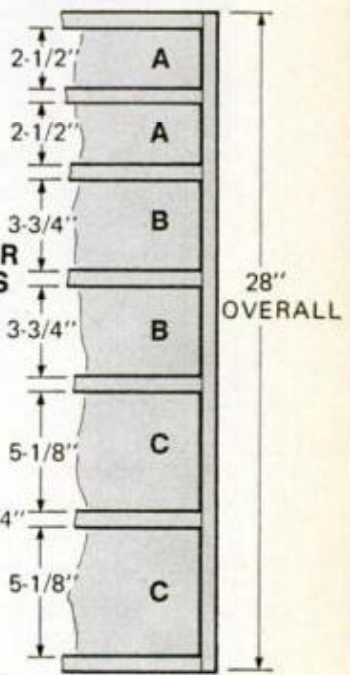
3/4 X 1-5/8 X 19-3/4"

PEDESTAL (2 REQD.)

RAISED PANEL LET INTO STILES AND RAILS

HARDWOOD CORNER GUARD

DRAWER DEPTHS



7/8 X 1-5/8 X 28"

3/4 X 1-5/8 X 20"

GUIDE, 3/16 X 11/16 X 21"

SIDES AND BACK OF 1/2" STOCK

SEE DETAIL V

1/4" PLYWOOD BOTTOM

CENTER DRAWER

7/8 X 1-7/8 X 25-5/8"

1-3/4" NO. 8 FH SCREW

3/8 X 3/8 X 21-1/2" GUIDE

1/4 X 1/4 X 25-5/8" WALNUT STRIP LET IN

3/8"

7/16"

1-5/16"

7/8"

DETAIL W

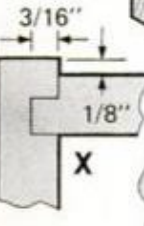
DETAIL V

TO SUIT CABINET OPENING. SEE A, B AND C ABOVE

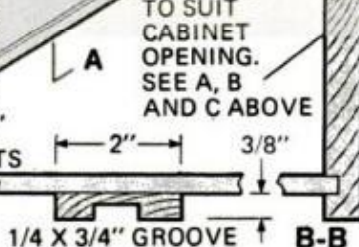
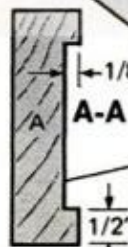
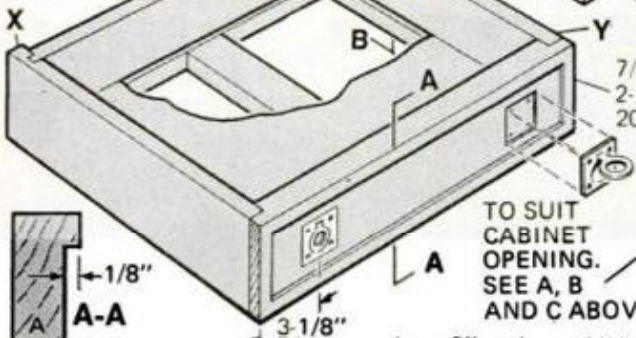
ROUND TOP EDGES

DRAWER FRONTS SCOOPED OUT WITH ROUTER

1/4 X 3/4" GROOVE

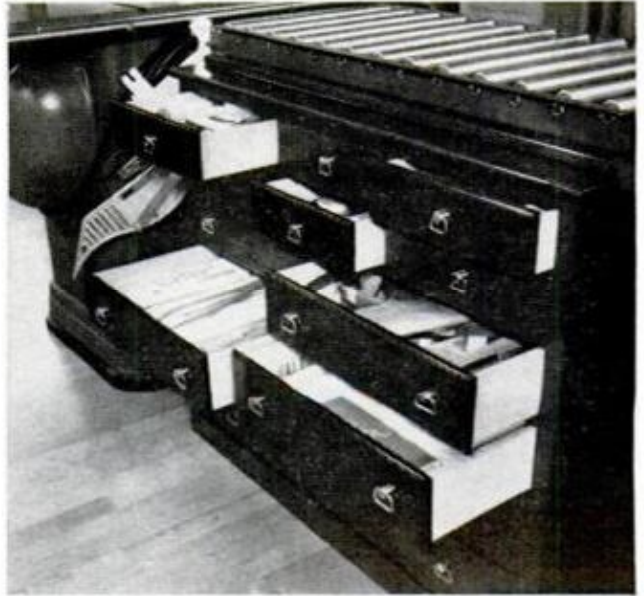


TYPICAL CABINET DRAWER





OFTEN-USED TOOLS are kept close at hand and neatly arranged in the workbench drawers. Fred also stores a set of drafting tools in the center drawer and right pedestal (above) for quick, at-the-bench drafting



LONG WORKPIECES are supported by rollers on cabinet as they leave bench saw. The walnut cabinet is built so that rollers are just below saw-table height. The cabinet has 24 half-depth drawers, 12 on each side

furniture has been fashioned from glued-up narrow boards rather than wide ones.

His workbench is particularly impressive. Entirely of hardwood, it has oak cabinets below and a rock-maple work

surface. Hale estimates that a similar commercial version would "probably run about \$400 to \$500." PM agreed that it is a dandy, thus we measured it and drew

(Please turn to page 210)

OAK CABINET positioned along wall between the bandsaw and drill press is used to hold accessories and related equipment for both tools. Fred practiced recessing of drawer fronts when he built the six drawers





Football: The name of the game is hit!

By J.F. PEARSON and GARY SHENFELD

IT HAPPENED IN THE CLOSING moments of a game last fall between the Detroit Lions and the Chicago Bears.

Chuck Hughes, a wide receiver for the Lions, suddenly stumbled after running a pass pattern. He fell to the turf—and lay still.

Dick Butkus, the tough Bear linebacker, recognized almost immediately that something serious was wrong. He waved and shouted to the Detroit bench, and soon doctors were administering mouth-to-mouth resuscitation. But the 28-year-old Hughes didn't make it. Soon after his arrival at a Detroit hospital he died of the heart attack suffered on the field.

Though Hughes' death did not appear to be the result of physical contact, the incident triggered questions and concern: Was football too violent a sport? Had it become increasingly dangerous in recent years?

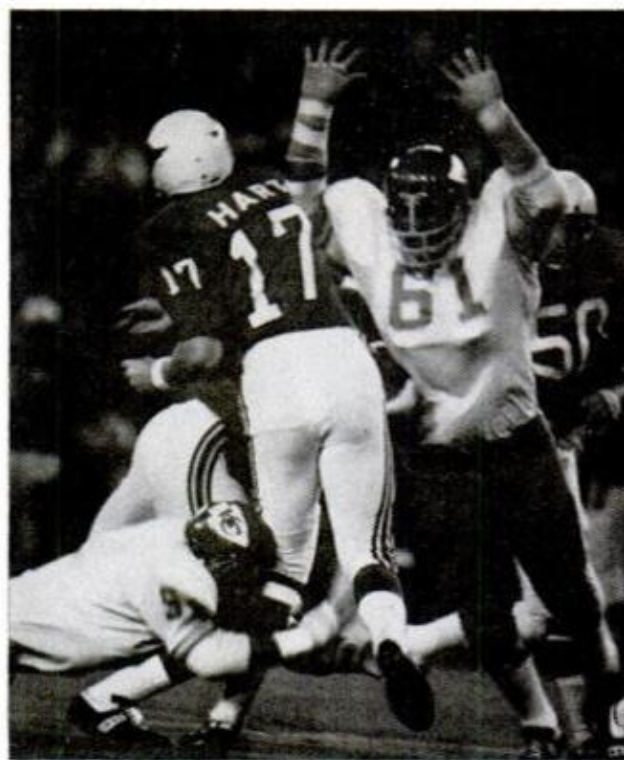
It has been said there is no team sport played anywhere that rivals American

DENVER LINEBACKER does a headstand as he nails the Atlanta Falcon quarterback for an eight-yard loss

HEART-ATTACK VICTIM Chuck Hughes is rushed from the playing field in Detroit. He died in the hospital

Football is a collision sport that generates surges of excitement, a spate of injuries and some fatalities. Now new equipment designs and tighter rules give promise of greater player safety





HOW PLAYERS CAN GET HURT: Face-mask tackle (left) is strictly against rules, can cause neck injury. In photo at right a pro quarterback is about to get creamed. Note how left leg bends under pressure

football in terms of injuries. Hughes' death was not the first connected with the sport, and it won't be the last.

Records going back to 1931 show that 764 players have died from football injuries over a 40-year period. These statistics—compiled for the National Collegiate Athletic Assn., American Football Coaches Assn., and the National Federation of State High School Athletic Assns.—include players in several categories: sandlot, 155; pro and semipro, 74; high school, 466; college, 69.

How many players suffer nonfatal injuries is impossible to say. There is no central clearinghouse for such information, and some organizations—the National Football League, for one—don't like to discuss such statistics. But the seriousness of the problem can be gauged from available information:

- Last season almost 200 NFL players received surgery for knee injuries.
- Dr. Vincent DiStefano, the Philadelphia Eagles' team physician, estimates that of 100 players reporting to training camp, 15 will be operated on during the season, most of them for damaged knees.

Lack of meaningful data on football injuries at the high-school level led three researchers—Drs. James M. Robey, Carl S. Blyth and Frederick O. Mueller—to undertake a continuing five-year study of

athletes in 43 high schools in the state of North Carolina.

An initial report reveals that over 50 percent of the 14,066 high-school players in the study were injured in 1969. Apply that rate to the estimated 1.2 million high-school players throughout the country, and you have over 600,000 suffering minor—and major—injuries annually.

The North Carolina researchers also determined that the highest injury rate occurred among 17-year-olds, a finding they can't explain. Their statistics, they say, refute the idea that older high school players (17 and 18) are injured more often because they see more action, but they speculate that "a fair portion of these (injured) youths were retarded in their . . . physical development."

What are the most dangerous situations on the football field? The 40-year study of football deaths shows that almost one-third of the 746 fatal injuries occurred when a player made a tackle. The second most dangerous situation occurred when the ball carrier was tackled, resulting in 15.62 percent of the deaths. Blocking was third—almost 10 percent.

The North Carolina study shows that the more severe injuries occurred during downfield tackling and blocking. The three authors commented: "It has been said that the old, crushing, bruising types of body

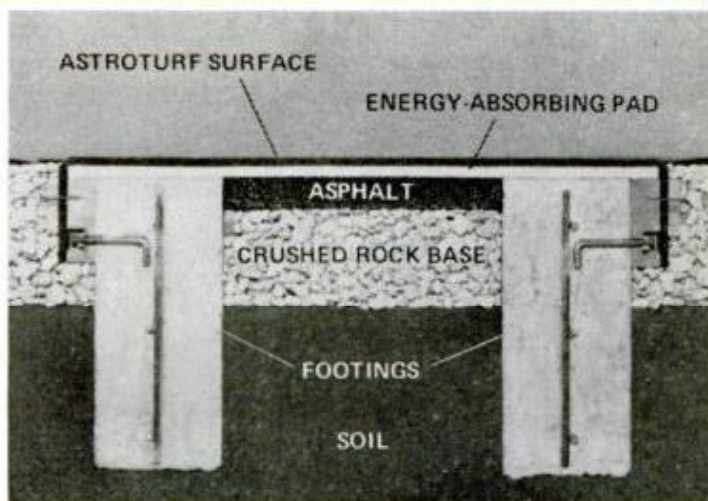


HARD HELMET rammed into an opponent's midsection can do damage to both men involved in the play

contact have been eliminated by the new so-called open game. But, perhaps we have traded the bruises of close-in line play of the 'three yards and a cloud of dust' era for the more severe injuries that result from a greater frequency of impact between youths traveling at high rates of speed over greater distances prior to collision. Add the element of plastic armor plate and you have the necessary ingredients to explain the relatively greater severity of downfield, sideline and open-field injuries during games and scrimmage activity. For example, of the 103 concussions occurring to students in the study population in 1969, 49 (46 percent) occurred during such midfield collisions."

Cross section of AstroTurf installation

Best known of the synthetic turfs, AstroTurf was first installed on an athletic field in 1964. Since then nearly 100 such playing surfaces have been installed on fields in the United States and abroad. A typical installation of Monsanto AstroTurf is shown. The pile, substituting for blades of grass, is green nylon ribbon anchored in a synthetic fiber and latex backing. The turf is joined to an energy-absorbing synthetic foam pad, and the pad is bonded to an asphalt subsurface. Concrete footings, which run the length of a field, provide stability and prevent heaving.



This comment would hold true for college and pro teams, too. If anything, the pros play the most wide-open game.

A typical fall weekend in front of the television tube provides convincing evidence that modern football is not a contact sport—but a collision sport. Open-field collisions, clothesline tackles, quarterbacks smeared by gigantic defensemen—the assorted violence is enough to make even the most avid fan wince. Then there are familiar headlines announcing that a Joe Namath, Gale Sayers, Matt Snell or Len Dawson has a knee injury requiring surgery, or that a Sonny Jurgensen or Bart Starr has been sidelined by an arm injury.

Small wonder that today many fans think football is a rougher, more violent game than ever. But available figures don't bear this out. There is no way of knowing if injuries have increased on all levels of play. *So far as fatalities go, however, the game might be a bit safer on the whole.*

From the 40-year fatality study referred to earlier, here are figures for the 1931-1940 period compared with those for the latest decade, 1961-1970:

- '31 to '40: high school, 100 fatalities; college, 25; semipro and pro, 34.
- '61 to '70: high school, 178 fatalities, college, 24; semipro and pro, 5.

Only among high-school players was there a jump—partially accounted for by a large increase in participants between the two decades. Surprisingly, so far as college and pro ball are concerned, the game would seem to be safer today.

As every veteran fan knows, the game of 1940 is not the game of 1970. Rules are different (often changed for safety rea-

sons), the style of play altered, equipment improved, and players are bigger, faster and better conditioned.

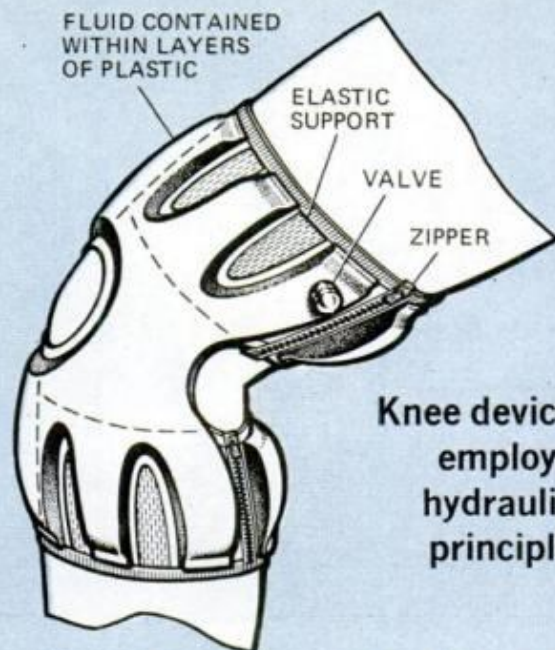
A relatively recent and controversial innovation is the synthetic playing surface. Some people connected with the game—players among them—claim it is a harder, more slippery surface to play on than natural turf. Others with equally good credentials claim that artificial turf offers a more uniform and “faster” surface with better traction.

One synthetic turf critic is Dr. James G. Garrick, an orthopedic surgeon and head of the University of Washington's

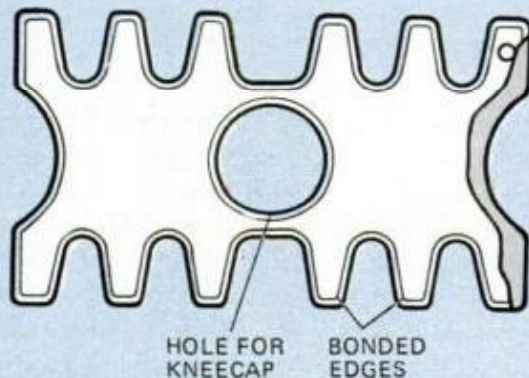
UGH! St. Louis back's heavy foot lands on opponent's gut as he blasts through line for good gain



New equipment designed



Knee device employs hydraulic principle



The most common injury in football involves the knee—a joint ill-suited to contact sports. This device—called the Hydrolig—is designed to blunt the effect of a blow against the knee by distributing impact forces throughout a liquid contained between layers of plastic. Foam rubber pads worn by some athletes are said to be relatively ineffective against sudden impacts.

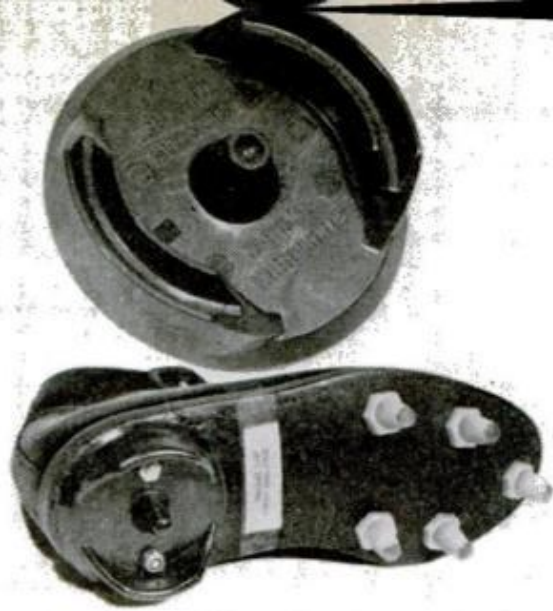
division of sports medicine. He made a study of injuries incurred by 26 high-school teams in the Seattle area during one season. His conclusion: that players suffered 50 percent more injuries on dry synthetic turf than on wet synthetic turf or grass in any condition. Dr. Garrick attributed the increased number of injuries to the better traction afforded by dry synthetic turf.

Dr. Donald L. Cooper, takes a different

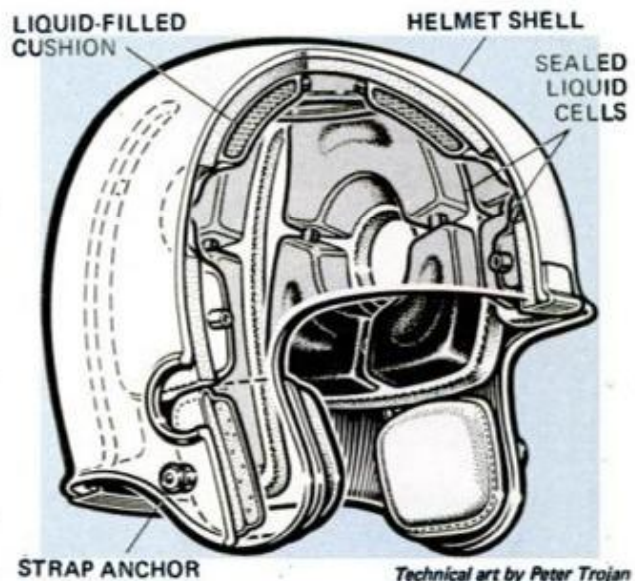
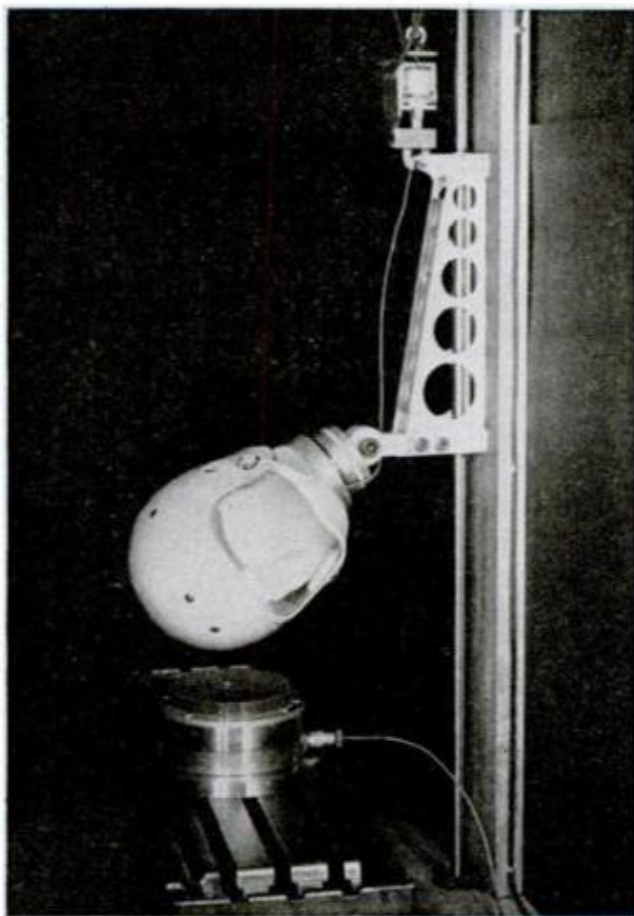
for safety

Dual-arc cleat designed to reduce knee injuries

This new cleat is said to be superior to the standard type because the arcs permit the foot to pivot. Standard cleats don't—they tend to "lock" the foot to the turf. Thus, if a player wearing standard cleats is hit while "dug in," his foot may not move and twisting forces can tear his knee joint. The cleat shown above the shoe is designed for use on artificial turf.



Helmet research . . . and new impact-absorbing helmet



The Hydra-Flo helmet has a resiliently deformable outer shell, an inner liner in contact with wearer's head and a cushion-like suspension in between. Liquid in the suspension's cells helps absorb and distribute impact forces. Photo at left shows how impact tests on helmets are carried out at Wayne State University.

view. Team physician at Oklahoma State University and chairman of the National Collegiate Assn.'s committee on medical aspects of sports, Dr. Cooper says: "From all the statistical data that I've looked at, I don't feel artificial turf is an important factor in most injuries. I feel that 90 percent of the injuries in football occur in direct relationship to the contact that occurs above the turf. The name of the game is violence . . ."

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Dr. Cooper says any meaningful study of the role played by artificial turf would take years, not months. Medical men agree, however, about one characteristic of synthetic turf: It produces more skin abrasions than does grass.

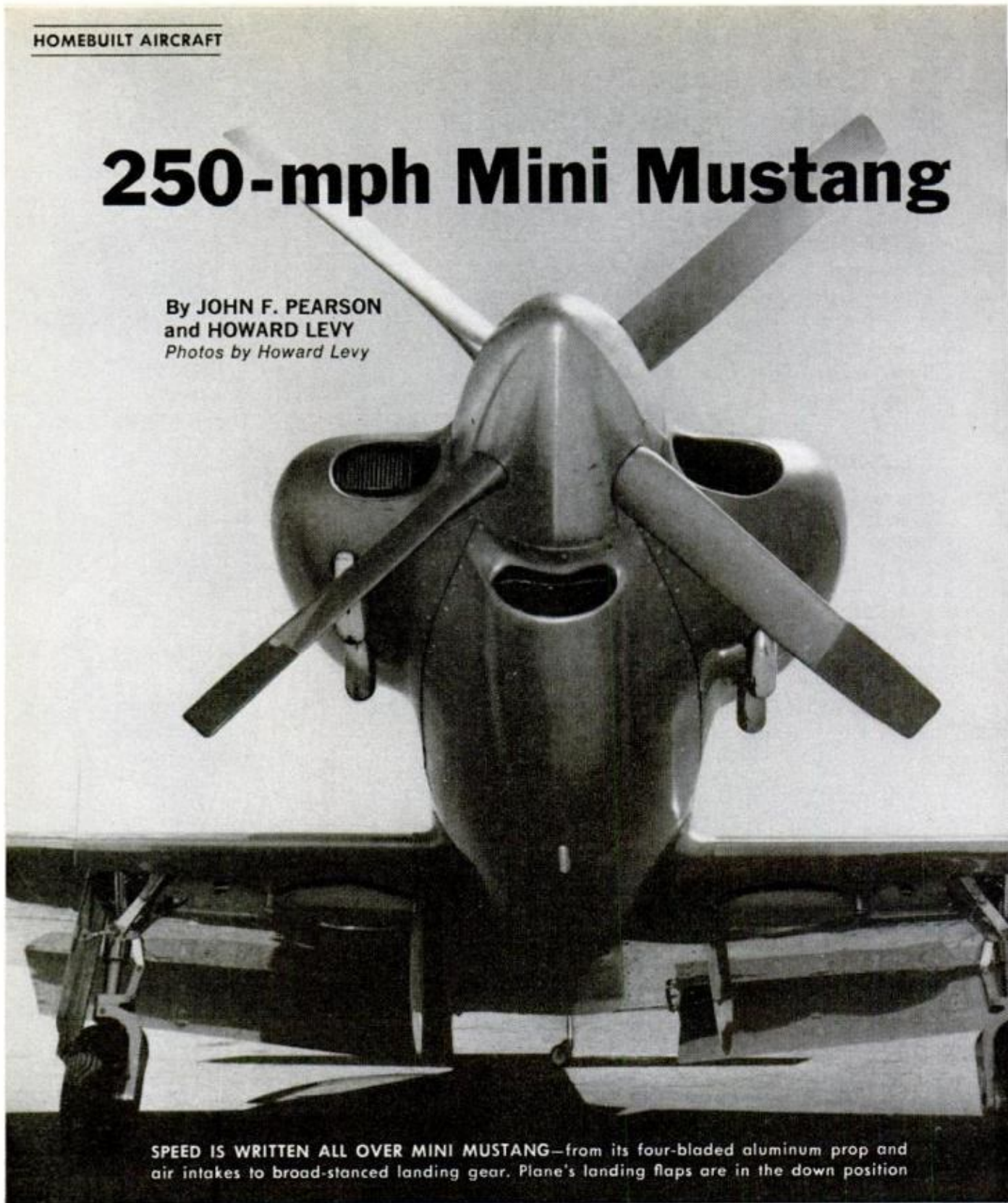
Rules and equipment changes have promoted game safety. In the days of the leather helmet, broken jaws and fractured skulls were common. Molded helmets,

(Please turn to page 212)

95

250-mph Mini Mustang

By JOHN F. PEARSON
and HOWARD LEVY
Photos by Howard Levy



SPEED IS WRITTEN ALL OVER MINI MUSTANG—from its four-bladed aluminum prop and air intakes to broad-stanced landing gear. Plane's landing flaps are in the down position

FOR A SMALL PLANE, the Mini Mustang can really go. Open up its 125-hp Lycoming engine, and it streaks through the sky at better than 250 mph.

The Mini Mustang is the end result of years of dreaming and planning by its designer, Charles C. Linn, a Lancaster, Calif., machinist. "Ever since I was in high school I had wanted to build my own plane," he explains. Later, he gained valuable

know-how when he helped rebuild an old small plane.

"By working weekends and some evenings the average mechanic can build a Mini in about two years," he estimates.

If you make all your own parts, you can build a Mini Mustang for from \$1200 to \$1500, Linn says. That includes the engine, which may cost about \$300.

The Mustang is an all-metal single-



1



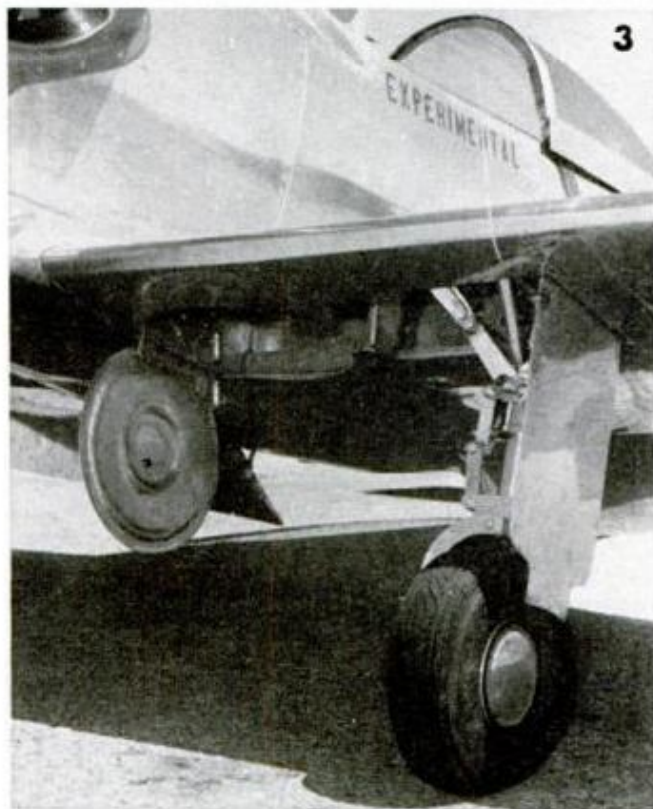
2



4



5



3



6

"I'VE ALWAYS LIKED SMALL PLANES," says Charles C. Linn (1), who towers over his tiny Mini Mustang. Though only 14½ feet long, the plane (2) still manages to have a sleek look. The landing gear (3) is fully retractable—by means of hand crank—and is enclosed in wells in wings. There's plenty of tail surface (4) to insure good stability. Linn's first Mini Mustang (5) is shown in flight over Rockford, Ill., during 1962 Fly-In of Experimental Aircraft Assn. Unfortunately, this plane was destroyed in 1966 while being flown by another pilot. By then, Linn already was at work on the current version (6)

seater that weighs 590 pounds empty and 930 pounds with fuel and Charlie Linn aboard. (He is a husky six-footer who tips the beam at 230 pounds.) The plane is 14 feet, 6 inches long, has a wingspan of 16 feet, and is only 4 feet, 4 inches in height.

It needs 1000 feet for takeoff, 1500 for landing, and climbs at a rate of 3000 feet per minute. It cruises at 200 mph and has a range of 500 miles.

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Despite its diminutive size and good top speed, the plane is not tricky to fly, according to Louis K. Brandt, another Lancaster man and Mustang builder. "It handles very well and, above all, responds beautifully," says Brandt.

For further information, write: Charles C. Linn, 5104 West Ave. K-10, Lancaster, Calif. 93534. A set of complete plans costs \$125.

★★★

97

Minolta's latest 35s have lots of bright ideas—and some surprises



By IVAN BERGER, Photography Editor

YOU needn't be a dumb photographer to appreciate smart cameras like Minolta's new Hi-Matic E and F. The cameras even have a new way to increase depth of field.

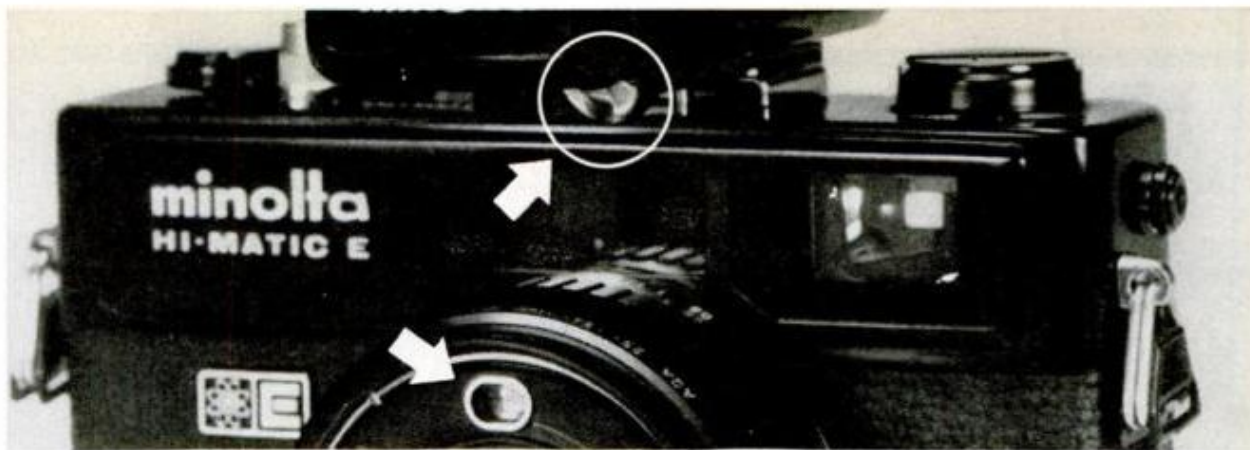
Like a lot of cameras today, these new Hi-Matics have fully automatic exposure control—just focus, frame and fire, and they'll automatically select the proper shutter speed and f-stop for the light, your film, and whatever filters you're using. (The electric-eye cell, in the lens mount, reads right through the filter. It also signals when you're trying to shoot through the lens cap.) Again conventionally, a warning will flash when dim light requires exposures slower than $\frac{1}{30}$ second at full aperture, so you can decide to skip it, use flash or brace the camera for a time exposure. That light stays on during long exposures (the \$160 E times automatically to 2 seconds, the \$110 F to 4), so you won't move the camera while the shutter is still open. And when you shoot flash, the exposure varies as you focus to compensate for the increase in illumination when your subject nears your flash—still nothing new.

But the Hi-Matic E has still more brains to show off. Slip on a flashgun and it still won't fire unless the light is dim enough



to call for exposures under $\frac{1}{30}$ second (or unless you flick a switch on the back of the camera). Conventional automatic cameras (like the F) program their auto-flash exposure systems with guide numbers based on the film speed and flash output; the E is programmed with a guide letter that represents the flash output only. So there's no need to change the flash guide number when you change films—setting the meter for the film speed does it all. (You still have to reprogram it when you change flashguns, of course.) And pins on the accessory shoes of both the E and F tell the camera whether a flashgun is or is not there.

Even the flashguns have some brains. Both shut off automatically when they're removed from the camera, so your batter-



READY-LIGHT (top arrow) or Electro-Flash 2 is visible in the Hi-Matic E viewfinder. Light-meter cell (lower arrow) is in lens housing, where it automatically compensates for filters over the lens—and reminds you if you are trying to shoot with the lens cap on

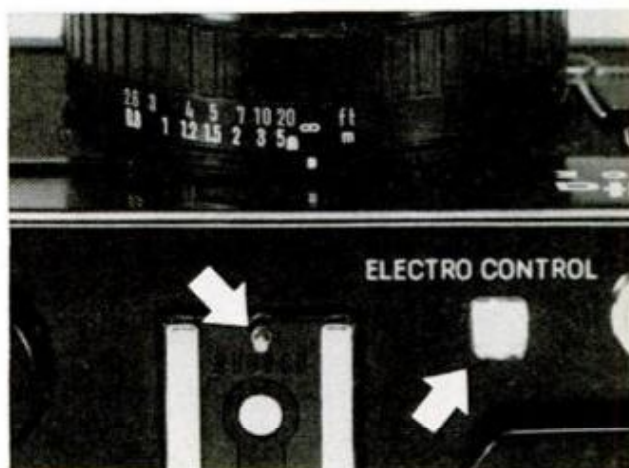
ies won't burn out in the bottom of your gadget bag. And the E's matching Electro-flash-2 gun (\$35) has a bottom-mounted ready-light visible in the camera finder.

Viewfinders on both the E and F show large, bright frames (the one on the E moves for parallax correction; the F has only parallax correction marks), green lights that indicate both battery and exposure are okay, the slow-exposure signals (which are repeated atop each camera), and lights that tell when each camera is in flash mode. But, unlike the viewfinders on most other automatic cameras (including some other Minoltas) these don't tell you what f-stop or shutter speed you're using.

Most of the new Hi-Matics' features are ingenious. But one is positively amazing: their "apodizing" shutter, which actually increases depth of field! The trick is in the



JUST A HANDFUL, even with flash attached, Hi-matic F is ultracompact, though still feature-packed



TOP VIEW of Hi-Matic E shows pin (arrow) that programs camera for flash operation, Electro Control light that warns of long exposure times (see text)

shutter, whose single set of blades serves both as shutter blades and aperture control. In effect, the shutter blades open only to the f-stop desired, then shut tight again. (In most cameras, the shutter opens all the way regardless of the f-stop, while a separate iris diaphragm controls the aperture of the lens.)

A normal camera shutter opens swiftly to full aperture, stays at that aperture awhile, then closes swiftly. The apodizing shutter opens slowly till it reaches the full desired aperture, then slows suddenly. Most of the exposure actually takes place at smaller f-stops, so there's more depth of field. There's just as much light hitting the film, because the whole process takes longer. But when you shoot action, you don't get the blur you'd get from using a slower shutter with a smaller f/stop to get greater depth of field!

There is still blur, but it's different. Conventional blurs start and end abruptly at the moments the shutter opens and closes, and they're the same density throughout. "Apodized" blur fades in gently while the shutter is gradually opening, then cuts off sharply at the end. ★★



The little van that grew (in the middle) to be a motor home



It's simple. To get a bigger camper van, just cut a standard one lengthwise, add a center section—and you have a vehicle 14 inches wider than the original. The Superior Coach people of Lima, Ohio, do this to produce their roomy new Superior V-1700 (above). They slice a Chevy G-30 van (near left), add the 14-inch width and a reinforced fiberglass top to get a "Superior-sized small motor home" (far left). Widening is accomplished without cutting axles or vital drive-train parts. The V-1700 has full galley, bath and sleeps six with optional overhead bunks. Width is 93.9 inches; length, 200.95. A Dodge version, the V-1800, is 11 inches longer.

Robot fireman: No burns for him

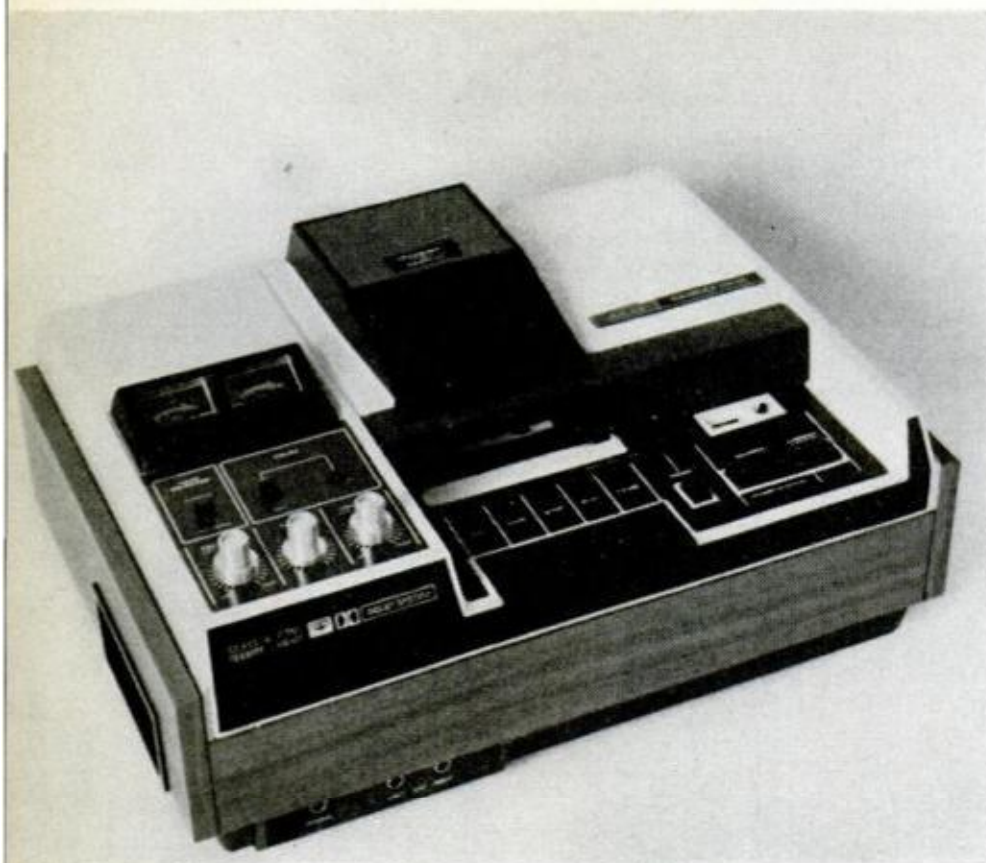
Japanese firemen don't believe in taking risks when they can get a robot to do it for them. The fearless mechanical firefighter at right marches boldly right up to a blaze, spewing water and chemicals from built-in nozzles. Developed by the Yokohama Fire Brigade, it sports searchlight "eyes" for night use, can even waddle up steps into burning buildings on spiked wheels. The monster-like machine is remotely controlled by radio.



Jungle fighter: Old-fashioned look with a modern punch

It doesn't look much like a fighter, but the single-prop-powered plane below is actually a potently armed mini-gunship designed especially for guerrilla-type jungle warfare. It can fly at speeds under 100 mph for treetop hopping and has very short landing and take-off characteristics. Rocket-launching pods are slung under wings, and turret-mounted machine guns can be fired from side doors. Built by Fairchild, the AU-23 Peacemaker is one of two similar ships under test by the Air Force. The other is the Helio AU-24 Stallion.





Cassette-flipping deck has reverse and Dolby

When one side of a cassette tape ends, this new deck flips it over to play or record the other side. There's a Dolby circuit built in for lower noise. And an exclusive "Auto Distortion Reduction" circuit lets you record at higher levels without increased distortion. In recording, this ADR cuts back the high frequencies above 8 kHz whenever they reach a level of -10 VU, preventing tape saturation; lower frequencies, or high frequencies below the -10 VU level, are unaffected. Takes chromium dioxide tapes, too. Model GXC-65D, \$299.95. Akai America, Ltd., 2139 East Del Amo Blvd., Compton, Calif. 90220.



Piano sounds like an electronic organ

Looking like a couple of many-legged crawlers, these electronic feelers turn an ordinary piano into an organ merely by resting on the keys at the back. As a key is pressed, a spring-loaded plunger drops, closing a switch and sounding a corresponding electronic tone through an amplifier. The note plays as long as the key is held down, giving the normally short piano tone a rich, sustained organ sound. Piano-Mate was invented by Dubreq Studios, London.



Truck for all occasions comes in many styles

You name it, you can have it—that's the idea behind this versatile, low-cost utility vehicle to be made by Ford in a variety of styles. Called the Fiera, it's designed to provide rugged, economical transportation, especially for developing countries in South America and the Middle East. It starts out as a basic cab and chassis. From there, you can have it as a flat-bed hauler, box-bed pickup, fully enclosed van or 12-passenger minibus. While prices have yet to be established, they are expected to be far below those set for fancier, more conventional trucks available in comparable lines.



They finally did it—a quartz wristwatch for under \$100

With quartz watches selling for thousands of dollars, it didn't look like they'd ever get one down to a practical price range. Now Benrus has done it—coming out with an electronic quartz model for men priced at just \$99. Using the precise oscillations of a quartz crystal to keep time in place of the conventional balance wheel, it's said to be accurate to within a minute a year. For added convenience, it has day and date readouts and a sweep hand that moves in one-second increments, instead of continuously, for easier use as a timer. A ladies' version is \$150. Benrus Corp., Ridgefield, Conn.



Mini-trailer with maxi features that even a small car can pull

It's only 13 feet long but sleeps four and packs such features as sink, range, icebox, fresh-water tank and dual 12 and 117-volt power systems. Called Trail-Mite, the mini-

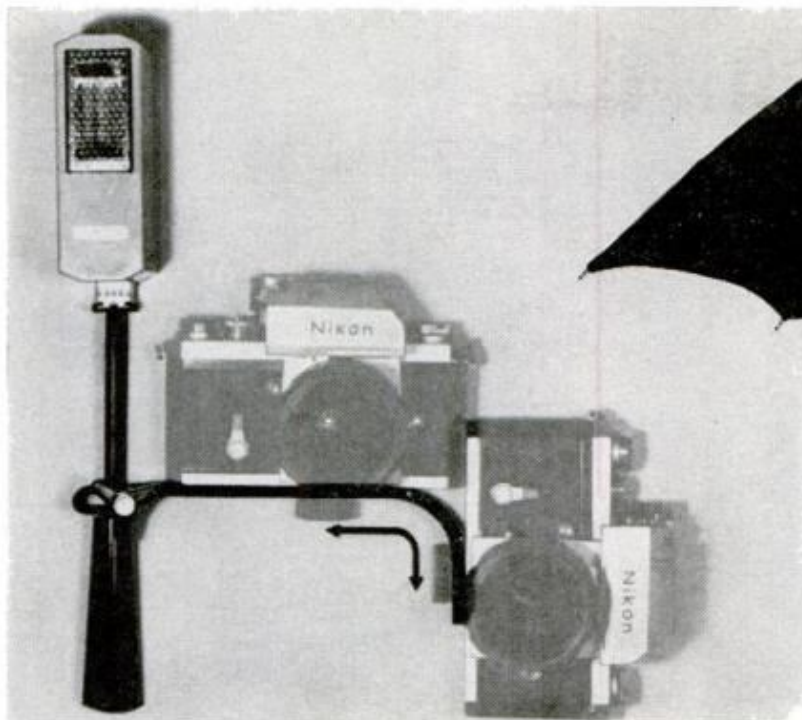
trailer has a tongue weight of only 85 pounds and is designed for easy towing by sports cars and subcompacts. Henry Engineering Co., 3001 Red Hill Rd., Costa Mesa, Calif. 92626.



Eek! I've been shot! Well, sort of

You can shoot a burglar without killing him with this "stun gun." Powered by CO₂ cartridges of the type used in seltzer bottles and air pistols, it fires a blunt but heavy pellet accurately to 100 feet. The effect is to stun an intruder, giving you time to call for help or get away. Designed for homeowners and storekeepers who want protection without carrying actual firearms, gun is \$59 postpaid, Prowler Foulter, Box 238, San Ramon, Calif. 94583.





Rain or shine bounce flash bracket

This bracket can prevent red eyes and wet photographers. It holds flashguns and cameras in nearly any position, eliminating red-eye reflections and allowing easy bounce flash. Remove the flash and it holds an umbrella, too. System J, \$8.95. Cleaveland/Price Enterprises, 1954 North Fremont St., Chicago, Ill. 60614.



Just whistle and—like magic—on or off go your lights, TV, electric appliances

You can shut off your TV set without getting out of bed, turn on lights without fumbling around in the dark for switches and do other tricks with ultrasonic remote control. The control plugs into any wall outlet, and your light, radio or TV plugs into it (left). Two high-pitched whistles—one you blow and one with a bulb you squeeze (above)—are supplied to activate the control. \$14.95, Signal Science, 140 Lowland St., Holliston, Mass.



Soft drinks in soft cans for campers

Instant soft drinks come dry in these handy plastic packets for easy carrying on hunting, fishing and camping trips. Just add water, shake and sip. Twelve flavors include fruit drinks, milk shakes, even hot chocolate made with hot water. About 15 to 25 cents. Trail Chef Camping Foods, 520 North Michigan Ave., Chicago, Ill. 60611.

Half plane, half helicopter, it can do the work of both

One way to take off in a small space is simply to tilt your wings and engines up and go. That's the system used in this new Canadian CL-84 bomber combining the advantages of helicopter and conventional plane. Its wings swing vertically for straight-up takeoffs and horizontally for fast forward flight. The U.S. Navy is considering the ship for carrier use.



Pushbutton tuning isn't here yet, but look what's coming after it!

You don't turn a knob or even press a button to change channels on this experimental Panasonic prototype television set. Instead, you just lightly touch a metal plate to get the channel you want. Each of 11 "feather-touch" plates can be preset to a different UHF or VHF channel. Illuminated numbers tell you which channel is tuned in at the moment.





This home-on-wheels has a garage-on-wheels, too

When Guy Evans and his family take off in their motor home, they pack along an extra car in a "garage" in the rear. Evans, of San Bernardino, Calif., finds the small Subaru

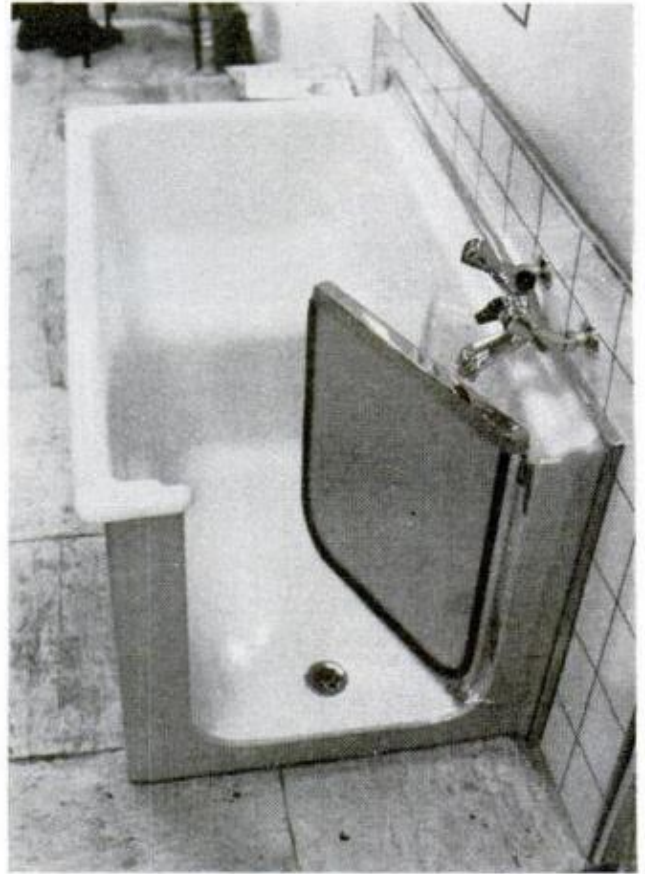
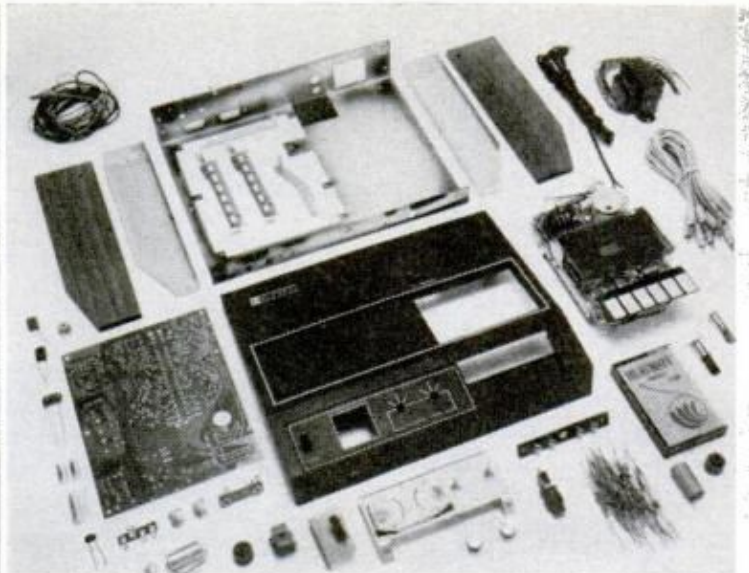
minicar handy for trips to town and off-road exploring. Other features of this unusual 23-foot home-built home-on-wheels: a fireplace and double bed that drops from the ceiling.



Two-way luggage carrier can be hand-toted or cartopped

This handy suitcase doubles as a cartop carrier without requiring special roof racks. Molded-in strap guides permit it to be securely anchored, using tie-downs that hook to the rain gutters. A rubber gasket around the lid keeps out rain, and rubber foot pads protect car finish. Black plastic, about \$30 with straps. Rubbermaid, Inc., Wooster, Ohio 44691.





Boat horn: Big blast on a small can of gas

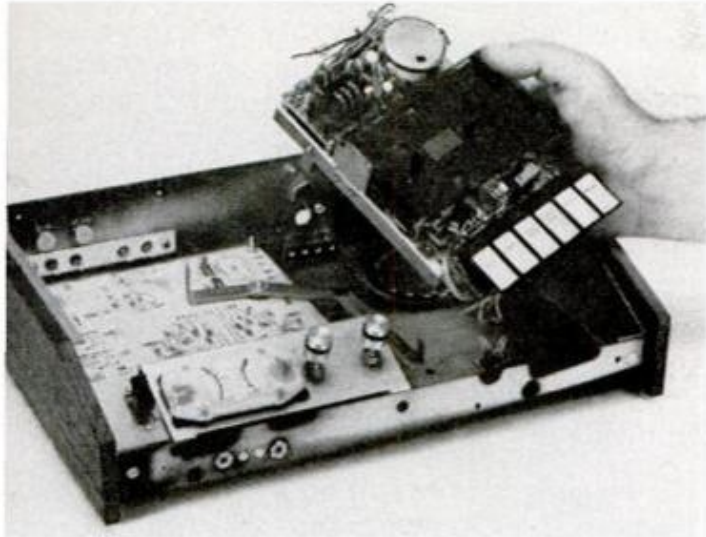
Powered by Freon from replaceable aerosol containers, this boat horn sounds off with a deep bellow that can be heard a mile away. One neat feature: The Freon canister can be removed any time without discharging so the horn can be disassembled for easy stowing in a small space. Price is \$7.50; refill, \$2.50. Thorpe Industries, Mountainside, N.J. 07092.

It had to come: A bathtub with a walk-in door

There's no danger of slipping and falling when getting into or out of this bathtub—you just step safely through a hinged door. Designed primarily for use by elderly and handicapped persons, the walk-in tub was recently introduced at the Brussels Inventors Fair in Belgium. One caution: You must remember to let the water out before opening the door.

Cassette deck you build from a kit

It's hard to believe, but you can actually assemble this Heathkit cassette deck in two or three evenings. The seemingly complicated machine is made easy to build by single-circuit-board wiring and a preassembled push-button tape transport, shown being installed in photo at near left. Kit parts and finished unit are shown at far left on opposite page. The stereo deck both plays and records, and features adjustable bias to accommodate the new high-fidelity chromium dioxide tapes. Other nice touches are twin VU meters for precise control of recording volume and automatic shutoff at the end of each tape. The AD-110 kit is \$129.95. Heath Co., Benton Harbor, Mich. 49022.



Two-way trailer for yardwork: You tow it and it tows you

You can tow this trailer around your yard with a small garden tractor, then hitch it to your car and haul your tractor or other heavy equipment to another location. Combination

road-and-yard trailer has drop-down gates at front and rear, tilts for easy loading or dumping. Electric brakes optional. Bock Products, 2132 South Main St., Elkhart, Ind. 46514.



1
CHUTIST TRIPS
COMPRESSED-AIR
VALVE WITH
LEFT FOOT

COLLAPSED
LANDING
PAD IS
WORN
ON RIGHT
FOOT



2
LANDING PAD
INFLATES
AS AIR VALVE
IS PRESSED

AIR
VALVE

3
CHUTIST
LANDS
SAFELY
WITH BOTH
FEET ON
PAD TO
CUSHION
IMPACT



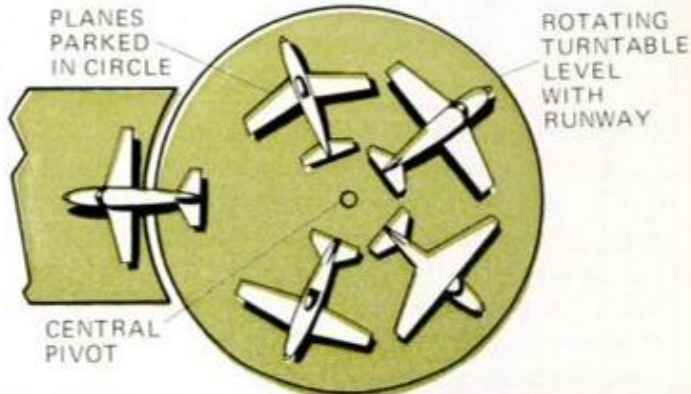
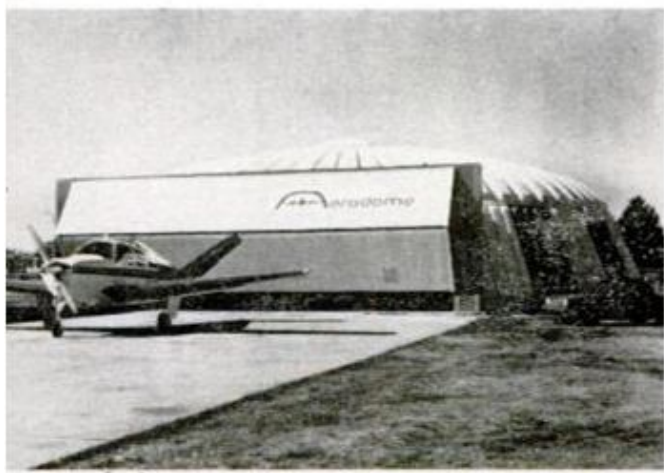
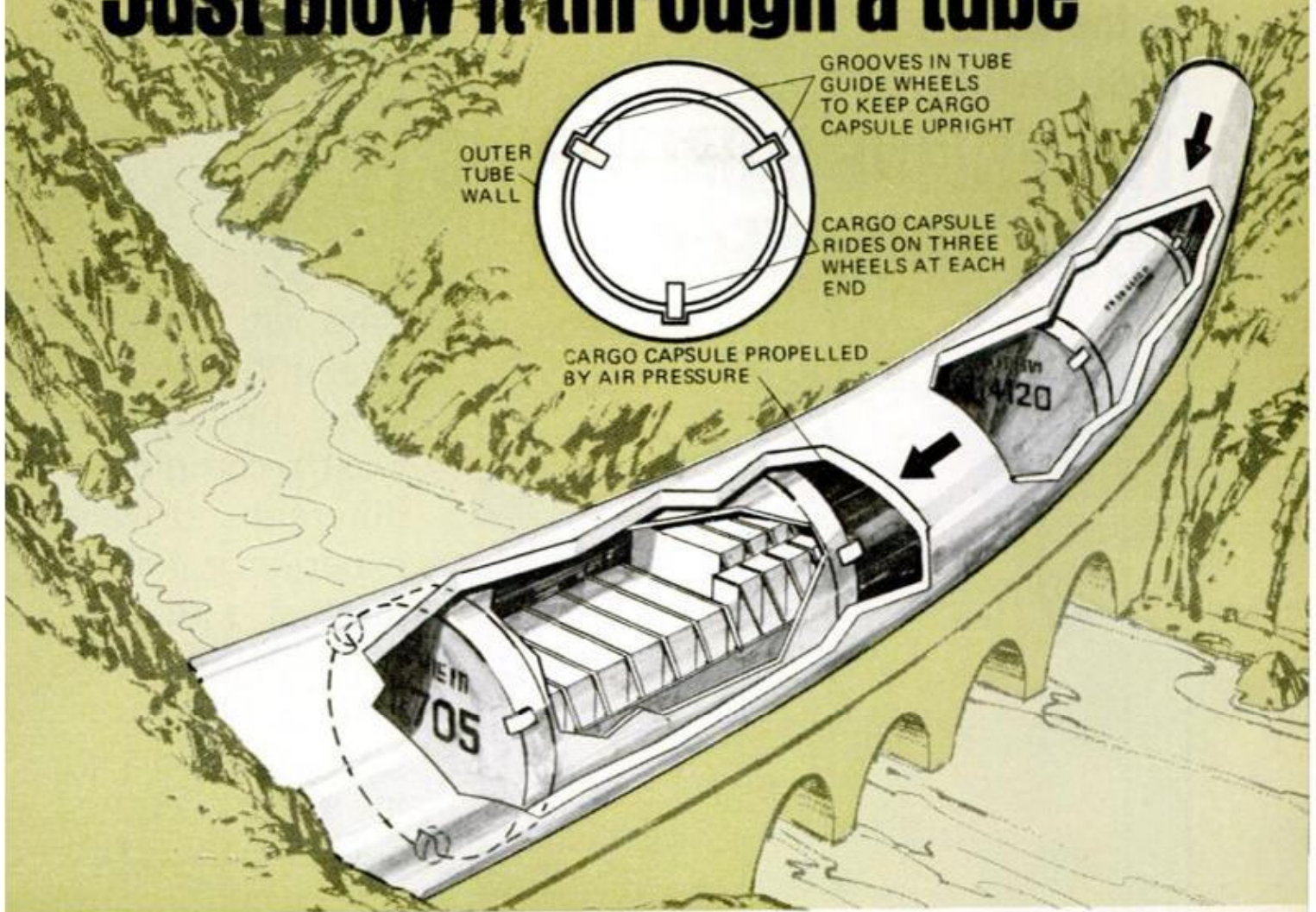
Fast freight:

Remember the pneumatic money-changing tubes they used to have in department stores back in the old days? If you're under 40, you probably don't, but the system was intriguing. The sales clerk would put your money in a small round cylinder, slip the cylinder into a tube and, with a whoosh of air, off it would go flying through a pipeline to the cashier's office, often several floors away. Moments later, back would come your change in the same tube. Now the British Hydromechanics Research Assn. at Cranfield, England, is proposing such a system for transporting freight quickly and cheaply through long underground tubes. The freight would be carried in cylindrical capsules propelled by air pressure, requiring no power or crew. Meanwhile, back in the United States, a Rand Corp. physicist is working on a similar system for passenger travel. In his version, people-carrying pods would be magnetically propelled through vacuum-sealed, frictionless tunnels at incredible speeds up to 10,000 mph, making it possible to cross the country from coast to coast in half an hour!

Coming: Padded landings for parachutists

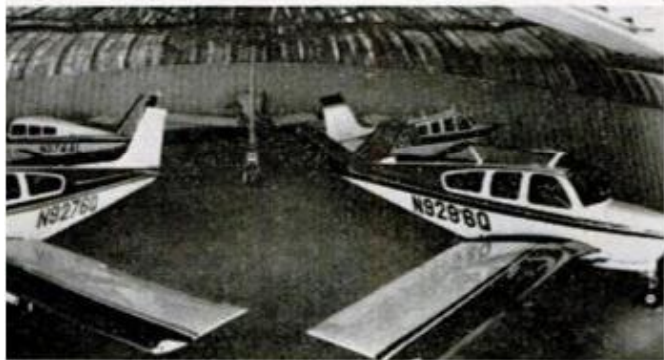
Parachuting airmen and paratroopers often hit the ground hard enough to cause severe leg and ankle injuries. With this inflatable landing pad, a cushion of air softens the impact and helps to prevent such injuries. The pad is worn collapsed on one foot, something like an overshoe. During the descent, a valve in the toe is pressed with the other foot. This releases a small built-in compressed-air cylinder, inflating the pad in a few seconds. The chutist then places both feet on the cushion just before striking the ground to absorb the shock. The clever device was invented by Henry Doherty, 19B Byrne Court, Wayne, N. J.

Just blow it through a tube



Lazy Susan airplane hangar

Jockeying small planes in and out of a crowded hangar can be a nuisance, often requiring several ships to be moved to reach another. This rotating hangar is designed to end the fuss. Just push a button and the revolving floor swings around until the desired plane is right at the door. Made by Aerodome Industries of Wichita, Kans., the device is said to house twice as many planes as a conventional hangar of equivalent area. ★★★



In the world's
most exciting cars...

THE ENGINE'S BREATHING DOWN YOUR NECK!



Cars with the engine in the middle offer the enthusiast a completely different driving experience. Prices start at a reasonable \$4000, but take a couple of quick, big steps up to a very enthusiastic \$25,000!

By **BILL HARTFORD**
Auto Editor

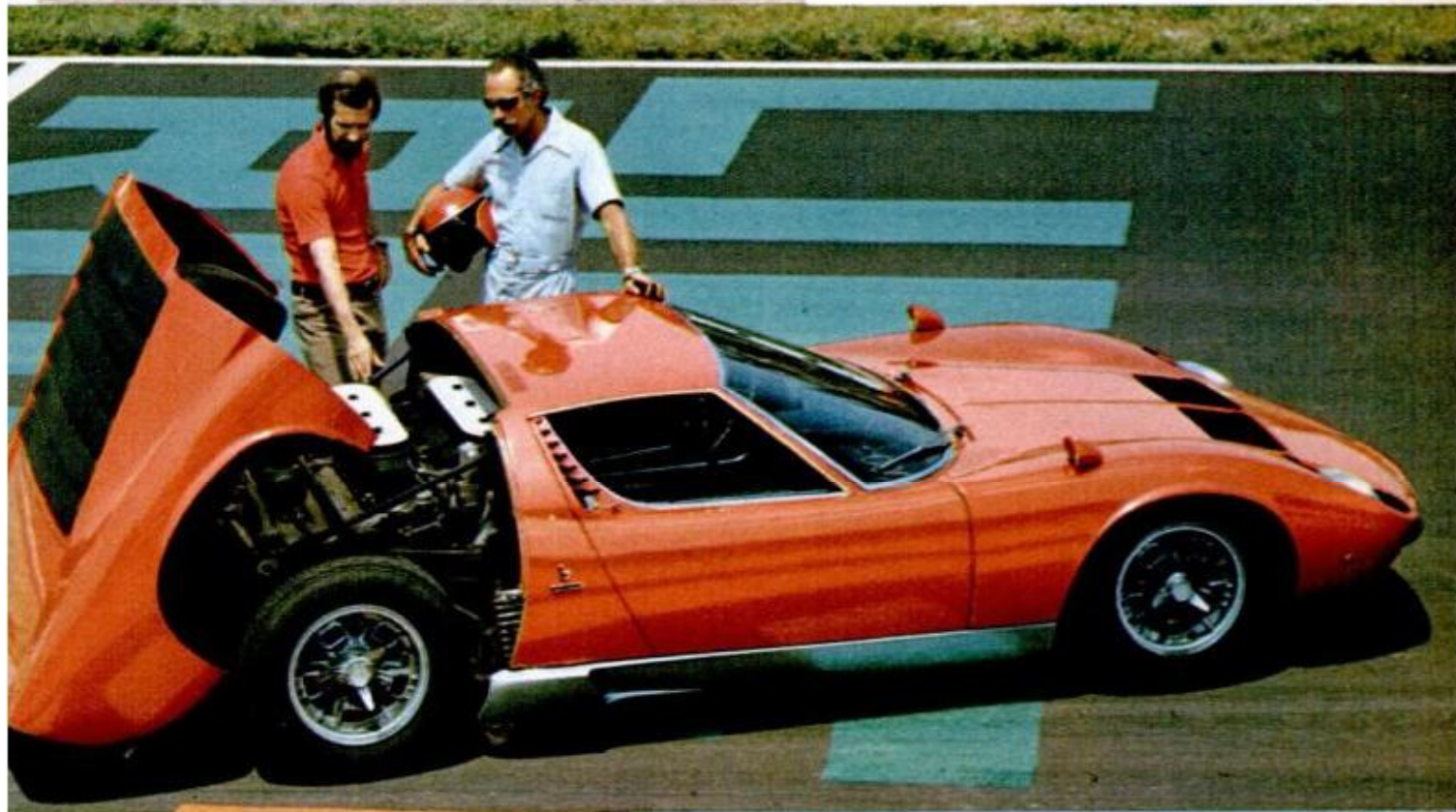
Photos by Irv Dolin

“YOU CAN GO AROUND A CORNER SO FAST that you'll throw the radio off tune!” That's merely one of the hyperboles about the handling of mid-engine cars that buffs bandy about. Sounds like a real exaggeration, but it could just be true. I never found out. Who cares about radio when the crescendo of a double-overhead-cam V12 winding up to red line is playing right behind your ear; when speed has fused the dashed line on the road into a solid, white stripe and all you want to feel are the G forces in the turns!

We took out all the mid-engine machines that you can buy in the United States to find out if they really give the enthusiast his money's worth. What price enthusiasm? A quick \$25,000 for the Maserati Bora, certainly the most exciting mid-engine car you can buy and drive here. The Lamborghini Miura is in the same price range, but, hurry, there aren't many left. In Italy, the Miura's successor, the Countach, is being tested and readied for limited production—not for us, however: There's no place for a five-mph bumper on its knife-edge nose! Going down the scale, there's the \$14,000 Ferrari Dino, the



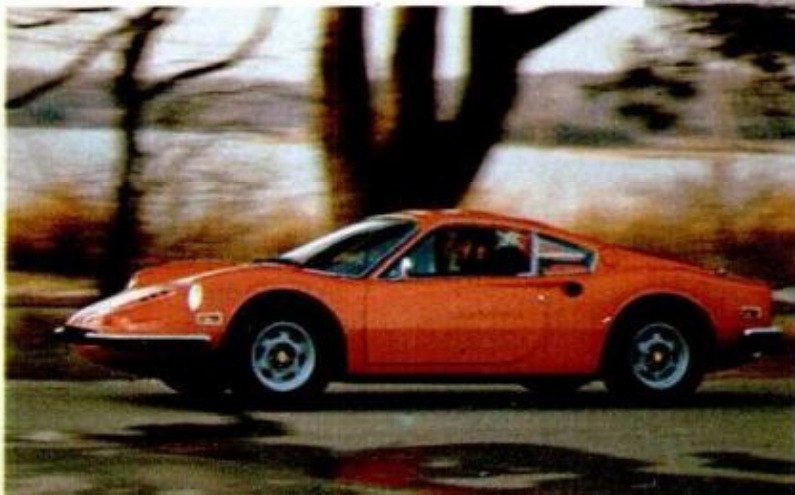
PORSCHE 914 is an affordable, easy-to-live-with, mid-engine machine that combines operating economy with performance; sports-car features with excellent creature comfort. The 1700 cc, fuel-injected Four (VW 411 engine) is accessible through lid ahead of the rear trunk. Lower gears of the five-speed transmission allow very strong acceleration while the tall top gear gives extraordinary high-speed (over 100 mph) cruising economy at a low noise level for an air-cooled engine



LAMBORGHINI MIURA, shown here on the grid at Lime Rock, is a car that has to be experienced on a racing circuit since there are few roads where it can be driven as it was meant to be: The machine is capable of speeds up to 180 mph—fine on Italian *autostrada* but not on U.S. 66! The V12 has two overhead camshafts per cylinder bank and breathes through four Weber carburetors. The transversely mounted engine is easily accessible with the rear body panel lifted



DE TOMASO PANTERA, made in Italy for Ford, is free for the looking at select Linc-Merc dealers. The 351 V8 blasts it to 60 mph within 6 seconds



FERRARI DINO V6 displaces a modest 147 cu.in., but with its twin overhead cams and electronic ignition it winds up to 7600 rpm letting out 195 horses



\$10,000 de Tomaso Pantera, the \$5500 Lotus Europa and the that's-more-like-it, \$4000 Porsche 914.

All the cars are two-seaters with engines placed immediately behind the cockpit either longitudinally or transversely in a sidewinder position, with gearbox integral or hanging out behind. (They all seem very conventional when compared to the Countach which turns the engine back to front with the gearbox forming an armrest between driver and passenger!)

The mid-engine mystique derives directly from the successful adaptation of this configuration to racing cars. The weight distribution and handling characteristics made possible by placing the engine ahead of the rear axle put a car one up on the competition. Add some concessions to highway regulations and driver

comfort, put it on the road, and you've got a car meant to be *driven*.

Both Ford and Chevy have played with prototypes of mid-engine road cars for would-be racing drivers, Ford having gained considerable expertise with its GT40 and Mark II of Le Mans fame, but so far neither has made the decision to go into production with one. The only things being cranked out now are rumors: How about a mid-engine Wankel Corvette for 1975? That's one. Closer to reality is a small, economical mid-engine replacement for the Fiat 850 Spyder and, already being tested is the exotic Lancia Stratos. There's hardly a manufacturer without a mid-engine concept on the boards. The boom may be around the corner. Meanwhile . . .

The Maserati Bora is the saltiest car we've ever driven—not because it was the first Bora off the boat from Italy, but



THE INCREDIBLE

Maserati Bora dominates the page as it dominates the mid-engine car scene. *PM* was the first U.S. magazine to drive and photograph this new machine, the first to arrive here last summer

for its boldness of design and incredible performance. It is, at the same time, the most unusually engineered and refined mid-engine machine of the group.

The recently concluded collaboration between Citroen and Maserati has not only resulted in the Maserati-powered Citroen SM, but in a Bora with famed Citroen hydraulics. At the touch of a switch you adjust the driver's seat and move the pedals fore and aft to tune in the perfect driving position.

LIFTING LID on Bora reveals carpeted cover which is removed to reach the four-cam, five-liter V8



As with the other mid-engine cars in the group, all the running gear, hydraulics and electrics have to be tucked into all available corners, sometimes making accessibility difficult—not to mention finding things in the first place! Something like finding and checking the battery, which in some of the cars can be aggravating, is fun in the Bora: You slide it out of its secret compartment on tracks—slick and sanitary, aircraft style.

The Bora's worth 25 thousand, and I've figured out how you can swing it: Instead of wasting your time with five, bland, \$5000 cars over the next 15 or 20 years, get a Bora now and run it into the ground!

The Lamborghini Miura is at the end of its tenure as *the* big-muscle mid-engine. Its influential design was put into production in the late '60s and, along with the de Tomaso Mangusta (older brother of the Pantera), helped pave the way for the mid-engine concept in a practical road machine.

The car is the closest thing to a brute road racer in a street-legal trim, rocket-

(Please turn to page 206)

**The
dazzle
from
Detroit**



opens with an 'ultimate Nova,' a



**a growling hatchback and a charging
but the bodywork blitz is from**



'73
CARS

FORD (TORINO) RANCHERO

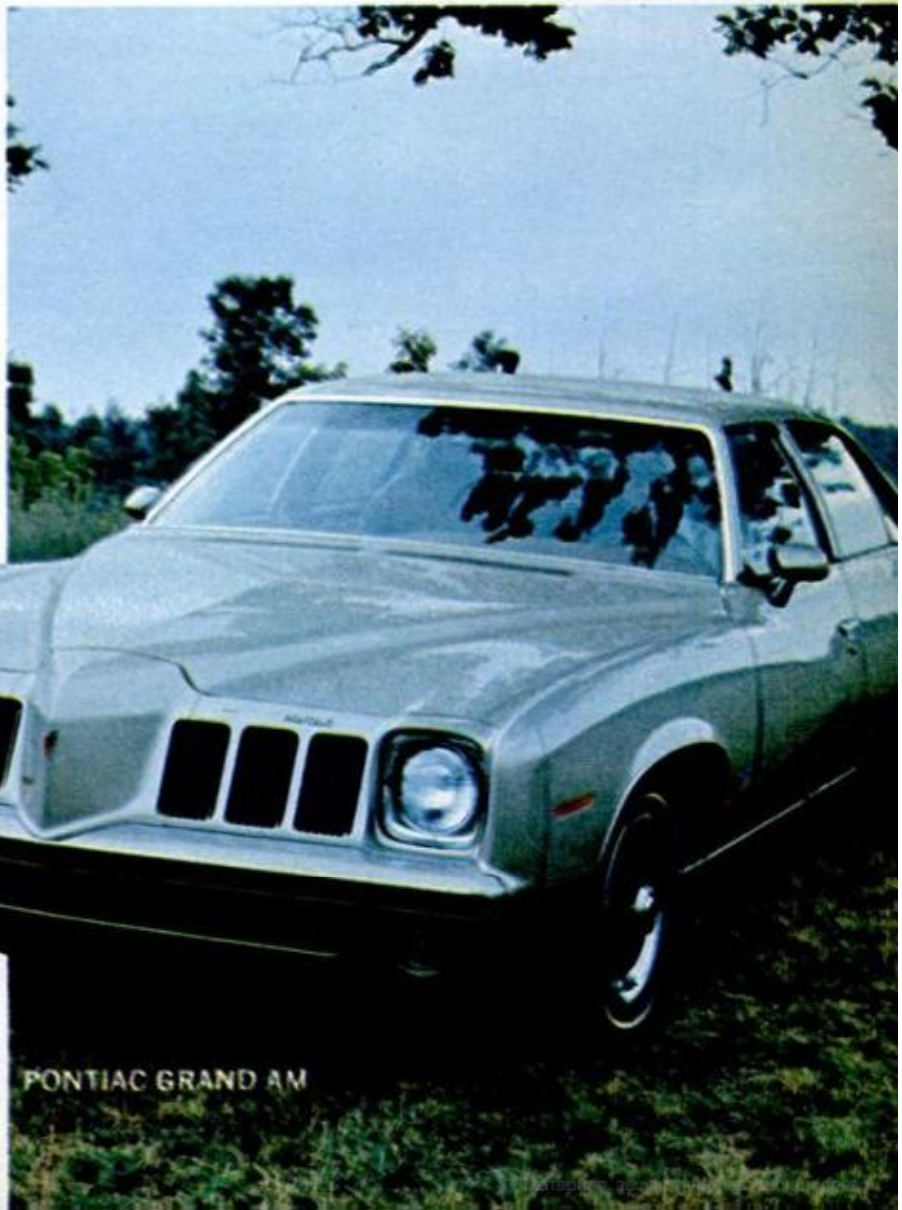


tougher Torino,



'slot car,'
GM...

with intermediates
boasting
fender-skirt
nostalgia
and '2001'
nose cones!



PONTIAC GRAND AM



AMC:

Hornet hatchback leads the lineup

By
MICHAEL LAMM
West Coast
Editor

AMC HATCHES a new hatchback this year—a good-looking little coupe in its Hornet line. Fact is, Hornets turn out to be the most changed of all American Motors' not-so-different 1973 models.

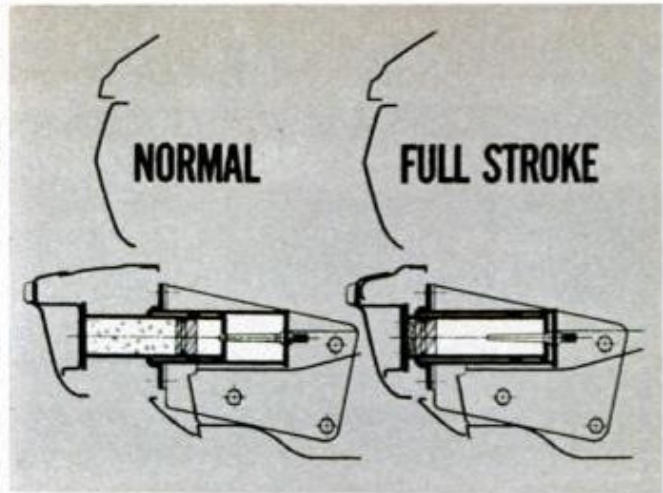
The Hornet hatchback comes in answer to similar body styles from Vega, Pinto and the 1973 GM intermediates. Hatchbacks are 2+2 coupes with a third door astern. This third door lifts and the rear seat folds flat to convert the coupe into a miniature wagon. With its rear bench folded, the Hornet hatchback has 23 cu. ft. of cargo space. With the seatback upright, it's 9.5 cu. ft.

AMC makes a hinged cargo floor optional for the hatchback. This covers a hidden storage compartment. If you order the hinged floor, you get a space-saver spare tire along with it.

All Hornets are facelifted this year: V-grille, peaked front fenders, a recessed hood and wraparound taillights. There's an X-package option for the hatchback, with slotted mag wheels, rally stripes and sporty interior.

The Hornet's wheelbase stays at 108 inches, but overall length is up 6½ inches due to new impactable bumpers front and rear. AMC's front bumpers on Gremlins, Hornets, Matadors and Ambassadors use the telescoping shock-absorber principle. Oil and nitrogen gas inside two telescoping cylinders at the front subframe horns take the shock of up-to-5-mph direct hits and 2½-mph side impacts. After impact, spring loading returns the face bar to its normal position. These AMC bumpers are designed to "give" as much as 3½ inches.

The 1973 Javelin and AMX use a different bumper system—



ENERGY-ABSORBING front bumper telescopes up to 3½ inches and returns to normal. Front steel cylinder is attached to bumper, the rear cylinder to the car frame. It's standard on all cars except Javelin which uses nondynamic system. Recoverable system is optional on rear of Hornet and Gremlin

FASHION INTERIORS by Pierre Cardin and Aldo Gucci are continued in '73 Javelins and Hornet Sportabouts. New for '73 is a blue-jean "Levi's" interior for Gremlin. Fabric is actually nylon to conform to flammability standards and meet requirements for wear and stain resistance for car interiors

two rigid rubber guards up front. AMC's ponycars have no real wall-to-wall front bumpers. Rear bumpers on all AMC lines are rigid, yet you can order bounce bumpers (like the front ones) on the Gremlin and Hornet. They're options on those two lines alone. AMC bumpers are so good that Allstate is offering up to 20 percent discounts on collision insurance.

Outwardly, Gremlins, Matadors, Javelins and Ambassadors go virtually unchanged—very minor liftings of face. There's a cute Levi's interior scheme for the Grem: blue-jean material that looks just like the real thing. Actually, the

Levi's upholstery is spun nylon, not cotton denim but the copper rivets are real.

There's no more SST line in the Ambassador, just the Brougham. But the Ambassador's standard equipment list has grown considerably. It now includes not only airconditioning, automatic trans and V8, but also power steering, power disc brakes, whitewalls, tinted glass, undercoat, clock, lapse-swipe wipers, remote outside mirror and vanity.

Nothing much is new in AMC's engine compartments except smog stuff: an exhaust-gas recirculating system to help cut

(Please turn to page 202)

1973 AMERICAN MOTORS SPECIFICATIONS

Car	Body Style	Wheel- base (in.)	Overall Length (in.)	Overall Width (in.)	Track f/r (in.)	Engines in Model(s) Series* (Displacement—V8 except as noted—carburetion)	1973 Changes (Not federally regulated)
Gremlin	2-dr. sedan	96.0	165.5	70.6	57.5/57.0 ¹	232-6-1bbl., 258-6-1bbl., 304-2bbl.	Refinements, "Levi's" interior
Hornet	2-dr. sedan, hatchback, 4-dr. sedan, 4-dr. wagon	108.0	184.9	71.0	56.4/57.0 ²	232-6-1bbl., 258-6-1bbl., 304-2bbl., 360-2bbl.	Hatchback coupe added, new grilles and front treatment
Javelin	2-dr. hdtp.	110.0	192.3	75.4	59.1/60.0	232-6-1bbl., 258-6-1bbl., 304-2bbl., 360-2&4bbl., 401-4bbl.	New taillights, minor grille changes
Matador	2-dr. hdtp., 4-dr. sedan, 4-dr. wagon	118.0	208.5 ³	77.2	59.9/60.0	Same as above	Minor trim changes
Ambassador	2-dr. hdtp., 4-dr. sedan, 4-dr. wagon	122.0	212.9 ⁴	77.2	59.9/60.0	304-2bbl., 360-2&4bbl., 401-4bbl.	More std. equip.: power steering, disc brakes, radio, more

1, 57.2/56.6 for V8s; 2, 57.1/56.6 for V8s; 3, wagons 207.7 in.; 4, wagons 212.0 in. *Not all engines available in all models

'73
CARS



FORD LTD TWO-DOOR HARDTOP is among 16 models of big Fords—most-changed cars in '73 lineup

FORD/LINCOLN-MERCURY

Biggest changes for biggest cars

By MICHAEL LAMM, West Coast Editor

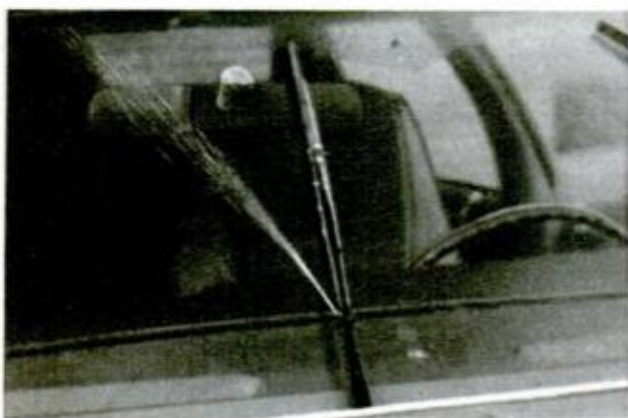
BUXOM BUMPERS might give FoMoCo cars that big-shelf-in-the-front look, but as one company spokesman puts it, "Everybody's gonna know they're 1973 models."

Big news from Dearborn this year is the complete restyling of the company's two major full-sized lines. All big Fords and Mercurys again share basic body shells, and have totally restyled sheet metal from the beltline down. Dashboards and interiors are likewise redesigned, and four-door Ford and Mercury rooflines are different to boot.

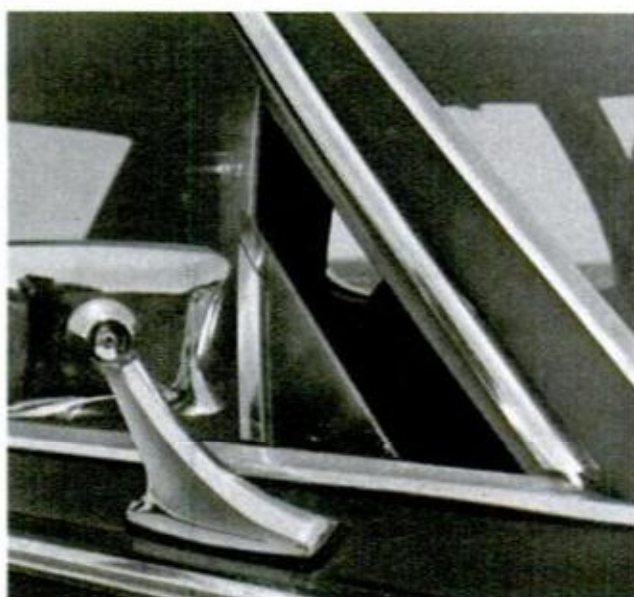
No startling changes, though, from Pinto, Maverick, Comet, Mustang, Cougar,

Lincoln, nor Mark IV—just evolutionary refinements. Torino, Montego and Thunderbird get different grilles and are less like their 1972 forebears.

Some of FoMoCo's 1973 Better Ideas are: Windshield-washer nozzles mounted onto the wiper arms. A hammock-like, nylon spare-tire extractor for the big wagons. Disappearing power mini-vents that come up out of the front doors in Ford, Mercury and Lincoln four-doors. An optional desk/table for wagons. A right-hand outside rear-view mirror that's adjustable by a dashboard knob. An anti-theft electronic alarm system. And a new AM/FM/multiplex stereo radio/tape sys-



FULL-SIZE FORDS AND MERCURYS offer new technical features, including windshield-washer jets on the wiper arms for more positive cleaning. Optional power mini-vent windows raise and lower vertically



1973 FORD AND LINCOLN-MERCURY SPECIFICATIONS

Car	Body Style	Wheel- base (in.)	Overall Length (in.)	Overall Width (in.)	Track f/r (in.)	Engines in Model(s) Series* (Displacement—V8 except as noted—carburetion)	1973 Changes (Not federally regulated)
Pinto	2-dr. sedan, 2-dr. wagon	94.2	164.5 ¹	69.4	55.0/55.0	97.6-4-1bbl., 122-4-1bbl.	No major changes
Capri	2-dr. sport coupe	100.8	174.0	64.8	53.0/52.0	122(2000cc)-4-2bbl., 155(2600cc)-V6-2bbl.	2-liter Four now standard
Maverick	2-dr. sedan, 4-dr. sedan	103.0 109.9	183.3 190.2	70.5	56.5/56.5	200-6-1bbl., 250-6-1bbl., 302-2bbl.	200-cu.-in. Six now standard
Comet	2-dr. sedan, 4-dr. sedan	103.0 109.9	185.4 192.3	70.5	56.5/56.5	200-6-1bbl., 250-6-1bbl., 302-2bbl.	200-cu.-in. Six now standard
Mustang	2-dr. hdtp., convertible, fastback	109.0	193.8	74.1	61.5/61.0	250-6-1bbl., 302-2bbl., 351-2bbl., 351-4bbl.	Trim changes
Cougar	2-dr. hdtp., convertible	112.0	199.5	75.0	61.5/61.0	351-2bbl., 351-4bbl.	Disc brakes standard
Torino	2-dr. hdtp., fastback, 4-dr. sedan, 4-dr. wagon	114.0 118.0	208.0 212.0 ²	79.3	62.8/62.9	250-6-1bbl., 302-2bbl., 351-2&4bbl., 400-2bbl., 429-4bbl.	Different grilles distinguish high and low series
Montego	2-dr. hdtp., fastback, 4-dr. sedan, wagon	114.0 118.0	211.3 215.3 ³	78.6	62.8/62.9	250-6-1bbl., 302-2bbl., 351-2&4bbl., 400-2bbl., 429-4bbl.	Different grilles distinguish high and low series, low-back front seats
Ford	2-dr. hdtp., 4-dr. hdtp., 4-dr. sedan 4-dr. wagon	121.0	219.5 ⁴	79.6	63.3/64.3	351-2bbl., 400-2bbl., 429-4bbl.	Complete restyling inside and out, disc brakes standard
Mercury	2-dr. hdtp., 4-dr. hdtp., 4-dr. sedan, 4-dr. wagon	124.0 ⁵	222.5	79.6	63.3/64.3	351-2bbl., 400-2bbl., 429-4bbl., 460-4bbl.	Complete restyling inside and out, disc brakes and steel radial tires standard
Thunderbird	2-dr. hdtp.	120.4	218.9	79.7	63.0/63.1	429-4bbl., 460-4bbl.	New grille, optional opera windows
Mark IV	2-dr. hdtp.	120.4	223.3	79.8	63.0/63.1	460-4bbl.	New grille, Silver Luxury Coupe
Lincoln	2-dr. hdtp., 4-dr. sedan	127.0	229.5	79.6	64.3/64.3	460-4bbl.	New Town Coupe model

*Not all engines available in all models
1, wagons 173.7; 2, wagons 215.6; 3, wagons 218.5; 4, wagons 222.8; 5, wagons 121.0 6, wagons 234.4

tem that's optional for almost all lines.

Many of Ford Motor Co.'s cars now come with inside hood latches. Front disc brakes are standard for 1973 on all full-sized Fords, Mercurys, Cougars, Lincolns and Mark IVs. Engines and power trains remain pretty much as before, but two engines have been dropped—the 170-c.i.d.

Six from the Maverick/Comet lines plus the 240-c.i.d. Six. The two-barrel 302 V8 is no longer available in full-sized Fords.

FoMoCo's bashable front bumpers consist of a heavy steel-face bar with a steel or aluminum reinforcement behind it. This attaches to the front frame horns or un-

(Please turn to page 202)

MERCURY MARQUIS Brougham has new sheet metal below belt, new greenhouse with thinner windshield pillar





CHRYSLER-PLYMOUTH/
DODGE

The emphasis is on engineering

By **ROBERT LUND**, Detroit Auto Editor

CHRYSLER CORP.'S CARS for '73 are good, solid machines, generally mainstream in styling but maybe a lap ahead of the competition in engineering. Big C's done the same thing with its '73s that it did with its '72s. Certain improvements have been applied to all cars, regardless of price class, excepting only the two imports, Colt and Cricket. Here's a list of improvements common to all Chrysler nameplates:

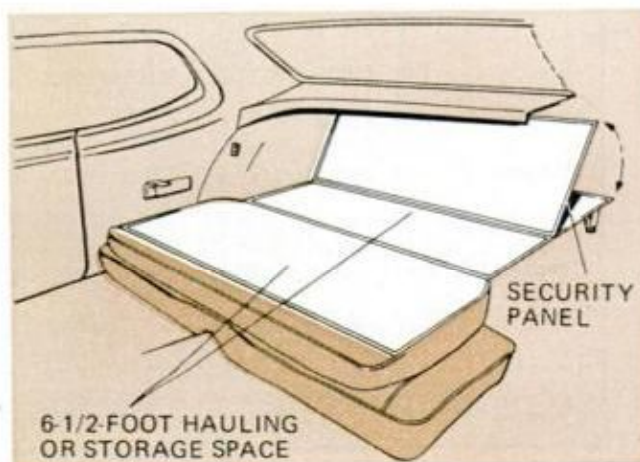
Disc brakes: Standard on V8s, optional if you buy either a six-cylinder Dart or Valiant.

Quieter ride: Chrysler went whole hog in this department, from making chassis modifications to reduce road noise to adding sound-deadeners to the hood, dash, floor pan, trunk, rear shelf and C-pillar.

Protection against rust: The company's using a new mechanical plating process to apply antirust treatment to parts, safety-related parts in particular—fasteners, screws and bolts.

Windshield wipers: Better match-up of the rubber blade with the surface of the

122



DART AND VALIANT feature a fold-down rear seat and fold-down security panel opening to the trunk



DIGITAL CLOCK gives numerical readout with an accuracy within one minute per month; it's optional on all Chrysler models, standard on the Imperial

windshield. The blade's more rigid, so you don't get as much smearing and streaking.

Electronic ignition: Not exactly a new item, because Chrysler made this standard on all cars last June.

In the government-says-you've-got-to-have-it department, all '73s will sport these improvements:

Steel guard rails in doors: Chrysler's had this safety protection against side-

POPULAR MECHANICS

impact accidents in some cars since 1970. The beams will go in all production beginning Jan. 1, 1973.

Pollution control: To cut emissions of oxides of nitrogen (NOx), Chrysler's using what it calls an OSAC (orifice spark advance control) system in its '73 engines. The OSAC valve controls the rate of buildup vacuum in the vacuum advance chamber of the distributor. Vacuum advance is delayed during acceleration by restricting the flow of air from the distributor vacuum advance chamber to the carburetor port.

Fire-retardant materials: All interior fabrics are treated chemically to slow the burn rate in the event of fire.

Impact-resistant bumpers: These are federally regulated—capable of taking a five-mph impact in the front, half that in the rear, without damaging safety items.

Chrysler's cut the number of models from a total of 90 cars last year to 87 for 1973. Plymouth dropped three models of the Fury, and the Chrysler line is down by one car. (For you mathematicians who'll notice the figures don't add up, the

explanation is that Cricket added a car since the '72s came out.)

Checking 'em off by name, here's what's new on individual cars:

CHRYSLER: Alternator, airconditioning compressor, power-steering pump and air pump have been relocated to make servicing easier. There's a new power door-lock switch, and the security alarm system the company announced last spring is a new option. The alarm causes the horn to blow and all lights to flash off and on if a thief attempts to get into the passenger section, engine compartment or trunk. An electronic digital clock, first one offered by an auto company, is another new extra.

CHRYSLER IMPERIAL: Six inches longer than last year because of the new energy-absorbing bumpers. Trunk-lid release, an option, is electric, instead of vacuum-actuated as last year. You can also order the security-alarm rig and digital clock.

DODGE CHALLENGER: Both V8 engines offered on this car will get a new

(Please turn to page 204)

1973 CHRYSLER-PLYMOUTH AND DODGE SPECIFICATIONS

Car	Body Style	Wheel-base (in.)	Overall Length (in.)	Overall Width (in.)	Track f/r (in.)	Engines in Model(s) Series* (Displacement—V8 except as noted—carburetion)	1973 Changes (Not federally regulated)
Dodge Colt	2-dr. hdt. coupe, 4-dr. sedan, wagon	95.3	166.0	61.8	50.6/50.6	97.5-4-2bbl.	None
Plymouth Cricket	4-dr. sedan, wagon	98.0	167.0	62.5	51.0/51.3	91.4-4-1&2bbl.	New station wagon model
Dodge Sport	2-dr. coupe	108.0	200.0	71.7	59.1/55.6	198-6-1bbl., 225-6-1bbl., 318-2bbl., 340-4bbl.	Fold-down rear seat, trunk panel
Dart, Swinger	2-dr. hdt., 4-dr. sedan	111.0	203.8	69.7	59.1/55.6		
Plymouth Valiant	2-dr. coupe, 4-dr. sedan	108.0	195.8	71.0	59.1/55.6	198-6-1bbl., 225-6-1bbl., 318-2bbl., 340-4bbl.	Fold-down rear seat, trunk panel
Duster	2-dr. hdt.	111.0	199.6	71.0	59.1/55.6		
Scamp	2-dr. hdt.	108.0	193.0	75.6	60.2/60.7	318-2bbl., 340-4bbl.	Refinements, 6-cylinder engine dropped
Plymouth Barracuda	2-dr. hdt.	110.0	198.2	76.4	60.2/60.7	318-2bbl., 340-4bbl.	Refinements, 6-cylinder engine dropped
Dodge Challenger	2-dr. hdt.	110.0	198.2	76.4	60.2/60.7	318-2bbl., 340-4bbl.	Refinements
Dodge Charger	2-dr. coupe, hdt.	115.0	212.7	77.0	61.9/62.0	225-6-1bbl., 318-2bbl., 340-4bbl., 400-2&4bbl.	
Coronet	4-dr. sedan, wagon	118.0	212.9	77.8	61.9/63.4	440-4bbl.	
Plymouth Satellite	2-dr. hdt., coupe, 4-dr. sedan, wagon	115.0	210.8	79.1	61.9/62.0	225-6-1bbl., 318-2bbl., 340-4bbl., 400-2&4bbl., 440-4bbl.	Refinements
Plymouth Fury	2-dr. hdt., 4-dr. sedan, hdt. wagon	117.0	213.3	78.6	61.9/62.0		
		117.0	216.1	79.2	61.9/63.4		
		120.0	223.4	79.8	62.1/63.4	318-2bbl., 360-2bbl., 400-2bbl., 440-4bbl.	Refinements
Dodge Polara	2-dr. hdt., 4-dr. sedan, hdt., wagon	122.0	227.5	79.8	62.1/63.4		
Monaco	2-dr. hdt., 4-dr. sedan, hdt., wagon	122.0	226.6	79.6	62.1/63.4	318-2bbl., 360-2bbl., 400-2bbl., 440-4bbl.	Refinements, 6-cylinder engine dropped
Chrysler	2-dr. sedan, hdt., 4-dr. sedan, hdt., wagon	124.0	230.2	79.4	62.1/63.4	400-2bbl., 440-4bbl.	Refinements, 360V8 engine dropped
Chrysler Imperial	2-dr. hdt., 4-dr. hdt.	122.0	229.6	79.4	62.1/63.4		
		127.0	235.3	79.6	62.4/63.4	440-4bbl.	Refinements

*Not all engines available in all models



The intermediates steal the show

By ROBERT LUND, Detroit Auto Editor

SOMEWHERE IN THE VASTNESS of the world's largest corporation—General Motors, natch—there's a crew of alchemists who have discovered the secret of creating silk purses out of sows' ears. Sort of an industrial version of the Avon lady. Plain girls made pretty.

GM has done it again with its '73 cars, transforming what looked like losers into almost certain winners.

First, there are the new intermediates. Colonnade styling, GM calls it. The story behind this is that the government has been saying it might make a B-pillar mandatory in all cars. Outlaw the hard-top. GM took the threat to heart in re-

making its mid-size cars and stuck a post right up the center of the side. If that sounds ugly, reserve judgment until you look at the pictures or, better, see the cars. They're handsome automobiles.

Second, remember all the weeping Detroit did over impact-absorbing bumpers? They were going to jut out like the lower lip on a bulldog and ruin the looks of cars. It hasn't happened. There's not a bad-looking bumper in the GM fleet.

GM's made a lot of other changes that apply to all or nearly all nameplates. Such as:

Along with other auto firms, it's using more sound deadeners and insulation in



LUXURY LE MANS TWO-DOOR has fixed rear side windows and fender skirts that are standard equipment

1973 GENERAL MOTORS SPECIFICATIONS

Cars	Body Style	Wheel- base (in.)	Overall Length (in.)	Overall Width (in.)	Track f/r (in.)	Engines in Model(s) Series* (Displacement—V8 except as noted—carburetion)	1973 Changes (Not federally regulated)
Buick Opel	2-dr. sedan, 4-dr. sedan, 3-dr. wagon, 2-dr. sports coupe	95.7	161.9 164.6 171.0	62.2 64.3	49.4/50.6 52.4/52.0	115.8-2bbl.	None
Chevrolet Vega	2-dr. sedan, coupe, wagon, delivery	97.0	172.2	65.4	55.1/54.1	140.4-1&2bbl.	Refinements
Chevrolet Corvette	2-dr. coupe, convert.	98.0	184.7	69.0	58.7/59.5	350-2&4bbl., 454-4bbl.	New front end, refine- ments
Pontiac Firebird	hdtp. coupe	108.0	192.1	73.4	61.3/60.0	250-6-1bbl., 350-2bbl., 400-2&4bbl., 455-4bbl.	Refinements
Chevrolet Camaro	2-dr. coupe	108.0	188.4	74.4	61.3/60.0	250-6-1bbl., 307-2bbl., 350-2&4bbl.	LT coupe, refine- ments
Chevrolet Nova	2-dr. hatch- back, 2-dr. coupe, 4-dr. sedan	111.0	194.3	72.4	59.8/59.6	250-6-1bbl., 307-2bbl., 350-2&4bbl.	Hatchback, refine- ments
Pontiac Ventura	2-dr. hatch- back, 2-dr. coupe, 4-dr. sedan	111.0	197.5	72.4	59.9/59.6	250-6-1bbl., 350-2bbl.	Hatchback, refine- ments
Oldsmobile Omega	hatchback, 2-dr. coupe, 4-dr. sedan	111.0	197.5	72.2	59.1/58.8	250-6-1bbl., 350-4bbl.	All-new model
Chevrolet Chevelle	2-dr. coupe 4-dr. sedan, wagon,	112.0 116.0	202.9 206.9	76.6	61.5/60.7	250-6-1bbl., 307-2bbl., 350-2&4bbl., 454-4bbl.	Restyled, refinements
Pontiac Le Mans	2-dr. hdtp. 4-dr. hdtp., wagon	112.0 116.0	207.4 211.4 213.3	77.7	61.5/60.7	250-6-1bbl., 350-2bbl., 400-2&4bbl., 455-4bbl.	Restyled, refinements
Buick Century (Regal)	2-dr. coupe, 4-dr. sedan, wagon	112.0 116.0	208.4 212.4 216.6	78.0	61.5/60.7	350-2&4bbl., 455-4bbl.	Restyled, name change, refinements
Oldsmobile Cutlass 'S'	hdtp. coupe hdtp. coupe, hdtp. sedan	112.0 116.0	207.0 211.0 212.9	76.5	61.4/60.7	350-2&4bbl., 455-4bbl.	Refinements
Chevrolet Monte Carlo	2-dr. sport coupe	116.0	210.4	77.6	61.9/61.1	350-2&4bbl., 454-4bbl.	Restyled, refinements
Pontiac Grand Prix	2-dr. hdtp. coupe	116.0	216.6	78.3	61.9/61.1	400-4bbl., 455-4bbl.	Restyled, refinements
Buick Rivera	2-dr. hdtp. coupe	122.0	223.4	79.9	63.6/64.0	455-4bbl.	Refinements
Oldsmobile Toronado	2-dr. coupe	122.0	226.8	79.8	63.5/63.6	455-4bbl.	Refinements
Chevrolet	2-dr. coupe, convert. 4-dr. sedan, sports sedan, wagon	121.5 125.0	221.9 226.8	79.5	64.1/64.0	250-6-1bbl., 350-2&4bbl., 400-2&4bbl., 454-4bbl.	Caprice convertible, refinements
Pontiac Catalina (Grande Ville)	2-dr. hdtp., 4-dr. hdtp., 4-dr. sedan, convert.	124.0 127.0	224.8 228.8	79.9	64.1/64.0	350-2bbl., 400-2&4bbl., 455-2&4bbl.	Refinements
Cadillac Eldorado	2-door coupe, convert.	126.3	222.0	79.8	63.5/63.0	500-4bbl.	Refinements
Buick Le Sabre (Centurion)	2-dr. hdtp. coupe, con- vert., 4-dr. hdtp. sedan	124.0	224.2	79.6	63.6/64.0	350-2&4bbl., 455-4bbl.	
Oldsmobile Delta 88	hdtp. coupe, 4-dr. hdtp. sedan, convert.	124.0	225.0 226.3	79.5 79.6	63.7/64.0	350-2bbl., 455-2bbl.	Refinements
Buick Electra 225	2-dr. hdtp. coupe, 4-dr. hdtp. sedan, wagon	127.0	229.5	79.6	63.6/64.0	455-4bbl.	Refinements
Oldsmobile 98	4-dr. sedan, 4-dr. coupe	127.0	230.3	79.6	63.7/64.0	455-4bbl.	Refinements
Cadillac	2&4-dr. hdtp. 4-dr. sedan 4-dr. sedan, limousine	130.0 133.0	228.5 231.5	79.8	63.0/63.0	472-4bbl.	Refinements

*Not all engines available in all models

floors, doors, in the sail area, plenum chamber and under the hood. Makes 'em ride quieter. Also in the interest of a softer, better cushioned ride, GM's using more body mounts and thicker mounts. Engine mounts have also been beefed up to make them more durable. The company doesn't want any more whopper recalls such as it had last year to replace weak motor mounts.

Some uncredited soldier in GM engineering has come up with a nifty idea for the front-suspension, lower-control-arm ball joint to beat mechanics who want to sell you a replacement when you don't need it. The amount of wear of the ball joint is revealed by the position of a wear indicator neck on the ball-stud seat. You can tell when you need a new one just by looking at the joint. As long as the neck protrudes from the bottom of the housing, replacement isn't necessary.

There are two new items for wagons and hatchbacks. Hatchbacks have telescoping tubes—GM calls them "telestruts"—to support the hatchback door in the open position. On wagons there's a new warning light on the dash that flashes a message—LIFTGATE AJAR—if you start the car with the gate open or only partially latched.

New to GM (but not new to the industry) is a swivel bucket seat. It swivels 90°, making it easier to get in and out of the car and improving access to the back seat. The swivel feature costs extra.

On most regular-size cars, the switch for changing from low-beam lights to high beams has been moved off the floor and made part of the directional signal lever. You switch beams by giving the turn signal a tug toward you, in the direction of your chest. All mid-size cars have single

headlights, replacing the two-lamp setup of last year. GM says it's using a new sealed beam that gives better illumination with a single light than it used to get with dual lamps.

GM's putting in more airconditioning outlets than it did in the past. Cars that used to have three outlets now have four, and five-port jobs now have six outlets.

Capacity of most fuel tanks has been increased, which is going to lead a lot of people to believe they're getting the same mileage or better mileage than in previous years, although fuel economy will actually be down due to the new emission-control equipment installed on all cars. Tanks that used to take 16 gallons have been expanded to carry 21.5 gallons. Tanks that had a 20 or 24-gallon capacity last year will carry 22 and 26 gallons, respectively, in the '73 cars.

With the convertible apparently doomed—several soft tops have been dropped this year—GM's going in heavily for the sun roof with a sliding metal panel as a replacement. Sun roofs, either manual or power-operated, are available for all new intermediates with the exception of the Olds Cutlass. Instead of a sun roof, which Olds is expected to get next year, you can special-order a Cutlass with an oblong glass vent 12.5 by 29.5 inches positioned in the roof over the front seat. On the other cars, you can have a sun roof with a vinyl top or the standard metal top.

Here's a rundown on what's new from the different divisions:

CHEVROLET: Really new: Monte Carlo, Chevelle and front and rear treatment of the standard-size Chevrolet. Monte Carlo comes in three models, all V8s, all two-door coupes with B-pillars

(Please turn to page 202)



MONTE CARLO has a new look and—with new chassis, suspension, radial tires—an emphasis on handling

NASCAR photo

Safety cars: Boon or boondoggle?

By BILL HARTFORD, Auto Editor, and ROBERT LUND, Detroit Auto Editor

NUMBER 60 is not an experimental safety vehicle being crash-tested. It was a Grand National stock car running well over 100 mph coming off Turn 2 at Daytona before it got out of shape and hurtled end over end down the back straight. The driver, Maynard Troyer, is alive and well and still racing.

What miracle saved him? It wasn't an air bag. That wouldn't have helped in this type of "accident." A simple roll cage and safety harness worked the miracle for this driver as they have for hundreds of others; just as a simple lap belt or combination lap and shoulder belt have saved countless drivers and passengers in accidents on the road. Not to mention drivers who have avoided an accident only because the belts kept them at the wheel to make a violent, evasive maneuver.



There are no statistics to justify not wearing belts, yet these inexpensive lifesavers are still ignored by all but a small percentage of drivers. Every appeal, in print or on radio and television, exhorting drivers to buckle up voluntarily, has been met with almost total apathy. This year apathy becomes annoyance as buzzers and electrical interlocks are installed to force us to drive responsibly secured behind the wheel—for our own safety and that

of all others who share the public roads.

The simple way to have beat the buzzers would have been to make seat-belt wearing law! It makes sense, and will continue to make sense even if reliable air bags are installed in all new cars: Air bags won't protect you after the initial frontal impact.

Increasingly complicated and expensive devices are being researched to prevent accidents. But can you afford, say, a radar beacon in the grille of your next new car? An extra pair of radar eyes would truly be a boon—if the price comes down to a reasonable level in mass production.

Meanwhile, the costliest car crack-ups in the history of the automobile are about to take place. The "accidents" will involve three of the most expensive cars ever built—the United States Experimental Safety Vehicles (ESVs). These cars are hand-assembled, one-of-a-kind machines that are worth several million dollars each.

The crunching contest will see the cars slammed from the sides, front and rear

with a force of 5000 pounds. Driven head-on into a pole or concrete wall at 50 mph. Rolled over, roof sledgehammered against the road, in a series of somersaults. Gas tanks will be punctured in an effort to split them open. At least one and possibly two tires will be ripped off the cars as they negotiate turns at 75 mph. The passenger compartments will be set on fire.

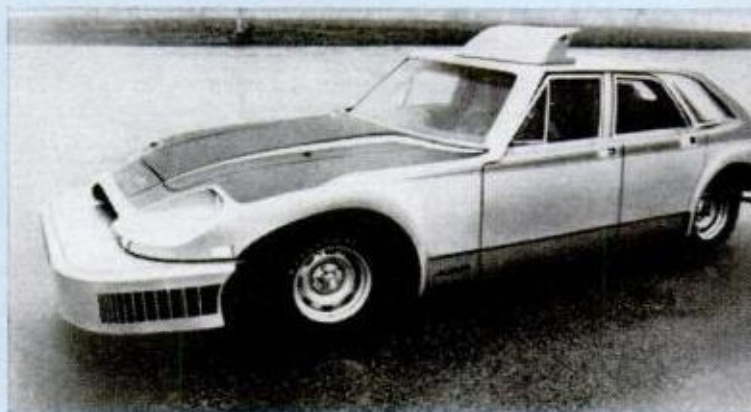
Why all the rough stuff? The government is pushing Detroit to build safer cars—"to better avoid crashes in the first instance and to minimize injury should a crash occur," to quote Secretary of Transportation John A. Volpe. The Department of Transportation has put up the money—some of it—for the three ESVs. The government doesn't expect Detroit to adopt all the ideas incorporated in the ESVs into production cars. Not immediately, anyway. But maybe over a period of several years.

"The ESVs will indicate what the state of the art should be 5 or 10 years from now," says Douglas Toms, head of the National Highway Safety Bureau. "They will give the auto companies plenty of ad-

U.S. EXPERIMENTAL SAFETY VEHICLES

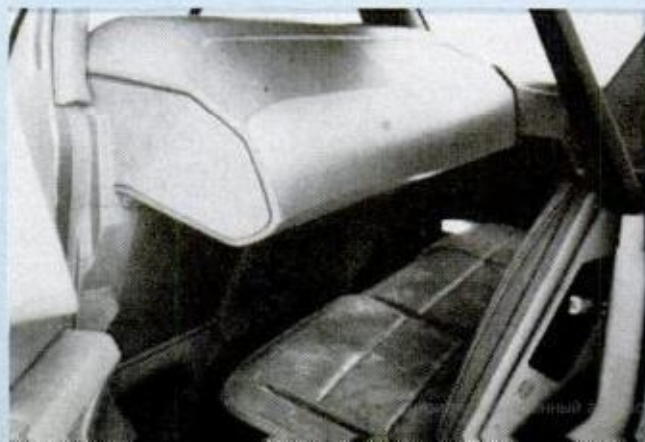


FAIRCHILD ESV has front bumper that automatically protrudes farther as speed of the vehicle increases



AMF ESV periscope may be required on future cars if rear-view mirror can't meet DOT performance specs

GENERAL MOTORS ESV has just been delivered to U.S. Department of Transportation for crash testing. DOT will write future safety standards for production cars based on its tests of all submitted vehicles



EUROPEAN ESVs—VOLKSWAGEN and MERCEDES-BENZ



PASSIVE BELTS IN ESVW: Shoulder belt moves into restraint position when engine is started. Piston fires to tighten belts further in crashes over 15 mph. Torsion bars in belt anchors limit forces on occupants

VOLKSWAGEN ESV weighs in at a sensible 3200 pounds, with crash goal still to protect four occupants from fatal injury at 50 mph. The "ESVW" will test crashworthiness as outlined by the U.S. Department of Transportation and try to do it at reasonable cost with a practical-sized car. Backbone of the car is a large console or center tunnel running between seats to keep occupants apart in a collision. Front seats

MERCEDES-BENZ ESV-13 is based on the 250 model passenger car. It's a five-passenger concept weighing under 5000 pounds. The ESV-13 is the latest in a series of ESVs being tested by Mercedes. Crashes of earlier ESVs have already resulted in the "survival" of test dummies at 50 mph. In addition to its features enabling occupants to survive collisions, the car uses the Mercedes-Benz ABS braking system that keeps wheels from locking up and causing skids.

vance notice so they can phase these requirements into models on the drawing boards."

The three pilot jobs were built by American Machine & Foundry Co., Republic Aviation Div. of Fairchild Hiller Corp. and General Motors. The GM vehicle is the automobile bargain of a lifetime. GM's fee for producing it was a buck. That's the full price: \$1. The cost of the AMF and Fairchild Hiller cars is in the \$1.5-million to \$3-million bracket. What the government is getting from GM for its dollar is a car that costs even more than the AMF and Fairchild cars. GM hasn't released the price, but it's a stiff one.

There will be a runoff between the cars with the company producing the winning vehicle to get a second contract from DOT to produce 12 additional cars. GM wants no part of the second stage of the program unless the government comes up with some real money. One deal-of-a-lifetime,

are fixed and welded to the central tunnel and side pillars to form a transverse bulkhead. A "silent copilot," designed to correct car's steering angle in strong side winds or on rough roads, is among safety hardware. Vehicle is not designed for production, but as test bed to enable VW engineers to evaluate cost vs. benefits of various safety features that can be incorporated in future production automobiles.



the GM hierarchy feels, is the limit.

DOT judging of the cars will probably be on a point system with merits or demerits to be awarded in four areas: (1) packaging the passengers, (2) innovations in hardware—who has the most, best, newest safety features, (3) crashworthiness and, (4) repairability of the vehicle after it's gone through the smash-it-to-smithereens test. That is, if there's anything left to repair.

As specified by the government, the cars are five-passenger, four-door sedans with wheelbases in the area of 116 to 124 inches. The target weight was 4000 pounds, but all of the cars, built with every consideration given to weight, are still about 5000 pounds (DOT agreements with importer-manufacturers call for smaller, lighter safety cars, some of which are shown and described on the accompanying pages).

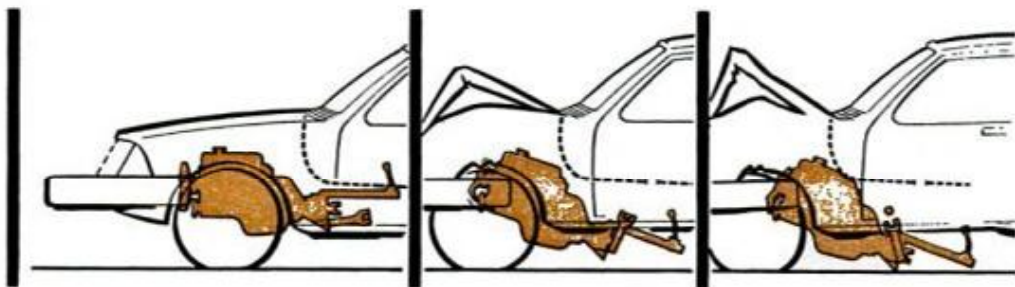
Government specs also required that

EUROPEAN ESVs—VOLVO

VOLVO'S EMPHASIS ON SAFETY has long been a part of the automaker's reputation. Antilock brakes on the VESC are an improvement on the production car's already excellent system (see *Why can't American cars have brakes like these?* page 130, March '67 PM) and three-point safety belts—so effective and incredibly easy to use—have been standard on all Volvo cars for a dozen years. Volvo began work with experimental safety cars in '69 before the DOT standards were released. Volvo's concept of a safety car gives almost equal emphasis to crashworthiness and crash avoidance (handling, visibility and driver environment), contrasted to the U.S. assumption that the crash is inevitable so it's best to build cars like tanks.



VOLVO EXPERIMENTAL SAFETY CAR (VESC) has hydraulic bumpers that will flex 7 inches to absorb impact of minor collisions. Front end is designed to deform as much as 40 inches in serious collisions. Headlight washers and circular-sweep wipers aid night driving. Leveling devices keep the lights aimed



SEMPASSIVE BELT is hung on hook when you exit car, tightens around you when door is closed and car started. Engine mount forces engine under floor in frontal crash

the cars be equipped with passive restraints—air bags or something better—and that fuel tanks and lines be made of a material or so designed to retard fire if the tank is penetrated or if there's a break in a fuel line.

In addition to the mandatory items, the AMF car has floating bumpers to absorb energy in a crash, a heavily padded interior, an antiskid braking system, a roof-mounted periscope to provide almost unlimited rear vision, brake and signal lights mounted in the roof over the rear window so they can be spotted by drivers several cars back, stronger seat mountings and probably adjustable foot pedals (brakes and accelerator), so the pedals can be moved up or down to accommodate different-size drivers.

The AMF has the gas tank behind the rear firewall, and both the gas tank and the engine will be equipped with automatic fire extinguishers.

Fairchild Hiller's car has an extendible hydraulic front bumper, an accordion frame that will allow up to nine inches of

bumper travel without permanent deformation, a total package design that integrates passengers, air bags and interior protection in one system, a lateral bulkhead behind the front seat for better protection in side crashes and rollovers, adjustable foot controls, periscopic rear vision, a method of mounting the engine to prevent it from coming into the passenger compartment in high-velocity crashes and dry nitrogen back-up for braking and steering.

Fairchild Hiller is also working on a double-duty bumper. The bumper combines solid media—no explanation is given as to what "media" means—shock isolation cylinders for minimizing damage sustained in low-speed collisions along with a plastic hinge structure that causes the metal to deform so that it will absorb energy in high-speed collisions. Both features in one bumper.

The GM car has a pillarless windshield design for improved driver vision, a "credenza" designed to protect unrestrained rear-seat passengers from impacts at

JAPANESE ESVs

speeds up to 30 mph, a special side-opening trunk, a single-pivot front seat with movable pedals for the difference between 5th and 95th percentile drivers, a "message center" instrument panel over the steering wheel in which the driver sees only need-to-know information and fixed side glass to reduce the chance of ejection during rollover.

Although the ESVs will carry the names of the three major contractors, other companies are working on devices that may be used in the cars. (One of the subcontractors on the Fairchild Hiller car is the Chrysler Corp.) There's a long list of products and ideas in development that are aimed at reducing the risk of driving an automobile. The hardware items and concepts, some of which are on the ESVs, include:

Tire jacks that are built into the vehicle.

Distress warning lights—all red flashers—mounted high on the car to warn approaching vehicles when a car ahead is in trouble.

Heavier doors, about 50 pounds of additional weight per door, to provide a stronger cage for protection against side-on collisions.

Improved front suspension and steering systems so a car can hit a deep pothole or a foreign object in the road at speeds of 50 or 60 mph without the driver losing control.

A sensing device that will alert the driver in the event that carbon monoxide should leak into the passenger compartment.

Laminated safety glass, instead of tempered glass, in side windows. (There may be some trade-offs here. Under certain conditions, air bags can blow out the windows. What's the lesser evil? Tempered glass side windows that shatter and blow out? Or laminated windows that remain in place and cause an internal explosion because air trapped inside when the air bag goes off has to find a way out of the car?)

Floorpans that will give but not break away under extreme pressure. In the panic-braking situations accompanying an accident, drivers have been known to hit the floor so hard their feet go through the floorpan.

Elimination of all protrusions and sharp surfaces, inside and out, that could cause injury in an accident. This includes the



TOYOTA ESV is a two-seater. The 2500-pound car makes extensive use of electronics for skid control, automatic transmission gear-ratio selection, automatic deployment of air bags when speed and distance computations add up to unavoidable accident



DATSUN ESV is a four-passenger design slightly larger than the 510 sedan and weighing under 3000 pounds. Safety tires are fitted to maintain control of the vehicle in event of a puncture, and non-flammable types of materials are used throughout

rear-view mirror mounted on the windshield.

Plastic instrument panels that will shatter under impact.

Fireproof interiors.

Bumpers of uniform height installed on all cars.

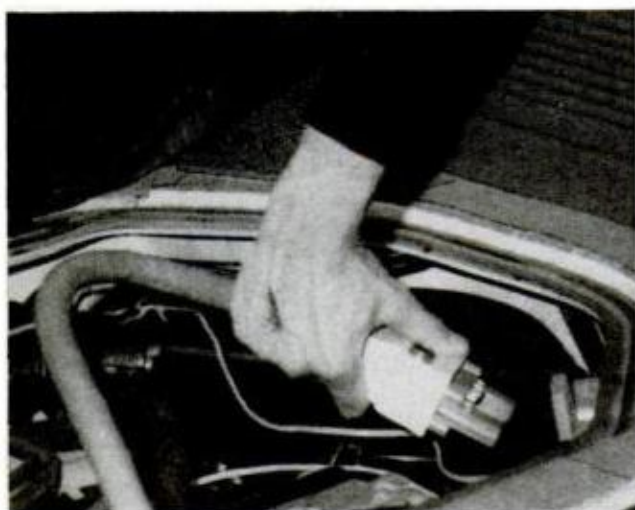
Contoured seat backs.

Seatbacks equipped with a sensing device that will pop up automatically to cushion the rear of the occupant's skull in an accident.

Headlights, probably polarized, that will throw a lower, longer beam, provide more illumination in fog and snow and reduce glare for oncoming cars.

Don't expect to see all or even most of these innovations on your next car, the one after the next or even the one after that. As safety czar Toms points out, the ESVs are to show what can be done and to give Detroit a long-range target. Hopefully, the innovations will be evaluated with their cost versus their lifesaving potential carefully considered. What good is a "safe" car, if you can't afford it? ★★★

How plug-in troubleshooting will save you money



**VW has it now
and more are on the way**

By **ROBERT LUND**, Detroit Auto Editor

GUESS-AND-MISS DIAGNOSIS isn't a new problem, but it's a more acute problem today than ever before. There are more cars around, more complex cars, more things to go wrong. As the car population increases, the skilled mechanic has to spread himself thinner, over more automobiles, to try to accommodate more people. What's the solution?

Detroit's working on an idea to take the seat-of-the-pants element out of automobile service: To make cars that will be virtually mistakeproof when a mechanic works on them—at a price that won't cause the customer to suffer a catatonic seizure when he gets the bill.

The idea is to build diagnostic units into the vehicle, so a mechanic can plug into a car, run the other end of the plug to a computer and then read what the problem is and how to correct it. This requires development of two types of hardware: (1) diagnostic devices that will be mounted in the vehicle and (2) computers to take the readings. Some of the hardware is ready now, some is under development and some hasn't been conceived yet.

Volkswagen has developed both types and is a couple of laps ahead of Detroit in this area. VW began installing the on-car socket a year ago when it started production of '72 models. By the end of the year all VW dealers will have the computers to plug into the socket.

Using the VW system, a mechanic can conduct 60-plus checks on a car in less than 30 minutes. Without any guesswork. He begins by inserting a program card for the particular year and model of the vehicle in the computer. Using a handheld input device, he then runs through the checkpoints. The computer compares the readings against factory specifications and prints an analysis—fix it or leave it alone.

Obviously, you have to take your VW to a VW dealer to get the service-by-computer treatment. You can't have your car repaired by a non-VW dealer or at the corner gas station. That equipment isn't on the market—yet.

When will domestic car companies catch up with VW? Detroit gives you one of those run-around answers you have to sort out for yourself.

General Motors acknowledges it's hip-deep in a service-by-computer program,

POPULAR MECHANICS

VW COMPUTER DIAGNOSTIC SYSTEM connects sensors in the car to a digital computer. Readings taken are compared to specs for a healthy VW, and printed results detail what work is necessary on car

**PROGRAM
CARD**

**COMPUTER
CONSOLE**

**PRINTOUT
SHEET**

**UMBILICAL
CORD**

**CENTRAL
SOCKET**

but won't estimate a date when the gear will be ready beyond saying it will be "sometime in the next 10 years."

Ed Cole, the engineer who became president of GM, says the company is working on "advanced electronic concepts which we believe can perform effective on-board control and monitoring functions for many operational parameters of the car."

Trevor O. Jones, head of electronic control systems for GM's engineering staff, isn't saying when plug-in diagnostic devices will be installed on cars either, but he supplies answers to a couple of key questions. Take the dipstick, for example. It costs about a dime. GM's not going to replace a 10-cent item with a \$3.50 electronic whatnot to do the same job.

How many areas of the car, how many components, lend themselves to computer diagnosis? The number of potential applications, Jones replies, "is virtually unlimited."

The other auto manufacturers are running behind GM in developing on-the-car devices, although Ford is ahead of GM in one area. Ford is tackling the idea from the other end—from the angle of building the read-out computers first. Ford's Philco Div. has reportedly put together a piece of equipment that can (1) tell if bearings and valves are worn, (2) predict how much life they have left, (3) pick out a particular bearing or valve requiring replacement and (4) indicate if the engine needs a tune-up. Philco hasn't confirmed existence of the machine, but a government source claims to have witnessed a demonstration of it.

The cost of the sophisticated shop equipment required to take readings off the plug built into the car is a deterrent to early adoption of the concept. It's one thing to build a computer to provide service readouts for one make of car. But a far more expensive, complicated computer will be required to give readouts on all makes of cars.

There's a related development that's much more short-term than the computer diagnosis idea. GM has installed on-board monitors in an experimental Vega, alias Delta III. The system continually monitors brakes, shocks, tires and steering to warn the driver if a part's failed or is about to fail. It won't assist the mechanic in pinpointing a problem when something goes wrong. But it will help

you avoid getting stuck with an oversize repair bill due to a part conking out and then being driven to destruction before the failure becomes evident.

The most advanced monitoring system that's surfaced so far is the product of a British company, Joseph Lucas, Ltd.

The Lucas system monitors eight conditions on the car. It operates automatically and continuously while the car is running. If two or more components being monitored fail simultaneously, the system can discriminate between the most serious failure and the least serious.

The Lucas monitor covers the brake system, brake-fluid level, oil pressure, bulb failure, oil level, radiator-coolant level, brake pad or lining wear and windshield-washer fluid level. An illuminated panel on the dash warns the driver if an emergency develops in any of these important areas.

The system consists of sensors, alarm circuits, an electronic discriminator unit and the instrument panel display. An eight-volt stabilized voltage-supply bus and a single alarm bus are routed around the car to serve all alarm circuits.

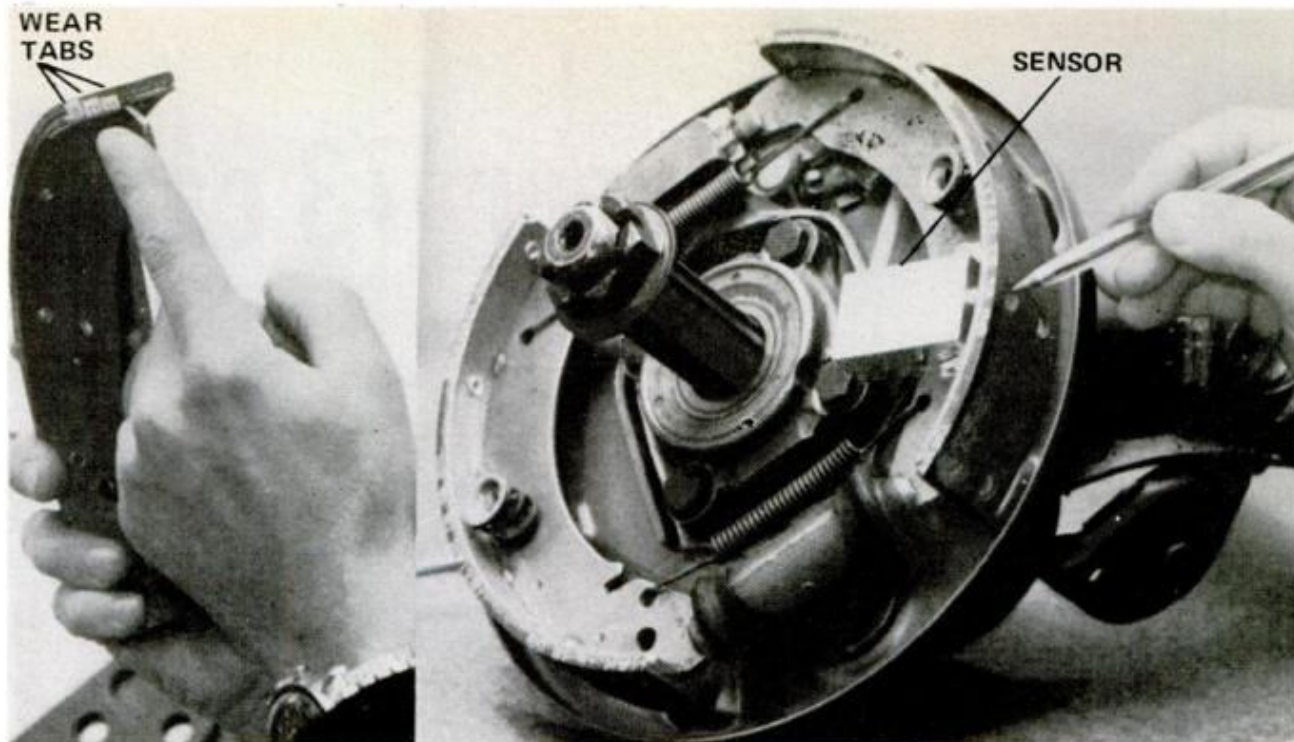
The cost of installing a service monitor for the eight items listed above would run about \$40. Lucas engineers agree with GM's Trevor Jones that the number of components that could be monitored is virtually unlimited.

Lucas isn't the only company working on service-monitoring devices. A Detroit company, Impact Promotions, has a mini computer available now—for some cars.

The device measures engine running time, cranking time in starting the engine and calendar time. By keeping track of these items, the computer knows when the car is due for an oil change or tune-up. An alert sign goes on automatically when the car requires a lube or tune-up and the driver can't cancel the signal without taking the car in for service. The company says it will have the unit available for '73 model GM cars and gradually extend availability to other makes over the next few years.

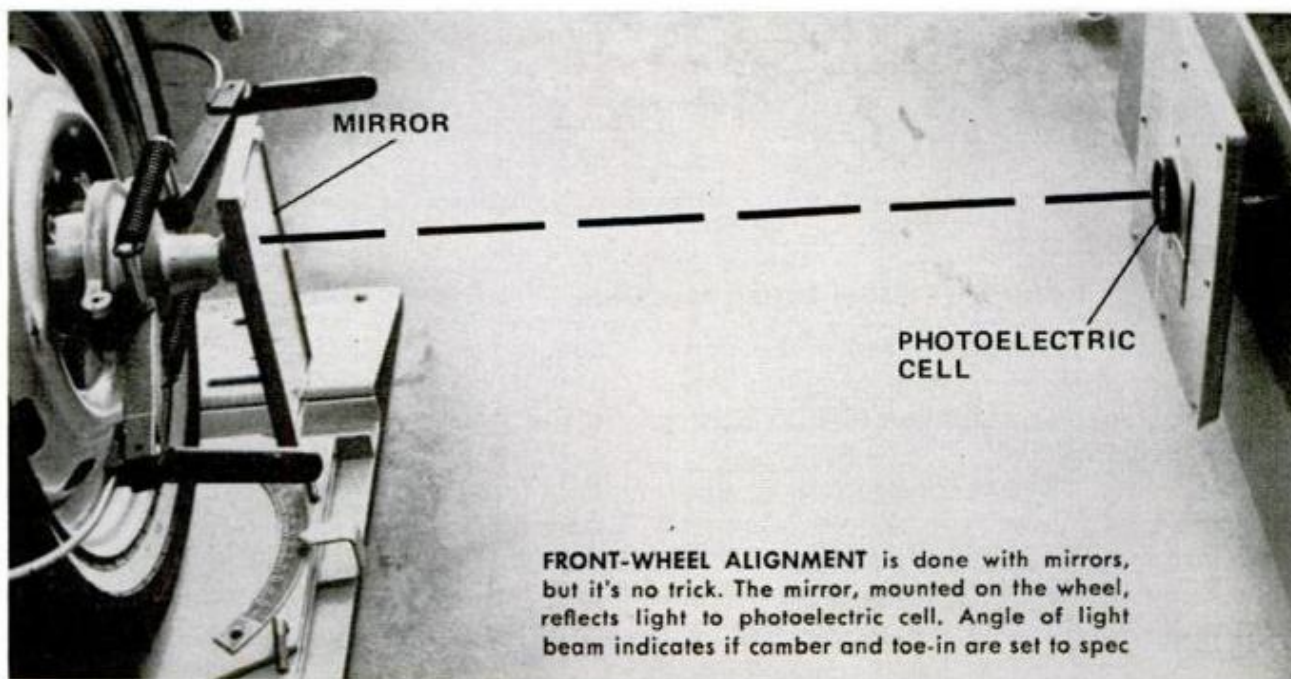
Another Detroit-based company, Federal Screw Works, is working on a service monitoring system that will put out voice signals (via a voice synthesizer) when a component needs replacement or service.

Dramatic as these approaches may seem, an even more exciting development is



VOLKSWAGEN'S COST-EFFECTIVE APPROACH to monitoring component wear is illustrated by technique of measuring brake-lining wear. Sensor at right uses pin arrangement for continual measure-

ment; excellent, but very expensive. Stepped tabs at left are in electrical circuit: One by one they break off as lining wears, changing resistance of circuit. This setup is effective, cheap and therefore used



FRONT-WHEEL ALIGNMENT is done with mirrors, but it's no trick. The mirror, mounted on the wheel, reflects light to photoelectric cell. Angle of light beam indicates if camber and toe-in are set to spec

taking place at a military facility in Warren, Mich., the Detroit suburb where GM's Technical Center is located.

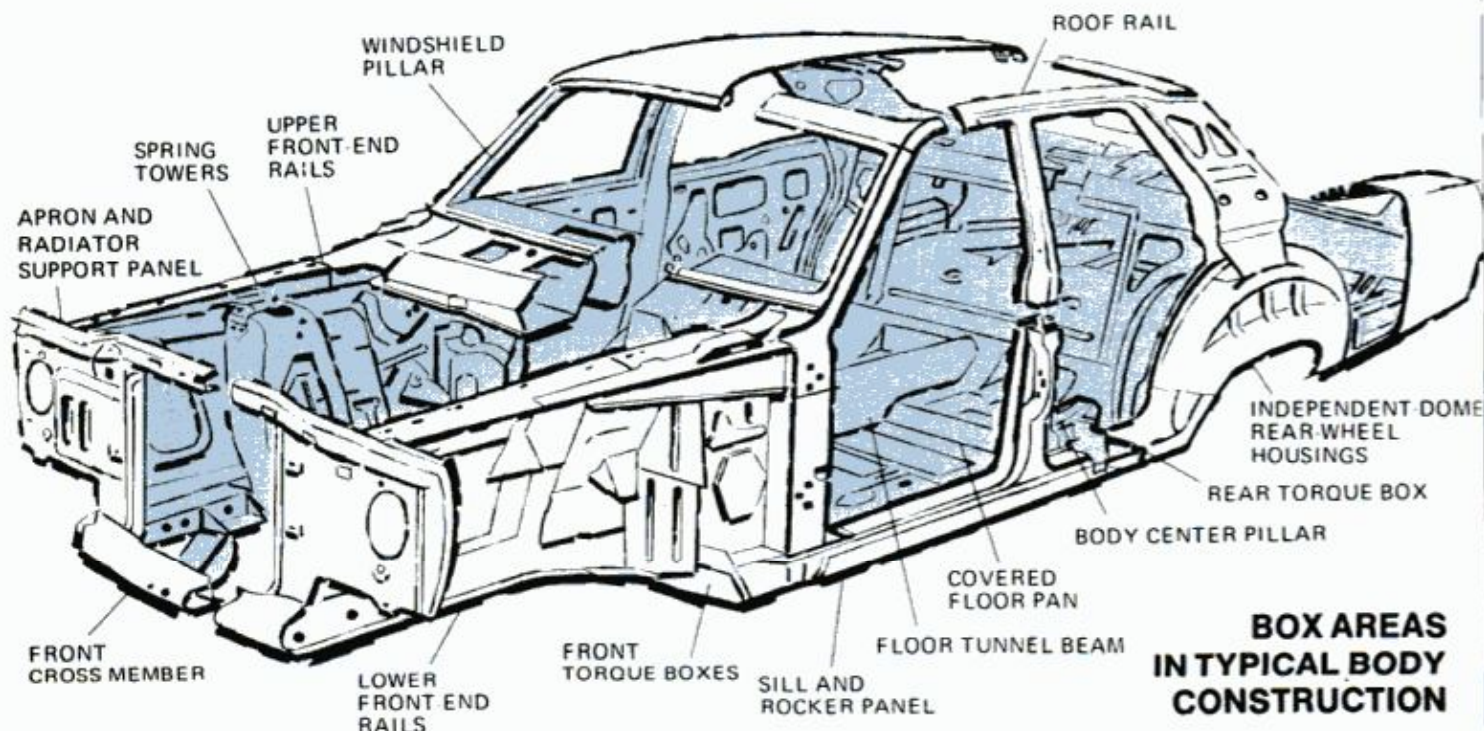
Engineers on the staff of the U.S. Army Tank-Automotive Command (ATAC) believe it's possible to detect malfunctions in cars in advance—before the part fails or wears out and before the failure puts the car out of commission. There's no backing in to correct a problem after it occurs, because the breakdown never occurs. It's anticipated before it happens.

The ATAC system is based on pattern recognition. When a part is functioning correctly—any part—it produces a definite pressure pattern. If the part is defective or requires service, the pattern becomes distorted.

ATAC first takes a component and determines the pattern recognition for that particular part. It then determines the life of the part. This is done in various ways, frequently by running the part to de-

(Please turn to page 208)

Rustproof your '73 car?



RUSTPROOFING isn't an option at Detroit: You have to go elsewhere for real protection of boxed areas

By **ROBERT LUND**, Detroit Auto Editor / Illustrations by Ed Valigursky

BEFORE WHEELING onto the driveway with your new car, you might consider spending another \$70 to \$100 to have it rustproofed.

But whoa! Before hotfooting it out to have the job done, you should know that rustproofing isn't for everybody. It could be a smart move or money down the drain, depending on where you live and how long you keep a car. You have to decide, and to do this, you have to know what rustproofing is and isn't. Let's take the "isn't" first.

Rustproofing isn't undercoating. That's a common misconception. Undercoating consists of spraying an asphalt material on the underside of the car.

Undercoating provides some protection against rust. But not much. Imagine eight guys trying to fend off the rain with one umbrella and that's about as much anti-rust protection as you get from undercoating. Undercoating doesn't get in the

seams and the hollow pockets of the car. But it does provide a degree of surface protection.

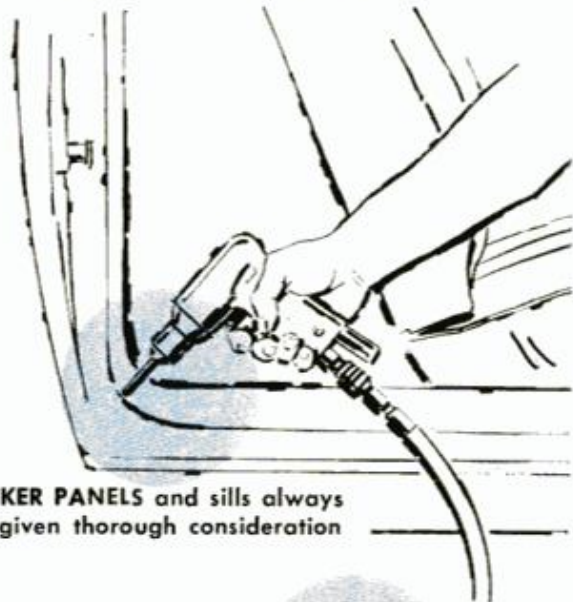
If undercoating's such a nothing, why do the auto companies still offer it? Undercoating does a good job as a sound deadener. It reduces rattle and road noise and provides minor protection against external corrosion.

GM and Ford no longer offer undercoating as a factory option, but GM and Ford dealers will do the job for you. In the case of Chrysler and American Motors, the factory will apply the spray before shipping the car. The price will run \$22 to \$26, including a silencer pad for the hood that comes as part of the package.

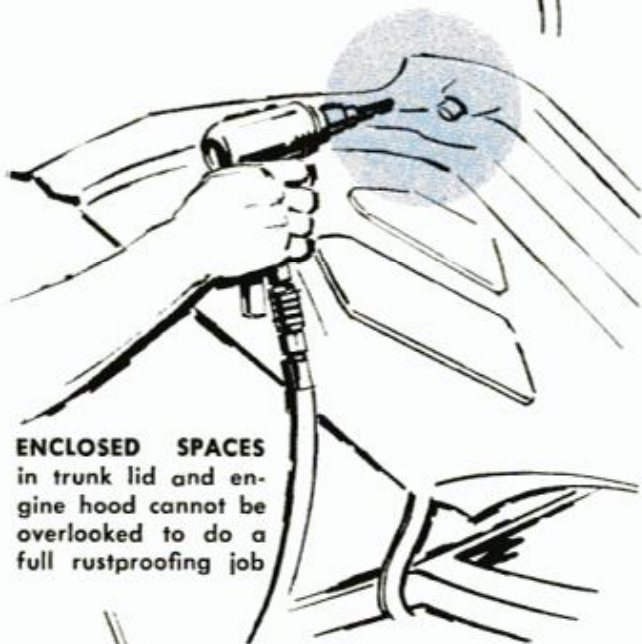
You can't have your car rustproofed before it leaves the factory. You have to have it done by a dealer or rustproofing specialist.

The reason the auto firms haven't put the item in the option catalog isn't be-

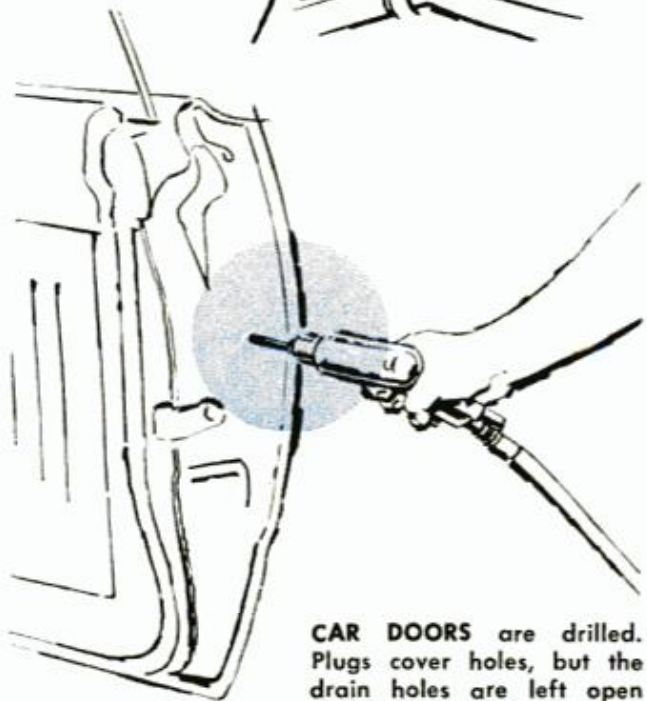
DRILLING ACCESS HOLES



ROCKER PANELS and sills always are given thorough consideration



ENCLOSED SPACES in trunk lid and engine hood cannot be overlooked to do a full rustproofing job



CAR DOORS are drilled. Plugs cover holes, but the drain holes are left open

GOOD RUSTPROOFING COMPANIES use auto manufacturers' engineering drawings to determine just where the access holes should be drilled in the body

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cause they aren't sold on it. They don't offer rustproofing as a factory option because it's a complicated job, expensive and would add another half-day or day to the production process.

While undercoating involves nothing more complicated than spraying the underside of the car, rustproofing gets into minor alterations of the vehicle, partial disassembly and putting the parts back together.

There are no universally accepted standards as to what constitutes a good, thorough rustproofing job. But the old rule applies—you usually get what you pay for. You can get value for your money or you can get stung.

The two leading companies in the field, Ziebart Process Corp. and Tuff-Kote Rustproofing, Inc., don't see eyeball-to-eyeball on what constitutes a perfect job, but they're in general agreement. Both companies remove components to get into hidden areas and drill inconspicuous holes in sections of the car to apply the rustproofing compound.

The formulas for the substances that are injected into and onto the car are secret. The material looks like a shiny thick oil or wax and has an odor like that of furniture polish.

If you have the job done by Ziebart, Tuff-Kote or any reputable free lance, you'll have to give up use of your car for a day. Take it in the morning, pick it up at night. It takes awhile for the sealant to set. In addition, some of it seeps out and has to be cleaned up and all holes that are drilled to inject the material have to be plugged.

The price of the job varies, depending on the type of car—VWs cost less than Cadillacs, wagons more than sedans—and location in the United States. Ziebart's price averages around \$90, but it could be \$30 more or less than that. Tuff-Kote's prices range from \$80 to \$100, with some leeway up and down. Car dealers and independents usually charge about \$10 more than the chains.

You'll pay the high side of those prices if you live in a coastal area—the tip of New England, all along the Atlantic Coast and down in the Gulf area. The reason for this is that the treatment differs depending on climatic conditions. Cars that are exposed to salt air require a more extensive treatment than cars in the mid-

TRAPPED WATER in boxed sections starts corrosion as steel goes back to its original iron-oxide state. In winter, when trapped water is frozen, corrosion rate is low, but if you put the car in a heated garage, the corrosion rate is accelerated markedly!

west snow belt. Ziebart, for example, has two types of treatments—tropical and semitropical. The tropical treatment covers cars in the coastal regions and includes a special treatment for the roof. The semitropical treatment is used inland, where cars have a tendency to rust out below the beltline.

You can have your car rustproofed anytime, regardless of age or condition. But if you've had the car a year or two, giving the corrosion process a chance to start, rustproofing won't correct the cancer once it sets in.

Tuff-Kote has just introduced a rustproofing service for used cars already showing signs of corrosion. The company says it uses a new material that eats through accumulated corrosion, then bonds itself to the metal. The rust is still there, but it won't spread. If you go for this treatment, you might want to have some body work done before the rustproofing is applied.

Ziebart, Tuff-Kote and the other square shooters in the business have a cutoff point when they'll accept a new car for rustproofing and guarantee the job or give a full guarantee. The rule of thumb is that the car shouldn't be more than three months old. There are exceptions both ways. Older cars they'll accept and newer cars they'll reject.

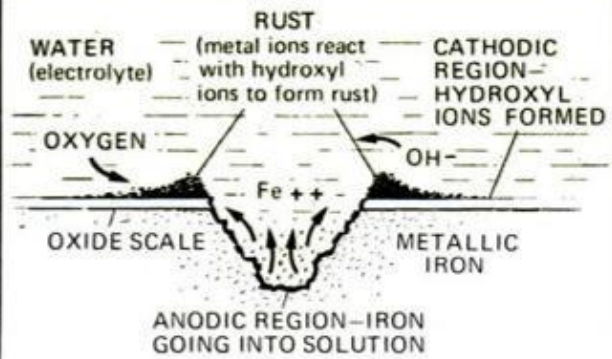
New car to you doesn't necessarily

CONTROLLED SPRAYING

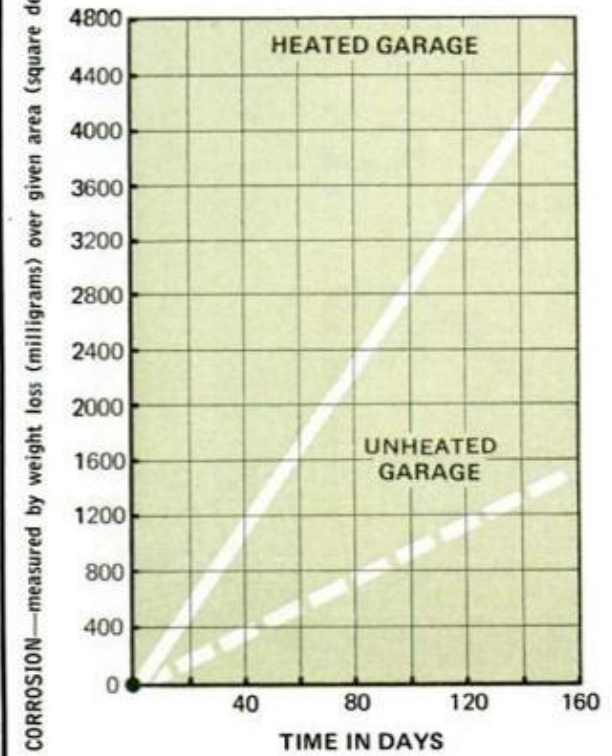


SPECIAL NOZZLES
spray rust preventive

ELECTROCHEMICAL CORROSION



COMPARATIVE CORROSION RATES



AFTER SPRAYING, holes are capped with plastic plugs

mean new car to the rustproofer if he has to guarantee the job for five years or 50,000 miles. A car can have fewer than 100 miles on it and be turned down for rustproofing if you want the guarantee. If the dealer had the car in inventory a long time, sitting on a lot where it was exposed to salt spray, cinders flying off a train or gunk from a factory chimney, an honest rustproofer will be reluctant to do the job and give a guarantee against rust-out. The damage already has been done, it doesn't matter what the odometer may say.

How good is the guarantee? The standard guarantee is for five years or 50,000 miles. But with reservations.

Both Ziebart and Tuff-Kote require that you bring the car back for a checkup after two years or 20,000 miles to keep the guarantee in force. You may have to pay a nominal fee—usually under \$10—for cleaning the car, inspecting it and injection of additional rust-inhibiting compound in areas that need it. There are exceptions to the 5/50,000 guarantee. In Hawaii, for instance, the guarantee may be reduced to three to four years because of the problem encountered there with salt spray.

While rustproofing's a good deal for many car owners, don't plunk your money down if you don't need it. If you live in an extremely dry area or in a state that's relatively free from industrial fallout, then you can get along without having your car rustproofed.

How do you know if you live in a safe area? Check the ads in the papers and phone book to see how many shops offer

a rustproofing treatment. If there aren't many businesses selling the service, that's because rust isn't a big problem in those areas.

The biggest surprise that turned up in gathering information for this story is that rust isn't a big problem in California, except along the coast and on the northern tip of the state, despite all you hear about air pollution in that part of the country. Most of the state is dry and few cars suffer from corrosion. Obviously, this doesn't apply to San Diego, Los Angeles, San Francisco and where California borders Oregon.

You may want to think twice about having your car rustproofed, even if you live in an area where corrosion is a serious problem. How long are you going to keep the car? Detroit's doing a good job these days with galvanizing steel, with special coatings, primers and paints to resist corrosion. That goes for the imports, too. Cars don't rust out in a year and seldom in two years. So if you trade cars frequently—every year or two—the rust problem, if one should develop, will transfer to the next person who buys your used car.

The response to this pass-the-problem-on thinking from the rustproofing companies is that you'll realize more from the sale of the used car if you have it rustproofed. Well, maybe. If you sell the used car to an individual, you'll get part of the money back that you put in rustproofing. But dealers and used-car lot operators won't give you much of a shake just because a car's been rustproofed. They'll use the rustproofing feature as a plus to resell the used car, but they don't allow much for it when the shoe's on the other foot.

Ziebart makes an additional point—and it's a valid one—that there's a safety factor in having a car rustproofed. With a rustproofed car, you're less likely to have an accident due to corrosion of such critical parts as the steering mechanism, electrical wiring, brake lines and the gas line.

Frames can also corrode to a point where they constitute a hazard. The National Highway Traffic Safety Administration put out a warning last March advising the owners of all cars produced prior to 1968 to have the frames examined for damage due to rust. ★★★



EXTERNAL AREAS that are rust-prone are also coated

The amazing magic of mini-computers

By RONALD M. BENREY



HOME COMPUTERS like this one owned by Maryland engineer Thomas Prugh can prepare anything from tax returns to grocery lists, control alarm systems and diagnose car troubles. So far, though, they're expensive

Priced like expensive sports cars, new and simple-minded, pint-sized computers are showing up everywhere—from farms to baseball stadiums. Next: your home?

IN BOSTON, an electronic computer the size of a mechanic's toolbox helps "match" home buyers with 10,000 different available homes. In Denver, another mini-computer controls an atomic electric generating station. In Pittsburgh, a mini works the huge automatic scoreboard at the Three Rivers Stadium during Pirate baseball games (remember the "POW" signs during the last World Series?). In Seattle, a team of minis is helping to study the behavior of sockeye salmon. In Jakarta, Indonesia, a mini-computer figures odds and runs the "tote board" at the local racetrack. In London, a mini at Heathrow Airport automatically calculates runway visibility. All over the world, thousands of other pint-sized computers are at work controlling industrial machinery, making scientific calculations, gathering and sort-

POPULAR MECHANICS

ing data. And the list is almost endless.

Chances are that when you think of a "computer" you picture a room full of cabinets crammed with electronic chassis, and alive with blinking lights and spinning tape reels. Actually, for each of these behemoth brains there are probably a score of mini-computers hard at work at specific calculating and controlling tasks. A typical mini, by itself, is hardly more impressive looking than a shortwave radio. Even when surrounded by its "peripheral" equipment—such as tape and disc memory banks—a mini looks more like a fancy hi-fi rig than the electronic wizard it really is.

And yet, the development of the mini-computer has triggered revolutions in health care, industrial automation, scientific research and dozens of other surprising fields—including, soon, the home.

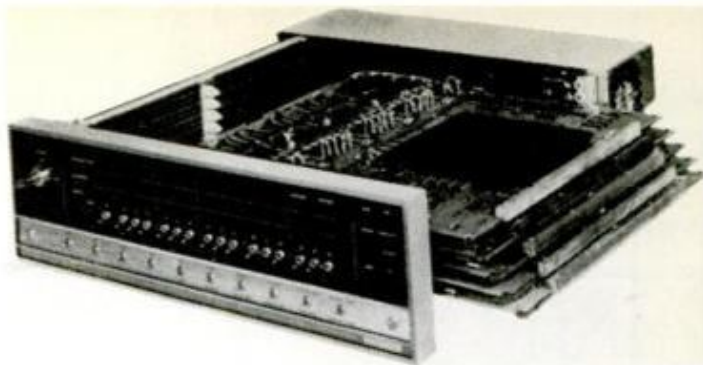
What will you do with your mini? Well, a man who owns one right now is Thomas Prugh of Silver Spring, Md. Prugh, an engineer by profession, bought his \$8500 computer for "off-hour amusement, rather than a boat or a fancy sports car." He has written programs to figure taxes, calculate mortgage interest and help plan menus. And he's working on several "home control" applications that will, for example, let the computer monitor fire and burglar-alarm systems, watch over the heating system and diagnose family car troubles.

Not long ago, I lived with a borrowed computer for a while to see how useful such a "household brain" would be. Actually, only the teletypewriter input/output unit was in my house, tucked into a corner of my den. The computer itself was miles away, in an airconditioned computer center. Telephone lines linked the computer with my den.

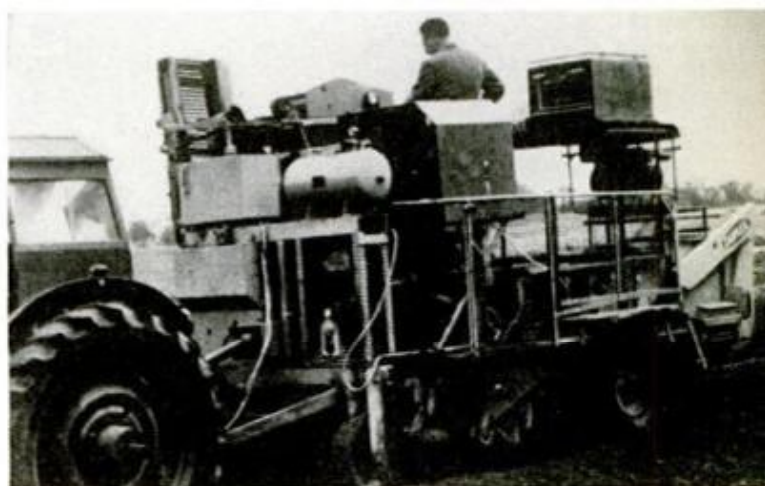
What did I do with the computer? First I learned a simple programming "language" called BASIC that enabled me to write simple programs—those sets of detailed instructions that tell the computer, step by minute step, just what to do and when to do it. This took just a few hours (though I admit it would take years for me to learn the ins and outs of writing elaborate programs). Then, I got to work:

- I used the computer as a high-powered electronic calculator to help me figure my income tax and to perform everyday calculations.

- I wrote a program that could figure out

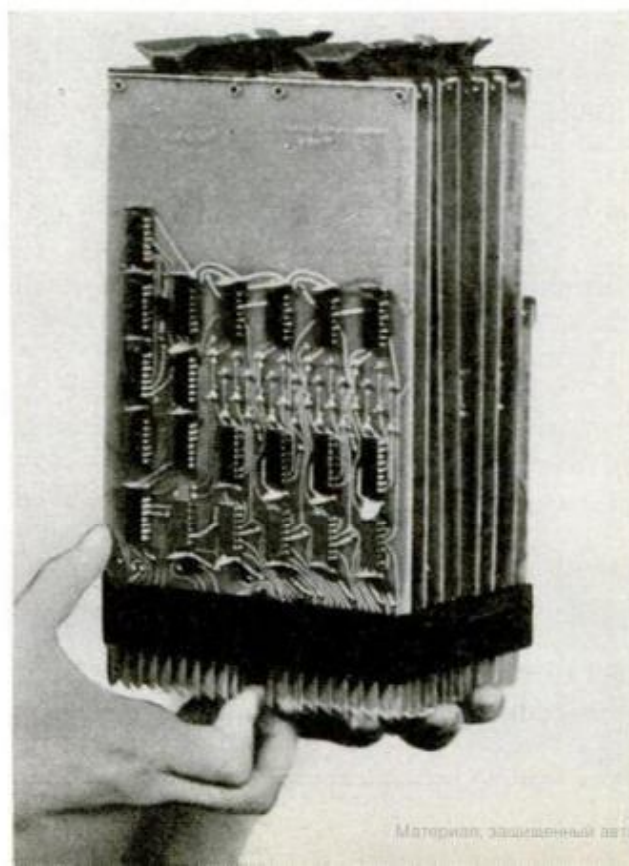


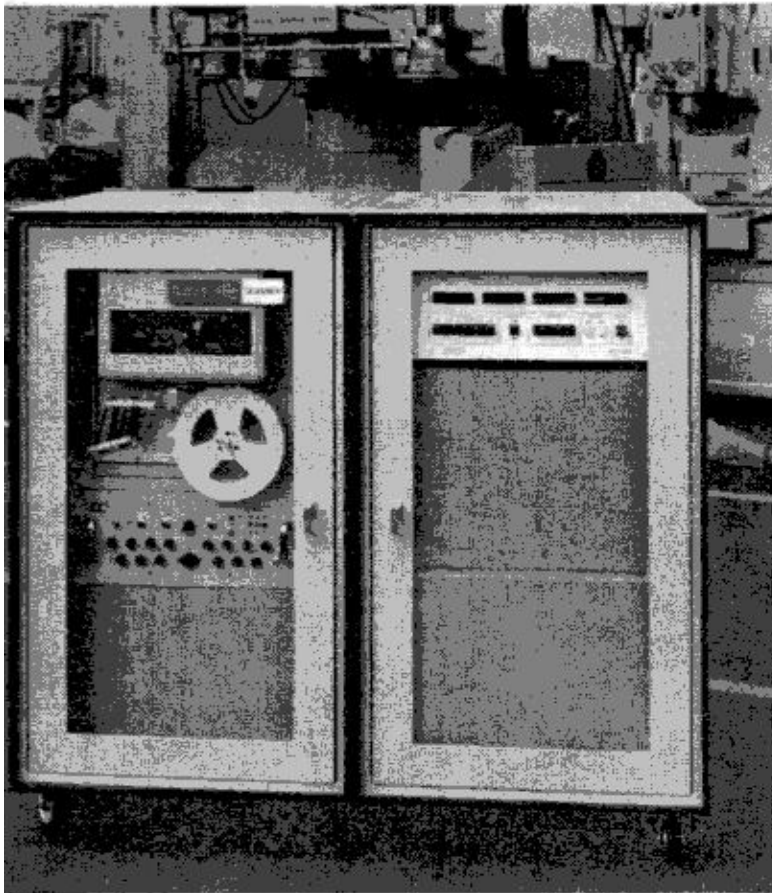
TYPICAL MINI-COMPUTER is barely larger than some stereo receivers, though more complex. But complete mini-computer installation, including memory storage and a teletype input/output, is a lot bulkier



TESTING POTATO PICKERS, Scottish agricultural researchers monitor machine performance with a mini-computer (box at upper right) in preproduction tests

HOW MINI IS MINI? This complete, basic computer should give you some idea. And the manufacturer hasn't even claimed it as "the smallest in the world"





AUTOMATIC MILLING MACHINE controlled by mini-computer can perform more complex operations than the older, numerically-controlled, tape-operated units and it is far easier to reprogram for new operations

the exact amount of wall and trim paint needed to paint a room. I fed in the room's dimensions, number of windows and doors, and whether or not two coats of paint would probably be necessary; in a split second, the computer figured total gallons of paint.

- I computed the efficiency of my house's insulation, based on the total quantity of fuel used in a year and overall dimensions. And I estimated the cheapest way to heat my house by "plugging in" the costs of oil, gas and electricity.

- I used the computer to prepare a long set of time-versus-distance tables for automobile rallies, and to produce a set of ballistics tables to help me when I reload rifle ammo.

- I prepared an automated shopping list for my wife that "predicted" (on the basis of past experience) when we were about to run out of a specific grocery item. Each Friday, the computer typed out a list of items we probably should buy when we went shopping on Saturday. When we got back from the supermarket, I entered a list of stuff we bought that day to "update" the computer's memory bank.

- I used a set of professionally written programs to play games with the machine. At a party, the computer "dealt" blackjack, ran a crap game and played roulette.
- I created an automated Christmas card list. For several weeks before the holiday season, I entered the names and addresses of different people we wanted to remember at year's end. About two weeks before Christmas I triggered the machine and placed a long chain of pregummed labels into the teletypewriter. The computer automatically typed a name and address on each label—we got our cards out in less than an hour (including the time it took us to lick the stamps).

All in all, I proved that a computer is a handy gadget to own. I can't wait until the declining price of mini-computers makes it possible for me to have my own computer permanently. Right now, even the least expensive minis cost \$5000, and typical installations that include teletypewriters to feed in data and print out answers, plus other peripheral gear, are likely to cost between \$8000 and \$25,000, depending on complexity. For budgets like mine, that's a lot, but compared to the millions that large-scale computers cost, it's peanuts.

The reason for the cost difference is simple: The mini-computer is built to do much smaller jobs than the full-scale computer. It's usually "dedicated," as the experts say, to one particular task, making it a foot soldier in the automation army.

Sure, a room-size computer can out-think a mini in a dozen different ways—but a mini-computer has the perfect mentality to help determine if new-born babies at Montreal's Royal Victoria Hospital have normal hearing . . . or to monitor exhaust emissions at the Standard-Triumph automobile plant in Coventry, England . . . or to create the formulas for making special eyeglass lenses at the American Optical Corp. plant in Massachusetts . . . or to run automatic milling machines all across the United States.

Using a full-size computer for these jobs would be like shooting ducks with a cannon—even if someone wanted to try, costs would make it impossible.

Look inside a mini, and you'll find a set of large printed-circuit boards covered with integrated-circuit modules. What you can't see, is the machine's under-the-skin "architecture"—the way the circuitry is ar-

ranged to enable the computer to do its job. Most mini-computers are built along the same lines as the giant brains, but out of much smaller building blocks. A typical mini might consist of:

- *An arithmetic processing unit*—the cluster of circuits that actually performs arithmetic when the machine operates. It also makes “logical decisions” that enable the computer to work automatically. A common logic operation lets the circuitry compare two numbers and decide which is larger. If number “1” is larger, the computer proceeds to perform one specific operation; if number “2” is larger, the machine does something else.

- *A group of registers*—electronic circuits that can temporarily hold numbers and data. They serve as “electronic scratch pads” for the arithmetic processor when it calculates.

- *An electronic memory unit*—the block of circuits and devices that can store (or remember) a large quantity of individual numbers and data items that the computer will use to do a specific chore. Equally important, the memory stores the detailed step-by-step program of instructions that tells the computer how and what it is to



SCOREBOARD COMPUTER in Pittsburgh's Three Rivers Stadium controls thousands of individual light bulbs precisely, to flash pictures and messages. Print-out of one scoreboard pattern is in foreground

do. The machine slavishly follows each instruction in turn as it works.

- *A group of control circuits* that tie the operation of the three main building blocks together, and one or more input/output devices (teletypewriter, display, output control circuitry) that route numbers and data into the computer, and answers or commands out of it.

There are close to 20,000 minis at work around the world today; industry experts predict that 15,000 more will be added in 1972—and the pace is accelerating. Dozens of companies build small computers—firms like Digital Equipment Corp. (the industry giant), Raytheon, Data General, Varian, and Cincinnati-Milacron—and, as you'd expect, there are differences among many of the minis.

Some are “configured” to perform complex calculations and produce numerical answers; others control mechanical and electrical equipment (here, the “answers” are output signals that operate switches and valves); still others gather together data generated by scientific instruments, and process it into meaningful information for scientists to interpret. In most cases, these different requirements are met by changing one or more of the internal circuit boards. However, the basic mini architecture remains intact.

A mini in your future? It's almost a sure thing that before another decade

(Please turn to page 200)

LOWELL OBSERVATORY uses its mini-computer to cancel out errors in planetary brightness measurements that are caused by differences in the atmospheric brightness at its site in Flagstaff, Ariz.



New take-downs put it all together for archers

By GARY DENNISON

NOW THE NEW TAKE-DOWNS give the archer extra bows for practically the price of one. Bonus benefits include easy adjustment to fit and feel, plus a bow you can almost put in your pocket. Simply by changing limbs on a basic handle you can assemble nearly any bow

you want—light 30 to 40-pound draw-weight limbs for learning and target shooting, heavy limbs of 45 to 60 or more pounds for hunting, and maybe a third set of limbs for your youngster to use.

The trend to take-downs was inevitable. Bowhunters wanted a multi-use



design, partly to save money but also because they could shoot better using the same familiar handle for target, field and hunting. The diversity of limb combinations makes the old one-bow archer almost obsolete. Now you can have the exact bow to fit each situation at a reasonable cost. Usually the handle is the most expensive part of the take-down bow, and if one limb is damaged or twisted, only it will need to be replaced.

With the new take-downs, you spend the usual time becoming familiar with its grip style (as you would with any bow), but once you have it, you have it for good. Attaching a new set of heavier or lighter limbs won't wreck your shooting because, essentially, you will be shooting with the same bow and will be simply adjusting to different draw weights. You'll skip the one-piece bowshooter's trauma. When he switches bows he must get used to a new grip style unless he buys an identical model. The new and different handle can throw his shooting well off for a while.

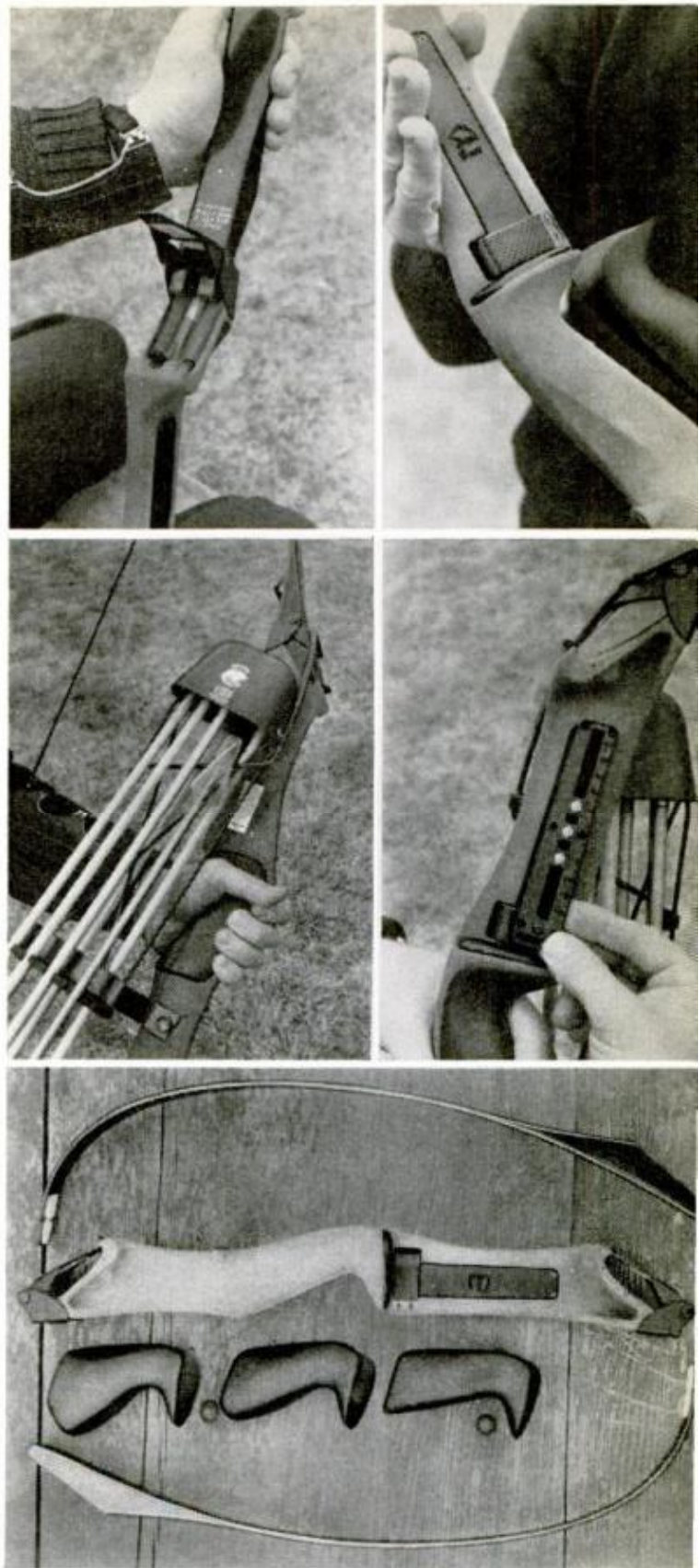
The take-down handle, however, actually builds confidence and consistency. You'll know how the bow handle feels, how it positions when you make a good shot, and how your wrist and hand set into it for best results. (Even competitive archers do not always realize how a strong, consistent bow hand affects accuracy.)

Compactness and portability of take-downs also appeal to a growing number of bowhunters who travel. Out-of-state trips may include flying, canoeing, horseback riding, backpacking and cycling with the demountable bow packed safely along.

New materials and construction methods are making bows as exceedingly fine, durable instruments for the first time—to be handed down from father to son as fine rifles have been. Archery materials were never as permanent or diverse as they are today. The take-down's structural strength, as well as versatility of limb weights, helps make it a long-range investment.

Many new take-downs have all-metal handles of aluminum or magnesium, specially processed wood handles, ebonite or composite and metal handles—all stronger than regular wood. Because of added strength, handles can be thinner, easier to hold, and they won't twist (torque) in your hand. More mass weight can be

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BOWS THAT COME APART, like this Bear Archery model, provide a wide variety of designs to match archer style and preferences, as shown on facing page. Bear bow (top left), slides grooved limbs into a matching seat in handle. Pressure latch then is snapped shut to secure socket-and-latch unit. Options include choice of demountable hand grips (top right), quiver that mounts on bow (center left) and adjustable hunting sight (center right). Complete set (directly above) can fit in travel case that's only 30 inches long. Accuracy equals conventional one-piece bows

placed near ends of handles at limb attachment points, to give better balance, control limb and riser twisting, and damp out vibrations that produced "kick" in old heavy-handled bows.

More centershot—the sight window cut to, or sometimes past, the center axis of the handle—is possible with these new bows. Arrows now come off the string in a straight line, and a bow with more centershot can handle several arrow sizes, including stiffer heavier hunting arrows.

Among more than a dozen different brands, you'll find one, two or three handle lengths, optional grip styles to fit high, standard or low wrist positions, and several with removable grips. Since metal handles can be uncomfortable in a bare

or thinly gloved hand during cold weather, some manufacturers have begun adding leather or plastic grips.

The new materials accept additional drilling and tapping for accessories such as screw-in fishing reels, hunting sights, bow quivers and front-mounted hunting stabilizers. A few have broadhead cutouts so you can use same-length hunting and target arrows. Normal riser lengths are 16 to 20 inches, and nearly every maker has two or three limb lengths so you can have a bow of, say, 56 to 64 inches.

Demountable bows can be divided into take-downs and take-aparts. The take-apart concept attaches the limbs with bolts or screws, tightened with a box wrench, Allen wrench or coin. This style is slower to put together but is strong and

TWO-PIECE TAKE-APART Ben Pearson bow, made by Brunswick's archery division, joins in middle with interlocking aluminum knuckles secured by a single pin that is tightened with coin

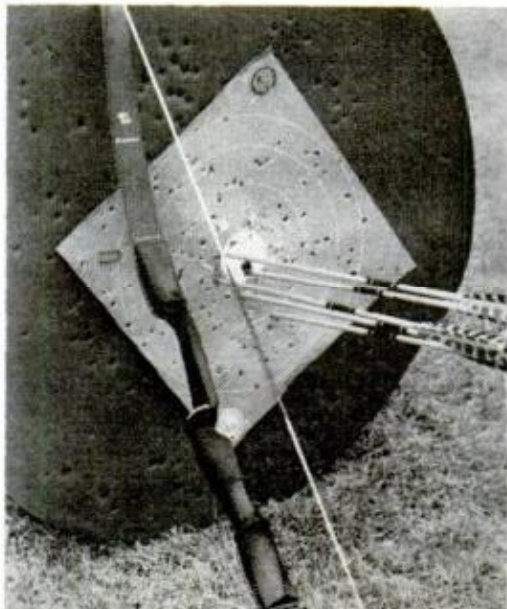
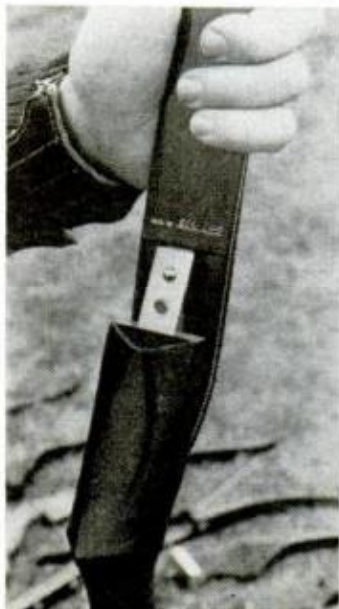
BOLT-ON LIMBS, like those on Carroll and Wing take-apart bows, bolt laminated limbs to the handle with an Allen wrench



FISHING REEL, like other bow accessories, bolts quickly onto an easy-to-tap modern handle

NO FASTENINGS are needed with Wing's Slide-Loc system. String tension holds coupling

PERFORMANCE is the test for take-downs. SlimLine Competition model bow from Wing proved able to group archer's test shots



allows easy limb interchanging. Usually an archer will leave this bow assembled and carry it in a regular long-bow case.

The take-down has the same favorable features but usually takes only a few seconds to assemble or unstring and remove limbs from the handle. No tools, loose bolts or screws are used and the bows are easy to carry knocked down between shooting sessions. Attachment systems usually involve one or two bolts for each limb. On most, like the Wing and Carroll models, the limb is simply laid over the handle and bolted. Others use a metal dowel on the limb which fits into the handle. Either way is good.

A variation is the two-piece Ben Pearson bow. It resembles a conventional bow sawed in half, with the butt of each piece

fitted with interlocking aluminum knuckles secured by a single pin. Close milling tolerances provide a very solid fit.

The Bear bow has a socket and latch in which you simply slide the limb into a grooved seat and snap the pressure latch shut. The new Wing Slide-Loc involves a tongue-and-groove system, with flanges on the bottom of the triangular tongue and pressure ball bearings which help lock the limbs into the handle once it's fitted together. The Herter's take-down limb slides under a metal tongue and clips into place. Other take-downs, like the new Hoyt and the just-being-released Golden Eagle Hunter, simply slide the limb into a socket and are then fastened tightly with a permanently fitted thumbscrew.

All take-down and take-apart attachment systems have proved safe, solid and dependable. They are closely milled and tight. They won't fly apart should a string be cut or broken. With performance equal to that of conventional one-piece bows, take-downs are popular on archery tournament tours.

Prices range from about \$35 to \$200, with most about \$100 to \$175. With today's take-downs, Robin Hood and his merry men could almost have carried concealed weapons.

Among manufacturers are:

Bear Archery Div., Victor Comptometer, Rt. 1, Grayling, Mich. 49738.
Ben Pearson Archery, Brunswick Corp., Box 270, Tulsa, Okla. 74101.
Black Widow, Wilson Bros., Box 33, Rt. 8, Springfield, Mo. 65804.
Carroll's Archery, Box 845, Moab, Utah 84532.

Gordon Plastics, 534 Banks St., San Diego, Calif. 92110.

Groves Archery, 5200 San Mateo N.E., Albuquerque, N.M. 87109.

Herter's Inc., Waseca, Minn. 56093.

Hoyt Archery, 11501 Natural Bridge Rd., Bridgeton, Mo. 63042.

Indian Industries, 817 Maxwell Ave., Evansville, Ind. 47717.

Magna Flight Archery, 5103 Airways Rd., Peoria, Ill. 61607.

Mountaineer, Kimberling City, Mo. 65686.

Plas/Steel Products, Walkerton, Ind. 46574.

ProLine Golden Eagle, 241 E. Kalamazoo Ave., Kalamazoo, Mich. 49001.

Wing Archery, Jacksonville, Tex. 75766. ★★

STRINGING BOW with slide-off limbs was found not different from bolt-on or one-piece bow



HANDLING of take-downs is like the conventionals. Limbs do not come apart if bowstring breaks



COMPARISON OF A DOZEN take-down models indicates that once archer becomes accustomed to one grip, he can change strength and the length of limbs with better results than with older models



Special effects put more punch in your pictures

Creative, exciting effects are easy to add to your pictures. All it takes is practice and the right accessories, many of which you can make yourself

By BURT MURPHY

THE FUN IN PHOTOGRAPHY increased when automatic cameras made good, clear photos easy, but automation took some of the fun away, too. You can recapture some of that fun—and dramatize your pictures—with easy (and mostly inexpensive) special effects.

With the right gadgets, a single-lens reflex, and a little know-how, you can:

- Take startling, 180° fisheye views.
- Shoot prismatic, multiple images.
- Vignette away portrait backgrounds.
- Soften portraits with soft focus or diffusion.
- Emphasized distance in scenic shots.

Fisheye shots are less expensive than you may have thought. True, fisheye lenses cost hundreds of dollars, but fish-



eye attachments start around \$59.95 (for Spiratone and Prinz units) and can fit in front of virtually any lens on any camera.

Fisheye attachments work best on normal or moderate wide-angle lenses, such as a 50 or 35-mm on a 35-mm camera. With very-wide-angle lenses, the circular image may be too small. And with long telephoto lenses, the curvature of the image is reduced and the effective f-stop becomes uncomfortably slow. Behind-the-lens meters may work with fisheye attachments; if not, or if you're using another type of meter, a ring on the attachment tells the true effective f-stop for each focal length.

Fisheyes take in more than you may think possible at first. Until you're used

to them, you'll find your pictures showing your feet, your tripod's legs or other things you'd rather not have in the picture. Fisheyes distort, but selectively: objects at the picture edge are always curved, but central objects aren't very distorted unless they're very close.

The diaphragm of the prime lens should be wide open when a fisheye attachment is used, and the control ring of the fisheye should be set to the desired f-stop. For best definition, close down about two to three stops from maximum aperture.

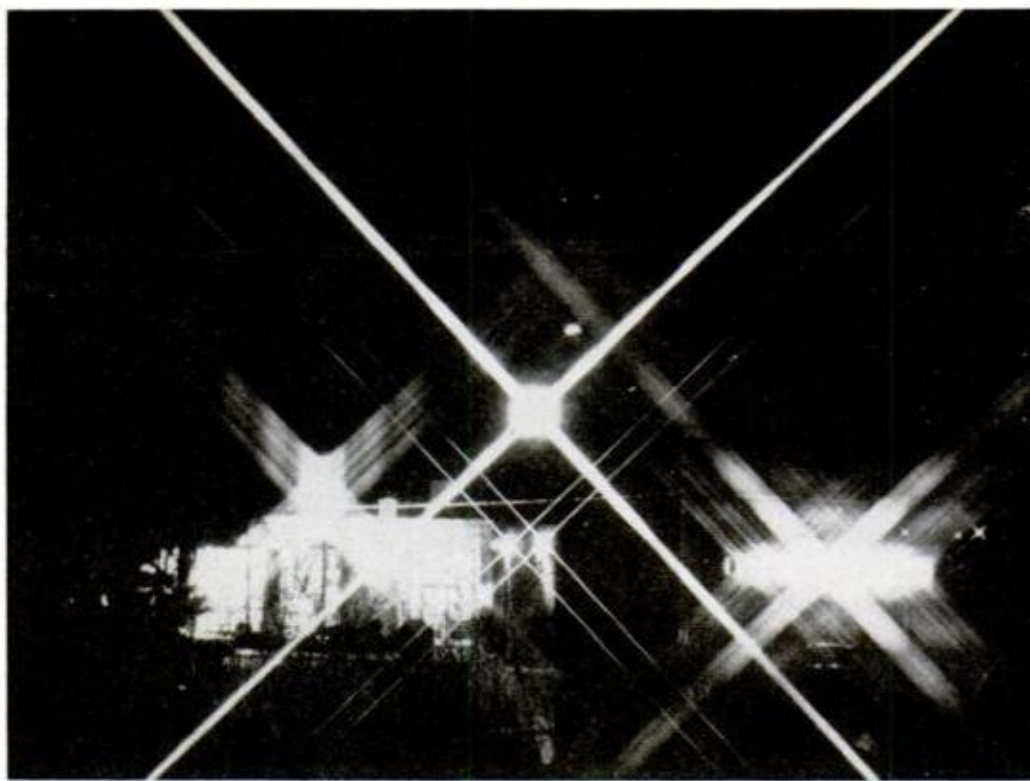
Multiple images require even simpler, less expensive attachments: filter-like prisms designed to produce three, five or six simultaneous images on one frame. Spiratone offers three models: the 3P,

MULTIPLE IMAGES (right) are made with filter-sized prisms mounted in front of your camera lens. Several prism types are available; some give you five concentric images, as in this picture; others give three or four concentric images or three parallel ones. Multiple-image prisms are designed to mount like filters; but some photographers prefer the shots they get with the prism held an inch or two ahead of the lens. A paper cup, spray-painted black inside, makes such a mount (below); but you'll have to focus and adjust your aperture before you cover the lens with the paper cup



FISHEYE SHOTS (left) take in an ultrawide, 180° angle. But unlike the regular wide-angle lenses, they curve the objects in their field of view, with the curvature increasing toward the edge of the picture. (The face, since it's in the picture's center, is less curved by the fisheye effect than it is distorted by proximity to the lens.) Note the lens flare—a problem with fisheyes, since lens hoods can't be used with them. Fisheye attachments (right) fit almost any lens, start at about \$60. Used on wide-angle lenses, they produce full circles; with 50-mm lens, edge of circle may be lost





SPARKLING STARS spread out from lights in night scenes, or from sharp highlights in daylight shots, when you use commercial or homemade star filters.

To make one, cut a piece of screen to fit your lens hood or filter holders; use two layers for eight-pointed stars. You'll lose a little contrast, though

which produces three parallel images; the 3C, producing three concentric images, and the 5C that surrounds its central image with four secondary images. Prinz's Mirage is similar, with five secondary images surrounding its central one. Prices, depending on the size and model chosen, range between \$9 and \$20.

Though these prisms can attach to the front of almost any camera lens, reflex or view cameras are by far the best to use, since they let you place the secondary images exactly where you want them. The prisms also rotate in their mounts, to help you place images precisely; the concentric models may even be rotated during exposure, producing deliberately blurred secondary images surrounding a sharp, central one.

For more clear-cut images, mount the prism a few inches in front of the lens. A paper cup, its inside sprayed with flat black paint, can be used to mount the prism this way.

Multi-image prisms don't affect exposure, but they may cut off the corners of the picture at small apertures. Check this by previewing your pictures with the lens

stopped down to the f-stop you're actually shooting at.

Star effects—long streaks or crosses of light surrounding strong highlights in daylight pictures, or light sources in night scenes—can add glitter, romance and sparkle to your shots. You can buy filters to produce these effects, or make your own.

Spiratone has three models available: the Crostar 2P, which extends highlights

SOFT-FOCUS EFFECT (right) makes old-fashioned looking portraits, hides skin blemishes. Shot was made with Spiratone's special Portragon soft-focus 100-mm f/4 portrait lens





VIGNETTING softens look of pictures, hides distracting backgrounds for another soft, old-fashioned touch. Effects vary with lens used (135-mm above left, 50-mm above) and attachment type. Spiratone's Vignetar attachment (left) is adjustable; homemade, nonadjustable types include frosted cellophane tape on lens hood (below left) and clear filter with petroleum jelly smeared around edges (below right)

along a single line, and the 1SQ and 2SQ, which produce crossed highlights (the 1SQ produces more sharply defined "stars"). Prinz markets the Cross-Screen, producing an effect like that of the 2SQ. Prices are around \$5 to \$10, about the same as other filters.

To make your own, use aluminum screen patches (or scraps from discarded screens), either cut to fit your filter holder or simply crimped inside a lens hood. These homemade attachments diffuse the image more than commercial ones do, reduce contrast; and they can't be rotated as easily to orient the starlines where you want them. But they are practically free.

If you combine two star attachments at right angles, you'll get eight-pointed stars. The angle between the points will vary if you vary the angle between the grids of the attachments.

Vignetting, or gradually blanking out the edges of a picture, is a time-honored technique to focus attention on a subject by separating it from its background. It's usually done in the darkroom, but it's even easier to do it in your camera—and that way, you can vignette your color slides as well.



For maximum control of your vignetting effects, you can use Spiratone's Vignetar attachment (\$15.88), which is adjustable for sharply or softly defined vignettes. Prinz has a spot filter that is not adjustable, but—at \$5.95—is even less expensive. Or you can make your own by rubbing petroleum jelly around the outer portions of a haze filter; here, the effect will vary with the thickness of the coating and the size of the clear central spot. (You can get a similar effect by ap-

(Please turn to page 200)

How to get a

Trapped moisture seeking to escape through the walls of your house will cause paint to peel and blister year after year, unless you can control it

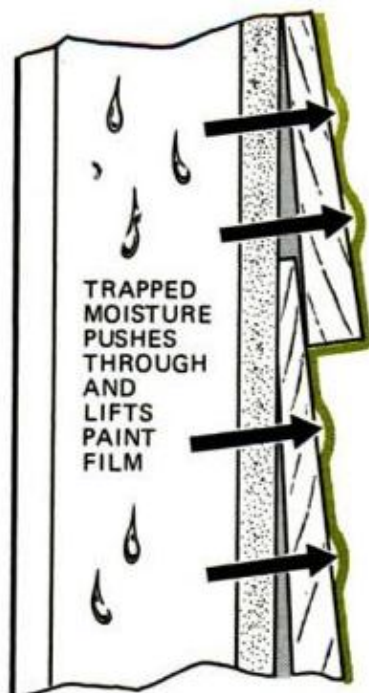
YOU CAN USE the best paint that's made, apply it to the best seasoned wood and brush it on under ideal painting conditions (warm, dry and slightly breezy), but if your home has a moisture problem, repainting isn't going to solve paint peeling. Less than six months after application, you'll be right back where you started with a paint job that continues to blister and peel.

Who or what is to blame? When an exterior paint job blisters and peels, most

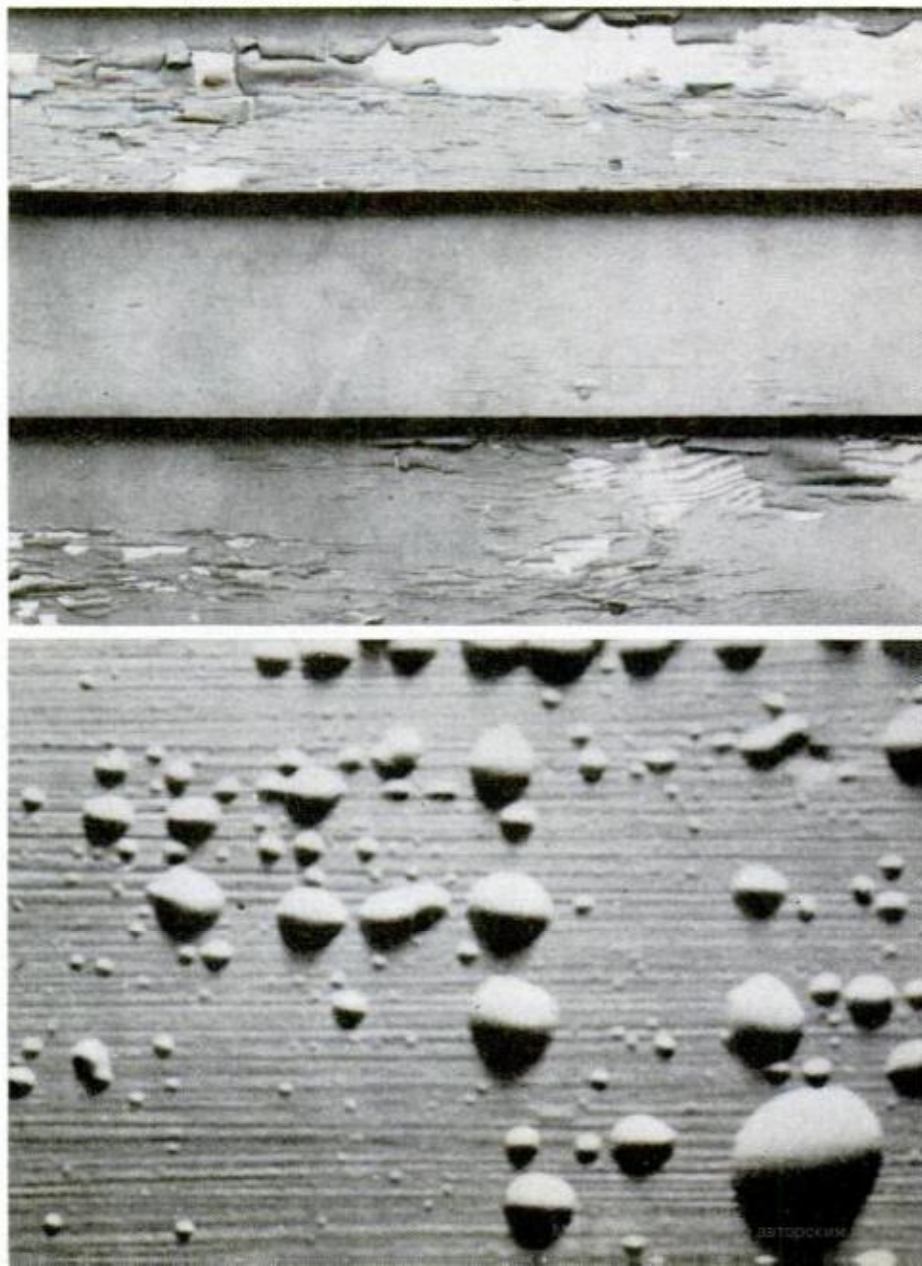
homeowners are quick to blame the paint, regardless of its price. If it's their first paint job, they are apt to blame themselves and their inexperience. They often wind up blaming the siding itself. In most cases it's not the paint, it's not the person who put it on and it's not the wood. Four times out of five, so-called paint failures are due to just one thing—excessive moisture.

Hidden moisture from within can not only wreck a paint job, it actually can

NATIONAL PAINT, VARNISH AND LACQUER ASSN., INC. PHOTOS



TRAPPED MOISTURE has to escape and when there is no easy way out, it passes right through the siding, lifting the paint as it goes. Excessive moisture can cause peeling, blistering, mildew, loss of heat and even structural shifting



peelproof paint job

wreck an entire house. Rotted wood, soggy insulation and general decay are extreme results of uncorrected moisture problems—moisture that gradually eats away at any poorly ventilated house.

Proper ventilation is the key to a lasting paint job since all houses must "breathe" to allow excessive moisture to escape to the outside.

Because moisture in your house is usually produced in the form of vapor and quickly disappears inside the outer walls, it's seldom noticed. In fact, the only way you know there is moisture inside the walls is when it finally pushes its way through the exterior siding and escapes, leaving behind a blistered and peeled paint film as shown on page 152.

Where does it come from? There are three main sources:

- Conditions within the house
- Original construction faults
- Unprotected openings.

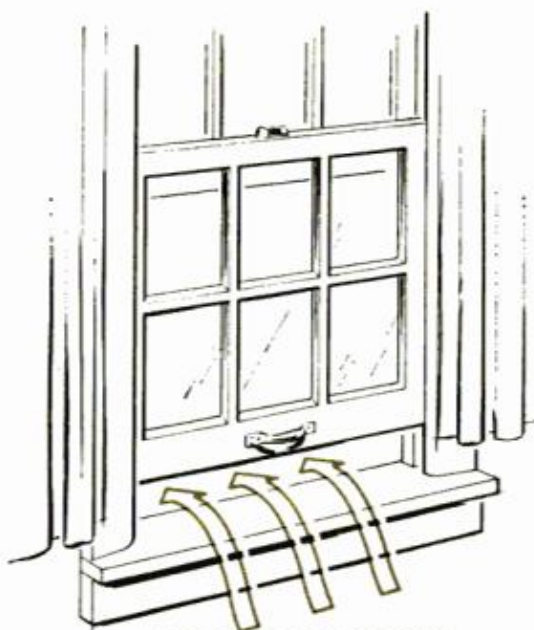
Conditions existing within the house are the most common causes of moisture accumulation there. Daily cooking, bathing, dishwashing and clothes drying all contribute great amounts of moisture vapor to the air. Everyone in the house contributes to this problem by the simple acts of breathing and perspiring. It is not uncommon for a family of four to produce some 50 lbs. (6½ gals.) of moisture every 24 hours.

Many moisture problems are caused by obviously poor workmanship or the use of inferior materials. Green lumber, loosely fitted window and door frame and corner butts, inadequate sealing and caulking, the absence of metal flashing all let moisture play havoc with exterior painted surfaces.

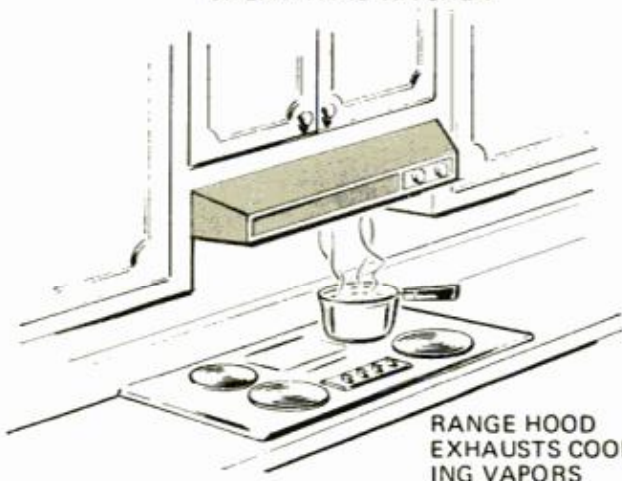
Actually, your peeling-paint problem is doing you a favor. It's a sure sign that all is not well within the framework of your house.

But even the best constructed house is not safe from moisture. Expansion and contraction of wood during drastic temperature changes may cause caulking to fall out. The foundation may settle, boards may split. Be watchful that moisture from the outside does not enter open joints. Also, see that wood siding does not contact the ground.

Moisture, like a caged animal, seeks to escape continually. Oddly enough, the fact that modern homes are usually better



VAPOR FROM STEAMED UP BATH AND KITCHEN



RANGE HOOD EXHAUSTS COOKING VAPORS

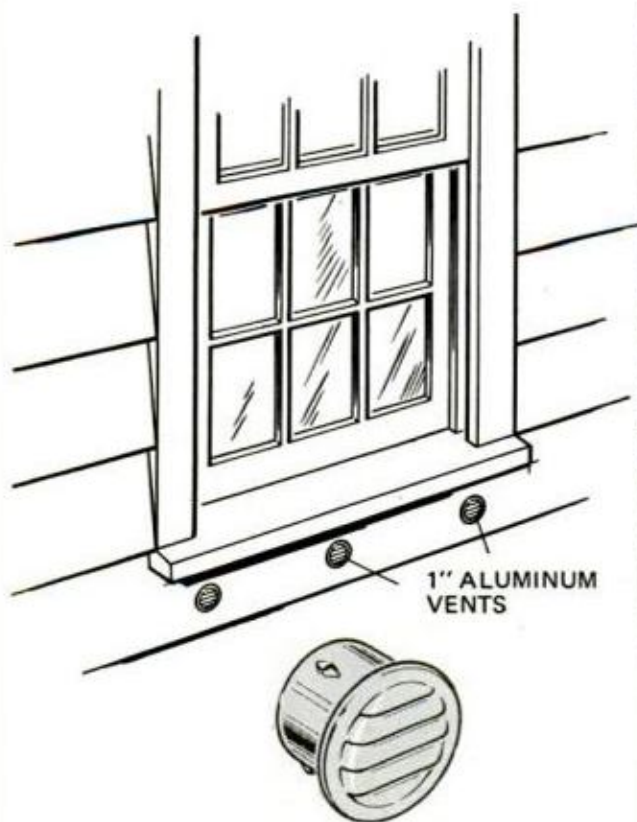
built than older homes makes it all the more difficult for trapped moisture to escape. Because of insulation, tight-fitting storm doors and windows and superior caulking materials, inside moisture has less chance than ever to reach the outdoors. But it will get outside some way. When it can't get out through normal openings, it's forced to escape directly through the outside walls, literally lifting the paint as it pushes its way to freedom. Unless moisture is controlled, the task of keeping your home painted will be an endless job.

Naturally, it's both desirable and necessary to have a certain amount of moisture present in every home—life would be impossible without it. But moisture does

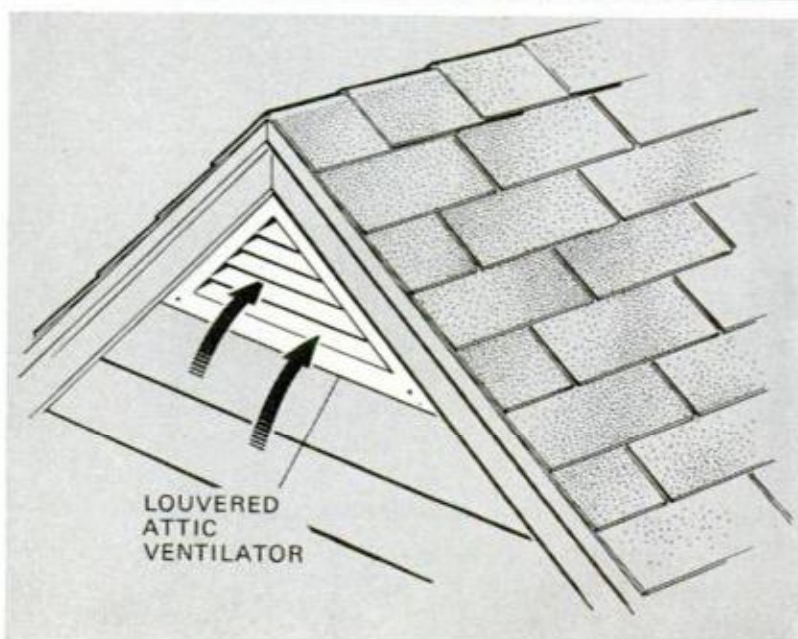
have to be controlled and circulated—in much the same way as heat. Ideally, a humidity meter should show a reading of between 30 and 40 percent (depending on local factors.)

You can control and help moisture escape merely by opening a window a bit. In a few seconds, vapor from a steamed-up bathroom or kitchen will disappear. If opening a window is not feasible, then you should install a ventilating fan in the bathroom and an exhaust fan over the range.

In bathrooms, kitchens and laundry rooms and in other areas of moisture accumulation, it's a good idea to install ventilating louvers under the window sills. These are 1-in.-dia. round vents which are



MOISTURE CONTROL is the secret of a peelproof paint job. A power roof ventilator will get rid of moisture in an attic, gable louvers will help circulate it and siding vents will let it escape freely without wrecking paint



fitted in holes bored through the siding and sheathing and let moisture escape without wrecking the paint.

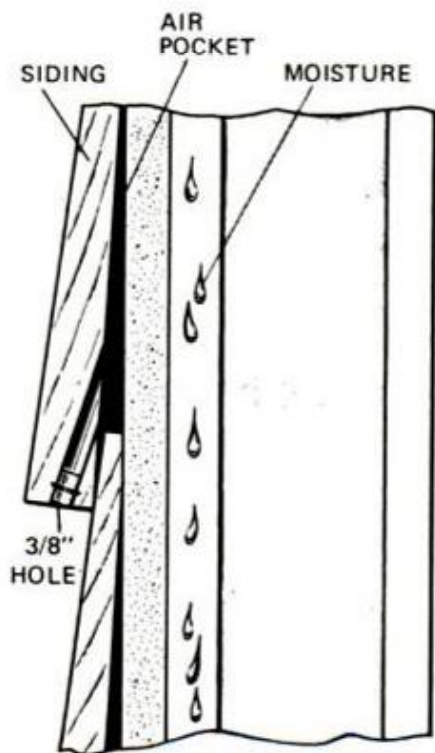
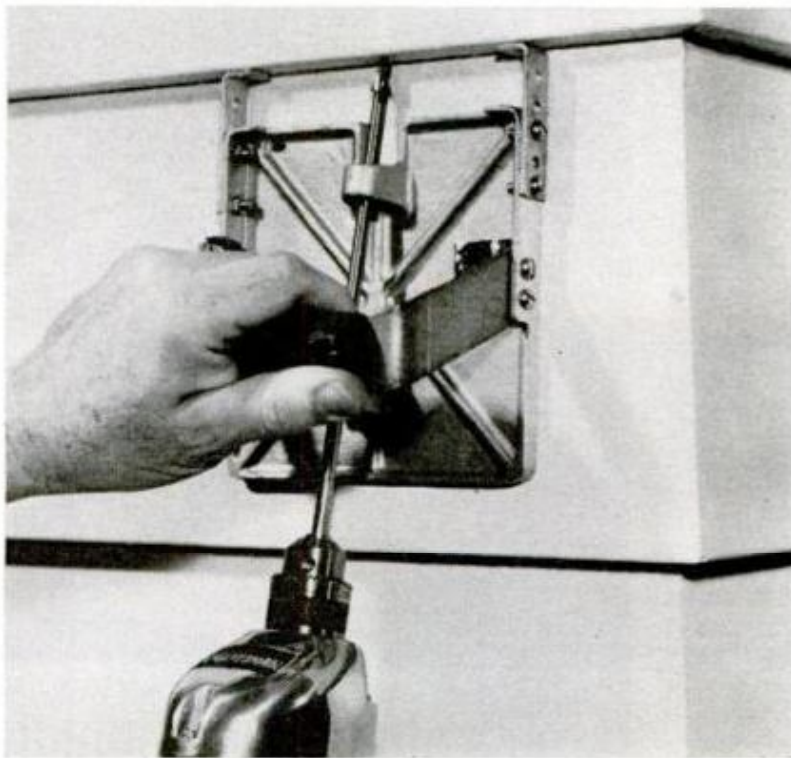
Moisture trapped in the attic can attack the insulation there and seep down into the walls. Installations of roof end-gable louvers and rooftop ventilators are your best bet to help circulate and pull moisture out of an attic.

Probably the best corrective measure you can take to make sure that your home is properly ventilated is to install special vents up under the lapped edges of the exterior siding. Such vents provide "breathing holes" for moisture to escape. A special drilling tool, designed for use with a portable drill, holds a drill bit at precisely the right angle to bore $\frac{3}{8}$ -in.

holes up through the butt edge of the siding. In the case of lapped bevel siding, the holes are drilled through the siding and into the air pocket behind it, but not into the sheathing. In the case of rabbeted siding, which fits flat against the sheathing, the holes are drilled through both siding and sheathing.

The holes are lined with special plastic inserts designed to keep them open, while effectively blocking out insects. In badly peeled areas, these vents should be installed every 16 in. between studs.

When paint is discovered peeling around the roof line, the cause may be winter ice dams. If possible, heavy accumulations of snow along the gutters should be removed before an ice dam can form. ★★★



SECTION THROUGH WALL

"BREATHING HOLES" drilled into air spaces behind siding will allow moisture to escape before it attacks the painted surface. Special tool helps you drill holes at proper angle up through lower edge of siding with portable electric drill. Kit (above) sells for about \$16 at Sears, Roebuck & Co.

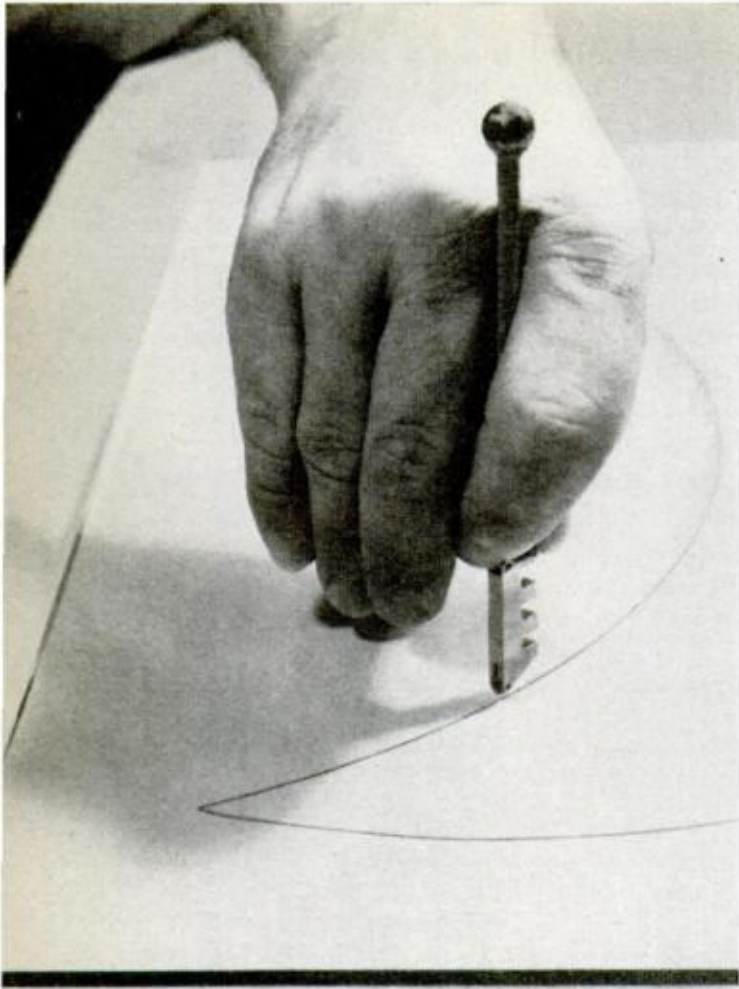
Short course in

By PHILIP HERMANN

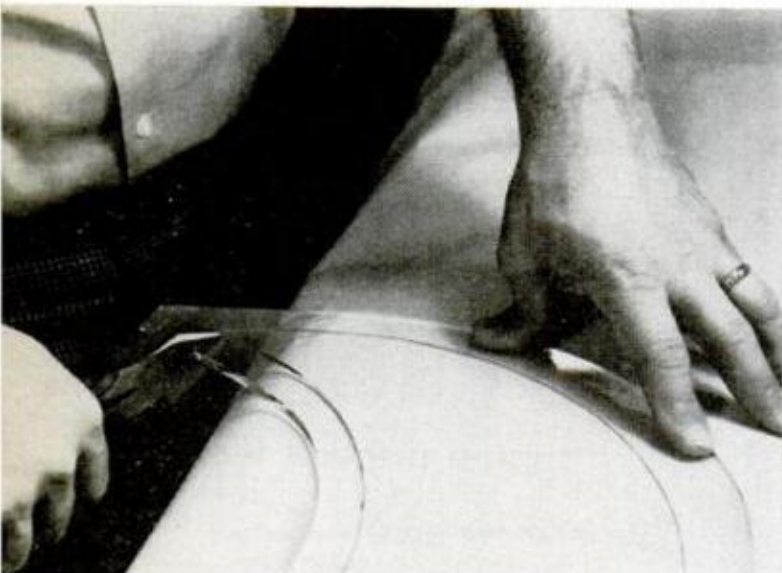
MOST OF US have lived through at least one exasperating work session in which a couple of sheets of glass were shattered by clumsy glass-cutting efforts. Usually, the aggravation is compounded later when you stand in the glazier's shop and watch him make the cuts while hardly looking at the material. With the tips listed here, plus the right tools and some careful practice, you should come close to duplicating his expertise.

A good glass cutter costs about \$1 at a hardware store. If you plan to do any pattern cutting, you'll also need plate pliers (about \$8). For most work, straight pliers—with the jaws ground so *the tips meet first*—will suffice. The only other tools needed are tape measure, straightedge and a square. Finally, your worktable cutting surface should be covered with a piece of short-pile rug.

When making a straight cut on either sheet or plate glass, similar techniques are used, but there is a slight variation in cutter pressure. As a rule, sheet glass requires roughly twice the pressure that plate glass does due



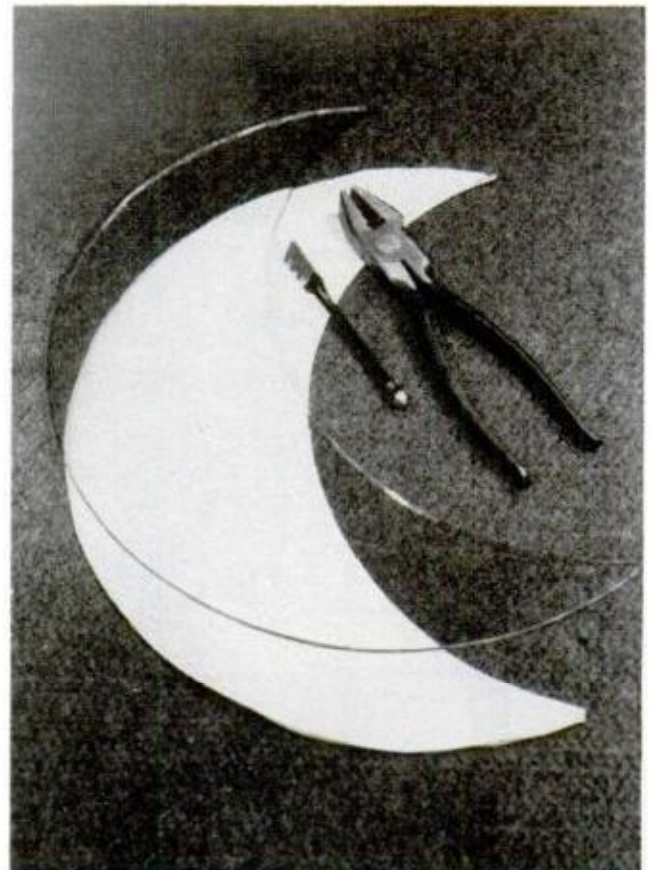
TRACING a contoured pattern on glass is possible if the cutter is kept well oiled and sharp



PATTERN to be cut from glass is traced onto paper. The paper is placed under the glass and the glass is scored, following pattern. After excess glass is removed, score line is "run" (above) with plate pliers

TWO BASIC TOOLS—plate pliers and glass cutter—were the only ones used to complete quarter-moon design in glass. For work such as this, benchtop must be covered with a scrap piece of short-pile rug

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POPULAR MECHANICS

glass cutting

to its harder surface. Never apply excessive pressure because the glass will fracture on the surface, and the cut will run erratically.

Because of the cutting wheel's shape, a straightedge should be placed $\frac{1}{16}$ in. away from and parallel to the intended cut. Before scoring, dip the cutter wheel in a lightweight motor oil.

Score with one movement—no stops. The cut should sound smooth and be free of skips. After scoring, the cut can be run (removed). If the cutoff is 1 in. or less, remove it with plate pliers. Let the glass hang over the cutting-surface edge. Then place the flat end of the pliers on the score line and apply a downward twist to peel off the glass in one piece. If the cutoff piece is more than 1 in. wide, the glass can be snapped off.

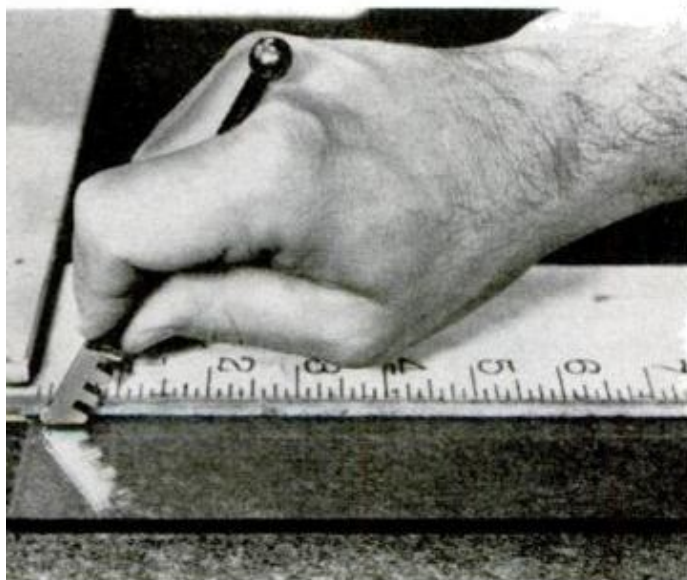
In pattern cutting, place the paper pattern under the glass. With cutter in normal position, follow the pattern on the glass. Before breaking, remove all excess material to within 1 in. of the score line, then run the original cut. ★★★

ABOUT GLASS

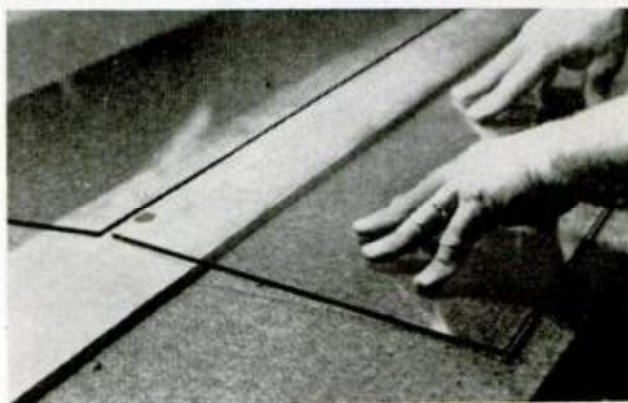
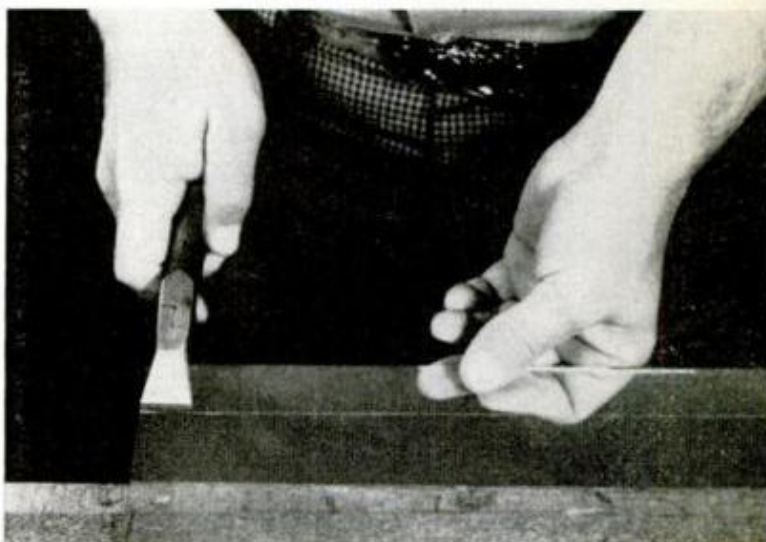
Before making your first cut, you should have a basic understanding of glass and glass-industry terminology. In the trade, sheet glass is referred to as single-strength, double-strength and crystal glass. Sheet glass has a wavy appearance and a very hard surface. On the other hand, heavy plate glass comes from the furnace with a rough texture and is ground and polished on both sides to make it clear and free of waves. Glass type also tells you the thickness; single strength is $\frac{1}{16}$ in., double is $\frac{1}{8}$ in. and crystal is $\frac{3}{16}$ in. Plate glass comes in a number of thicknesses varying from $\frac{1}{4}$ to 1 in. and thicker. For the most part, the thickest plate glass that an average do-it-yourselfer will come into contact with is $\frac{1}{4}$ -in. material.

Since a glass cutter is a seldom-used tool, make some practice cuts on scrap if possible. Though you can hold the cutter as if it were a pencil and apply pressure with your index finger, most pros prefer the more stable grip between first and second finger shown below. Here, the ball end of cutter rests on your knuckles and, by placing the first finger on top and your thumb directly underneath—and the notches facing down—you will be able to master this handy—but sometimes ornery—tool.

Making straight cuts



PROPER GRIP on cutter is important when moving it along a straightedge. Grip shown above is best method. Small strip of glass (top right) is snapped by placing flat edge of pliers on the score line and applying a downward twist. To break off large piece (right) the straightedge is carefully placed squarely under the score, then glass is snapped off by applying a quick, definite pressure. Notice that all glass-cutting steps are accomplished on carpet to minimize the chance of breakage by impact



PM tests the

By **WAYNE C. LECKEY**, Home and Shop Editor

Photos by Robert D. Borst

WHILE THE SPECS include such worthwhile features as permanently lubricated ball bearings, a precision-ground steel-tubing bed and an indexing pin for dividing faceplate work, I was anxious to see just how rugged Sears' new Craftsman 12-in. wood lathe would be when put to the test. Frankly, I had my doubts about the sturdiness of its tailstock when mounted on a single-tube bed.

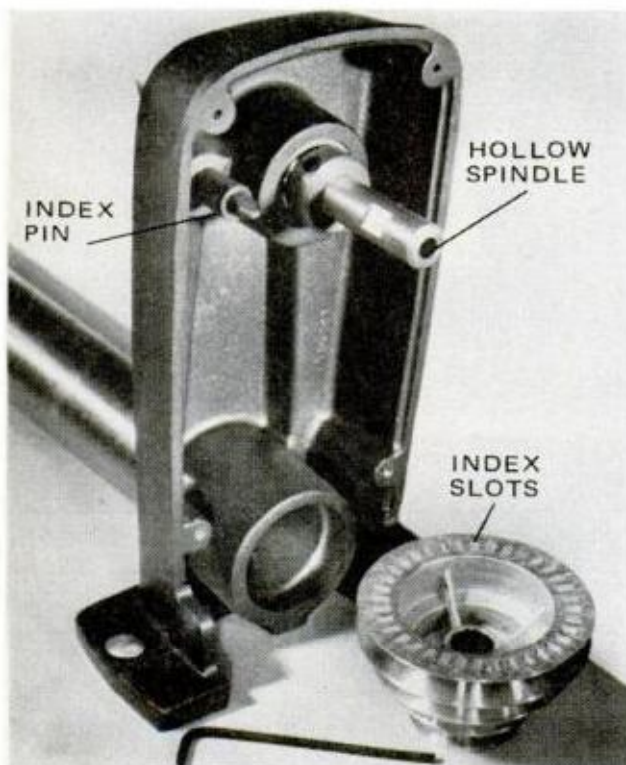
To give it a severe test, I chucked a 36-in. length of 4x4 between centers, flipped the switch and watched for tailstock "whip." To my surprise I found that even at high speeds this tubular-bed lathe performed with the ruggedness of lathes costing much more than its \$99.50 price.

The lathe is equipped with a switch you can lock by removing a novel plastic key, a hinged belt guard you flip up to change speeds and a handy quick-check speed chart posted on the guard.

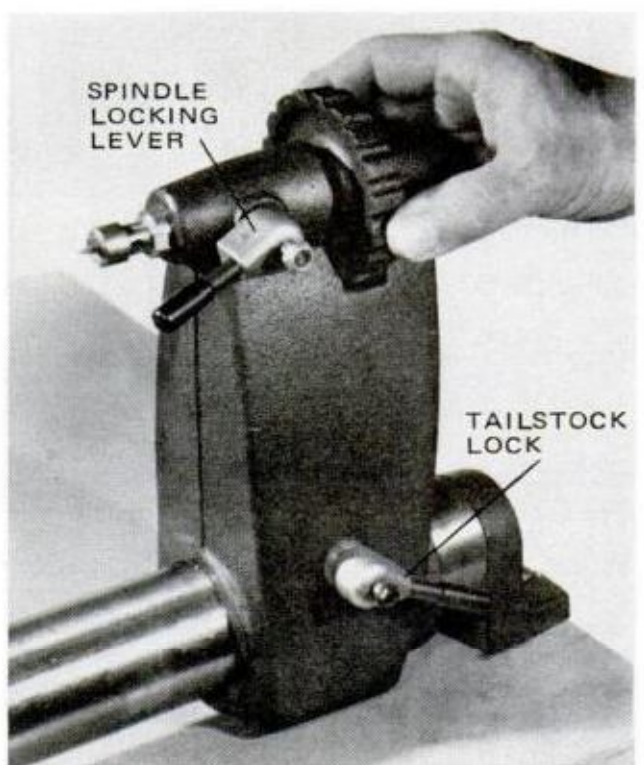
Two minor things I found "wrong" with

(Please turn to page 201)

BIG CAPACITY (37 in. between centers and 12-in. swing) allows king-size spindle, faceplate turnings

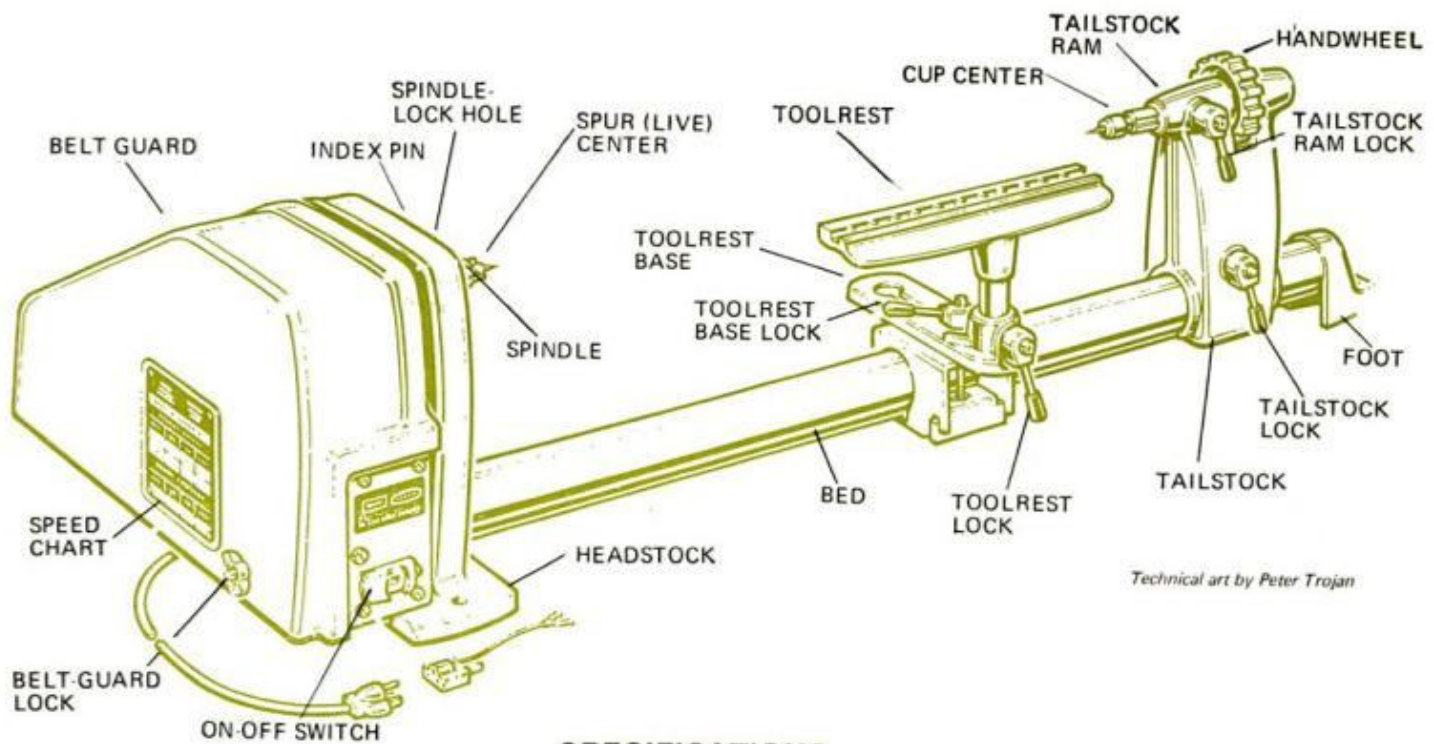


INDEXING PIN engages 35 equally spaced holes in spindle-pulley flange when dividing faceplate work



TAILSTOCK HANDWHEEL is turned counterclockwise to advance cup center; bolt-like lever locks spindle

Craftsman 12-in. wood lathe



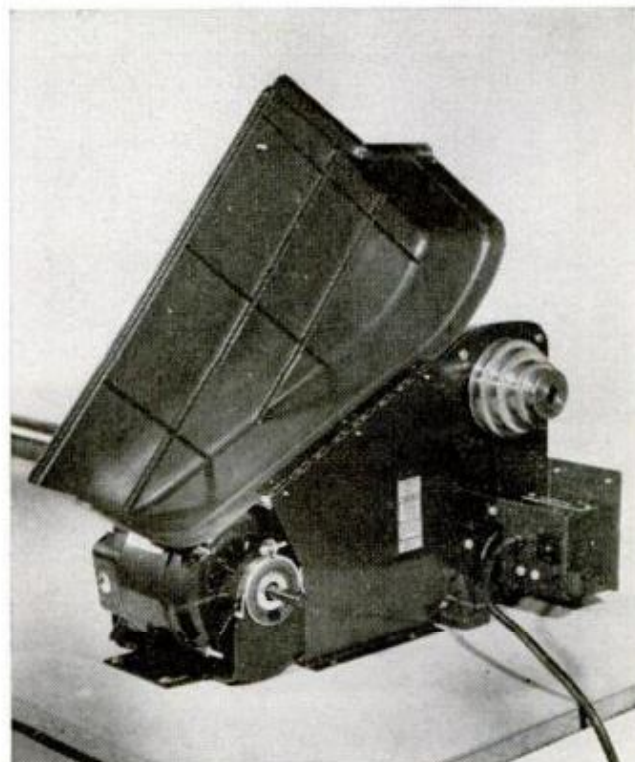
SPECIFICATIONS

Swing over bed, 12 in.
 Center to center, 37 in.
 Length of bed, 45½ in.
 Spindle, inboard end ¾ in. x 16,
 right-hand thread with No. 1 Morse,
 female taper
 Ram travel, 1⅞ in.
 Spindle bearings, two sealed
 radial-thrust ball bearings

Machine pulley, 4-in. 4-step V-type cone
 Mounting, 6⅜ x 49⅜ in.
 Tailstock taper, No. 1 Morse, female
 Motor pulley (not included), 4 in.
 4-step V-type cone
 Motor (not included), ⅓-hp. 1725-rpm
 split-phase, 60-cycle a.c.
 Lathe bench (not included), steel legs,
 2x5 ft. laminated wood top



REMOVAL OF PLASTIC KEY from switch prevents unauthorized use of the lathe. Spare key is furnished



SWING-UP BELT GUARD makes it handy to switch belt on pulleys for varying lathe speed to suit work

HINTS FROM READERS

Emergency 'rasp'

In a pinch, a leftover length of threaded rod can be used as a round rasp. The sharp edges of a newly threaded rod, such as Redi-bolt sold in hardware stores, will cut soft wood almost as well as a regular coarse file. To avoid a punctured palm, fit one end with a handle. I force-fitted an old doorknob over the rod.

—Ken Patterson, Regina, Sask.

Saw-blade holder at the ready

Because of their size, I've always had a job keeping my jigsaw blades where I could locate them readily. To solve the problem, I drilled three holes in a scrap block of wood, which I then fastened to the saw arm with large rubber bands. Now, when I change blades, the replacement is always at my fingertips.

—Ned Somner, Houston.

Pencil 'fused' to clipboard

In *Hints from readers*, I've seen several good ideas for keeping a pencil at the clipboard. So, I'll pass on to other readers the stunt that I've used with much success. It's simply a fuse clip fastened to one edge of the board with a 6-32 machine screw and nut. The pencil is held snugly, yet is easily removable.

—Marshall Lincoln, Wickenburg, Ariz.

Egg carton toolbox

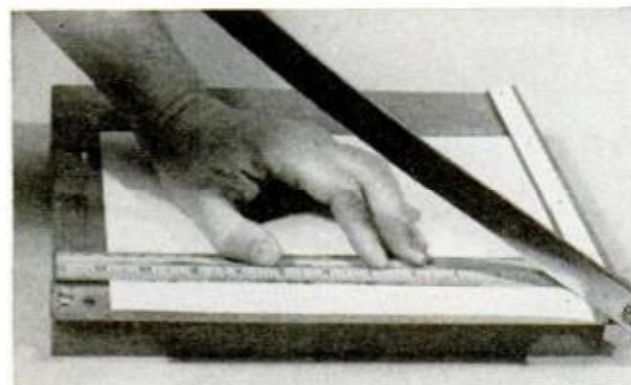
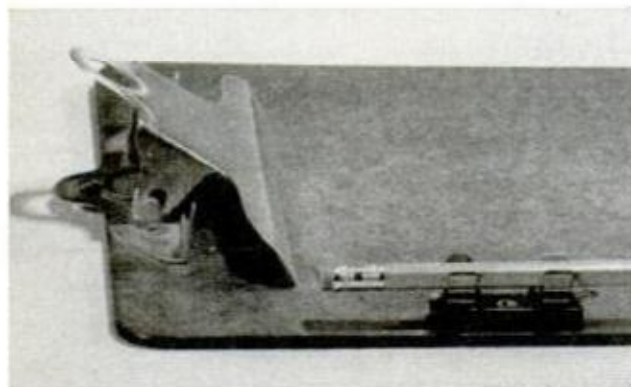
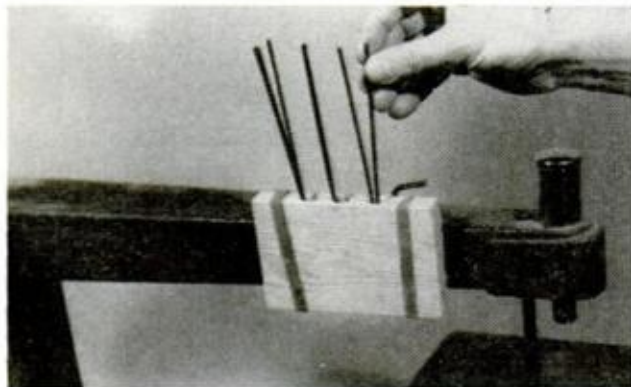
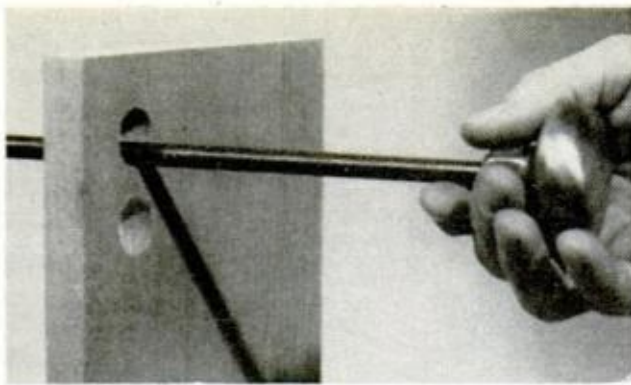
Empty pressed-fiber or plastic-foam egg boxes can be used as a cover or shield for garden tools, hooks and other items. They will prevent accidental contact with sharp edges and points and protect the tool from rust. To provide space for the head of the pruning tool shown, one cone in the box was trimmed off.

—Walter E. Burton, Akron, Ohio.

Keep paper flat when cutting

Frequently, when you're trimming thin stock—such as pictures cut from a magazine—the paper tends to crease and move as the knife blade starts its shearing action. By keeping a 12-in. or longer wood rule at the paper cutter, you will always have a handy paper holder that spans the paper to hold it securely while you cut.

—Ken Patterson, Regina, Sask.



New tools you should know about



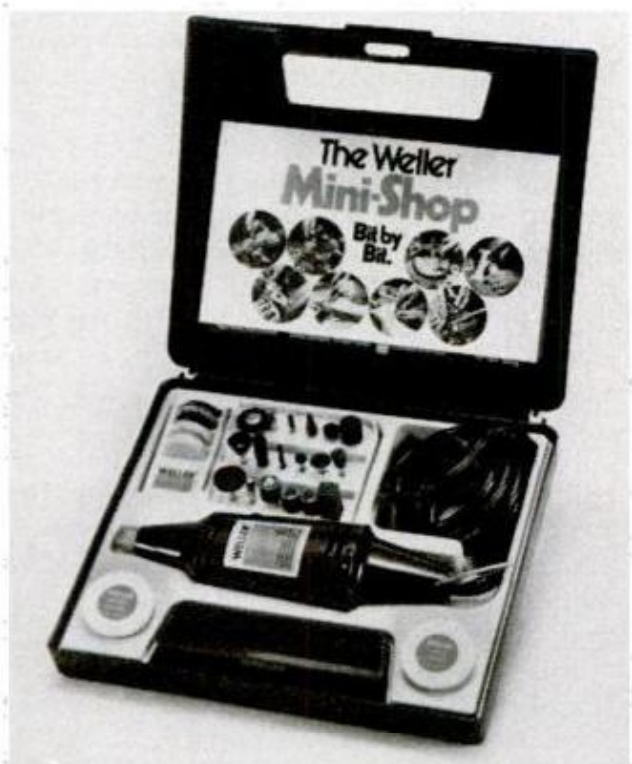
NINE COMMONLY USED TOOLS, including a wire stripper and Surform "block" plane, come in convenient, slim case. At hardware stores, set 90-064 sells for \$19.95. Stanley Tools, New Britain, Conn. 06050.



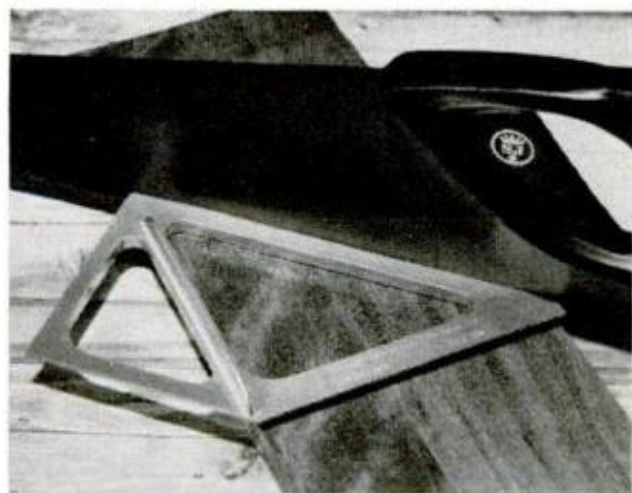
PAINT 'N TRIM KIT includes a specially designed paint tray for pad-painters, plus all the tools—including spackling paste—to paint any room. Price is \$11.25 at hardware and paint stores. Red Devil, Inc., 2400 Vauxhall Road, Union, N.J. 07083.



VERSATILE SPRAYER has an adjustable nozzle allowing user to spray insecticides and other liquids in a fine mist or jet stream. Spray head and refillable quart container won't rust or clog. AFA-77 sprayer is \$1.98 at most hardware stores. AFA Corp., Box 262, Palatine, Ill. 60067.



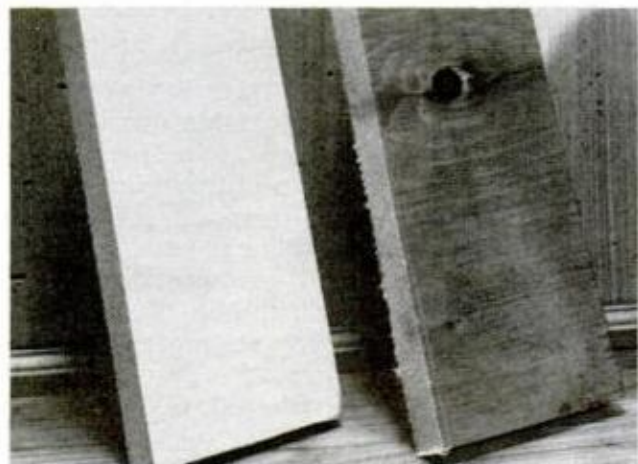
IDEAL FOR HANDYMEN, hobbyists and professionals, 38-piece Mini-Shop 600K by Weller, 100 Wellco Road, Easton, Pa. 18042, has 27 cutters, dressing stone, drill, mandrel, jeweler's rouge, abrasive wheel. \$33.95.



MITER TRIM AND MOLDING accurately with this handy, pocket-fit Trim Square. Claimed to replace the miterbox, it's at hardware and building supply stores; \$2.98. Estwing Mfg. Co., 2647 8th St., Rockford, Ill. 61101.



UNIQUE TRANSPARENT FINISH is easy to apply, it can be used on glass and metals as well as on wood



TWO PIECES OF PINE cut from same board: Piece on the right was given one spray coat of Tuf (red)



ALL COLORS come in liquid form and in aerosol cans. Per ounce, the latter costs just a little more

PM USE TEST:

When you've seen one paint

BY HARRY WICKS, Workshop Editor

Photos by Robert D. Borst

For decorating and antiquing: A colored, transparent finish

URETHANE FINISHES are not new. Most do-it-yourselfers have known for some time now that a coat of the stuff gives a durable finish with extra good resistance to mars, scratches and stains from noncompatible liquids. But, *this* urethane finish is new; though it comes in colors, it is not opaque.

The idea of such a paint is intriguing and, as I expected, it's real fun to work with. Frequently, a colored finish on a project is found to be more desirable than a natural, stained one. That's probably the reason why the "pickled" finishes are so popular.

The beauty of this finish is that you can choose a hue from six attractive colors to get the effect that you want, yet not lose any of the wood's grain because the finish is transparent. I took it a step further and tried "antiquing" by mixing two and three colors—right on the workpiece—spraying one color immediately after another. I was able to achieve a weathered look on a stained benchtop with my first effort. I did it by combining a small amount of red spray with coatings of blue and a little green.

Under normal drying conditions the paint sets in about 10 minutes and dries hard in two hours. It's versatile too: It can be used on outdoor furniture, glass, metals such as copper, brass and nickel and plastics.

Intensity is increased by applying additional spray coatings. If possible, for large jobs use the brush-on version of Tuf for economy.

SPECIFICATIONS—TUF URETHANE FINISH

Comes in pine green, burgundy, lemon, tangerine, flame red, colonial blue and clear. Prices: pt., \$2.69; qt., \$4.95; gal. (clear only), \$9.95; 16-oz. aerosol can, \$1.98. National Solvent Corp., 955 West Smith Rd., Medina, Ohio 44256.

POPULAR MECHANICS

Two new paints

you haven't seen them all

Dripless house paint

AN ADMITTED "SMEARER," I find nothing I'd rather do less than spend a Saturday painting from a ladder. I'm constantly looking for paints that will (1) let me do the job faster, (2) cut down cleanup time because paint will be on the house instead of the painter and (3) give a lasting finish so it will be a while before I ascend that ladder again.

For me, Glidden's Gel-Flo just passed those tests with flying colors. When you open the can, it's like looking at a giant glob of marshmallow. In every can I used there was a small amount of brownish liquid I'd guess is linseed oil. However, since the maker advises not to stir or thin, you simply start painting. Gel-Flo goes on beautifully, is self-leveling and you can transfer a big glob to a work surface without spilling a drop; you just work your brush back and forth to spread it. It covers a properly prepared surface well and dries to a soft, semigloss finish. To get familiar with it, I'd suggest buying a quart for use on trim. ★★★

SPECIFICATIONS—GEL-FLO

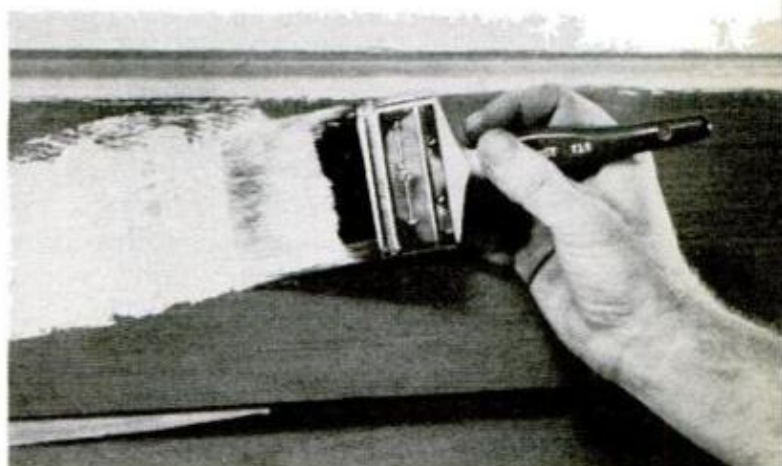
One-coat, alkyd-base house paint; in white and 20 colors. Prices: qt., \$3.15; gal., \$9.95. Glidden-Durkee, 900 Union Commerce Building, Cleveland Ohio 44115.



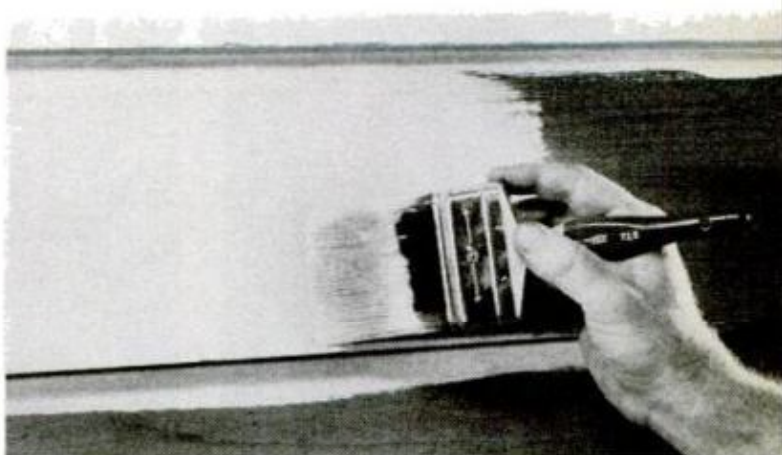
NO DRIPPING or runny paint all over the painter is what the author liked best about Glidden's Gel-Flo
OCTOBER 1972



IT'S NOT A GAG SHOT: A 4-in. brush is standing unaided in paint that has marshmallow-like texture



FULL BRUSHLOAD of paint can be carried from can to the siding, covers more area than usual brushful

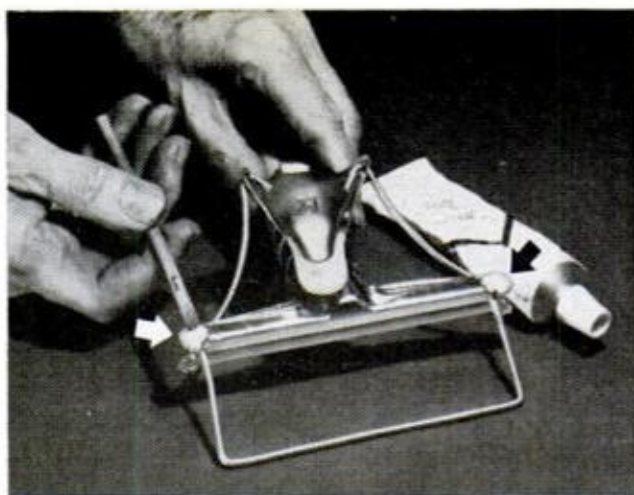


THICK GLOB is then smoothed out, using back-and-forth strokes. Next brushful will blend in perfectly

HINTS FROM READERS

Silicone sealant pads mop

To help make them more resilient—and quiet when contacting furniture—I recently padded the four “ears” at the ends of the grooved crossarm on a household mop. To do it, I spread silicone sealant with a small paddle to form caps about $\frac{1}{8}$ in. thick, extending far enough back to remain in place. Allow the silicone to “cure” for a couple of days before putting the mop to use.—*Walter E. Burton, Akron, Ohio.*



Screw tap starts thread

A “tap” made from a wood screw can be clamped in a tap wrench to preform threads in a pilot hole. It's easier to hold the tap straight than to try to start a regular screw with a screwdriver. To make the tap, cut the head from an ordinary wood screw of desired size and file a portion of the shank end square to fit the tap wrench. The tool permits considerable turning power without chewing the slot.—*W. B. May, Oak Park, Ill.*



Hangers from tin cans

Besides being a good way to recycle old tin cans, a No. 2 fruit can makes a perfect nonkinking holder for storing extra V-belts, tubing and the like. To attach can to wall, make a hole in the bottom; use a long lagscrew and washer.—*Stewart Pedd, Chicago.*



Tube-cutting trick

When severing short lengths from metal tubing with a tubing cutter, cutoffs have a tendency to drop to the floor and roll out of sight. To prevent this, insert a screwdriver blade into the end of the tubing to act as a retainer.—*Wilbur Hempstead, Louisville, Ky.*

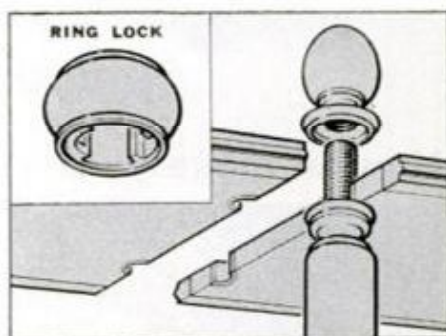


Picture hanger

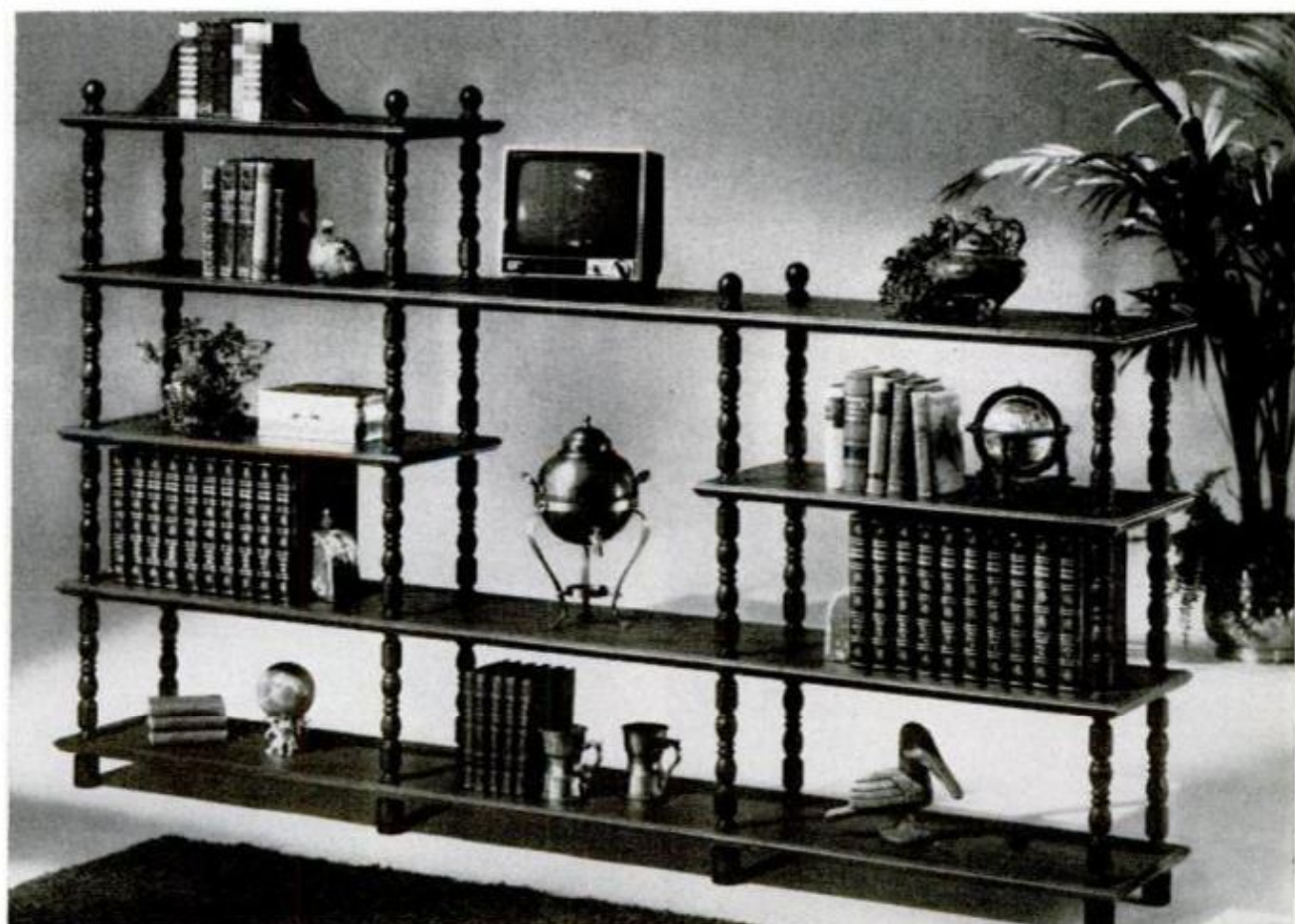
Neat hangers for lightweight frameless pictures can be improvised from sections of plastic tubing slit lengthwise. Slip tubing over the top and bottom edges of the picture and run hanging string through the top one.—*Burt Web, Skokie, Ill.*

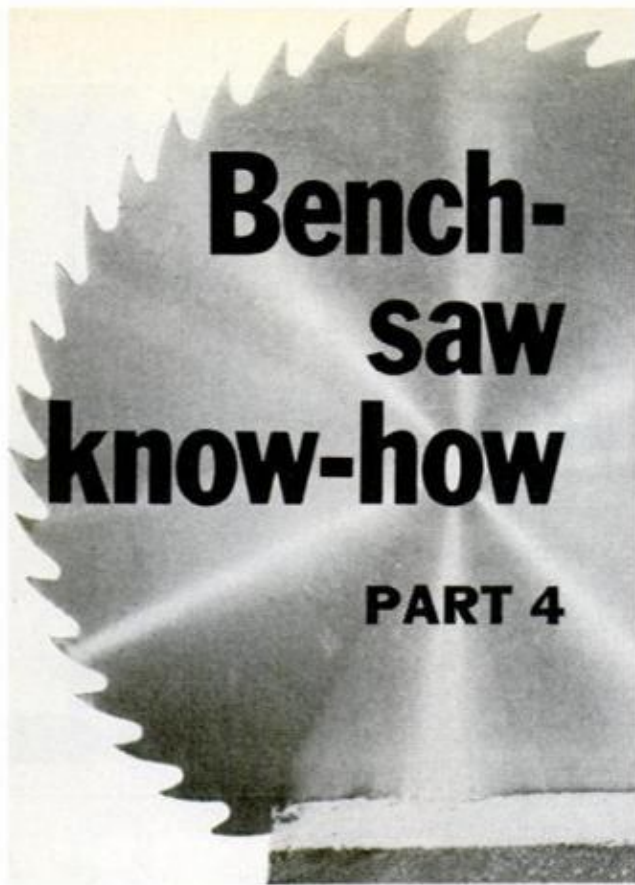


Now: Instant furniture you can assemble in a jiffy



ONE MINUTE it's a bunch of parts in a box, the next it's a fine piece of freestanding furniture ready to grace your home. That's how quickly Kirsch's new Cranmere all-plastic shelves go together without screws, nails, glue or tools. Cast threads in the plastic spindles, legs and finials let you screw them together end-to-end by hand in combination with interchangeable shelves to make handsome pieces as small as a bedside table or as large as a room divider. Special "ring-lock" spacers are used to join two 12-in. spindles into a single, longer one. Marproof vinyl-clad shelves, embossed with a grain you can actually feel, come in walnut and deep Spanish oak. Spindle components are walnut or black. The kits are priced at \$80 for the stand (above) and \$180 for the room divider (below). For more information about the kits, write to the Kirsch Co., Sturgis, Mich. 49091. ★ ★ ★





A simplified guide to those really tricky-looking cuts: Making raised panels, kerfing, compound cutting, faceting, pattern sawing.

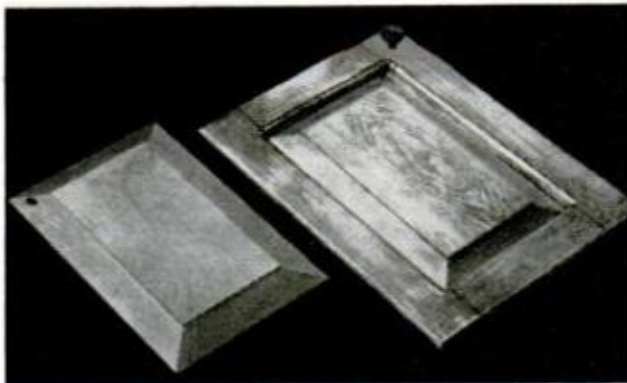
By **HARRY WICKS**, Workshop Editor

Photos by Robert D. Borst

MOST TECHNIQUES given in this concluding installment on the use of the bench saw are tricky, yet nonetheless satisfying saw exercises when successfully executed. They require a careful setup of saw and accessories and, mostly, some practice on scrap. Charts shown for kerfing and compound cutting will reduce your time making test cuts. Depending on your saw, the various settings shown may vary somewhat, but by using the charts, you'll start test cuts close to, or right on, the required settings.

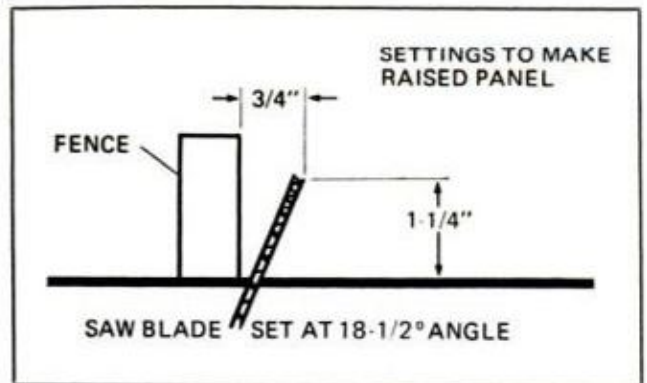
Decorative raised panels are frequently called for and add to the charm of Early

How to make your own raised panels



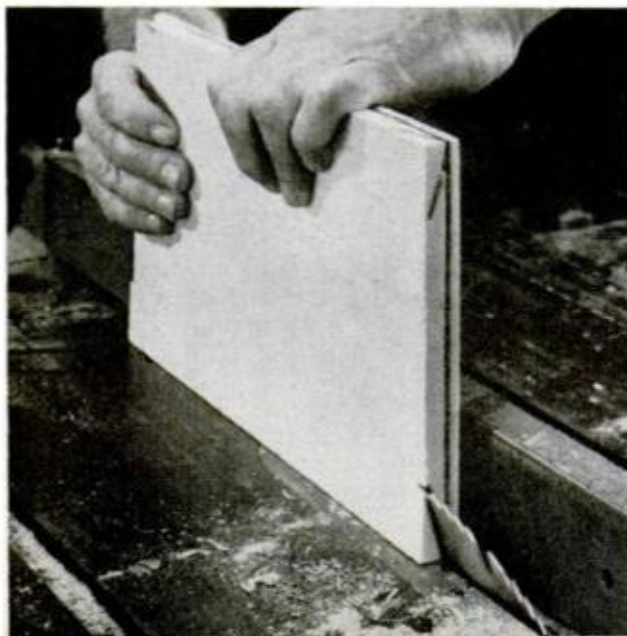
PANELS above were cut from the same piece of wood. All work on the finished door was done on bench saw

BEVEL CUTS are made across end grain first, then along lengths. To saw panels, use a planer blade

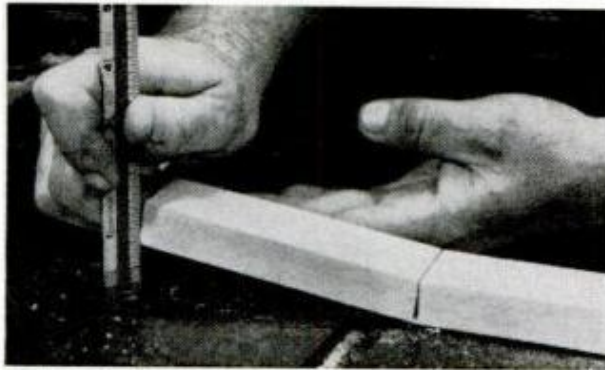


SETTINGS shown here were used to make the panels at left. The resulting shoulder gives a shadow line

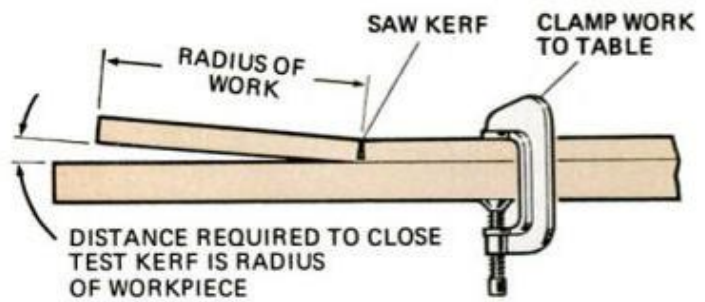
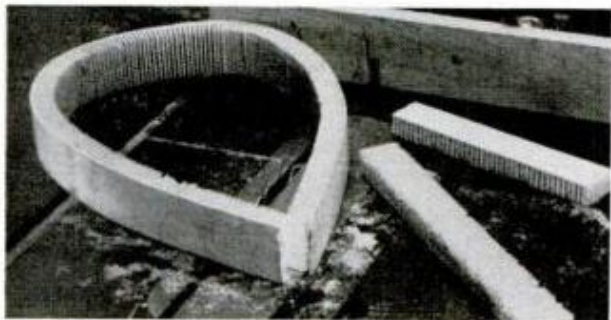
VERTICAL BLADE is lowered and fence adjusted so angled strips can be cut off neatly and accurately



How to bend wood without resorting to steam

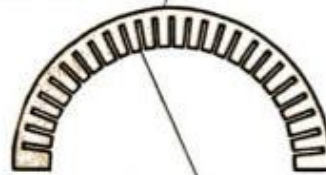


TEST BEND is made of scrap piece (top); amount of lift at end is value in first column of chart. For average work, 1/4-in. center-to-center spacing is used (above). Job is set up with a nail (pin) driven into miter extension to space cuts. Typical kerfing (below) permits elaborate bending of wood



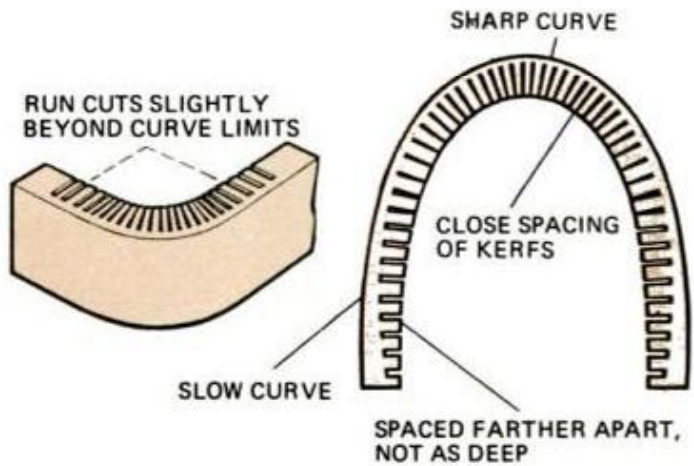
UNCUT WOOD CAN BE AS THIN AS 1/16"

THICK WOOD REQUIRES SANDING



OPEN KERFS WEAKER. ADD BACKING

CLOSE KERFS STRONGER. USE GLUE IN CUTS, NO BACKING



KERFING. Drawings above detail basic rules; tack to shop wall with chart (below.) To use chart, make test bend as above. Leave as much uncut wood as possible. Gradually deepen cut until wood can bend 1/8 in. Now, under Test

Bend, find 1/8 in. Reading across, number of cuts needed for full circle is 258 (for half circle, 129). Under 12-in. radius, 9/32 in. is center-to-center spacing, 1/64 in. is kerf width. Since this is impractical, use wider kerf.

SPACING OF CUTS

TEST BEND	CUTS IN CIRCLE	KERF TO CLOSE	RADIUS OF WORK IN INCHES													
			3	4	5	6	7	8	9	10	11	12	13	14	15	16
1/8"	258	.018 (1/64)	1/16	3/32	1/8	5/32	3/16	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
3/16"	171	.027 (1/32)	3/32	1/8	3/16	7/32	1/4	9/32	5/16	3/8	3/8	7/16	7/16	1/2	9/16	9/16
1/4"	129	.036 (1/32)	1/8	3/16	1/4	1/4	5/16	3/8	7/16	1/2	1/2	9/16	5/8	11/16	3/4	3/4
5/16"	100	.047 (3/64)*	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
3/8"	83	.056 (1/16)	3/16	1/4	3/8	7/16	1/2	9/16	5/8	3/4	13/16	7/8	15/16	1	1 1/8	1 3/16
7/16"	72	.065 (1/16)	1/4	5/16	7/16	1/2	9/16	11/16	3/4	7/8	15/16	1	1 1/8	1 3/16	1 5/16	1 3/8
1/2"	63	.074 (5/64)	1/4	3/8	1/2	9/16	11/16	3/4	7/8	1	1 1/16	1 3/16	1 1/4	1 3/8	1 1/2	1 5/16
9/16"	56	.084 (5/64)	5/16	7/16	9/16	5/8	3/4	7/8	1	1 1/8	1 3/16	1 5/16	1 7/16	1 9/16	1 11/16	1 3/4
5/8"	50	.094 (3/32)†	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2
1 1/16"	46	.102 (7/64)	3/8	1/2	11/16	13/16	15/16	1 1/16	1 3/16	1 3/8	1 1/2	1 5/8	1 3/4	1 7/8	2 1/16	2 3/16
3/4"	42	.112 (1/8)	3/16	9/16	3/4	7/8	1	1 3/16	1 5/16	1 1/2	1 5/8	1 3/4	1 15/16	2 1/16	2 5/16	2 3/8

*Average bandsaw

†Average circular saw

American furniture. Such panels are now commonly used on cabinet doors, drawer fronts and house doors.

The bench saw lets you raise your own panels—and more. For example, the finished cabinet door on page 166 was completely readied for assembly on this saw. All techniques for making such a door are included in this four-part series: ripping, crosscutting, edge-rabbeting stiles and rails to let in a panel and shaping the inside edges of stiles and rails with a molding head.

Raising panels

Actually, a raised panel is simply a deep, narrow chamfer cut around all four edges of a block of wood. The cut is made in the same manner as a chamfer cut except that blade and rip-fence settings are altered to get the desired raised panel.

The settings used to produce the raised panels shown on page 166 are detailed in the drawing. These panels have a slight shoulder to create an architectural shadowline. This can be eliminated if you raise the blade so it completely saws through the wood when you're making the chamfer cut. It's strictly a matter of personal taste.

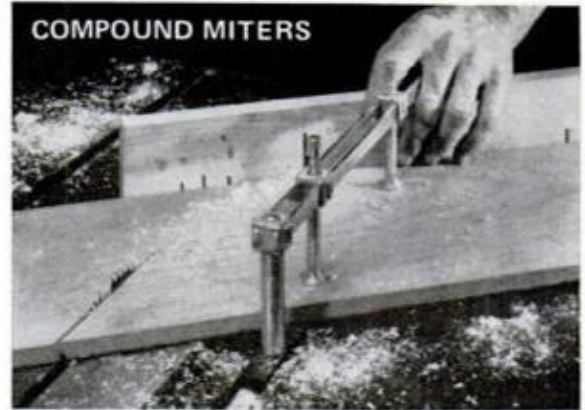
As with most precision cutting, a hollow-ground planer or fine-tooth plywood blade is the best choice for panel raising. But no matter which blade you use, always cut the chamfers across the end grains first, then make the two passes with the grain. It is also important to use a slow feed rate.

Bending wood

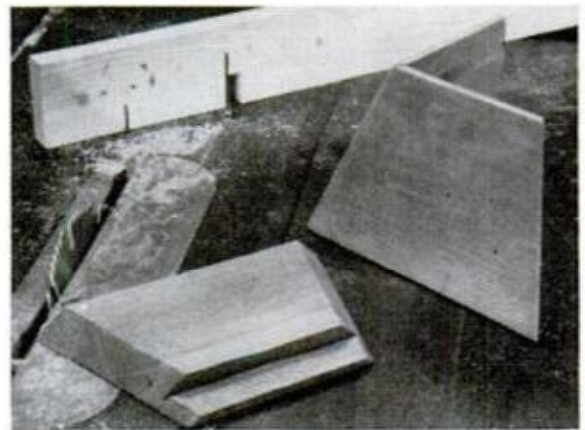
Do-it-yourselfers at some point are sure to find it necessary to make a turn with a piece of wood. Steaming will let you bend wood around a radius, but it is time-consuming and sloppy. Kerfing, often called the undertaker's cut (by pros) because casketmakers originated the idea for turning out the curved top of a casket, is the answer.

With a little practice, kerfing will allow you to make the tightest turn with minimum effort. In fact, the biggest chore about kerfing is the boredom that can easily set in while you make the repeated passes necessary to bend a long piece of wood. Acquire the habit of staying alert; *do not let your attention wander.*

Kerfing, as the name suggests is a series



CUTTING COMPOUND MITERS is tricky, requires good planning. Work hold-down is a must here



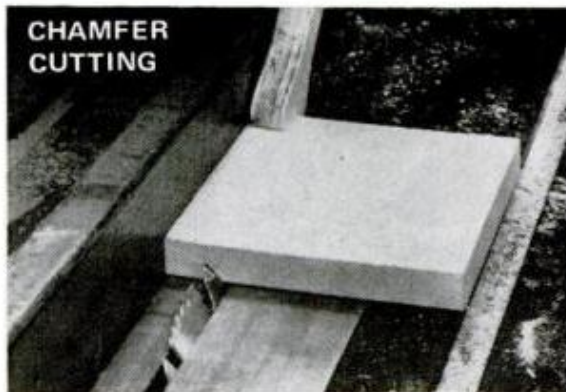
PIECE BEING FASHIONED above is for four-sided box with a bottom that's let into edge-rabbets

Work Angle (slope of side)	For Four-Side Box		For Six-Side Box	
	Blade Setting	Miter-Gauge Setting	Blade Setting	Miter-Gauge Setting
15°	43¼°	75½°	29°	81¾°
30°	37¾°	63½°	26°	74°
45°	30°	54¾°	21°	67¾°
60°	21°	49°	14½°	63½°

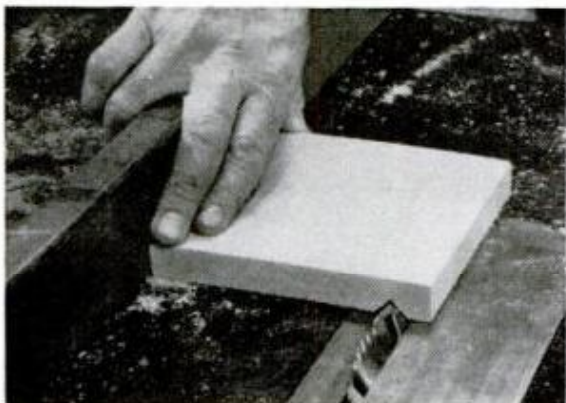
NOTE: Settings shown above for most commonly used miter cuts are close approximations of settings required to achieve the desired angle/slope. Test on scrap first; adjust the settings if required.

of equally spaced, kerf-wide dadoes sawed across a board so that the board can be bent back on itself. If the board is weakened in the kerfed area (see drawings, page 167), the kerfed segment can be beefed up with glue blocks after it has been bent to shape. Many craftsmen strengthen weak kerfs by pouring in white glue and sawdust, or by filling open kerfs with a wood filler. Either method is satis-

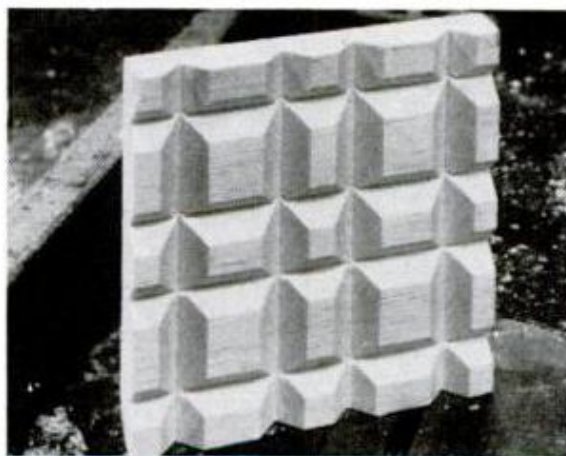
YOU CAN MAKE



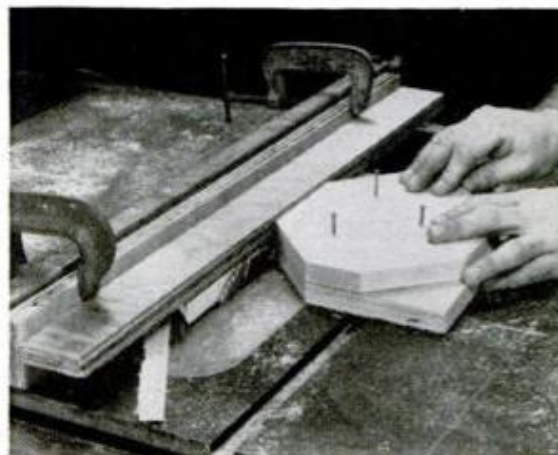
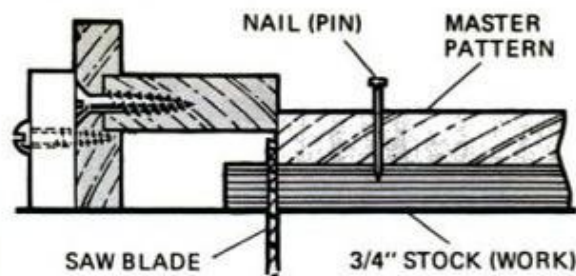
FACET CUTS are made using hollow-ground planer or fine-tooth plywood blade, slow-feed rate



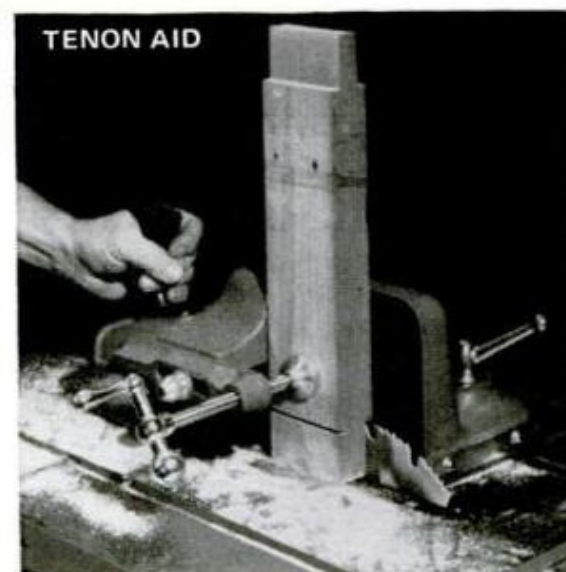
CUTS ARE MADE across grain first, then with grain. Countless panel designs can be created



PATTERN T-JIG



PATTERN SAWING is fast and accurate way to cut exact duplicates of straight-sided work



TENONING ATTACHMENT simplifies cutting tenons. You can feed stock with hand far from blade

factory, but for maximum strength use the glue blocks.

To set up for kerfing, run a saw kerf through your miter-gauge extension and drive in a nail to act as a guide for spacing. The first cut is made with the end of the board butted against the pin, and the balance of the cuts are made by placing the newest kerf over the pin to make the next kerf.

OCTOBER 1972

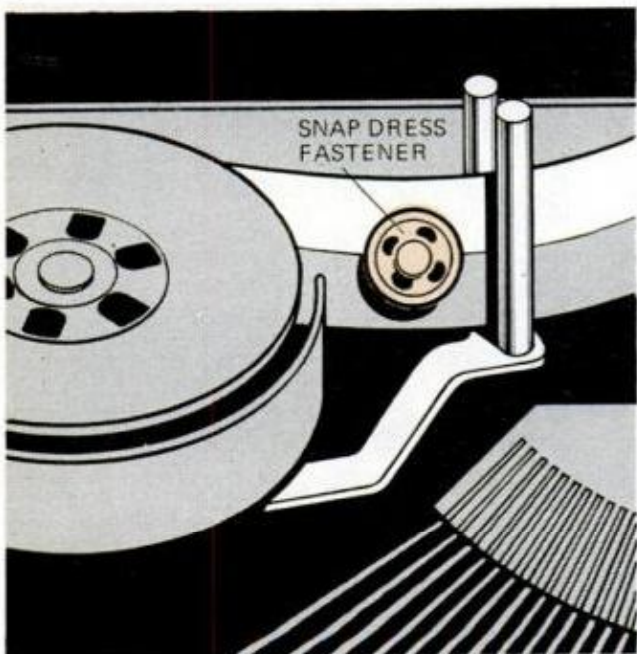
As seen in the chart on page 167, the tighter the turn, the closer the kerfs are spaced. As the turn becomes gentler, distance between kerfs can be increased. Use the chart to determine number of cuts, kerf depth and spacing.

I've found that bending a kerfed piece of wood is easier to accomplish, with less chance of breakage, if it is dipped

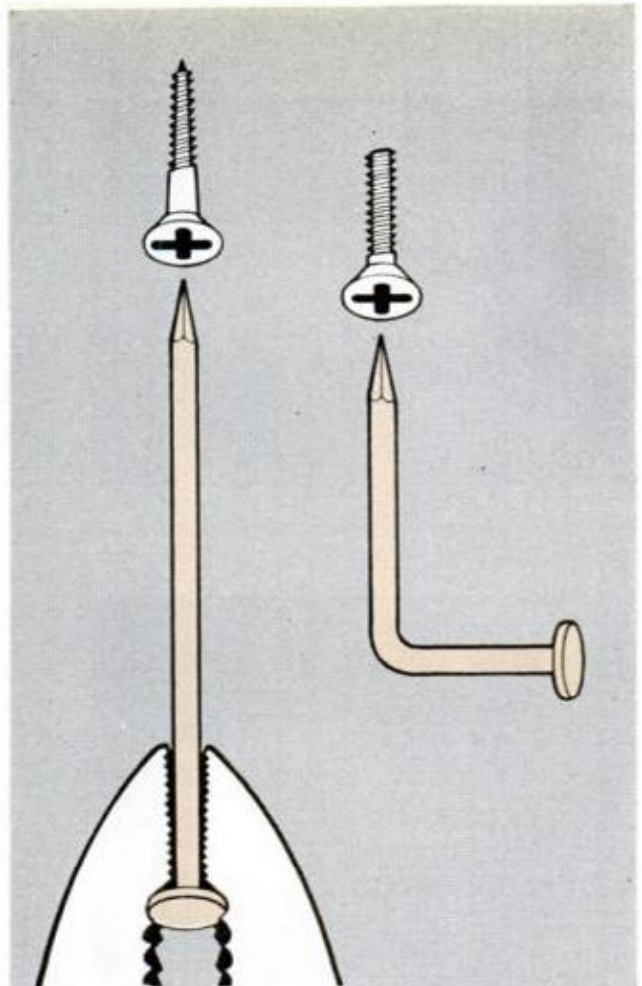
(Please turn to page 198)

169

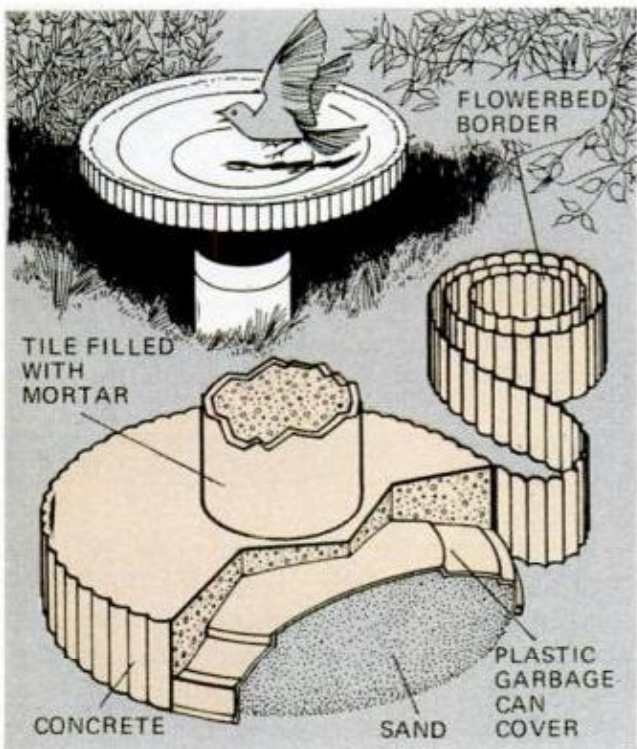
BETTER WAYS TO DO IT!



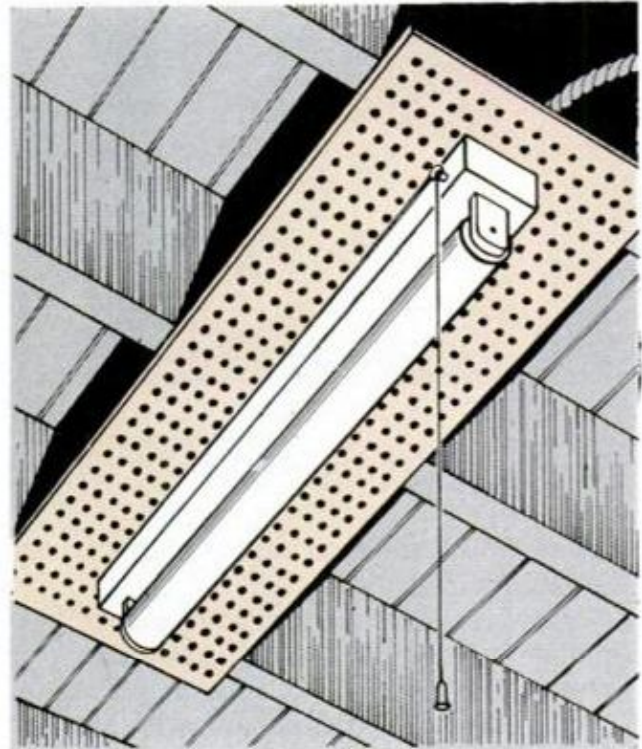
REPLACEMENT RIBBONS for portable typewriters often come without rewind stops. To serve as stops, I clip dress snaps to each end of the ribbon to catch on the rewind arms.—Cindy M. Burdick, Campbell, N.Y.



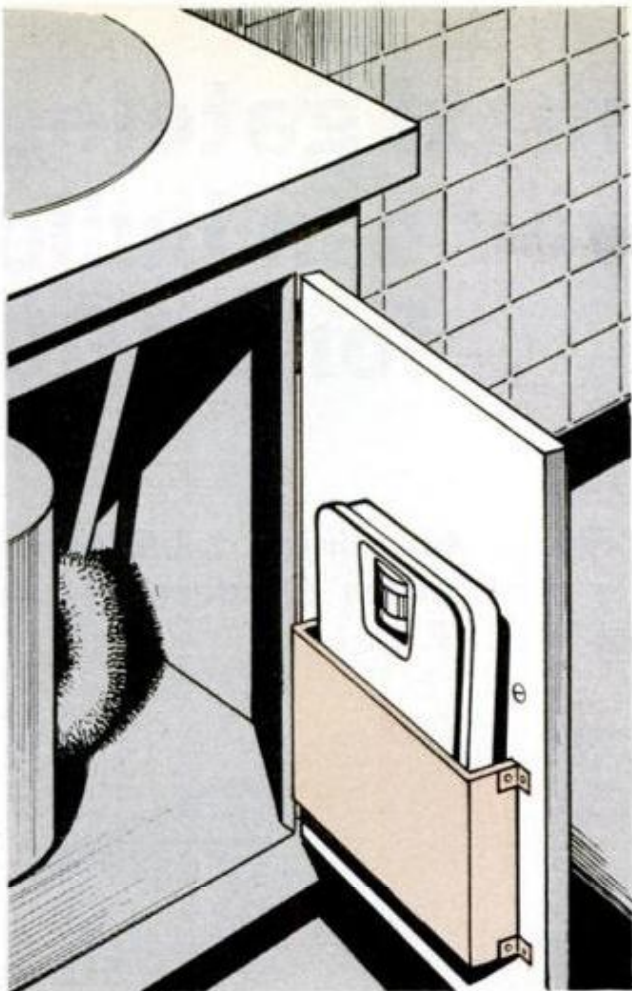
AN EMERGENCY PHILLIPS "SCREWDRIVER" can be fashioned from a hefty nail. To use it, hold the nail with pliers and, to increase leverage, bend it to form a right angle.—Morris G. Hulst, Churubusco, Ind.



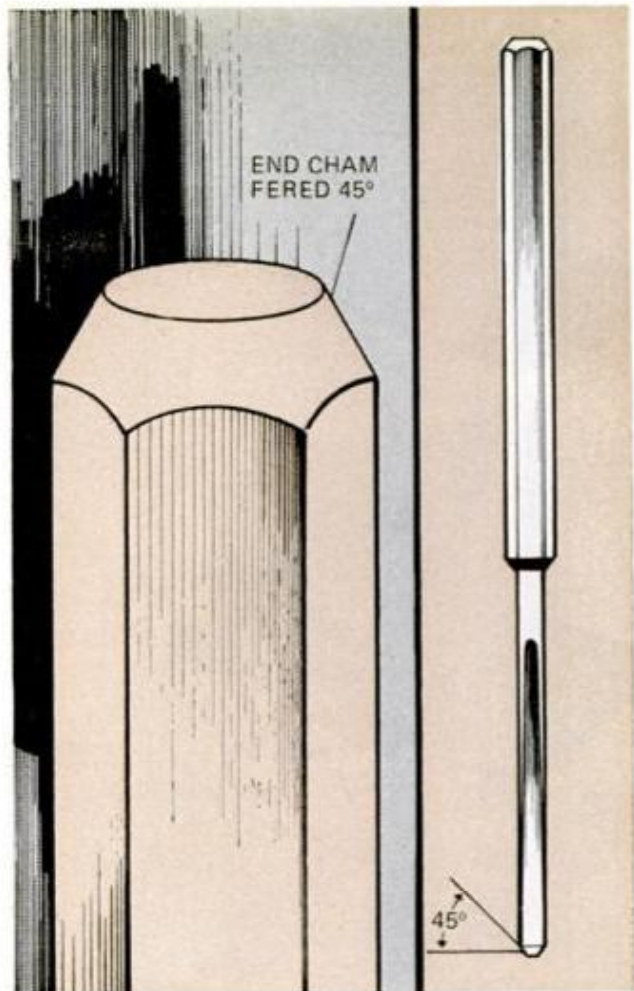
FORM FOR POURING BIRDBATH is made from flowerbed border wrapped around trash-can cover. Before concrete sets, center tile pedestal on the bottom and fill it with more concrete.—Robert Kelly, Garland, Tex.



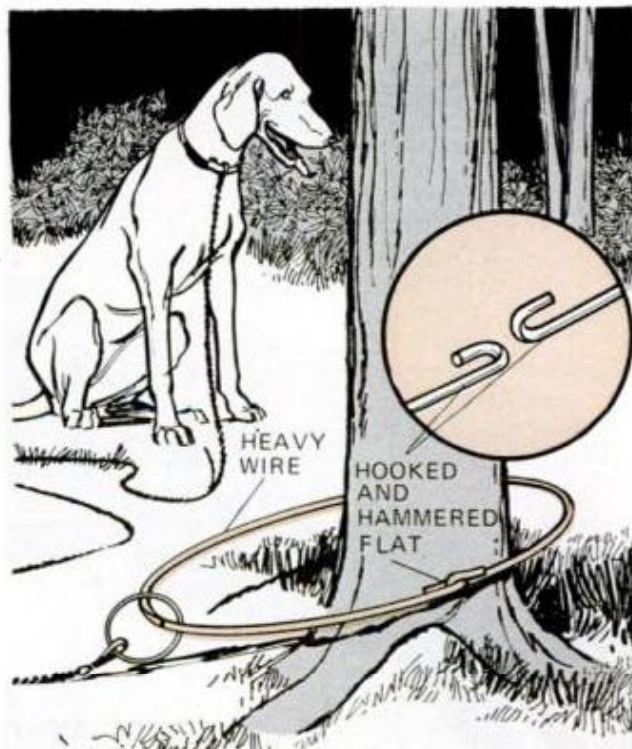
A PIECE OF PERFORATED BOARD makes an excellent reflector for a shop overhead light fixture. Mount the board with rough side down and give it two coats of a flat white paint.—C. L. Werner, Cleveland, Ohio.



SCALE CADDY for small bathrooms can be built of 3/4-in. plywood, fastened to inside of vanity door. Scale is easy to get at and can be returned to storage quickly.—*Stephen N. Stresnic, Fort Lauderdale, Fla.*



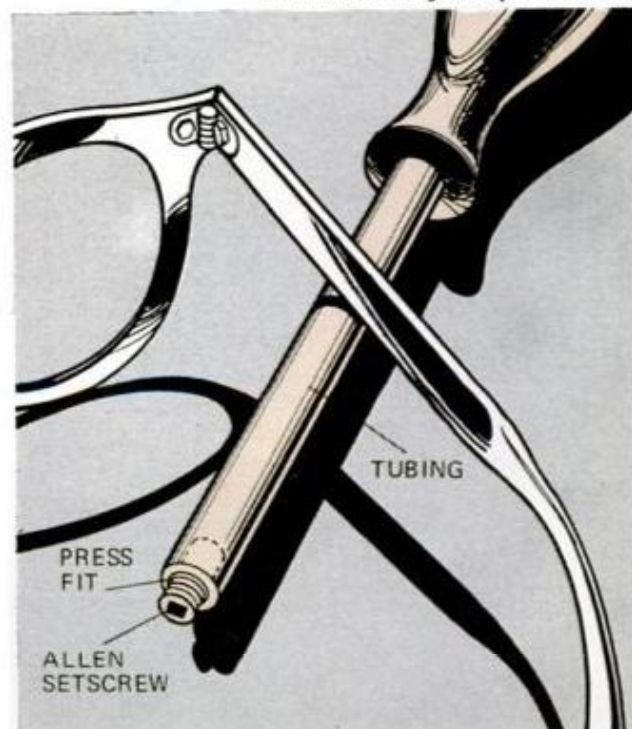
PROLONG LIFE OF A NEW PUNCH by chamfering the tool at both ends. The trick reduces chance of damage to either end by contact with work, and from hammer blows.—*Charles Stubbe, Cherry Valley, Ill.*



YOUR "BEST FRIEND" will be tangle-free when attached to a shade tree if you make the setup shown. Make certain the ring-loop is larger than tree diameter and free-wheeling.—*Harold Neibert, Davenport, Iowa.*

OCTOBER 1972

Illustrations by Adolph Brotman



NEED A TINY SOCKET WRENCH in a pinch? Make one by pressing an Allen-head screw into a piece of aluminum tubing. Add a file handle and you have a ready-to-use tool.—*W. H. McClay, Pasadena, Calif.*

171



Mini-maxi gateleg table you can build for \$100

Folded, this dining table takes
only nine inches of space. It can
seat **THREE . . .**

**SIX or
SEVEN**

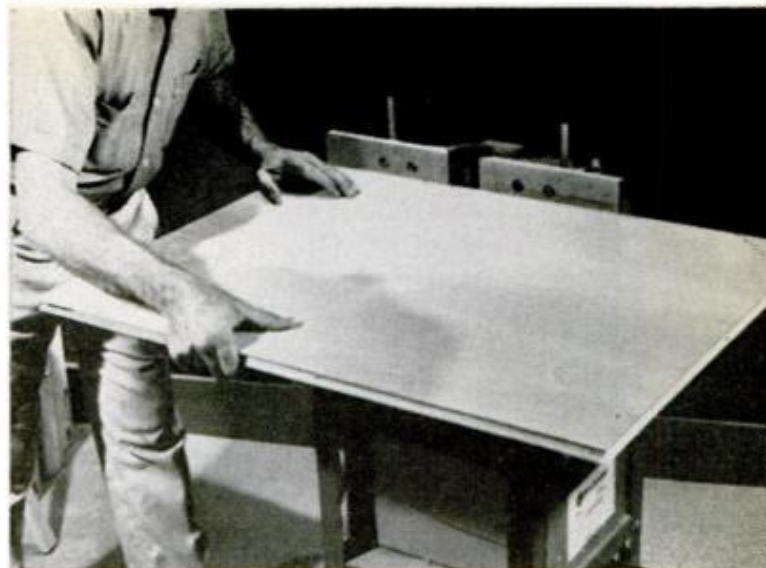
**. . . or even
TWELVE**

YOU CAN'T BEAT this table for versatility—use it in living or family room or out on the patio when entertaining a group. It'll comfortably seat up to 12 people—then fold away into 9 inches of space after the party.

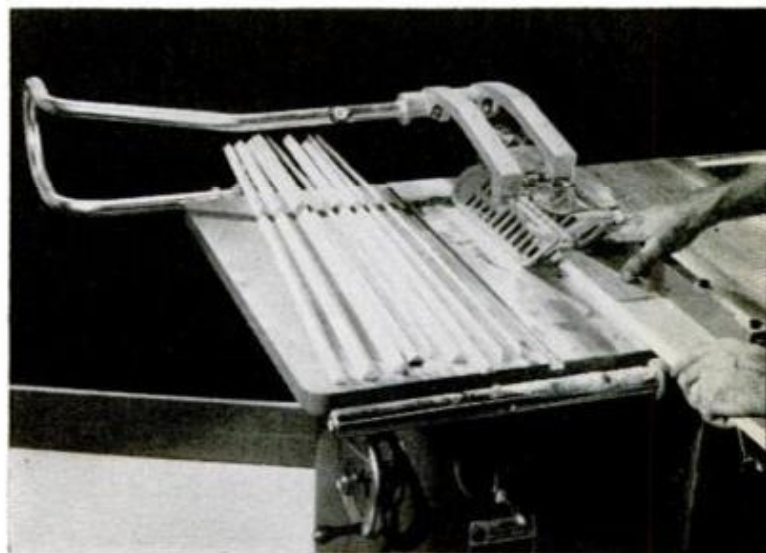
The table shown is of white oak veneer cabinet-grade plywood. This is a high-quality wood and, when finished properly, it will give your table the look of expensive furniture. If you are building yours for family room or patio use where it might be subject to greater abuse, you might consider using fir plywood (A-D) and covering the table entirely with a plastic laminate such as Melamite.

Since the four main tops are cut from two 4x8-ft. panels, lay out the sections so the grain runs parallel to the 36-in. dimension. This will avoid any chance of mismatched grain patterns butting end to end.

Connect each pair of tops to division strips with piano hinges. Recesses for the hinges need not be made on the bottom side of the panels. Instead, do the routing on the top of each frame cross member to take up the thickness of the hinge. Notice that the continuous hinges are



V-GROOVES are made on panel edges with shaper. Feed in work from both ends to prevent splintering



ANGLED INSERT STRIPS are ripped from solid lumber using hollow-ground planer blade and slow feed rate

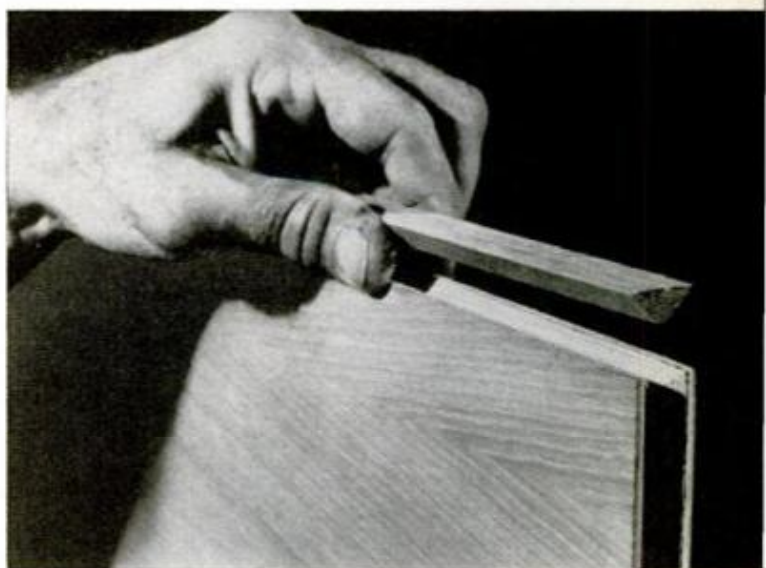
By **ROSARIO CAPOTOSTO**
Photos by the author

GATELEG CONCEPT is centuries old—and still a good way to gain extra seating in a hurry when you're entertaining.

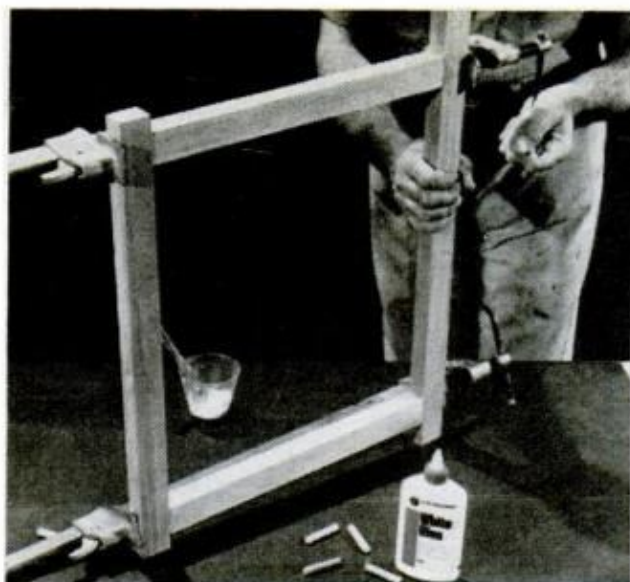
The version shown here has a contemporary design and is easy to build

spaced; this is essential to provide clearance for the swinging leg units.

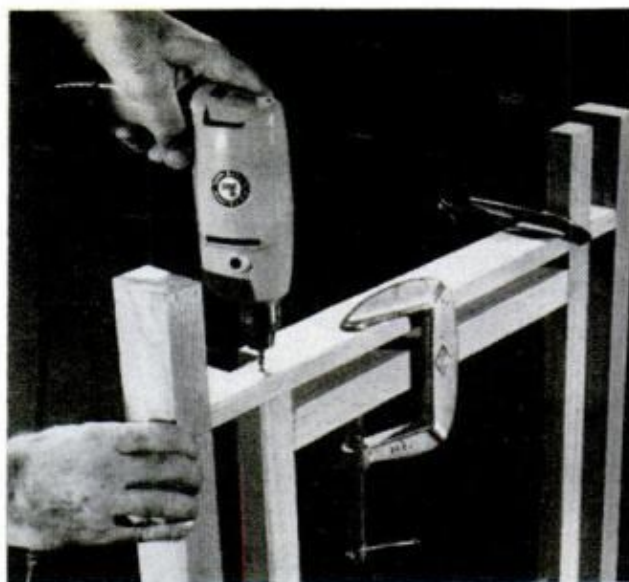
Construct the gate legs accurately. If they are out of square full-face or edge-wise, they won't operate properly. If you don't own a drill press, disregard the blind dowel joints indicated in the drawings;



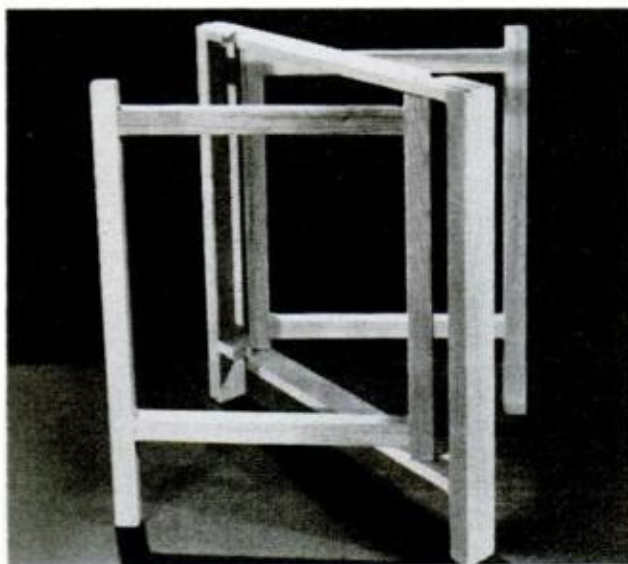
STRIPS are glued to two sides, then passed through shaper to obtain mitered corner on the strip ends



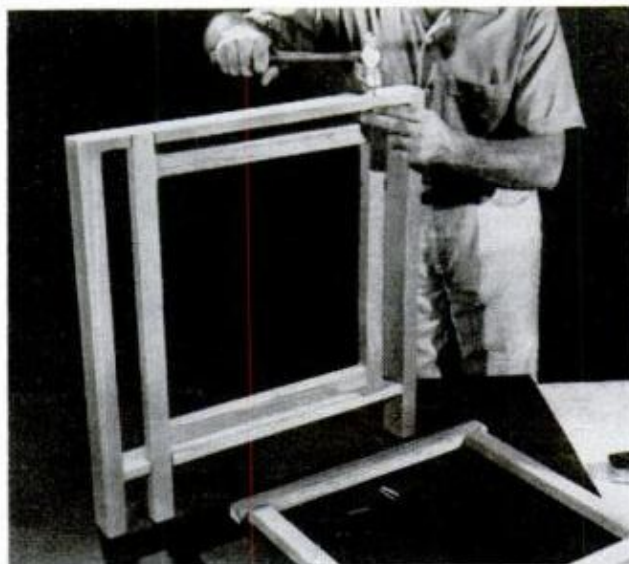
EXTREME CARE should be taken when you glue up gatelegs and framing to be sure assembly is square



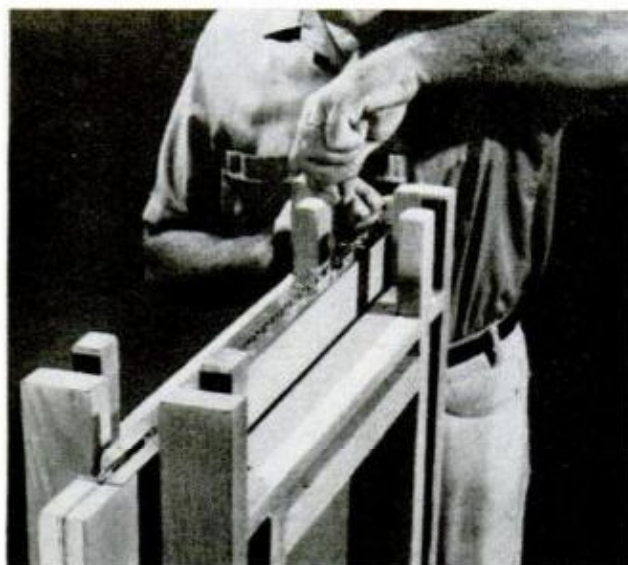
WHEN YOU BORE HOLES for pivot pins, clamp the gatelegs firmly to avoid any chance of movement



COMPLETED GATELEG ASSEMBLY, ready for installation, consists of a pair of gatelegs, one leg frame



ASSEMBLY is glued and screwed to divider strip. Slight edge-rabbet allows flush seating against hinge



PIANO HINGE is positioned and screwholes marked so you can drill pilot holes before fastening hinges
174



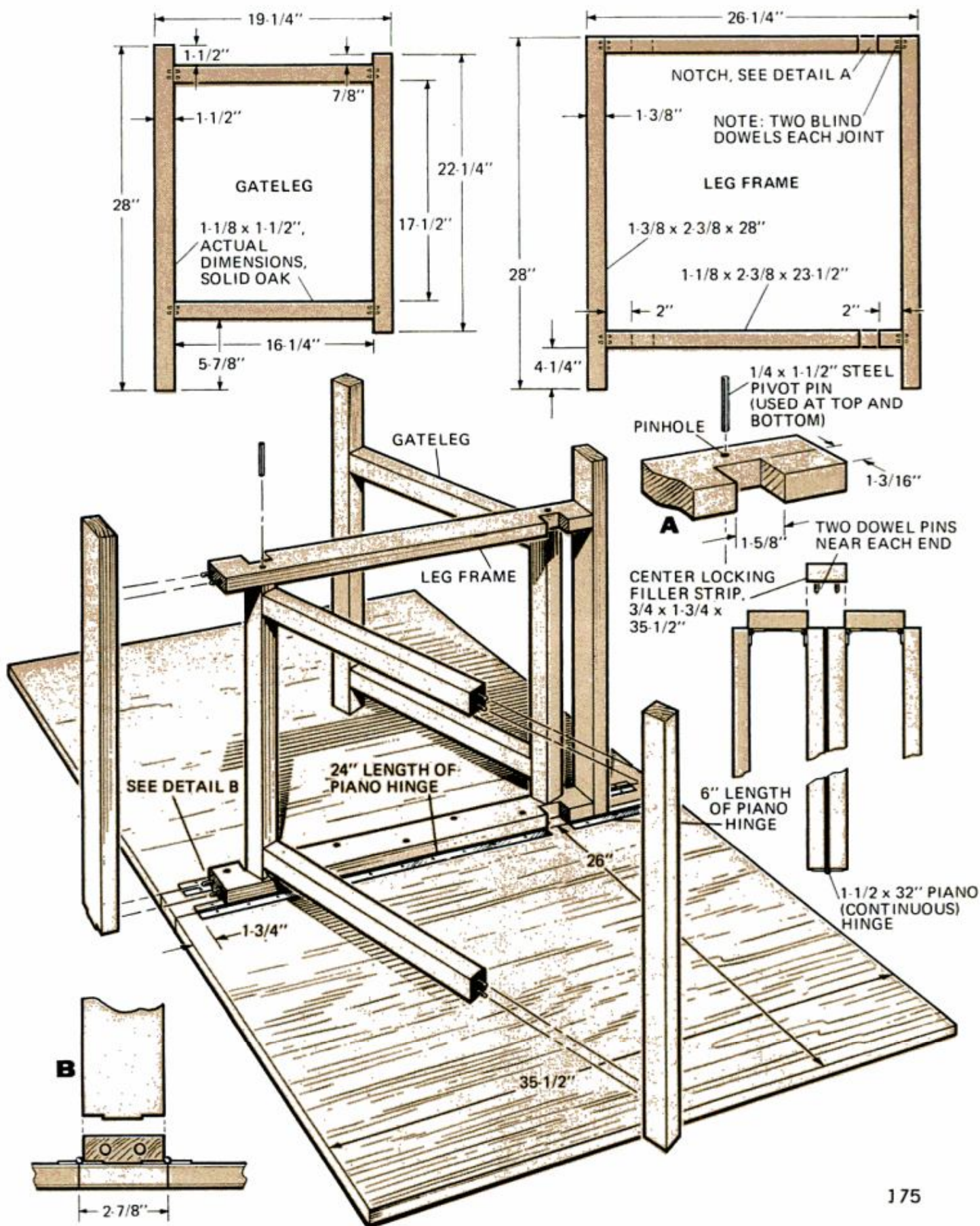
CENTER INSERT STRIP has two projecting pins to hold midsection in place when table is not expanded
POPULAR MECHANICS

instead, clamp the pieces together and bore dowel holes through from the outside with a portable drill. Dowel ends can be left exposed or driven in to allow room for wood plugs cut from the same lumber. Check for squareness after clamping and before the glue sets.

When the outer leg framing is complete,

you can bore holes for the pivots. Securely clamp a leg section to the frame and bore $\frac{1}{4} \times 1\frac{1}{2}$ -in. holes into both ends. Be sure to mark each subassembly so they don't get mixed up. Don't drive in the pins until all parts are sanded and finish-coated.

The pivots are cut from $\frac{1}{4}$ -in. steel rod
(Please turn to page 201)



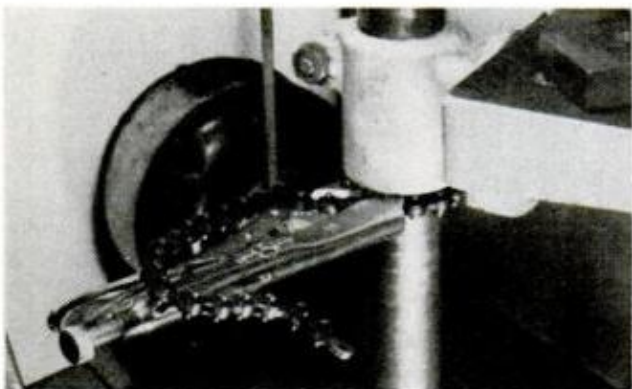


HINTS FROM READERS

Putting the needle to your shop

A "burlap needle," which was originally used for sewing coarse fabrics, is a handy tool to have in your shop. Useful for upholstery work, it also is helpful for threading cord through various kinds of grilles, lattices and netting. If you can't buy one, you can hammer a needle from soft iron or steel rod.

—Henry Orr, New Castle, Md.



Wrench serves as column collar

A Vise-Grip chain wrench clamped to a drill-press column can be used in place of a regular supporting collar to permit the table, when loosened, to be swung sideways without dropping. It will also act as a safety stop on a floor-model press to keep the table from dropping to the floor, injuring the operator's foot.

—W. B. May, Oak Park, Ill.



Protect your chisels

Wood chisels kept in drawers or a toolbox can be protected by plastic sleeves of the type in which many twist drills, taps, and cutters come packaged. I have found the tough plastic, given reasonable care, will last a long time. Big plus: One side of sleeve is transparent so the tools are easily spotted.

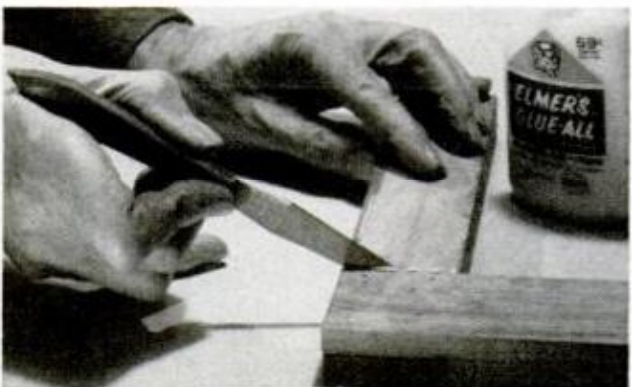
—Marshall Lincoln, Wickenburg, Ariz.



Small-parts organizer and toter

An empty aluminum-foil tray used for a TV dinner makes a dandy small-parts sorter and organizer when you take an appliance apart for repair. Most have at least three compartments to keep nuts, washers and bolts separated for quick re-assembly. A second tray will serve as a cover if the work must be set aside.

—Ken Patterson, Regina, Sask.



Palette knife useful in shop

An artist's palette knife makes a useful addition to a collection of workbench tools. Its thin, flexible blade is handy for working glue into cracks and for spreading paste or other filler. Often when a glue joint opens a bit, only a tool with an extra thin blade will fit the crack.

—Walter E. Burton, Akron, Ohio

Come to Marlboro Country.



You get a lot to like
with a Marlboro.

19 mg. "tar," 1.3 mg. nicotine
av. per cigarette, FTC Report Apr. '72

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

An old twist to woodturning

By GARTH F. GARVES

Color photos by Robert D. Borst



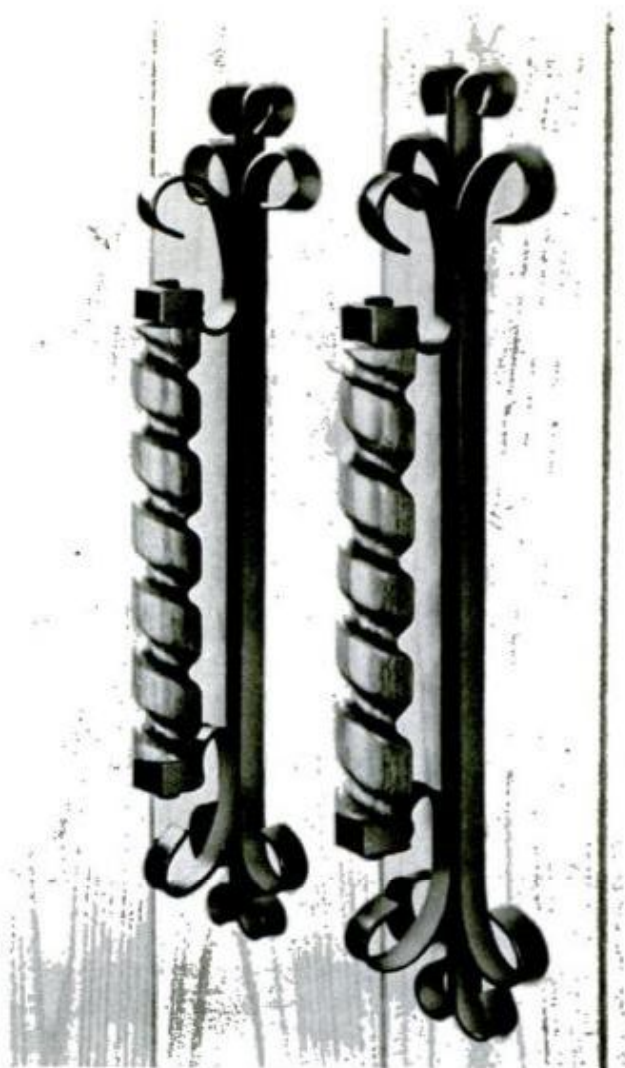
IT'S A GOOD TRICK if you can do it, but you really can't turn a spiral on a wood lathe. You can do basic turning, but after that it's strictly hand work with the lathe serving as a workholder.

Still, adding a twist to your lathe projects is fun and rewarding; you can give a 17th-century touch to Mediterranean-style furniture. Candlesticks and door handles shown are good examples of what a spiral can do to add individuality to your workshop projects.

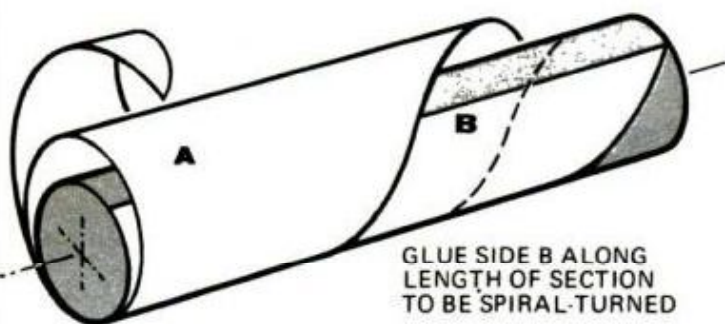
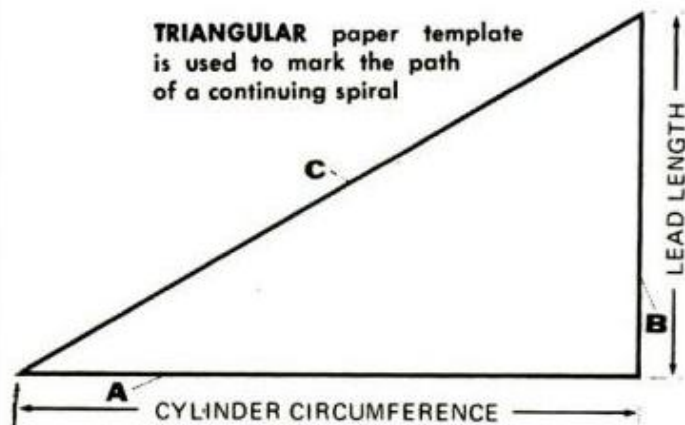
A spiral can be formed around a cylinder freehand, but a pair of spiral-turned cylinders must match, requiring symmetrical paths with distances and shapes the same as spirals wind around cylinders.

If a cylinder with one spiral revolution could be rolled on a flat plane, the spiral would become a straight line, and the portion below a right triangle.

To construct a spiral path, cut a paper template shaped like a right triangle as illustrated below. Length of the cylinder section is the base (side B) and height (side A) is the cylinder's circumference multiplied by number of spiral revolutions wanted within the cylinder's length. Glue or tape the template base along the cylinder length; then wrap the rest of the tem-

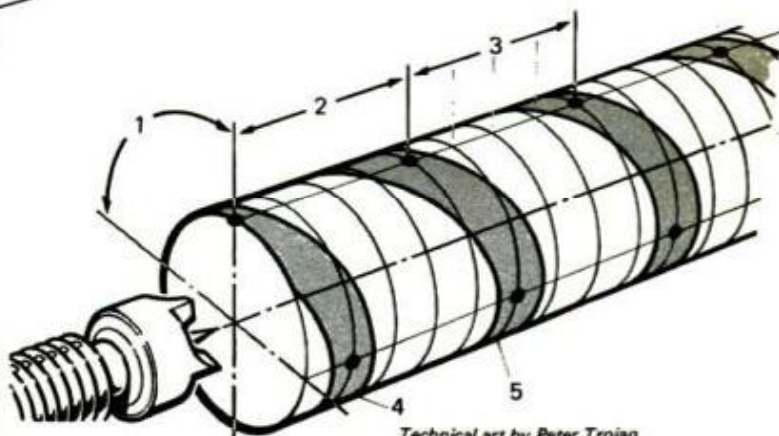


TRIANGULAR paper template is used to mark the path of a continuing spiral



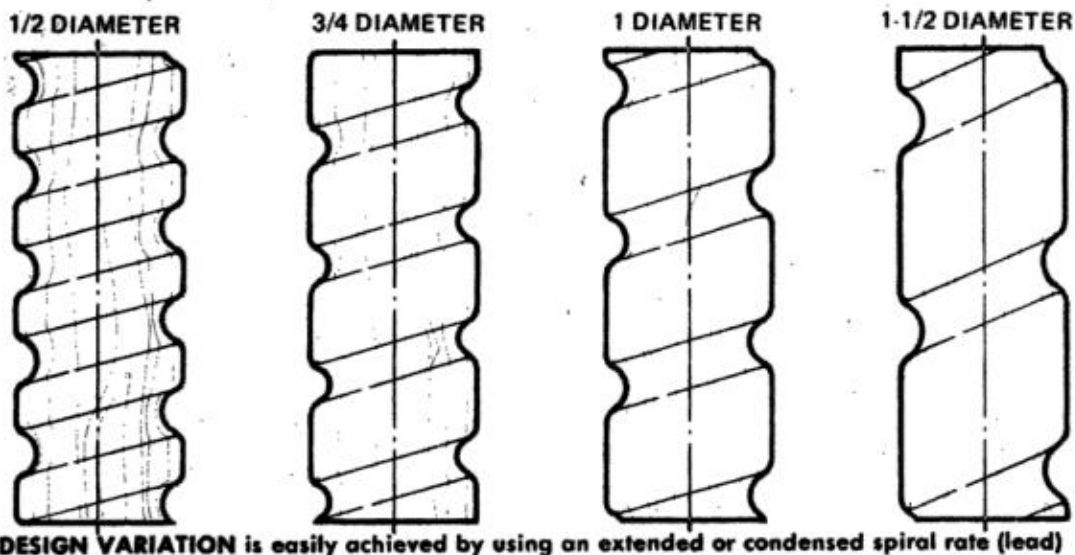
WRAP PAPER TEMPLATE tightly around the cylinder and keep side A aligned at a base reference point to avoid distortion of the spiral path. Hypotenuse of the triangle produces the spiral path

- 1** **DIVIDE SPIRAL-TURNED SECTION** into four equal divisions, both lengthwise and radially
- 2** **MARK RADIAL DIVISIONS** for the desired number of complete revolutions along length
- 3** **DIVIDE RADIAL DIVISIONS** into groups of four, then mark each group with pencil dots
- 4** **MARK LOCATION** of intersecting axial, radial lines with dot as you progress around cylinder
- 5** **MARK SPIRAL PATH** using a flexible straight-edge to connect the series of intersecting dots



Technical art by Peter Trojan

SPIRAL GROOVE TRAVELING one complete revolution within the axial distance of:



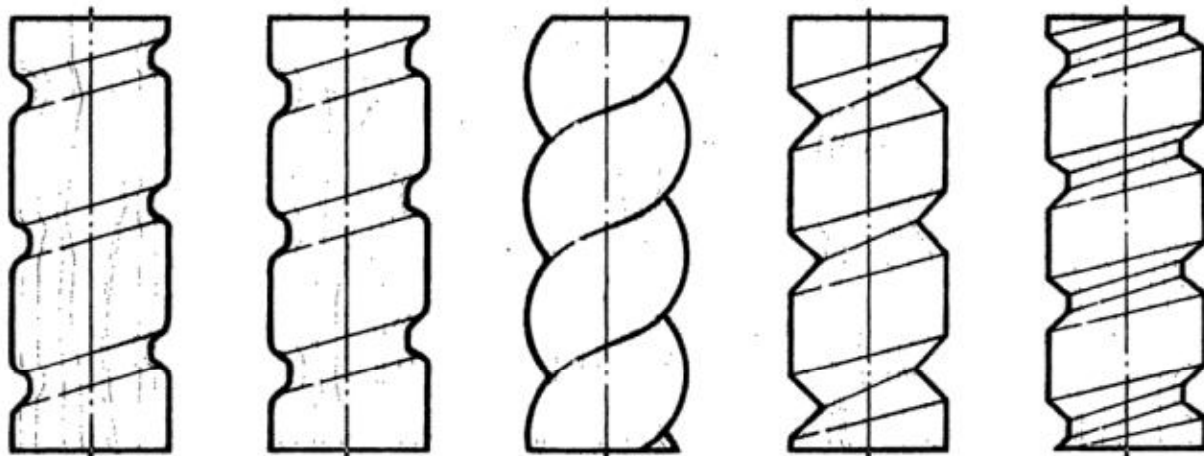
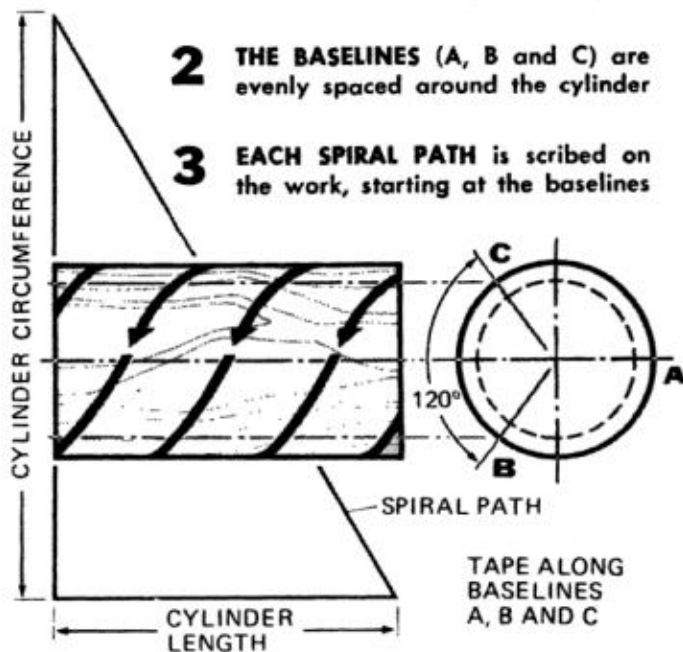
DESIGN VARIATION is easily achieved by using an extended or condensed spiral rate (lead)

plate around the cylinder, forming a diagonal line that marks the desired path of the spiral.

The template provides a quick way to locate a spiral on smaller projects—fewer than five turns around a small-diameter cylinder. For larger diameters or more tightly wrapped grooves, this is cumbersome, so try a grid method.

To mark a spiral on a large cylinder, divide the cylinder lengthwise into four equal sections (see page 179). Mark the spiral lead along the cylinder and draw lines around the cylinder to mark off each spiral revolution. Then divide each marked section into four equal parts and draw lines around the cylinder at these points. Where horizontal and radial lines intersect along the spiral, connect these points around and

- 1** THE PAPER TEMPLATE is dimensioned as one single-spiral path
- 2** THE BASELINES (A, B and C) are evenly spaced around the cylinder
- 3** EACH SPIRAL PATH is scribed on the work, starting at the baselines



SPIRAL PATTERN DESIGNS are limitless. Classic patterns shown above include (left to right) half-round groove, elliptical groove, continuous bead, V-groove and wide V-groove. All of them are illustrated at one revolution within the lateral distance of one diameter

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20 mg. "tar," 1.3 mg. nicotine av. per cigarette, FTC Report Apr. 77.

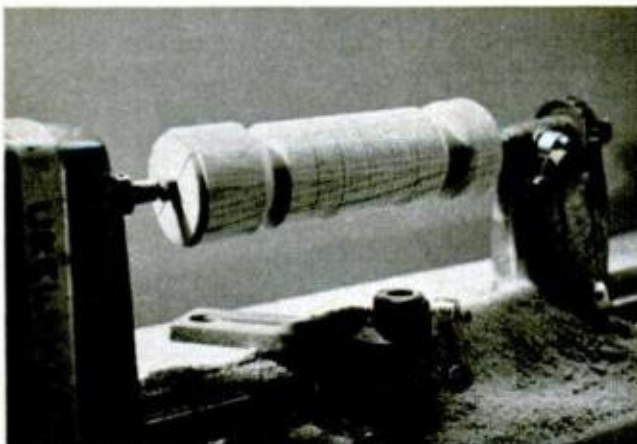


along the cylinder with a flexible straight-edge and mark the spiral path.

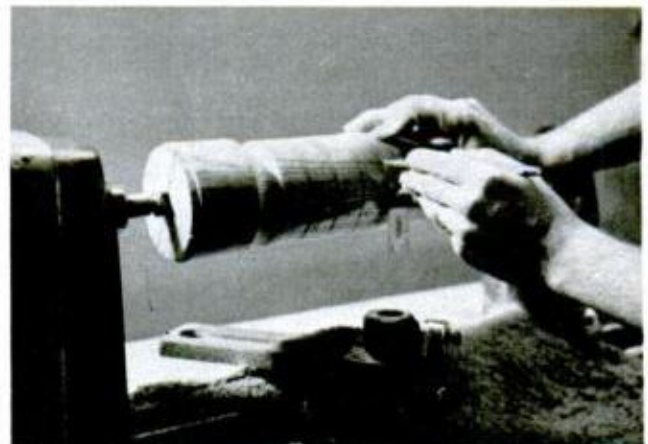
Rotation rate and groove profile both affect design. The top drawing on page 180 shows how you change this by using the same groove pattern but expanding the lead. Add another design variation to the groove pattern, and possibilities are almost limitless. For basic patterns, see page 180.

Methods described so far are for a single spiral path—one line around and along a cylinder. Multiple spiral paths in the same area create a smoother flow that may be better for certain projects. The principle of the single-spiral path is used, but it is repeated three or more times within the same cylindrical length. The center drawing on page 180 shows a spiral pattern obtained when the template is used to mark three paths starting on different baselines. Determine template size, then divide the cylinder lengthwise in

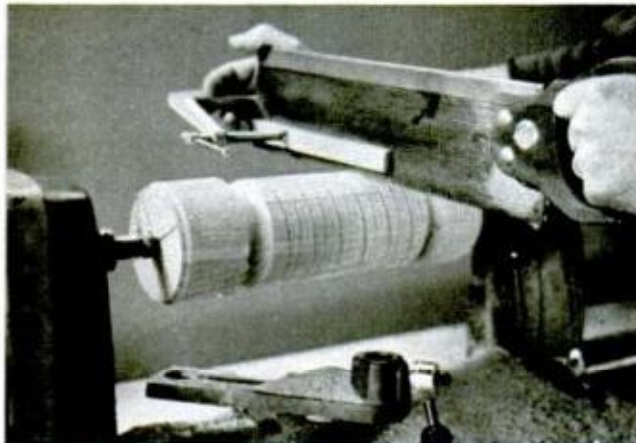
(Please turn to page 190)



LATHE IS USED to turn work to cylindrical shape, then used only as holding fixture. Initially, cylinder is made oversize and turned to final size after spiral groove is completed in body of cylinder



SPIRAL PATH IS MARKED by drawing a continuous line which intersects the longitudinal and radial grid points. If size of cylinder permits, you can use an alternate triangle template method of marking spiral



SPIRAL PATH IS CUT to predetermined depth with fine-tooth backsaw. Wood strip clamped to blade limits depth of cut. Kerf is used as gauge when filing spiral groove to depth; work is turned by hand

182



SEVERE CHIPPING IS PREVENTED by breaking (chamfering) the edges of the saw kerfs with a fine file before spiral groove is formed. If not done, coarse rasp will chip certain woods and spoil finished work

POPULAR MECHANICS

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Chevrolet

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New outboard power for '73



SEA-HORSE motors from Johnson in 27 models now crank out up to 135 hp; top mill is shown here on a new Starcraft runabout



STARFLITE 135, Evinrude's new line-topper mounted here on the high-styled Glastron, uses hydraulic assist for an improved shift

MERCURY 1500, at 150 hp the most powerful production outboard ever made, can plane a 20-foot Wellcraft Fisherman to 40 mph



Now they are packing herds of 150 horses into next year's mills.

By **BILL McKEOWN**

OUTBOARD MOTORS are getting better without getting bigger. Where else will you find packages of ever-ready push that harness hundreds of horsepower—yet are almost portable?

Marine muscle for your outboard boat can add up to as much as that in a high-powered car if you hang a couple of the new rigs on your transom next year. They'll also cost as much—but can provide a lot of action afloat for every penny spent.

The bigger mills are still [\(Please turn to page 188\)](#)

CHRYSLER'S 130 HP is the top of line of 57 models. New 25, 30-hp motors have also been added



POPULAR MECHANICS



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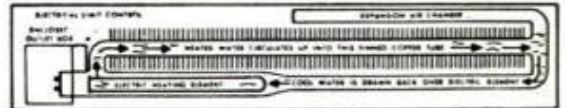
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making most news, and at post time for the 1973 horsepower race, Mercury is leading the field again with its 150-hp Merc 1500, up 10 from last year's 140 but without an increase in engine displacement. Outboard Marine's Evinrudes and Johnsons have also added 10 more horses of push-power, each up from 125 to 135 hp, and Chrysler's big one tops out again at 130. Biggest Bearcat, the only four-cycle outboard engine, is still 85 hp, though there is word it may go up substantially next year. A jet-pump version of the Bearcat 55 is also available.

High horsepower, however, is only part of the new story. Water and air-pollution controls are now important factors. Unburned gas-oil fuel mix is no longer dribbled overboard. It recycles up and back through the carburetor for total combustion.

There has been no claim that outboards are a major cause of fouling the air—although earlier models with a high oil-to-gasoline ratio could certainly lay a smoke screen over a lake. Leaner mix, high-tension ignition and surface-gap sparkplugs have gone far to correct those problems, but the no-lead gasolines have brought new ones. Additives put in an outboard

LOW PROFILE has been maintained for the new Johnson Sea-Horse 135 (above), up 10 hp from this year's line, and Evinrude's new Starflite 135 as well



FISHERMEN still make small outboards such as this 9.8-hp Merc (above), among the most popular mills

motor to replace the lead can attack the alloys of the cylinder head. This year, outboard-motor builders have advised against any use of no-lead gas.

As we predicted last year, however, the companies have tackled this problem and are already coming up with solutions. Evinrude and Johnson plan to allow low-lead or no-lead gasolines in motors of up to 40 hp in 1973. Mercury and Chrysler, as of now, indicate their new motors will tolerate low-lead. Since the situation is changing, it's still probably best to ask your local dealer what the factory recommends. If in doubt, stick with standard leaded gas for new or old motors.

In addition to the new 150, Mercury is adding a four-cylinder 85-hp Merc 850 to the line. Other categories will include 115, 50, 40, 20, 9.8, 7.5 and a single-cylinder 4 hp. Racing engine developments such as improved porting and pulse-tuned exhaust have been incorporated into production

Mercs to provide the extra performance. And for the three smallest motors, a lift lock has been installed so the lower unit will stay down in position when the motor is shifted to neutral or reverse but releases to let the mill tilt up if it strikes an obstruction while running forward.

Evinrude and Johnson will be similar in horsepower ratings for 1973. Improved porting and tuned exhausts, plus redesigned combustion chambers, are among improvements given credit for boosting this year's 125 to 135 hp and the 100s up to 115. For the 85, 65 and 50-hp models, power trim, hydraulically-assisted shift and tilt-position preselector are available. Models run 40, 25, 20 (for Johnson), 18 (for Evinrude), 9½, 6, 4 and 2 hp.

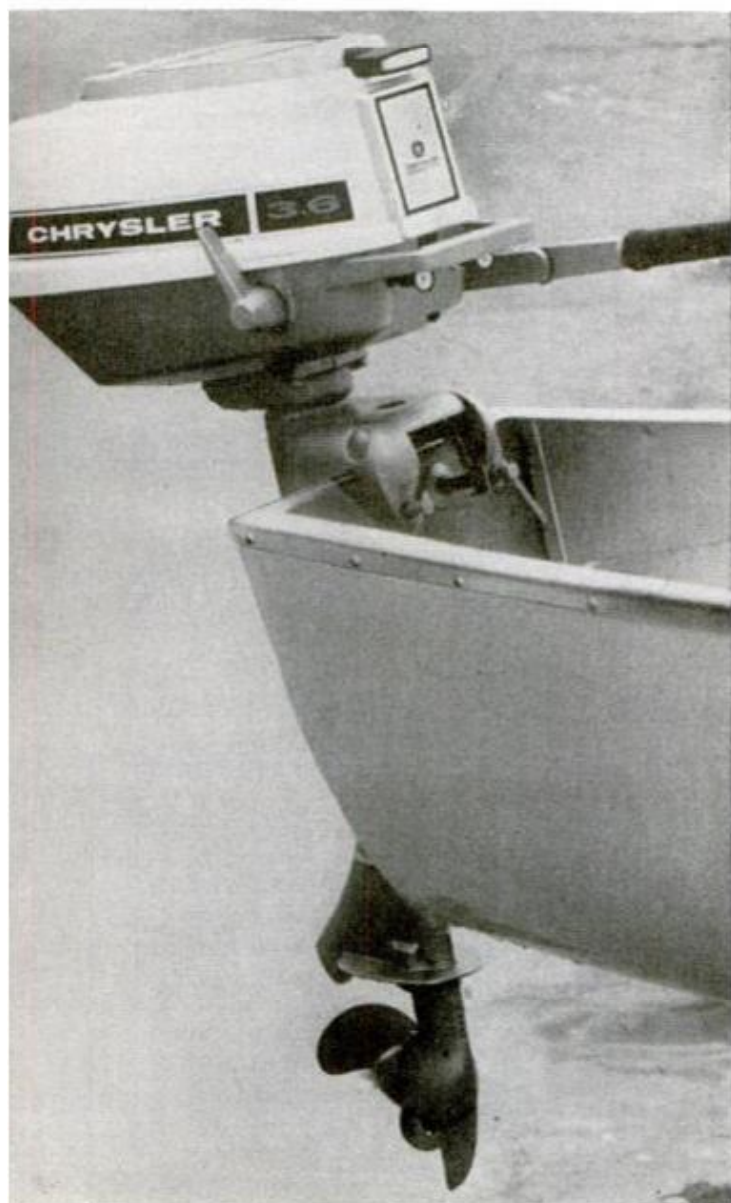
Chrysler will offer a new high of 57 different models, counting new engines of 25 and 30 hp and power ranges of 3.6, 6, 8, 9.9, 12.9, 20, 35, 45, 55, 70, 85, 105, 120 and 130 hp, plus a limited-production 150 racer. New power trim and power trim indicator, plus speed lever with indicator, are among the Chrysler options and 140 accessories.

Sears is going up to new 9.9 and 15-hp models in addition to its present line of 3, 4½, 5½ and 7½-hp motors. Other motor producers and importers may announce further changes by next spring's boat-show time. Rumors also hint some of the big builders will enter the booming field of small electric outboards.

And then there are the Mercury Twister II, Johnson Stinger GP and Evinrude Strangler racing mills that are being constantly upgraded and probably approach 200 hp. Developments from these secretly-powered mills are being passed down to every new motor for '73. ★★★

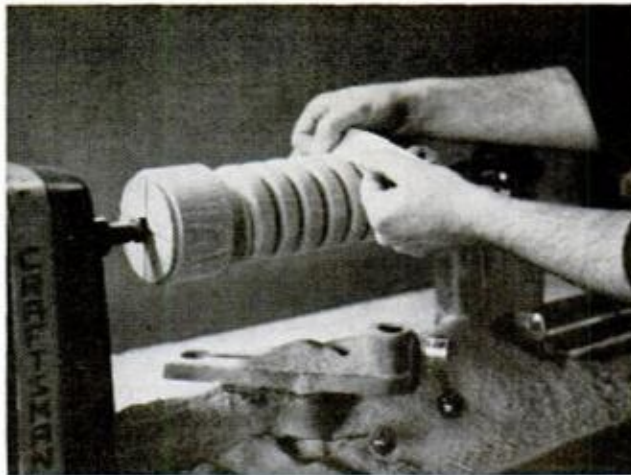
LONG-SHAFT LOWER UNITS, as on this Chrysler 306, also have optional extensions for sailboat mounts

TWISTER II, limited-production, high-performance racer from Merc, has secret hp but topped 106 mph





SPIRAL GROOVE IS CUT fastest with electric hand grinder and burr cutter; can also be filed by hand



SPIRAL GROOVE IS HAND-SANDED after filing, then lathe is switched on, cylinder is turned to final size

OLD TWIST TO WOODTURNING

(Continued from page 182)

three equal parts (120° each). This is easily done by dividing the line representing the circumference (diameter $\times 3.1416$) in thirds. Mark one horizontal baseline on the cylinder, tape base of the triangle template along this line, wrap template around the cylinder and mark the spiral path. Locate and mark the other two paths this way. Each will be equally spaced.

The actual spiral-cutting job is shown in the step-by-step photos on page 182 and above. Rough-turn the cylinder but leave its diameter a bit oversize. Turning it to final diameter after the spiral is shaped will remove chips and miscues.

When using a template, scribe the spi-

ral path with a saw, knife or tracing wheel. To cut the spiral line to uniform depth, use a fine-tooth saw with a depth stop clamped to the blade. Saw to proper depth gradually as you go around the cylinder. The cut should rise to match the diameter of the neighboring section at each end of the spiral section.

To mark width of the spiral groove, scribe and cut additional guide lines on each side of the initial cut. To prevent deep splintering and chipping when you file the groove, first round edges of the outer cuts with a fine file. A power hand grinder will shape the groove quickly, or you can use files and rasps.

After forming the groove, turn the cylinder to its final form, sand it well and apply a suitable finish. ★★★

NEXT MONTH IN SHOPS AND CRAFTS

NOW, SURFORM MAKES ANYONE A SCULPTOR. With rasp-like tools called Surform, you can turn out handsome two and three-dimensional carvings from wood blocks and free-form works of art from tree branches and twigs. The article starts you off with a simple owl to duplicate, then turns you loose to create your own masterpieces in wood.

FANCY CANDLES MAKE GREAT CHRISTMAS GIFTS. A fast-growing hobby, candle-making is both fun and rewarding (candles bring high prices) and can help you fill your Christmas gift list. PM takes you through the steps of melting, coloring, scenting and pouring; shows you the different molds you can use and tells where you can buy the wax, wicking, glow powder, stearic acid, mold release and other supplies.

FRIENDLY SANTA WAVES HELLO. Christmas yard displays have always been popular with PM readers, and this year we have made Santa come to life—he waves to passers-by from your front yard. He's simple to make: You paste Santa on plywood, saw him out and motorize his upraised arm. A pendulum keeps him waving as long as he is plugged in.

FIREPLACE FACELIFTS FOR LASTING BEAUTY. Starting with typical, uninspired-looking fireplaces, two Midwestern homeowners eliminated the dated look with a minimum investment of cash and time. In the November PM you'll see how one transformed a jut-into-the-room brick monstrosity into a handsome contemporary wall, and how the second added a "metal" hood to his hearth using plywood and sheet asbestos.

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porary relief for hours in many cases from pain, itching in hemorrhoidal tissues. And it actually helps shrink painful swelling of such tissues when infected and inflamed. Just see if doctor-tested Preparation H® doesn't help *you*.

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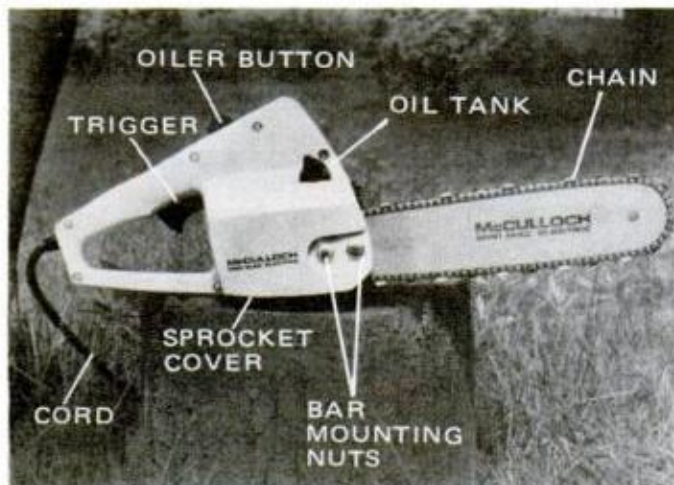
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PM use test: A quiet chain saw

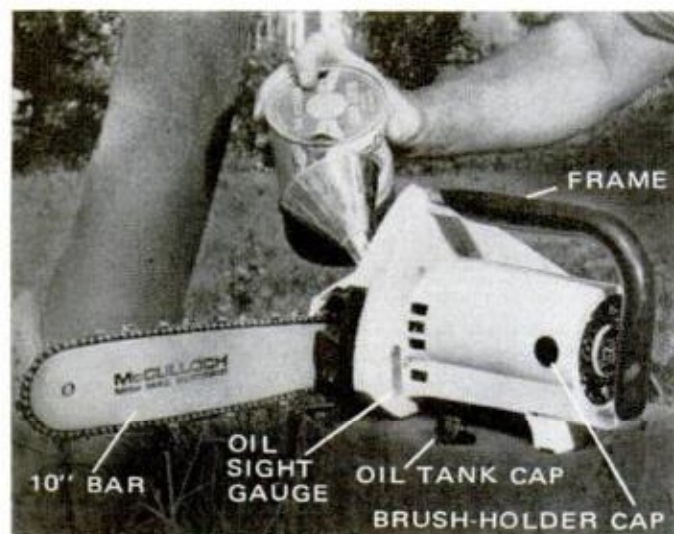
McCulloch's new electric 10-incher shushes its way through the cutting.

By **HARRY WICKS**, Workshop Editor

Photos by Robert D. Borst



ELECTRIC CHAIN SAW is designed for comfort of the user, eliminates messy gas mixing and pouring chores



OIL TANK FILLING is neater if funnel is used. Not visible in photo, but on tool, is a thumb safety switch

I DON'T KNOW exactly what I expected when I picked up the new Mini Mac electric chain saw. I'm as used to portable power tools as I am to a knife and fork, but not having to yank a cord to get this one going momentarily confused me. But not for long.

After pushing in the thumb safety switch, I squeezed the trigger and the chain zipped into action with no more noise than you'd expect from a contractor-size circular saw. Chalk one up for the McCulloch people; this one is sure to keep the neighbors happy. The 10-in. bar is a fooler, too. It cuts big stuff with a fury. I also used it to prune some dead branches on bushes and in a cherry tree. Here, its size is an asset because you can reach out with one arm to make cuts. Another good feature is the oil sight-gauge. With it, you can check oil level without having to remove the oil-tank cap. ★★★

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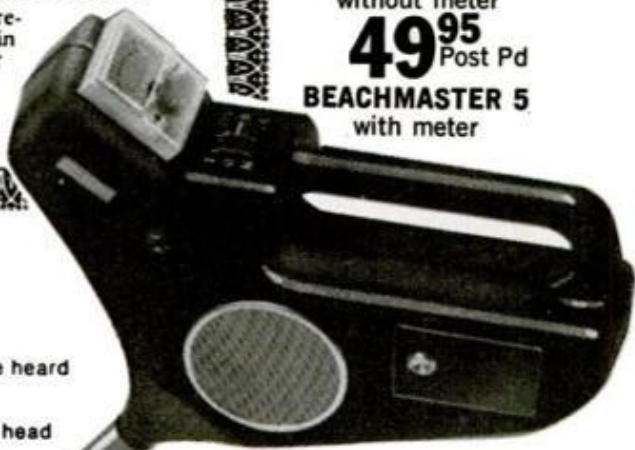
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BENCH-SAW KNOW-HOW

(Continued from page 169)

into warm water prior to making the bend. If white glue is to be used as a strengthener, it can be applied immediately. With nonsoluble glues, leave the wood clamped in a web clamp until dry and then apply reinforcing.

Facet sawing

You can use faceting to create decorative blocks of original design on doors, cabinets, drawer fronts and so forth. Like panel raising, faceting is similar to chamfer cutting; the rip fence and blade settings are simply varied.

Your best bet is to sketch a plan of your design; then, using scrap, make a test piece. Use a hollow-ground blade and feed the work slowly. And because faceting is, in effect, blind cutting, use a work hold-down and push stick. *Never* make a facet cut any deeper than three quarters of the thickness of the stock being cut.

As illustrated in Parts 1 through 3 in the preceding three issues of PM, faceted plaques can be cut using the dado and molding heads as well. Just make certain that you follow the safety rule mentioned above and feed the work even more slowly. The number of designs is virtually unlimited. By moving the rip fence in either direction, changing blade elevation, altering the arbor's bevel setting—or with any combination of the three—you will create a new design. That's the fun of facet cutting. If you hit upon a design that you feel you will want to repeat in the future, make a sketch with all saw settings listed.

Pattern sawing

For a fast way to duplicate straight-sided work, try pattern sawing. Whether you want to make 2, 20 or 100 pieces, each will be exactly alike. The setup requires an overhanging (T-shape) wood fence clamped to the rip fence and a master pattern of the part to be duplicated. Drive two nails through the pattern so that the points can be embedded in the part to be duplicated.

As shown in the drawing at the top of page 169, the plywood fence is aligned flush with the saw blade, and the blade is elevated just high enough to handle the thickness of the workpiece. Clearance un-

der the fence must suit the thickness of the workpiece and the pattern must be of stock thick enough so that it will ride against the fence.

To minimize waste and make the job go faster, the workpieces should be cut close to finish size beforehand. For safety on large duplicating runs, stop the saw from time to time and clear away the cut-offs. Pick the blade to suit the chore, and use a normal feed rate.

General information

The techniques presented in this series cover most cuts that an average home craftsman will ever want to make. Basically, good bench-saw technique consists of careful thinking, good safety habits and common sense.

Good saw accessories for an active workshop include the tenoning attachment shown on page 169. It is available at minimal cost that's well worth the investment if you do a lot of joinery. Another is the dial-type dado head that lets you quickly select dado widths because you don't have to break down the setup to make a change. Finally, as you add blades to your collection, seriously consider buying the carbide-tip type. A good quality carbide blade will last about 20 times longer between sharpenings, and most sharpening outfits now are equipped to do a professional sharpening job on these teeth. ★★★



AUTHOR'S SONS, Jack and Jim, serve their shop apprenticeship cleaning up pile of sawdust and scraps created by saw-cutting necessary for story photos



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Kawasaki. GA1-A, GA2-A, G3SS-A, G3TR-A, G4TR, B1L-A, F5, F6, F7, F8, A1, A1SS, A7, A7SS, S2, H1, and H2 models from 1966 to 1972. Cloth, **\$6.95(55)**

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SPECIAL PICTURE EFFECTS

(Continued from page 151)

plying Scotch Magic cellophane tape to a lens hood as shown in the picture on page 151, lower left.)

Longer lenses will enlarge the center spot and soften the edge of the vignette (too long a lens will integrate the spot and vignette into an overall haze). But smaller f-stops sharpen the edge, so you can juggle focal length and f-stop to get precisely the effect you want. Again, be sure to stop down to your shooting aperture and check the image before taking your picture. None of these techniques require any exposure change.

Diffusion and soft focus are also interesting portrait techniques, which soften the image for a more romantic effect and simultaneously minimize skin blemishes and wrinkles.

Diffusion is the milder of the two effects, gently lowering overall contrast by spreading light from the highlights into the shadows. Diffusion filters are available from Prinz, Spiratone and others for about the cost of ordinary filters. You can also make your own by stretching one or more layers of nylon stocking over a filter holder (use black or black-dyed nylon stockings in your color shots to prevent color casts).

In cool weather, you can fog the lens by breathing on it, then shoot at the instant the lens has cleared enough to give you the exact effect you want.

Soft-focus, a stronger effect than diffusion, is usually associated with professional portraiture, especially portraits of about 40 years ago. It's not the same as incorrect focus, but rather a combination of a sharply focused image with an unsharp image that is formed by the lens's aberrations.

Spiratone's Portragon (\$24.95) is a 100-mm lens (a good focal length for portraiture) with such aberrations deliberately designed in. Its aperture is fixed at f/4; you control exposure by your choice of shutter speed.

Equivalents of many of these products are available at photo stores. If your local store doesn't have what you want, you can get Spiratone products from Spiratone, Inc., 135-6 Northern Blvd., Flushing, N.Y. 11354, and Prinz products from Bass Camera Co., 179 West Madison St., Chicago, Ill. 60602. ★ ★ ★

AMAZING MINI-COMPUTERS

(Continued from page 143)

passes, small, special-purpose minis will find their way into automobiles. This will happen when major car systems, including automatic transmission, skid control, fuel injection and instrumentation all go electronic. A centrally-located mini will over-see all the gadgetry.

There's a good chance you'll soon have your own mini at home, too. Prices are steadily coming down, and by 1980, a complete—but modest—computer system may cost no more than a modern-day color television set.

But for the near future, the minis will keep their technical clothes on:

● In Flagstaff, Ariz., astronomers at Lowell Observatory are using a mini to determine how well Mars and Jupiter reflect light. The computer averages repeated brightness readings from instruments, to electronically "wash away" errors caused by Flagstaff's atmospheric changes.

● At Toronto General Hospital, a mini is fed data from X-ray movies of a cardiac patient's heart. The computer calculates the changing volume of the heart's chambers so physicians can study the "dynamic" of its operation, and can assess the effects of treatment.

● In Denver, a mini in the office of the Board of Water Commissioners keeps tabs on pumping stations, reservoirs and underground conduits to coordinate water flow and supply.

● Near Edinburgh, Scotland, a mini helps evaluate experimental farm machinery at the National Institute of Agricultural Engineering facility. The photo on page 141 shows the computer mounted on an automatic potato picker. The mini is connected to sensors at different points on the picker and monitors machine performance in pre-production tests.

● In Burlington, Vt., Vertek, Inc., developed an automatic respiratory system analyzer that includes a mini. The analyzer—a diagnostic tool for physicians—determines how much air a patient's lungs can hold, how rapidly he can breathe and how much air is left in his lungs when he exhales.

These are just a few places minis are at work today; tomorrow there will be thousands of new applications. The versatility of these "toolboxes that can think" is almost unlimited. ★ ★ ★

MINI-MAXI TABLE FOR \$100

(Continued from page 175)

and one end is ground slightly rounded to facilitate driving. Fit should be snug so they'll stay in place, yet offer a slight resistance so the gatelegs don't swing loosely. Six No. 10 x 1 1/4-in. wood screws and glue secure the leg assembly to the dividing strip. When both sections are completed, butt them together and install a piano hinge to connect inside table leaves.

Cut an insert strip to snug-fit the void. This filler strip fills the gap while a pair of projecting pins near each end serve to "lock" the two main sections together. The pins can be steel rod or slightly tapered dowels set firmly into the strip. To expand the table, you simply remove the center strip and extend the desired leaves.

For a finish that brings out all the natural beauty of oak, mix together some raw sienna oil color and natural wood filler. Work the filler well into the open grain, then wipe clean with burlap. Allow to dry for 24 hours; then apply several coats of a clear, semigloss wood finish such as Satinlac, or, if you prefer varnish, McCloskey Heirloom, following manufacturer's instructions. ★ ★ ★

PM TESTS CRAFTSMAN LATHE

(Continued from page 158)

the lathe: There is no provision for bringing the centers in alignment in the vertical plane. They appear to be in a fixed position and the centers of the test lathe were off about 1/16 in. While this would have little, if any, effect when woodturning, it could prevent accurate drilling of work between centers. This slight misalignment, however, may simply be a quirk of the particular machine I tested.

Although they do the job, I thought the locking levers on the toolrest and tailstock were dinky in size and lacked the good overall design of the lathe, to the point of appearing to be "afterthoughts."

For \$99.50, you get the basic lathe (no motor, motor pulley, V-belt or stand). If you already have a bench to mount it on, you can order a ready-to-run lathe for \$124.50. A 24x60-in. bench with steel legs and particleboard top will cost you another \$34.99. All prices are f.o.b. Turning chisels, drill chuck, faceplate and work arbors are accessories and priced separately. ★ ★ ★

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'73 CARS: AMERICAN MOTORS

(Continued from page 119)

down oxides of nitrogen and an electrically heated choke to help that butterfly open more quickly.

Engines continue with the 232-inch Six standard in all lines except the Ambassador and AMX. These two get the 304-c.i.d. V8 standard. Optional engines for the various lines: the 258-c.i.d. Six plus V8s of 304, 360 and 401 c.i.d. Horsepower ranges from 100 to 255 net.

AMC's Buyer Protection Plan (BPP), which proved so successful last year, will be expanded to cover expenses for lodging if overnight repairs are needed while an owner is away from home. AMC surveyed some 25,000 1972 customers, and 90 percent said they were happy with the way their cars had been dealer-tested and delivered. They were pleased, too, with service after purchase and felt they got a fair shake on AMC's 12/12 warranty.

AMC sales were up 10 percent for 1972, giving American Motors its best year since 1966. Company officials say the BPP helped considerably toward making 1972 so successful. ★★★

'73 CARS: FORD

(Continued from page 121)

derbody via two rubber-supported rams. The rams are made up of a steel inner I-beam slipped into an outer square-section steel case. Bonded permanently between the I-beam faces and the square case are long blocks of rubber. The bonding agent that holds the rubber to the steel rams is a superstrong, thermo-setting glue.

When hit, the bumper and I-beam can slide back into the square case, with the rubber stretching to absorb most of the shock. After impact, the bumper returns to its original stance. This bumper system "gives" up to 3.5 inches. A plastic bumper pan hides the space between the face bar and the car body.

FoMoCo's new bumpers add about 130 pounds to the weight of a standard Lincoln and 45 pounds to a Pinto, with weights for other car lines between these extremes. Compensations have been made to suspensions and braking systems to cope with the extra poundage.

Steel-belted radial tires are now standard on all 1973 Thunderbirds, full-sized Mercurys, Lincolns, Mark IVs and Pan-

teras. They're optional on other FoMoCo lines. To go along with these expensive and oft-ripped-off tires are spare-tire locks—standard with the standard radials, optional elsewhere.

Mustang and Cougar offer FoMoCo's only convertibles this year. The Mustang's major changes are a color-keyed urethane front bumper and longer front shocks. The Cougar now has a one-piece die-cast central grille, and the '73 Thunderbird gets a new extruded aluminum grille. Other T-bird changes include an optional opera window in the C-pillar, a standard split-bench front seat and bigger rear brakes.

The intermediate Torino and Montego get facelifts, with high and low series identifiable by their different grilles. Owners of 1971-72 models moaned so much about poor visibility with their high-back front seats that the 1973 Torino and Montego return to low-back seats with individual headrests. The sporty Montego GT comes only as a fastback, but its cousin, the Gran Torino Sport, is available either as a two-door hardtop or fastback.

Lincoln has added a Town Coupe and the Mark IV gets a slightly revised grille. Mark IV has a colorful cranberry interior scheme with silver exterior paint available as the Silver Luxury group. ★★★

'73 CARS: GENERAL MOTORS

(Continued from page 126)

and fixed rear-quarter windows. Chevelle has a new top-of-the-line called Laguna. Chevelle lineup consists of two-doors, four-doors and wagons. The four-door sedan and convertible have been discontinued. The big Chevy line has been re-named Caprice Classic and consists of coupe, sport sedan, four-door sedan and—for the first time—a convertible. Impala's convertible has been dropped. Also among the missing are the LS3 400-cu.-in. V8 and LS5 V8 engines offered last year.

Nova now comes in six models, vs. only two last year. Camaro comes in a new coupe, Type LT (for Lusso Turismo, which translates into luxury touring in English). Corvette gets side-door guard beams for the first time and the removable rear window is now sealed in at the factory. Vega has a new left-mounted prop to hold the hood open and the Opel manual transmission, an import from Germany, used in Vega last year has been

(Please turn to page 204)

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'73 CARS: GENERAL MOTORS

(Continued from page 202)

replaced by a made-in-the-U.S. shifter.

PONTIAC: There are 33 cars this year, down two from 1972. The Le Mans and Catalina convertibles have been dropped. The really new cars are the Le Mans and Grand Am. Grand Am is a new addition to the intermediate line. It comes in a two-door hardtop with a 112-inch wheelbase and a four-door hardtop with a 116-inch wheelbase. Grand Am and Grand Prix have a new modular instrument-panel wiring setup GM is certain to extend to other cars in years to come. Wiring connections plug in much the same way as a toaster or television set into the wall.

Firebird's still in the Pontiac catalog, as *PM* reported it would be back in July, 1971 (*Detroit Listening Post*, page 42) when other seers were killing it off. Except for a new grille, it's not much changed, but it's still flashy looking.

OLDSMOBILE: Olds has 27 cars this year, against a '72 count of 25. The new ones out of Lansing are Omega, Olds' remake of Chevrolet's Nova, and Cutlass. There are three versions of Omega—coupe, sedan and hatchback. Cutlass, the all-new intermediate, has an interesting grille. It's hinged at the bottom and retracts with the bumper during low-speed accidents. The Vista Cruiser wagon with the raised roof is no more, although the name has been retained. The glass dome has been replaced by a section of tinted vent glass over the roof of the front seat. The glass is hinged so you can raise it from the rear, but it isn't removable.

New options for the 88s and 98s are "dummy" lights on the dashboard. One tells you how much fluid you have left in the windshield washer container. The other tells you when an exterior light fails. Toronado is 6.2 inches longer than last year, with an overall length of 226.8 inches. The F-85 name has been dropped.

BUICK: Now there are 30 models, a gain of one over the 29 offered in '72. The new intermediate has been named Century, replacing the Skylark name. If Century sounds familiar, it's because this is the third time Buick has used the name. The top car in the mid-size category is the Century Regal. Rear shocks in full-size cars have been moved forward of the axle to improve the ride. Buick makes a point every year of trying to simplify ser-

vice so repairs and replacements can be speeded up. This year is no exception. On one job, for example—getting at components behind the dash—the flat rate time has been cut from five hours in 1972 to 2.3 hours on the '73 cars.

The Opel from Germany is down to seven models this year, two less than last year. The name is now Opel Manta.

CADILLAC: Same lineup as last year—nine models in three series. There are few outward changes except for the bigger bumpers. All cars have the retracting grille that telescopes below the hood on impact, also featured by Oldsmobile. Transmission fluid is now good for 100,000 miles. There's an optional power-operated antenna to improve radio reception. And for the ultimate in swank you can order a new comfort accessory—a pillow and robe to match the interior. ★★★

'73 CARS: CHRYSLER

(Continued from page 123)

high-speed starting motor that's said to reduce starting time by a third.

DODGE CHARGER/CORONET: Newest looking car in the Chrysler catalog for '73 is the Charger S.E. Where GM and Ford have opera windows in the C-pillar, Charger has three vertical, louvered slots. The windows are sealed in.

DODGE COLT: Same four models as last year for this import, but Chrysler says there'll be new cars coming in calendar 1973.

DODGE DART: The Demon and Demon 340 have undergone a name change. They're now the Dart Sport and Sport 340. The car has a fold-down rear seat to provide a flat surface of 6½ feet for carrying cargo or stretching out to take a nap. You can also get a factory-installed sunroof that operates with a hand crank.

DODGE POLARA/MONACO: Polara and Polara Custom have been given a new front end treatment to distinguish them from the higher-priced Monaco. Monaco keeps the hidden headlights. And you can special order the antitheft system.

PLYMOUTH BARRACUDA: Six-cylinder engine has been dropped. The 318-cu.-in. V8 is standard on the Barracuda and the 340-cu.-in. standard (and the only engine available) on the 'Cuda. Limited to one style—a two-door hardtop.

PLYMOUTH CRICKET: The four-

(Please turn to page 206)

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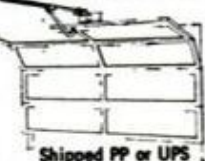
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'73 CARS: CHRYSLER

(Continued from page 204)

door sedan has different nameplates and is joined by the wagon version introduced earlier this year (See *Detroit Listening Post*, page 44, April PM).

PLYMOUTH FURY: Earlier in the year, Chrysler made several options for this car standard equipment. The items include automatic transmission, power steering, power front disc brakes and heavy-duty (11 by 2-inch) rear brakes. You can also buy the digital clock.

PLYMOUTH SATELLITE: The Road Runner hardtop has been replaced by a coupe. Nifty idea: The wood-grain treatment of the tailgate on the premium wagon, Regent, is a reflective material, making the car more visible at night to other vehicles approaching from the rear. Front and rear suspension systems of all Satellite models have been isolated to give a quieter ride. Front track of two and four-doors has been increased two inches—from 59.7 to 61.9 inches. Radiators of most cars equipped with airconditioning have more frontal area and use an aluminum seven-blade, thermal-drive fan. This also applies to other Chrysler makes with airconditioning.

PLYMOUTH VALIANT: The two Dusters have the same fold-down rear seat as the Dart Sport; also the factory-installed metal sunroof. Front track is wider—59.1 inches vs. 57.4 last year. ★★

MID-ENGINE CARS

(Continued from page 115)

ing to 60 mph in first gear, 85 in second, 120 in third . . . who needs fourth and fifth?

The Ferrari Dino, or the 246GT, to call it by its official number in the genealogy of prancing horses, is finally available here. I first saw this diminutive Ferrari in 1969 when none other than Pininfarina himself snapped it up to the curb in front of the Gato Nero Ristorante in Turin. Quite an eyeful . . . and an earful! Italians demand their cars make music, and the exhaust note of the transverse V6 is one of the sweetest sounding, and the engine the highest revving in a series production car.

Three-quarter rear visibility, always a mid-engine design problem, has been solved ingeniously in the Dino using a wrap-around rear window. The car is a bargain: At \$14,000, it is half the price of

the big Ferrari stallions, like the 365GTB4 Daytona. It's my favorite: a stable, high-speed road car, responsive and practical around town, and, best of all, "moderately" priced!

The de Tomaso Pantera is a car I've driven only on Ford's winding, undulating Romeo, Mich., proving ground—never on the street. So I've never had the frustration of sitting in traffic or poking through a 50-mph speed zone with it. Only the joy of letting it out. Pantera lines are crisp, angular, the steel monocoque, the work of Ghia, the Italian coachbuilder.

Behind the 351 Ford V8 is a five-speed ZF transaxle, combining gearbox, differential and final drive. Weight distribution of the 2860-pound machine is 42 percent front and 58 rear. Price is given as "about \$10,000" and therefore negotiable. Try for \$9500. Even at the higher price, it's the cheapest, high-powered, Italian-bodied mid-engine you can get!

The Lotus Europa is brought to you by the automobile designer who revolutionized the Indy scene in the mid-1960s with his rear- (really mid-) engine USAC Championship cars. This year Colin Chapman's Lotus works in Norwich, England, is sending us a race-bred Europa that looks a bit different and feels a whole lot different than last year's version. A small spoiler up front (see cover) improves directional stability at speed. Replacing the original Renault powerplant, is the Ford-based, twin-overhead cam, "Big Valve," in-line Four, same as used in the Sprint and Elan Lotuses. Displacement is 1600 cc and hp is 113 at 6500 rpm with two Stromberg carbs.


The rear sail area is notched for better visibility, there's better soundproofing, and legroom has been stretched. Still, you put on a Europa like a tight shoe. Only real enthusiasts need apply for this 1550-pound, fiberglass racer.

The Porsche 914 doesn't bare its pipes and growl at you, but don't mistake that for faintheartedness. Despite the lightweight look and ricky-tick sound, the car is all Porsche: very carefully put together, and extremely strong and responsive. Driving hard, you'll run out of courage before you run out of roadholding!

Of all the mid-engine cars, it's the best value as a basic transportation package. You might move up to the big Bora, but the 914 is great for starters! ★★

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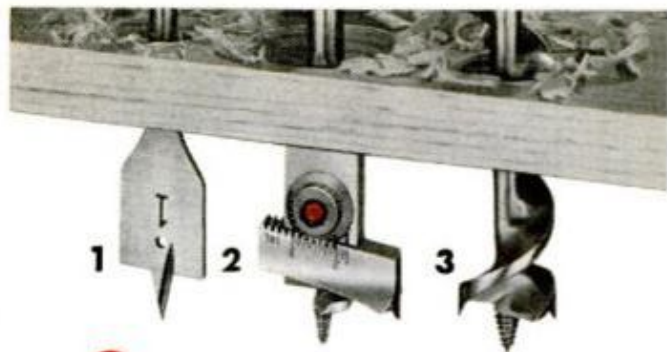
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PLUG-IN TROUBLESHOOTING

(Continued from page 135)

struction. The object is to find at what point the part will fail or malfunction; then backtrack to a point ahead of failure.

ATAC then builds a sensor—accelerometer, microphone or pressure gauge—into the vehicle to give a continuous reading on the operation of the component. The sensors feed their findings into the pattern recognition system.

Engineers assigned to the ATAC program agree with GM and Lucas that there's no limit on the number of components that can be monitored on a car—everything from engine, brakes, electrical system, transmission, differential to the tread life left on tires. But ATAC puts it stronger: the Army is convinced the monitors can predict failure in advance.

A company that has worked with the Army in developing the idea, Teledyne Continental Motors, has mocked up a five-ton truck to demonstrate how the system works. The Teledyne truck has a maintenance indicator panel mounted on the dash that emits a signal (a red light) if the "in tank" fuel supply pump isn't operating, fuel or lube oil filters require changing, lube-oil pressure is low or there's a low lube oil level in the oil pan, coolant temperature is too high or there's a low coolant level in the radiator, air cleaner has to be serviced, the generator isn't delivering a charge to the battery, brake air pressure is low or if crankcase pressure is high, indicating the engine should be replaced. The driver need only glance at the indicator panel to tell what's wrong.

What would it cost to outfit a standard production car with an all-points service alert system? The auto companies can't say, or won't. W. Kenneth Scott, an engineer who worked on the ATAC project for five years, offers a rough guess: \$150 to \$200.

That's a heavy sock to add to prices on top of all the other gear—safety and antipollution equipment—the Government will make mandatory on cars in a few years. But maybe it isn't so stiff at that.

If Ken Scott's estimate of \$150 to \$200 for a service warning-diagnosis hookup is right, the price would be less than \$15 to \$20 a year over the life of the car.

But, meanwhile, coming back from pie-in-the-sky, only VW has computers in the shop and sockets in its cars. ★★★

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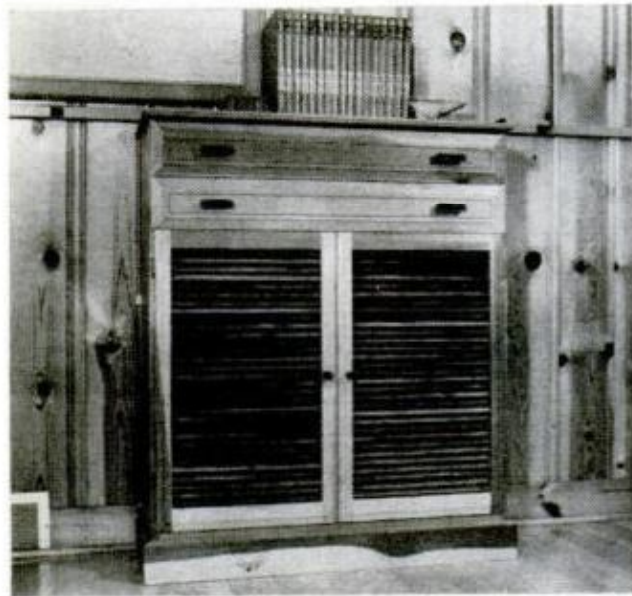
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WALL CABINET mounted over the right end of the workbench appears as if it belongs in a living room. The owner uses this cabinet for storage of frequently used items such as glue, twist drills, working drawings



"THE HARDWARE STORE" is label Hale puts on this cabinet, which provides storage for assorted screws, nails, sandpaper and similar items. Notice the prominent spot reserved for *Popular Mechanics Encyclopedia*

A BUSY SHOP

(Continued from page 90)

up plans for readers to build their own from. Even in a softwood such as pine, this sturdy, well-organized workbench is good-looking enough to serve in a contemporary kitchen or dining room.

Hale's shop is crammed with common-sense solutions to shop space-and-storage problems. He feels that tools are best stored in drawers and cabinets rather than on the wall. That's an argument that will probably go on forever among shop buffs, but, as photographer Fred Ward observed after we spent a couple of days in Winchester, "Hale has to be the most organized man that I have ever met."

That, in short, says it all.

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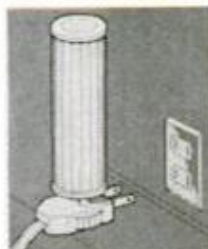
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FOOTBALL

(Continued from page 95)

face masks and improved padding reduced such injuries. Now, however, brain concussions and upper spine injuries are more common, partially due to the way players use the plastic helmet as a battering ram. They hurt their opponents and themselves. (This technique, called "spear" blocking or tackling, is condemned by all responsible football people.)

While NFL rules are liberal as to the protective equipment a player must wear, the National Collegiate Athletic Assn.'s are strict. In 1973, NCAA will require all its players to wear a mouthpiece. Dr. Cooper states he's been working for eight years to get the rule on the books.

"We reduce knee injuries . . . by getting rid of the crack-back block," he says. "That's a penalty of 15 yards now, and we're trying to get a rule that says no blocking below the waist on downfield situations." (A "crack-back" block usu-

***In 1973, NCAA will require
all its players to
wear a mouthpiece.***

ally was made by a split end who cut back inside from his wide position to wipe out an opposing lineman from the side or even the back.)

Dr. DiStefano (Philadelphia Eagles) would like to see the NFL tighten up its equipment rules, including the wearing of protective mouthpieces. But all players are not safety-minded. "Some pro players refuse to wear hip pads because the pads make them look too wide, causing them to lose their svelte profile," he observes. "This results in more hip pointer injuries, a bruise to the wing of the pelvis."

The development of safer equipment has been stepped up in recent years, with much attention focused on the knee, the player's most vulnerable area. Injury commonly results when he is hit while his cleats are dug into the turf. Because his foot can't move, the knee gives under pressure. Since it is not a ball-and-socket joint, the knee can't bend to the side. Result: a twisted knee and, possibly, damaged cartilage and tendons.

After studying knee injuries suffered by high-school players, Dr. Joseph Torg

and Ted Quedenfeld, researchers at Temple University, Philadelphia, urged that teams change from traditional cleats to a soccer-type shoe with short, stubby cleats. The switch reportedly reduced knee injuries.

Another researcher, Dr. V. Herbert Levin of Collegeville, Pa., has designed a cleat with a pivot point centered in the heel, surrounded by two arc-shaped cleats that let the shoe turn rather than lock it to the turf. He says the safety cleats can be put on most standard football shoes in a few minutes.

Another protective knee device, brainchild of Dr. Joseph P. Viglione of Stroudsburg, Pa., is the Hydrolog. It consists of plastic sheets bonded at the edges to hold water or other fluid. The device fits around the knee like a large knee guard. The force of a blow against one side is distributed by the water to the other side, according to the inventor, lessening the impact on the knee joint.

Dr. Voigt R. Hodgson of Detroit's Wayne State University is engaged in research to help reduce football head injuries. Using a plastic head model with physical and dynamic properties similar to those of the human head, Dr. Hodgson is subjecting a variety of helmets to impact tests.

Gladiator Athletic, Inc., in Florida, is making a helmet with a liquid-filled impact cushion or suspension. As the helmet is struck, liquid flows away from the point of impact, distributing the force of the blow. The maker says the cushion can be cooled for geographical areas where heat is a problem. A cool head supposedly will tend to keep a player alert, or at least more comfortable.

Though strides are being made in devising safer equipment, football is still football, a rough and exciting game. Dr. Harry H. Kretzler Jr., an orthopedic surgeon and chairman of the Medical Aspects of Sports Committee of the Washington State Medical Assn., has commented:

"While we worry about cleats, helmets, artificial versus natural turf, etc., are we missing the forest for the trees? Are we overlooking the facts of life in football? . . . The name of the game is *hit*. That is what football is all about, and as long as it is a collision game players are going to be hurt, no matter what surface they happen to be playing on." ★★ ★

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(Continued from preceding page)

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(Continued from preceding page)

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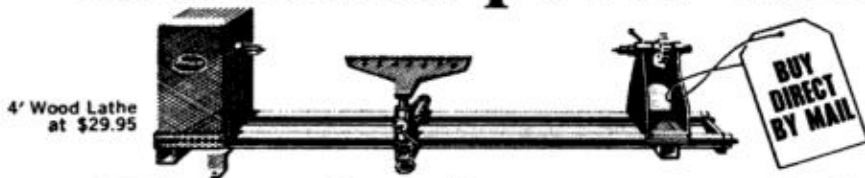
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14-inch bar and chain. Not 12". You won't find this on another chain saw for \$129.95. (You'll have a hard enough time finding another chain saw for \$129.95 anyway.)

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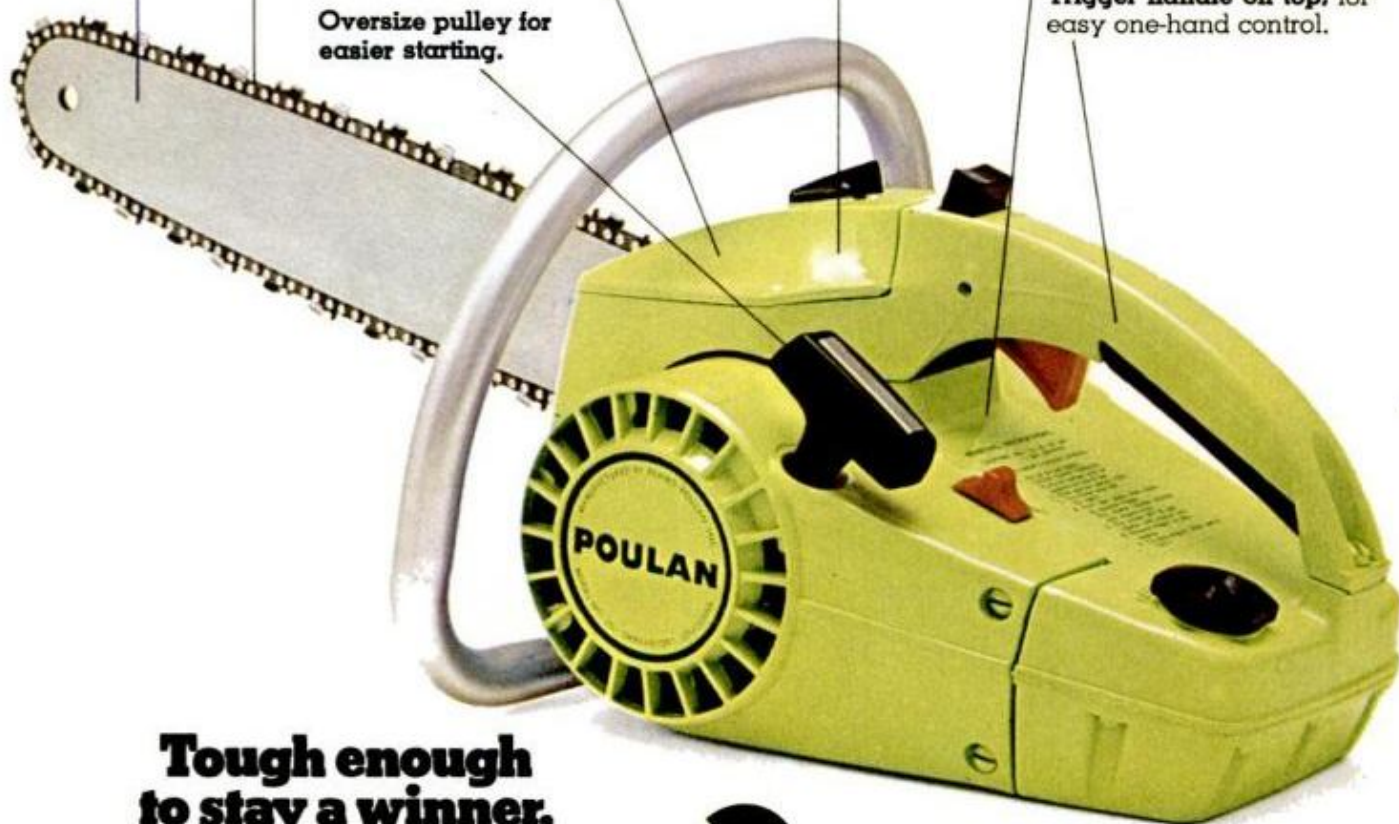
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